

## Chapter V

### Level II Analysis: Documenting Baseline Data And Tracking Change

The three main objectives of the Level II data analysis for of this study are to: (1) establish baseline data concerning mathematics instruction for the 1991-92 school year, (2) document any reform initiatives, or changes from 1991-92 to 1995-96, and (3) track the progress of any documented reform initiatives or changes. An analysis of artifact data related to curriculum, instructional materials, and assessment in conjunction with interview data from the three levels of the study (Building, Division and State) are used to triangulate the data and build a supportive structure for the baseline data conclusions.

A description of the research setting for the school and the mathematics teachers includes Division and State Level data that set the stage for the baseline data and provide necessary background information for interpretation of the baseline data. After the description of the research setting, a summary is presented of how the three sets of research data are combined to establish and verify, through triangulation, the methods of mathematics instruction that were used during the 1991-92 baseline school year. This is followed by artifact- and interview-data analysis results that pertain to curriculum, assessment and instructional materials for establishment of baseline data. After the baseline data are presented and interpreted, data for each of the interim school years are provided to document and track change initiatives through the 1995-96 school year.

#### Baseline: The School Setting

In the 1988-89 school year Pleasant Middle School had the distinction of being designated as a Vanguard Middle School for the State. This designation was a result of two years of work by the teachers and administrators to restructure the school's organization to match the emerging middle school philosophy. Prior to this time the middle school had been a typical junior high school with seventh and eighth graders changing classes six times each day. Teachers were organized by departments and considerations for students' class schedules were based on grade level and subject requirements.

The following excerpt from a letter to the middle school faculty members from the Principal conveyed the goals and climate of change for the 1989-1990 school year:

. . . We will know more of our responsibilities as a Vanguard School by the time school opens. Your faculty representatives are now attending a week long workshop provided by the State.

New, revised materials for the Administrative Review Service (ARS) are now being received. These will be the focus of our attention throughout the school year.

Following are some specifics that you need to be aware of prior to the opening of school.

1. Committee assignments are enclosed. Please be aware that I have made a great effort to integrate committees by the careful selection of their members. This will often provide direct communication between committees and help reduce duplication of efforts.

I truly believe each of you have been empowered by this process to make significant contributions to the quality and direction of our school and its programs.

2. Class assignments for students and the master schedule are still being developed. You were informed of the complexities of the scheduling process in June. We are committed to providing equitably for all [Pleasant] Middle School students and this is taking longer than we anticipated.

3. Technology, specifically computer assisted instruction (CAI), is to be a major program initiative beginning this year. You are encouraged to keep informed on available technology related to your curriculum.

4. Please see the enclosed TIME magazine commentary on the landmark Carnegie Study of middle school education.

5. "Essentials for Vanguard Schools" is a State Department directive that needs your close attention.

6. When I consider the many demands upon our time when school opens I request each committee leader that has not talked with me to please do so before school opens.

In addition, leaders of some committees may find it extremely important to have their committee meet prior to workshop days to develop direction and establish priorities.

7. The necessity of each teacher being informed of the curriculum guide and program of studies in their teaching area cannot be over emphasized this year. Lesson plans, evaluation of student work and departmental articulation of curriculum must be in compliance with the printed curriculum objectives of our County school system. . . . Principal (personal communication, July 17, 1989)

The goals of the Carnegie Corporation's report, "Turning Points: Preparing American Youth for the 21st Century" that are summarized in Tiff's article, "Help for At-Risk Kids" describe the changes that the faculty at Pleasant Middle School were implementing as follows:

Creating smaller communities for learning. This would be done by restructuring school into "houses," or "schools within schools," each consisting of 200 to 300 students; grouping teachers and students together in teams; and assigning an adviser to each student, so that every child is well known by at least one adult.

Teaching an interdisciplinary core curriculum that would include English, fine arts, foreign languages, history, literature, math, science and social studies. The emphasis would be on critical thinking—making connections between ideas—rather than rote learning. To promote positive values and encourage good citizenship, the curriculum would indulge health instruction and community-service activities.

Eliminating the practice of tracking students according to their achievement level. Instead, schools should promote "cooperative learning" in which small groups of students of varying abilities work in teams under supervision of one or more teachers.

Boosting academic performance through better health and fitness. School should ensure access to health-care and counseling program, preferably through a "health coordinator" or on-site clinic. Specifically, the report calls on middle schools to provide family-planning information to young adolescents. (p 51)

By the 1990-91 school year the teachers were immersed in change. Interdisciplinary instructional teams had replaced departmentalization and students were scheduled into academic classes by teams. In keeping with the middle school philosophy, the instructional focus of education shifted from subject matter to the needs of the students. Each student was assigned an advisor through the school-wide guidance program, CARE (Children are Really Exciting). The CARE program consisted of a daily twenty-minute block of time that replaced homeroom. Teachers were expected to involve their small groups of thirteen to fifteen students in monthly guidance activities such as conflict management, goal setting, and study skills. Teachers were provided notebooks with copies of the monthly activities but received no inservice or staff development on how to implement them.

Instructional teams were encouraged to teach interdisciplinary instructional units, but there was no additional time provided to plan for this instruction, and there was no inservice

or training provided for the faculty. Heterogeneous grouping and cooperative learning were also essential components of the middle school concept. Teachers were encouraged to use cooperative-learning instruction in their classrooms, but again, no inservice or training was provided. Other changes that were implemented that year included the addition of teacher advisory committee, site-based management, and new technology. The school system had committed energy, time and money to implement the middle school concept, and by the 1990-91 school year teachers were working under the new structure. Since they were to be on display as a model Vanguard Middle School for the State, they were under pressure to succeed in making all the restructuring changes.

With the 1991-92 school year came more changes. The teacher advisory committee determined that providing time for team planning was essential for the success of interdisciplinary instruction, and to provide teachers with both individual- and team-planning times, the daily schedule was changed from six to seven periods each day. Implementing this schedule change required additional middle-school staff. The County showed its support for the middle school concept by providing the necessary funds. To make this schedule work, teachers had to teach a fifth class which was called extended learning. This non-graded class was provided for students who were not in band or choir, and the design and content of the class was left solely to the teachers; however, there were no funds available for purchasing instructional materials. The most common arrangement was one in which a team divided the students not in band or choir into four groups. Each academic teacher then had a quarter of the students for one nine-week period in their extended learning class.

In the 1991-92 school year teachers were inundated with challenges to meet the recommended changes in middle school instruction. As recommended by the middle school philosophy, the sixth-grade students had fewer teachers during the day. The sixth grade teachers were organized into two-person teams. The usual practice in these teams was to group their students homogeneously for math and reading instruction. In the seventh and eighth grades there were four-teacher academic teams. Seventh grade students were grouped heterogeneously for all instruction, but due to criterion based selection into algebra or general mathematics classes, eighth grade students were tracked for mathematics instruction. Teachers were encouraged to use cooperative learning and interdisciplinary instructional units in their classroom instruction, but were provided neither training nor materials, and with the new seven-period day classes were shorter by approximately 45 minutes per class. In addition to these recommended instructional changes teachers were mandated to design and teach a fifth class, to act as counselors and advisors to their small CARE classes, and to serve on at least two different site-based management committees.

This completes the presentation of data for establishing the school climate and organization for the 1991-92 school year. The methods of mathematics instruction that were used in the 1991-92 classrooms will be the focus of the next section.

#### Baseline Data: Mathematics Instruction

This section artifact and interview data from all three Levels of the study (Building, Division, and State) are used to document the curriculum guidelines, assessment instruments, and instructional materials in place during the 1991-92 school year. Seven sources of artifact data provided evidence that supported the conclusions drawn about the methods of mathematics instruction used during the 1991-92 school year. These sources were: (1) State of Virginia's 1988 Mathematics *Standards of Learning* (SOLs), (2) Pleasant County's *Mathematics Curriculum Guide*, (3) the County-adopted and State-approved mathematics textbook *Addison-Wesley Mathematics* and its supplemental instructional materials, (4) the State's assessment instrument, Literacy Passport Test (LPT) and its related policies, (5) the County's assessment instrument, Iowa Test for Basic Skills (ITBS), (6) classroom assessment materials, and (7) teachers' archival documents which consisted primarily of handout or worksheets used for mathematics instruction in 1991-92.

The three levels of interview data (Building, Division, and State) provided support for conclusions made about the instructional content, instructional materials, methods of assessment, and methods of instruction. Excerpts from the teachers' interviews related to how their instructional practices had changed since 1991-92, and interview data from the school- and Division-Level administrators pertinent to mathematics instruction were triangulated to reach conclusions about methods of instruction during the baseline data year. Where appropriate, interview data across grade levels six, seven and eight were triangulated to build support for conclusions.

Figure 7 provides a diagram as to how triangulation of the artifact and interview data served to build a support structure for the post hoc baseline data conclusions. In this figure County Artifact data refers to both the Building and Division Levels' data. This figure shows how the County Curriculum Guide, the SOL document and the interview data were triangulated to verify the curriculum content of the 1991-92 classroom. It also shows how assessment artifact data from the County's standardized test, the state's minimum competency Literacy Passport Test, and the interview data were triangulated to document the methods and types of assessment used during the 1991-92 school year. As illustrated in Figure 7, the types of instructional materials used for mathematics instruction during the 1991-92 school year were documented through the triangulation of the following three sets of data: textbooks, nontextbook instructional materials, and interview data. Figure 7 shows

how, collectively, the analysis results of these three major components of mathematics instruction supported one another to document the methods of instruction used in the mathematics classroom during the 1991-92 school year.

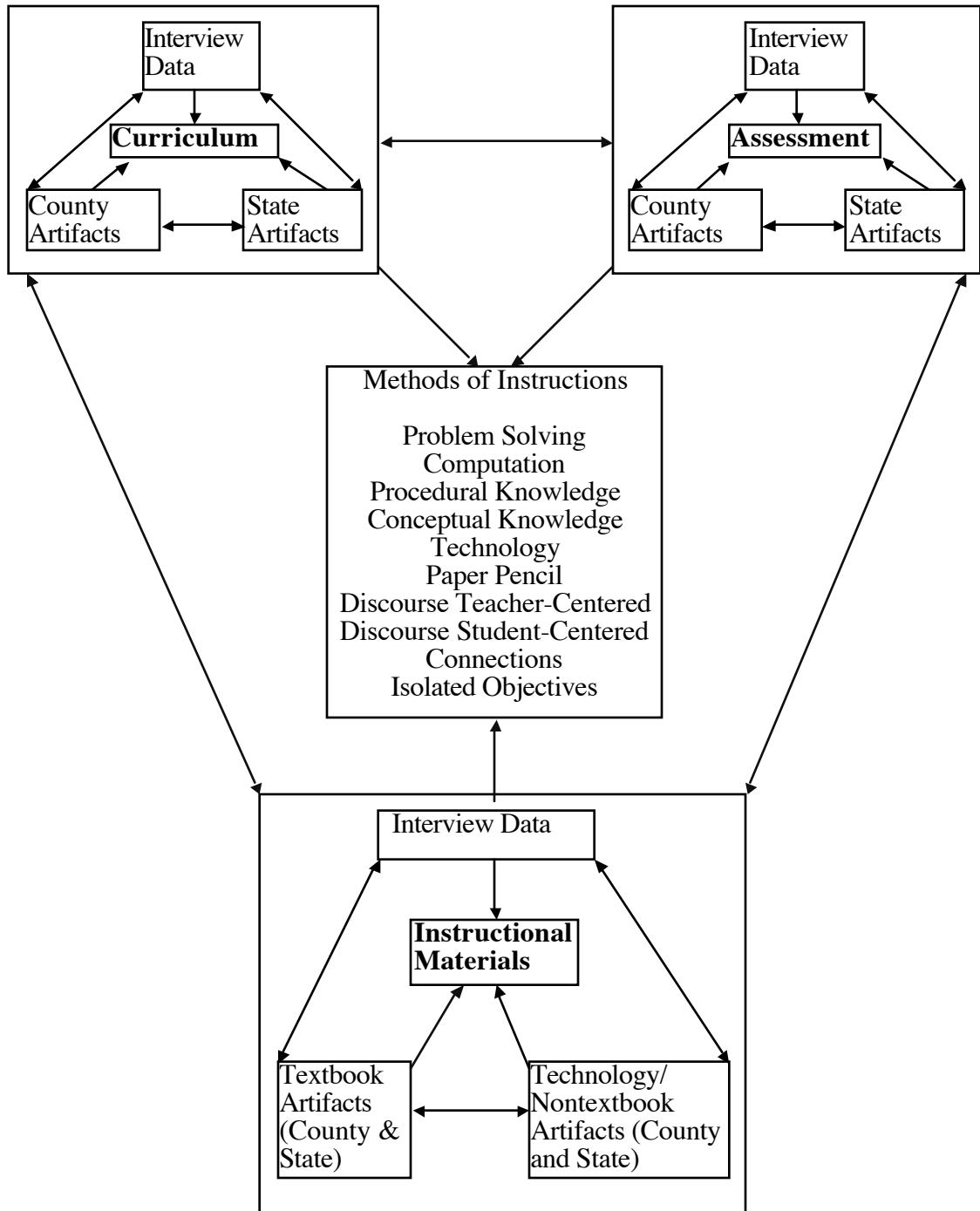


Figure 7. Organization of artifact and interview data for analysis of baseline data.

As mentioned, the interview data were triangulated in two ways: (1) by sixth, seventh and eighth grade teacher interview data and (2) by teacher, building-level, Division-Level and State-Level administrator interview data. Conclusions drawn from the interview data about curriculum content, instructional materials, and assessment during the 1991-92 school year were documented using both sets of triangulated data.

As depicted in Figure 7, the interview data were keys to relate to the artifact data to which they corresponded (i.e., Curriculum Assessment and Instructional materials). In each section of this analysis the teachers' interview data analysis results are presented first and followed by any applicable interview data from the school, Division, and State Level administrators. All interview data classified as assessment, curriculum, or instructional materials were included in the data presentation. Much of the interview data related to the methods of instruction used during the 1991-92 school year emerged when participants discussed how their methods of instruction had changed since the baseline year. When this occurred, only the portions of the statements related to baseline data were presented, but special care was used to ensure that none of the statements' intended meanings were altered. Where necessary, the topic of discussion is provided for clarification. Although the interview data were classified and presented as curriculum, assessment, or instructional data, some of the information was applicable to more than one component of instruction and, therefore, the same interview data may be presented as evidence in more than one section of the baseline data.

At the beginning of each interview, participants were reminded that in this study all instructional practices over the last five years were relevant. The following statement was used to open each interview:

This interview has been designed with two goals in mind. One is to provide details related to the classroom observation that will help me in creating a snapshot view of what mathematics education looks like in the school today, and, two, to help me discover any ways or areas in which your classroom instruction has changed within the last five years. . . . (Appendix D)

Therefore, when the teachers made comparisons of the method of instruction that they "used to use" to explain changes in their methods of instruction, the methods of instruction that they formerly used were the methods of instruction used during the 1991-92 school year. That year was memorable for the teachers because it was the first year that the Josten Computer Lab was used for mathematics instruction. The interview statements were presented as mixed voices to provide evidence of the type of instructional materials that were used, the content of mathematics instruction, and the methods of assessment, thus documenting the methods of instruction that were used during the 1991-92 school year.

Presentation of these data begins with the artifact data from the County's Curriculum Guide and the State's SOLs which provided data to document curriculum design, curriculum content, and methods of instruction encouraged by the State and Division Levels, and their suggested uses for technology and problem solving in mathematics instruction during 1991-92. After the artifact data were used to establish the curriculum content and State- and Division-level instructional expectations, the supporting interview data were presented. Next, the analysis results of the mathematics instructional materials that were used during the 1991-92 school year are presented. These results confirmed that the mathematical content of the instructional materials was consistent with State and County guidelines and established the method of mathematics instruction provided and encouraged by the County's instructional materials. Analysis results of the textbook and its supplemental instructional materials were also used to depict the role of problem solving and technology in mathematics instruction. To provide additional support for the conclusions made about methods of instruction, focus of instruction, and the use of calculators and technology for mathematics instruction, analysis results of related interview data immediately follow the presentation of the artifact data. Documentation of the baseline data concludes with the presentation of the assessment-data analysis results. Three different Levels of assessment artifact and interview data (Building, Division, and State) provided documentation that assessment practices and instruments were in alignment with the mandated curriculum and adopted instructional materials.

#### Baseline Data: Curriculum Artifacts

During the 1991-92 school year the mathematics teachers were using the state's 1988 *Standards of Learning* and following Pleasant County's curriculum based on those standards. The standards and the curriculum both placed a heavy emphasis on arithmetic and drill-and-rote practice. Four different excerpts from the County's Curriculum guide and four excerpts from the State's *Standard of Learning* objectives are presented to illustrate the emphasis placed on teaching arithmetic procedures and the suggested use of whole-group-direct instruction combined with individualized instruction as the preferred methods of classroom instruction.

The first excerpt presented is from *Pleasant County's Middle School Mathematics Curriculum*. The County's philosophy for mathematics education provides evidence that the County placed an emphasis on basic arithmetic skills and that the use of individualized instruction was encouraged. The second and third excerpts presented from the same document are the first set of objectives for the seventh and eighth grades. These curriculum objectives were selected because they exemplify how the objectives were written in



behavioral terms, and they also serve to illustrate the sequential nature of the curriculum and its focus on mastery of basic arithmetic procedures rather than on problem solving or conceptual understanding.

As stated in the County's *Curriculum Guide*'s introduction to the seventh grade objectives, "The *Standards of Learning* (SOLs), as mandated by the Virginia State Department of Education, are incorporated into the curriculum." The County's seventh and eighth grade objectives were correlated with the state's *Standards of Learning* objectives. Therefore, the fourth and fifth excerpt's presented are the state's SOLs that were ostensibly correlated with the selected seventh and eighth grades' County objectives. The last two excerpts address the role of technology in mathematics instruction; the sixth excerpt is from the introduction of the State's eighth grade SOLs in *the Standards of Learning Objectives for Virginia Public Schools* (1988), and the last excerpt presented is the seventh grade's calculator objective listed as number five in the County's *Curriculum Guide*. These selected excerpts were representative of the documents and provided evidence to establish both State and County recommendations for, and exceptions of, methods of instruction in the 1991-92 mathematics classrooms.

Pleasant County's philosophy for mathematics education was presented on page one of its *Mathematics Curriculum Guide* follows:

The [Pleasant] County Middle School mathematics curriculum, with emphasis on basic skills and concepts, is designed for the total development of the student. Each pupil will have an opportunity to fulfill his/her capabilities to the utmost, which implies individualization and opportunities to explore more areas than previously have been available to him/her. It is important that the student understand that success in mathematics does not depend solely upon intelligence, but hard work and self-discipline are equally important. The mathematics curriculum will provide each student with those skills necessary for application in his/her daily life; furthermore, a solid foundation for any future work in mathematics will be established. (p 1)

This philosophy made it clear that the County encouraged the use of individualized instruction to teach mathematics and that mastery of mathematics procedures and objectives required lots of practice. This was viewed as extremely important to future success.

It naturally follows that the curriculum was designed to match the suggested mode of instruction and, as mentioned, the first sets of seventh and eighth grade objectives were selected as exemplars of the curriculum. The County's objectives were correlated with the state's 1988 *Standards of Learning* (SOL). The number to the right of each part of the

objective identifies the matching State SOL objective. The first set of seventh and eighth grade objectives follow:

## GRADE SEVEN

### I. WHOLE NUMBERS

#### A ADDITION AND SUBTRACTION

The student will:	SOL
1. read and write whole numbers and identify place value in the decimal numeration system.	
2. compare, order, and round whole numbers.	
3. estimate sums and differences of whole numbers.	7.01
4. add and subtract whole numbers.	7.02
5. add and subtract units of time.	
6. solve word problem using cumulative computational skills.	7.20, 7.21

## GRADE EIGHT

### I. WHOLE NUMBERS

#### A ADDITION AND SUBTRACTION

The student will:	SOL
1. read and write whole numbers and use place value ideas to compare, order, and round whole numbers.	
2. recognize basic properties of addition and multiplication and perform operations in the correct order.	8.02
3. estimate and find sums and differences of whole numbers.	8.03
4. estimate and find products and quotients of whole numbers.	8.03
5. solve word problems using cumulative computational skills.	8.22

The first set of seventh and eighth grade objectives shows that the curriculum was designed as a spiraling curriculum; each year material was covered from the previous year and a new concept or skill was added. The objectives also illustrate the segmented and sequential nature of the curriculum. Thus, the curriculum was organized to facilitate learning mathematics as chunks of unrelated facts and arithmetic procedures. Ideally, students

mastered one objective before moving to the next. Although the word problem portions of objectives presented a possibility for application-type problems and connections to the real world, there was little, if any, focus on conceptual understanding or on making mathematical connections. The use of problem solving in mathematics instruction is investigated further in the review of instructional materials that were in place.

As mentioned in the introduction of this section, the state's mandated SOLs were incorporated into the County's curriculum and the state's (1988) *Standards of Learning* objectives that correlated with the examples selected from the County's curriculum are presented next. As before, the seventh grade objectives are immediately followed by the eighth grade objectives:

Mathematics  
Standards of Learning objectives  
Seventh Grade

- 7.01 The student will estimate the results to computation problems involving addition, subtraction, multiplication, and division.
- 7.02 The students will add, subtract, multiply, and divide whole numbers.
- 7.20 The student will solve problems dealing with everyday situations requiring the use of addition, subtraction, multiplication, and division of whole numbers and decimals, and addition, subtraction, and multiplication of fractions.
- 7.21 The student will determine probability of a given event occurring.  
(p. 18-19)

Mathematics  
Standards of Learning objectives  
Eighth Grade

- 8.02 The student will add, subtract, multiply, and divide with whole numbers, fractions, and decimals.
- 8.03 The student will estimate the results of computational problems involving operations with whole numbers and decimals.
- 8.22 The student will solve problems dealing with real-life situations.  
(p. 20-23)

These State SOL objectives illustrate that the state's objectives, like the County's, were written in behavioral terms, and that the objectives were sequential in nature and designed around arithmetic procedures. Both the State and County mathematics objectives

emphasized the importance of mastering arithmetic procedures. The mandated State SOLs curriculum objectives were designed to move through the basic operations of addition, subtraction, multiplication and division with whole numbers, decimals, and fractions in that order in both seventh and eighth grade.

The curriculum design was typical of a behaviorist philosophy of education and was compatible with the traditional methods of instruction promoted by those with behaviorist beliefs about learning. The traditional method of instruction was characterized by the teacher explaining and showing the students the procedure or information that needed to be learned, and the students copying the teacher's example and then using that example to do independent pencil-and-paper written practice until the procedure was internalized. Once the procedure was mastered by a majority of the students, the teacher moved on to the next arithmetic objective and repeated the process.

Review to maintain skills previously taught was a standard component of this type of instructional practice, and both the County and State curriculums were designed as spiraling curriculums, thus building in review of previously taught arithmetic skills from year to year. In addition to the objectives already presented the first statement in the introduction of the state's eighth grade SOLs provided additional evidence to this effect. The opening sentences of the introduction follows:

This course is designed to prepare students for an Algebra 1 course. Hence, the objectives contain content that is both a review and an extension of arithmetic concepts and skills learned in grades K-7, as well as new concepts in geometry; data analysis, probability, and statistics. (p. 20)

Since proficiency of paper-pencil arithmetic skills was the emphasis of the curriculum content, it stands to reason that the use of technology would be secondary to mastery of arithmetic skills and, thus, its use for mathematics instruction was limited. The next set of data provide evidence related to the use of technology in 1991-92 mathematics classrooms. In the County's curriculum the use of technology was addressed in the seventh grade's fifth objective. There is no corresponding eighth grade objective included because there was no eighth grade objective that addressed the use of technology. The County's seventh grade calculator objective follows:

## **V. CALCULATOR USE**

### **A. INTRODUCTION**

SOL

The student will:

1. identify the keys of a calculator.

## **B. OPERATIONS**

The student will:

1. add, subtract, multiply, and divide whole numbers and decimals on the calculator using order of operations.
2. find a percent of a number.
3. convert fractions to decimals. (in County Curriculum Guide)

There were no State SOL objectives correlated with this set of seventh-grade-curriculum objectives. Technology was not addressed in the SOLs until the introduction of the eighth grade objectives with the following statement:

Calculators and computers should be used where feasible by the student.

Instruction should place an emphasis on estimation, mental arithmetic, paper and pencil calculation, and the use of the calculator. Any technology that will enhance student learning should be used. (p. 20)

This introductory statement and the use of technology to teach mathematics “where feasible” was not introduced until after completion of grade seven provided evidence that both State and County placed a heavy emphasis on mastery of basic arithmetic skills. The use of technology was deemed secondary to mastery of basic-arithmetic facts and procedures. As a matter of fact, out of the 22 seventh grade SOLs, 18 focused on mastery of basic arithmetic skills while four of them focused on number sense, application, making connections, or problem solving. Although the eighth grade SOLs were a little better, the majority of the 23 objectives focused on mastery of basic skills. Seven of the eighth grade SOLs focused on number sense, application, making connections or problem solving.

### Baseline Data: Curriculum Interviews

Additional support for the conclusion that the curriculum in place during the 1991-92 school year focused heavily on computation and arithmetic procedures is provided by State Level interview data about the 1988 *SOLs* that served as the mathematics curriculum guide for the baseline instructional year. Following are the State-Level interview comments made about the strengths and weakness of the 1988 *SOLs* and about the need for rewriting those *SOLs*. The Principal Mathematics Specialist, K-8 described the 1988 *SOLs* in the statement that follows:

Well of course some of the old *SOLs* were— they got at, the major concepts or content. Much of the content issues, I guess, they got at many of them, not all of them, of course, they were old, and they lacked the probability and statistics focus. They lacked the pattern function and algebra focus. They

were heavy on computation and things of that nature. . . .Of course as you know, the old *SOLs* were very, in terms of Bloom's Taxonomy, they were all very low level. They were mostly identify this, or you know, they were really at the identify level, and a lot at the skill level, and what had to happen is they had to bring in the new focus of problem solving, reasoning, ah, connections all of those focuses. . . (p. 6-7)

The Mathematics Coordinator for Fairfax County was included in this study because Fairfax County had the job of developing the State's new *SOLs*, and the Mathematics Coordinator for Fairfax County served as the coordinator of the project. When describing the strengths and weakness of the 1988 *SOLs* he made the following comments:

Mathematics Coordinator for Fairfax County: Ah, the old standards were very clear. They were easily understood by virtually everybody, but I thought they were very outdated in that they had the wrong emphasis.

Interviewer: And that emphasis, I think, would be on computation?

Mathematics Coordinator for Fairfax County: That's right. Paper-and-pencil computation, that's correct. (p. 2)

The following comments were made by a teacher from Wise County, who was an Appalachia Education Lab training team leader for the southwest Virginia region that included fifteen school divisions, and she was a member of the assessment committee that was evaluating assessment instruments to implement with the new *SOLs*, and she was also a member of the team of writers that were responsible for the Middle School Mathematics *SOLs* concerning the need for rewriting the 1988 state's *SOLs*. Her statement follows:

Well one of the concerns has been that the students are not being successful in mathematics. They're not being prepared, and a lot of the criticism or concerns have come from the business community that students are coming out of school ah, without the ability to think and problem solve in away that is applicable to the business world. . . .the old *Standards of Learning* seemed to address the needs of our students who fell into the lower quartile and our special Ed [education] students. . . .there was [sic] not enough technology requirements in the old *SOLs*, and . . . . I think ah, that addressing the problem of ah, more, or probably more, problem solving skills and application that is emphasized in the new *SOLs* as opposed to a lot of rote memorization in the old *SOLs*. . . (p. 2-4)

The State Department's Principal Mathematics Specialist for the Secondary grades, and the coordinator for K-12 in terms of the Standards of Learning and the State assessment for mathematics, also served as the program manager for the V-QUEST

Systemic Reform Movement. When she talked about the need for rewriting the 1988 SOLs, she made the following statement:

Well hum, the last time we wrote Standards was in 1988, and a lot of things happened since 1988, and ah, the NCTM *Standards* came out. We've had some ah, state studies that we've conducted, and also the role of technology has changed mathematics. (p. 2)

While talking about the strengths and the weakness of the 1988 SOLs she made these additional comments:

. . . They [1988 SOLs] were very specific, and that is a strength as well as a weakness. It is a strength because teachers knew what was expected.

There was no room for multiple interpretations of what to teach. . . so, that was a strength, and the weakness is ah, like I said, one of the strengths. The weakness was they were very specific, and they were primarily computation. (p. 3-4)

These interview data not only support the conclusion in this section that computation was the main focus of instruction during the 1991-92 school year, they also support the results of the analysis of the 1988 SOLs presented in the artifact section. The result of that analysis was that at least 80% of the 1988 SOL objectives involved mastery of computational skills. Both the artifact and interview data support the conclusion that in 1991-92 teachers were mandated and encouraged to teach mastery of arithmetic procedures and computation skills in their mathematics classes.

#### Baseline Data: Curriculum Summary

The artifact and interview data presented were used to build a strong case that the 1988 *Standards of Learning* for mathematics that were in place in 1991-92 placed a heavy emphasis on mastery of arithmetic procedures and that County's 1991-92 *Curriculum Guidelines* incorporated the State-mandated *SOLs*. Both the *SOLs* and County's Curriculum documents were written in behaviorist terms using a spiraling curriculum design. The artifact data documented that the suggested uses of technology to teach mathematics were limited. Technology for instructional purposes was not introduced in the state's *SOLs* until grade eight and in the County's *Curriculum Guide* until grade seven. Even then, its use was limited mainly to supplementing the instruction of arithmetic procedures. The content of the curriculum emphasized learning mathematics as mastering arithmetic procedures; i.e., the objectives were written in behaviorist terms with built in review. The County's philosophy stated that the County's curriculum placed an emphasis on basic skills so that a solid foundation for any future work in mathematics would be

established. It naturally follows that the method of instruction used in the 1991-92 classrooms matched these desired outcomes.

NCTM (1989) definitions of the terms curriculum and standard support this conclusion. In the introduction of the *Curriculum and Evaluation Standards* (1989) NCTM defined curriculum and standard as follows:

A curriculum is an operational plan for instruction that details what mathematics students need to know, how students are to achieve the identified curricular goals, what teachers are to do to help students develop their mathematical knowledge, and the context in which learning and teaching occur. . . . (p. 1)

A standard is a statement that can be used to judge the quality of a mathematics curriculum or methods of evaluation. Thus, standards are statements about what is valued. (p. 2)

The definitions of curriculum and standard indicate that it is good educational practice for the mathematics curriculum, standards and methods of instruction to be compatible and supportive of one another.

These State-Level interview data support the conclusion in this section that computation was the main focus of instruction during the 1991-92 school year, and they also support the results of the analysis of the 1988 SOLs presented in the artifact section. The results of that analysis was that at least 80% of the 1988 SOL objectives involved mastery of computational skills. Both the artifact and interview data supported the conclusion that in 1991-92 teachers were mandated and encouraged to teach mastery of arithmetic procedures and computation skills in their mathematics classes.

Since the County's curriculum and the state's SOLs emphasized the importance of mastering mathematical procedures and were both designed and based on the behaviorist theory of learning, it follows that teachers were expected and encouraged to use matching instructional strategies which were traditional methods of mathematics instructions (direct instruction, individualized instruction and drill-and-rote practice) for mathematics instruction. The goal of the V-QUEST Lead Teacher Initiative was to reform mathematics instruction in the classrooms by replacing the behaviorist's traditional methods of instruction that were in place with constructivist's methods of instruction. These artifact and interview data provide strong evidence to support that during the 1991-92 school year mathematics teachers used traditional methods for mathematics instruction in their classrooms.

In the next section analysis results of the mathematics instructional materials that were in place during the 1991-92 school year are presented. The curriculum artifact data



pertaining to problem solving and technology supported that the curriculum in place during the 1991-92 school year emphasized the importance of teaching computation and instrumental knowledge. The analysis of the 1991-92 *Addison-Wesley* mathematics textbook provides a more in-depth study of the problem solving and technology tasks used for mathematics instruction during the baseline school year.

#### Baseline Data: Instructional Materials

In addition to the design of the curriculum, there were several other indicators that support the conclusion that a combination of direct instruction, individualized instruction, and drill-and-rote practice were the predominate instructional strategies used for mathematics instruction during the 1991-92 school year. The second set of supportive conclusions are from an analysis of the mathematics instructional materials that were used during 1991-92. There are three categories of instructional materials included in this analysis: (1) the mathematics textbook and its related instructional materials, (2) nontextbook instructional materials, technology, and its related instructional materials and (3) interview data related to (1) and (2). Results of the technology data follow the presentation of the textbook instructional materials' data analysis.

During the 1991-92 school year the mathematics teachers used the *Addison- Wesley Mathematics* textbook for mathematics instruction. These data support the conclusion that mathematics instruction consisted of a combination of direct instruction, individualized instruction and drill-and-rote practice with minimal use of technology and a heavy focus on arithmetic procedures. The conclusions are supported by the textbook's suggestions for writing effective lesson plans, delivering instruction, using calculators, teaching problem solving. Additional evidence for conclusion a about methods of instruction during the baseline year was provided by an analysis of the textbook's layout of the lessons and supplemental instructional and assessment materials.

#### Textbook and Teacher Role Data: Artifacts

Classroom discourse is determined by the type of lesson plan implemented. Information concerning recommendations for effective lesson plans was provided in a section of the seventh grade teacher's manual titled *How Addison-Wesley Mathematics puts Research into Practice*. To ensure student mastery of the material *Addison-Wesley* recommended that teachers include seven steps in their lesson plans. The seven steps recommended for effective instruction were based on a lesson design developed by Madeline Hunter and are presented in the following list:

1. Anticipatory Set

2. Objective
3. Instructional Set
4. Modeling
5. Checking for Understanding
6. Guided Practice
7. Independent Practice (p. T26)

In following this recommended lesson plan design, the teacher was expected to get the students interested in step one, explain what they were going to learn in step two, introduce the new skill or concept in step three, demonstrate or model the skill or concept in step four, present other examples of the skill for the students to try in step five, provide feedback while students practiced the skill in a warm-up session in step six, and then assign independent practice for internalization of the skill, concept or procedure in step seven. This type of lesson supported direct instruction, individualized instruction and drill-and-rote practice. Direct instruction used here to mean that the teacher explained and/or demonstrated, usually to the whole group, the skills or concepts that the students were to practice and learn. Individualized instruction meaning that after the skill or concept was introduced and taught the teacher would monitor their students' progress and provide reteaching or enrichment as necessary. Drill-and-rote practice meaning written or oral exercises designed for students to do repeated practice of a computation procedure, rule or fact to memorize or internalize it. With this traditional type lesson teachers take all the responsibility for students' learning.

Included in the instructional materials was a *Teaching and Research Bulletin* related to the lesson design, and this bulletin was titled *Madeline Hunter and Mastery teaching*. Since her lesson design was intended as a generic tool for all subject areas *Addison-Wesley* prepared a chart to summarize the purpose of each step in terms of a mathematics lesson and to highlight the features of *Addison-Wesley Mathematics* (AWM) that facilitated each step. This chart served two purposes: (1) it supported the conclusion that a combination of whole-group-direct instruction and individualized instruction were the instructional strategies recommended for use in the classroom and (2) it illustrated that the textbook's mathematics lessons were designed to facilitate this type of instruction. The *Addison-Wesley Mathematics* and *the Madeline Hunter Lesson Design* correlation that was presented on the front page of the *Teaching Research Bulletin* which was included in *Addison-Wesley's Teacher's Resource Book* follows:

Table 15.

The Addison-Wesley Mathematics and the Madeline Hunter Lesson Design

Madeline Hunter Lesson Step	Purpose	Corresponding AWM Feature
1. Anticipatory Set	To get the lesson started. To focus attention on the concept or skill to be learned.	Quick Review Ideas for Getting Started
2. Objective	To let students know what they will be learning.	Lesson Focus Lesson Title
3. Instructional Input	To give students the skills or concepts needed to achieve the objective.	Motivational Problem Concept Line
4. Modeling	To demonstrate the process visually.	Lesson development
5. Checking for Understanding	To determine whether the model is understood.	Other Examples
6. Guided Practice	To provide feedback while students practice the skill.	Warm-up
7. Independent Practice	To provide practice when success on the task is reasonably assured.	right-hand Page More Practice Practice Supplement

(p.1)

In addition to the recommendation made in the introductory section of the teachers' manual, the layout of the textbook is designed to facilitate whole-group-direct instruction and individualized instruction. The scope and sequence chart provides curriculum content information for all three grade levels, six, seven, and eight. This chart indicates that the textbook design was based on the spiraling curriculum concept, therefore review of previously taught material was apparent in the curriculum content. For example, in the sixth grade there were 244 different objectives listed to be covered in sixteen chapters, of those only 69 were concepts or skills that were being introduced for the first time. Since 72% of the curriculum content for sixth grade was review, it is clear that review and practice were stressed as important components of an effective instructional program.

The results of an analysis of the curriculum content for the seventh and eighth grade indicated that the percentage of new material introduced decreased with each successive year, thus three years of drill-and-practice on arithmetic procedures was provided for to ensure mastery of the procedural skills and instrumental knowledge. In the seventh grade there were 249 objectives and 48 of those were new concepts or skills, thus 81% of the curriculum objectives were review material. The results of the analysis of the eighth grade curriculum objectives revealed an even higher percentage of review material in the curriculum content with almost 90% of the objectives identified as review material. This analysis indicated that the mathematics instructional materials used during the 1991-92 baseline-data year were based on a spiraling curriculum and placed a heavy emphasis on review to maintain previously taught skills.

The *Addison-Wesley Mathematics* textbook in place during 1991-92 school year was adopted by Pleasant County teachers, which meant it was on the State's list of recommended textbooks for mathematics instruction. One reason for a textbook to be recommended, selected and adopted was that it corresponded closely to the State's *Standards of Learning* objectives and consequently to the County's *Curriculum Guidelines*. An analysis of actual curriculum content of the *Addison-Wesley* textbook provided results similar to the analysis of the State's SOLs with the majority of the mathematics objectives focused on mastery of arithmetic procedures rather than building number sense, or developing mathematical reasoning or problem-solving skills.

The first five chapters for all three grades focused on a review of basic arithmetic skills. Titles of the first five chapters follow: (1) "Addition and Subtraction of Whole Numbers," (2) "Addition and Subtraction of Decimals," (3) "Multiplication and Division of Whole Numbers," (4) "Multiplication of Decimals," (5) "Division of Decimals." Chapter 6 was Geometry followed by three more arithmetic skills review chapters: (7) "Number Theory" (Divisibility Rules, Least Common Multiple and Greatest Common Factors), (8) "Addition and Subtraction of Fractions," (9) "Multiplication and Division of Fractions." Chapter 10 covered Measurement: Metric Units, then Chapters 11 and 12 focused on the arithmetic skills for "Ratio and Proportion" and "Percents" respectively. Chapter 13 was "Circles and Cylinders," Chapter 14 was "Probability, Statistics, and Graphs," Chapter 15 was another basic arithmetic skill—"Integers," and Chapter 16 reviewed measurement "Measurement: Customary Units." Eleven out of sixteen chapters focused on a arithmetic procedures and computation skills, and many of the objectives in the measurement chapters were basic operations with different measurement units. These results revealed that about 70% of *Addison-Wesley's* textbook content focused on mastery of arithmetic procedures. Again, these data supported the conclusion that the bulk of

curriculum content taught during 1991-92 consisted of basic-arithmetic-procedure objectives, and therefore support the conclusion that the methods of instruction used were those identified by research as the most effective for teaching mastery of basic arithmetic skills and procedures during 1991-92.

A closer look at the layout of a chapter and its objectives served to illustrate how the mathematics concepts were broken down into small chunks for instruction. Following are the objectives from Chapter One of *Addison-Wesley's* seventh grade textbook:

Chapter One: Addition and Subtraction of Whole Numbers

- 1.1 Read and write whole numbers and identify place value in the decimal numeration system.
- 1.2 Compare, order and round whole numbers.
- 1.3 Estimate sums and differences of whole numbers.
- 1.4 Add and subtract whole numbers.
- 1.5 Add and subtract units of time.
- 1.6 Solve word problems using the 5-Point Checklist and cumulative computational skills. (p. T34)

Each chapter was broken down into five or six separate objectives, and a two-page-lesson layout was provided for each objective. As indicated by the chart that correlated *Addison-Wesley's* lessons with Madeline Hunter's suggested seven step lesson plan, each lesson in the book contained all seven components in its two-page presentation.

An analysis of the two-page-lesson format is presented to provide additional evidence that in the 1991-92 school year the mathematics textbooks' lessons were designed to teach procedural knowledge rather than conceptual knowledge. Conceptual knowledge consists of relationships constructed internally and connected to already existing ideas while procedural knowledge is confined to conventional symbols that are used to represent mathematics and to the rules and procedures that are used to carry out routine mathematical tasks (Van De Walle, 1994, p. 22). Van De Walle (1994) wrote, "Procedural knowledge is most susceptible to instrumental understanding or rote rule learning" (p. 25). When procedural knowledge is not supported by conceptual knowledge and is not integrated with other ideas it is referred to as instrumental knowledge, and knowledge that is learned instrumentally is learned by rote through drill and practice (Skemp, 1978, 1979, cited in Van De Walle, 1994, p. 24)

The two page lesson layout provided evidence that the lessons were designed for teachers to teach instrumental knowledge because there was little or no attention given to conceptual knowledge. An analysis of the lessons revealed that the primary mode of mathematics instruction was a combination of whole-group-direct and individualized

instruction that focused on teaching procedural knowledge. Occasionally conceptual understanding was addressed in the reteaching or remedial suggestions that were included for the teacher to use with individual students, but the lessons were designed to get the students interested in the objective, teach them the objective and have them practice the objective.

Since Chapter One of the seventh-grade textbook was used to exemplify how the mathematics content was broken down and presented in small chunks for instructional purposes, a lesson from Chapter One was randomly selected to provide an example of the two-page-lesson format. The correlation of *Addison-Wesley's* seven component lesson plan and the features of the two-page-lesson format were presented in the first section of the analysis of the 1991-92 instructional materials. Lesson 1.4, adding whole numbers, was selected to provide an in-depth example of the textbook's prepared lessons were presented. The material designated for the anticipatory set of lesson 1.4 was contained in "Ideas for Getting Started." The material contained the open-ended problem and the scripted lesson that follows:

To review the basic idea of regrouping in addition display a problem like the one below.

$$\begin{array}{r} \quad \quad \_ \quad 6 \quad \_ \\ + \quad \_ \quad 8 \quad \_ \\ \hline \_ \quad \_ \quad \_ \end{array}$$

Direct students to the problem. 'Why could the tens digit in the sum be either 4 or 5?' (If the sum of the ones is less than 10, the ten's digit will be 4; if greater than 10, it will be 5.) 'Could the tens digit in the sum ever be 6?' (No, the most we could be adding in the ones place is 9 + 9. where only 1 ten would be regrouped.) (p. 12)

Two things stand out about this part of the lesson: (1) This was a good critical thinking question, and the only change needed for it to be a task supportive of suggested mathematics reform was to change the first question to what possible digits could the ten's digit be in the sum and explain your thinking? (2) If the students did not have conceptual understanding of regrouping, then **teacher was expected to explain** the process using the scripted responses written after the questions, before moving to the next step in the lesson.

Step 2 of the lesson was the objective. During the 1991-92 school year teachers were instructed through the suggestions in the *Teacher Handbook* provided by the County to write the SOL objective and its identification number on the board, and according to the textbook's suggestions the teacher was to explain the objective to the students. "Students will be able to add whole numbers with regrouping" was the objective for lesson 1.4. Step

3, the instructional set, follows the introduction of the objective of the day. Instructional material for this part of the lesson was provided by a “Motivational Problem” presented with a labeled map in the textbook as follows:

The Mississippi-Missouri Red Rock river system is the longest in the United States and the third longest in the world. What is the total length of the system? (p. 12)

In the teacher’s manual the following suggestion and scripted lesson accompanied the Motivational Problem:

Remember: Be sure to give students frequent opportunities to estimate before and after computation.

**Motivational Problem** Read the introductory problem with students.

‘What are we asked to find?’ length of the river system) ‘What data does the map provide?’ (Where the rivers flow, how they link up, the length of each segment) ‘What data do we need to find the total length of the system?’ (Red Rock to Missouri, 246 mi; Missouri to Mississippi, 2,315 mi; Mississippi to Gulf of Mexico, 1,180 mi) ‘How would we use this data to find the total?’ (Add)

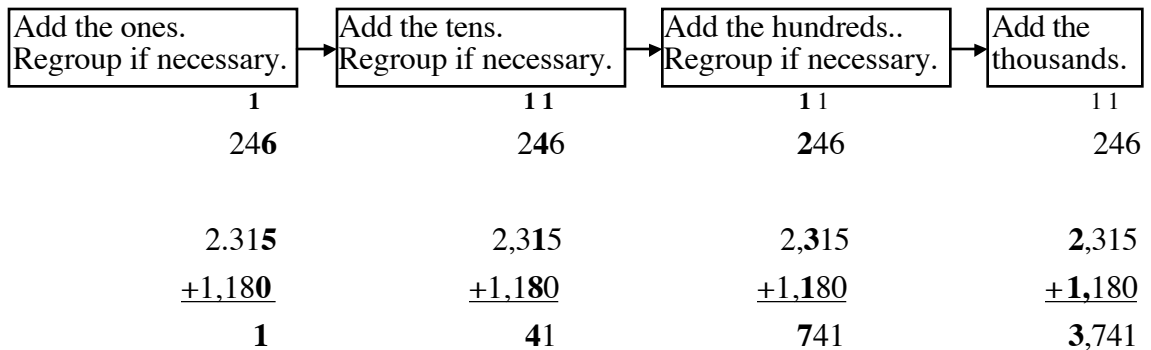
Have the students estimate the sum by rounding the numbers to the nearest hundred. Estimate:  $2,300 + 1,200 + 200 = 3,700$  addition (p. 12)

There are four significant points about this part of the lesson. (1) The lesson was designed so that the teacher did all the explaining. (2) The students were not expected to do any critical thinking, all the students were expected to do was answer factual questions. The questions provided for the teacher illustrated that the teacher was expected to guide the students through the problem solving process, and the **teacher** was expected to **explain** how to solve the problem. The scripted answers provided the factual data the teacher was expected to receive or provide. (3) Multiple solutions or alternative problem solving strategies were not encouraged. The teacher was instructed to **demonstrate** and **tell** the students how to estimate the distance, and there was only one correct estimate for the total distance: 3,700 miles. (4) Delivery of this part of the lesson was planned so that the **students** functioned as **passive** learners. Their tasks were to answer factual questions and complete a computation problem. The addition procedure for getting the exact answer was illustrated in a series of steps in the textbook, and in the next portion of the lesson the teacher was responsible for the explanation of that arithmetic procedure.

Step 4 of the lesson plan, Modeling, correlated to the Lesson-Development section of the two-page-textbook lesson. Instructional material provided for this part of the lesson highlighted the arithmetic procedure for adding whole numbers using the addition problem

for finding the total length of the river system. The solution to the river system problem was presented in the textbook as follows:

To find the total of the numbers, we add.



The total length of the system is 3,741 miles (mi). (p. 12)

This illustration was followed by three other problems which provided examples of the addition procedure for whole numbers without showing a different model for each place value in the problem. In the teacher’s manual the following instructional suggestions accompanied these examples:

**Lesson Development** Show how to find the answer by following the steps outlined. Explain the regrouping from the ones place to the tens and from the tens place to the hundreds. Then have students check the reasonableness of the answer by making an estimate of the sum using rounded numbers. . . .

**Other Examples** Point out the importance of aligning the digits properly. Then have students work through these examples. (p. 12)

The Modeling portion of the lesson again illustrated that the instructional emphasis was on arithmetic procedures and that the teacher was expected to show and explain the arithmetic procedure to the students. The students were expected to copy and practice the procedure; and the procedure by memorizing the steps. After completing the sample problems from the book with the whole group the teacher was directed to assign the ten practice problems provided in the warm-up exercise which was step 6 of the lesson, guided practice.

During the guided-practice portion of the lesson the teacher was expected to monitor the students’ progress and provide reteaching or remediation as necessary. Teaching suggestions taken from the teacher’s manual for the guided-practice portion of the lesson follow:



Watch for students having difficulty with basic addition facts or with regrouping. For students having trouble with memorization of the basic facts, plan additional drill. If regrouping is a problem, use place-value models to show the regrouping process. (p. 12)

The guided practice portion of the lesson reinforces that the teacher is the mathematical authority. It was the teacher's responsibility to determine if the students were ready for independent practice or if reteaching or additional instruction was necessary. The objective of the lesson was mastery of the addition-arithmetic procedure for whole numbers, and the main focus of instruction was on teaching the rules for addition.

The students were expected to copy the problems and work out their answers on paper while the teacher walked around the room and checked for procedural understanding. The reteaching suggestion, if a student was having a problem with basic facts more drill should be planned, highlights the importance drill played in learning mathematics. There was also a suggestion that if the student was having problems with regrouping then place-value models should be used to model the process of regrouping, but in 1991-92 there were no base-ten manipulatives in the building, and no teacher indicated that they had made any such manipulatives for the purpose of mathematics instruction. Therefore, reteaching was limited to showing the student another example of how to manipulate the mathematical symbols to find a total.

After students successfully completed the guided practice section independent practice was assigned which was step 7 of the lesson plan. For this lesson the independent practice in the book consisted of twenty-five addition problems. Fifteen of the problems were set up ready to add, eight of the problems required the student to line up the place values then add, and there were two word problems at the end of the lesson, one addition and one subtraction. If the student successfully completed the independent practice problems the books supplemental materials offered an enrichment exercise. For this lesson the enrichment exercise presented an alternate method of adding numbers and then provided nine practice problems. This method consisted of adding each column separately and then adding the partial sums. Although this presented an alternate method of getting the answer, it was still a lesson that provided the student with all the necessary information, and the student's task was to follow an example problem to practice the computation steps for the alternate procedure.

If the student did not successfully master the independent practice problems then the supplemental materials provided a reteaching exercise and practice supplement. The reteaching exercise provided another example like the river system problem that showed an addition problem being worked in steps: add ones place, then the next illustration showed

adding tens place and so on. After this example there were twenty-one problems for practice. This could be followed up with the practice supplement which contained thirty-three addition problems, and if more practice was needed there were fifteen additional practice problems provided in the back of the book in a section titled “More Practice.” The sheer amount of available “extra-practice” problems served to verify that drill-and-rote computational practice was considered an important and an essential element of mathematics instruction.

Every objective in the book was presented in this two-page-lesson format with supplemental materials for enrichment, reteaching, additional practice or more practice exercises as needed. This textbook was selected because it matched the mastery teaching instructional needs. The content of the textbook was in alignment with the State and County curriculum expectations, and approximately 70% of the SOLs focused on mastery of arithmetic procedures. Review and practice were important components for maintaining procedural skills and the *Addison-Wesley* series was designed with review of previously taught material built in from year to year. Lesson plans were designed to be compatible with teaching procedural knowledge, and the content of the textbook supported instruction that focused on procedural understanding. Teachers were expected to deliver whole-group-direct instruction, monitor progress, and reteach skills as necessary, and the *Addison-Wesley* textbook was designed to facilitate the teacher in doing just that. Interview data related to classroom discourse and instructional planning used during the baseline data year are presented next.

#### Textbook and Teacher Role Data: Interviews

Interview data from mathematics teachers that taught mathematics during the 1991-92 school year at Pleasant Middle School, from the Principal that observed mathematics instruction during the that school year, and from the Director of Elementary and Middle Instructional Programs, provided data to support that the method of instruction suggested and provided by the instructional materials was used by the teachers for mathematics instruction during the 1991-92 school year. Presentation of the interview data begins with teachers’ statements that confirm the *Addison-Wesley* instruction materials were used for mathematics instruction during the 1991-92 school year, and it concludes with descriptions of mathematics instruction used during the 1991-92 that match mathematics lessons described in the analysis of the textbook’s instructional materials.

While the lead teacher talked about how his methods of instruction had changed he indicated that during the 1991-92 school year he used the *Addison-Wesley* textbook for instruction. He stated, “. . . I don’t teach chapter to chapter. I **use** to do that, and now I

teach on a need to know bases” (p. 2). While talking about homework during his second interview the lead teacher said, “. . . I do use my textbook for homework assignments—traditional ones. . .” (p. 15). “. . . I used to go from the textbook chapter by chapter. . . I went through the chapter and did everything in sequence. . .” (p. 19).

When responding to questions about how her planning had changed, the other eighth grade teacher made several different comments about using the textbook for mathematics instruction during the 1991-92 school year. Those comments follow: “. . . I supplement the textbook more with almanacs, maps, newspapers, than I used to” (p. 2). “. . . formerly, I was more textbook and objective driven, and, especially with the increased time, I try to think more about what the students need, and now I meet their needs in that amount of time, than I do specifically meeting the objective” (P 3). “You know, from a teaching aspect I feel, you know, I feel that what I am trying to do is a little more worthwhile than just going through the textbook and learning to compute and teaching to compute, that kind of thing” (P 15-16). As the teacher described what she liked about the changes made in her mathematics instruction her comments indicated that during the 1991-92 school year she used the *Addison-Wesley* textbook as designed to teach mathematics.

The seventh grade teacher also indicated that she used the *Addison-Wesley* textbook for mathematics instruction during the 1991-92 school year. While discussing how increased instructional time had changed her methods of instruction she made the following comment: “. . . I don’t feel as pressured, we have a longer period of time for math, than we have had in previous years. I don’t feel as pressured to cover just material in the book and move on. . .” (P 2). This statement indicated that she used the *Addison-Wesley* textbook, as intended, to teach mathematics during the baseline data collection year.

One of the sixth grade teachers described her typical mathematics lessons as starting with the book saying, “Well, I begin with, of course, the lesson in the book, and as I go through there is something that comes up that one of the children will need me to help with, and I go ahead and include that in my lesson plan for the entire class. Basically that is what I do” (p. 3). While discussing assessment she stated, “. . . being able to master the material in the chapter is what I am after” (p. 12). This sixth grade teacher confirmed that she used the textbook for mathematics instruction in the traditional manner.

The other sixth grade teacher’s statements also indicated that he used the textbook for mathematics instruction as prescribed saying, “. . . I used to assign a page for them to do, and to come back and check it the next day, and every now and then I still do, cause there is practice in the back. Especially, if I feel like the majority of the class is not getting what I want them to get, then I will give them a practice exercise to do, and we will go over it to reinforce what we have already done” (p. 19).

All of the teachers involved in the study that taught mathematics during the 1991-92 baseline school year indicated that they used the textbook for mathematics instruction. Their comments also suggested that they followed the textbook chapter by chapter and focused on covering the objectives as they were presented in the *Addison-Wesley* textbook. Additional interview data about the methods of instruction used was provided as the teachers and administrators described aspects of a typical mathematics lesson.

The following interview data indicate that teachers used traditional methods of mathematics instruction during the 1991-92 school year, and that they were encouraged by the administration to do so. The eighth grade lead teacher stated that he used the textbook for traditional assignments, and in his second interview he conveyed frustration in the expectations for mathematics instruction. He stated, “I felt guilty at times about not doing all the activities that I knew I should be doing, but my evaluation depended on doing what the Principal wanted me to do, and the hell with the kids basically. Sorry. . . He [the Principal] felt students should be sitting at their desk doing book work. . .” (p. 3). It was expected that teachers use independent practice and individualized instruction to teach mathematics, and although the eighth grade teacher indicated that he did not agree with the methods, he used them.

The other eighth grade teacher made the following comment which not only indicated that she followed the direct instruction, individualized instruction and independent practice method of mathematics instruction advocated in the *Addison-Wesley* materials, but that teachers were expected to follow this instructional plan. The eighth grade teacher stated, “. . .with the 45-minute class period, we always— generally all the teachers in the school, were encouraged to follow the model of direct instruction, guided practice. . .” (p. 6) Later in the interview she commented that encouraging student-to-student communication was new to her mathematics instruction, and she described the change stating, “Well, that [student-to-student communication] was formerly known as cheating. I think, you know, you expected the kids to do their own work, be quiet, do their own work, and if you have a question ask the teacher. . .” (p. 7). This comment supported that student-to-student communication was not encouraged for use with mathematics instruction during the 1991-92 school year and that the methods of instruction encouraged for use were individualized instruction and independent practice.

The seventh grade teacher shared information about methods of instruction she used during the 1991-92 school year while she talked about how her lesson plans had changed. Her explanation of changes in planning included the following statements: “My assignments are shorter. I probably take as many grades as I used to, but the length of the assignment is much shorter, and in the block-period time they are doing more group work

instead of—you take this worksheet home and you do it. . .” (p. 10). She explained that the increased amount of time for mathematics instruction, provided by the implementation of block scheduling in 1993-94, changed her instructional planning in that she spent more time planning hands-on instructional activities, and she made the following statement about the reason for this change: “I don’t feel as pressured to cover just material in the book and move on. . .” (p. 2). When asked if planning hands-on instructional activities was something new to her lesson plans she stated, “**Absolutely**” (p. 2)! and later in the interview when asked if hands-on activities had always been apart of her mathematics lesson she said, “**No**. . . when I had the students for the blocked-period of time, we always did a hands-on activity” (p. 5). “. . .I don’t feel the need to continue pushing to cover more material. . .” (p. 6). These statements indicated that hands-on activities were not included in mathematics instruction during the 1991-92 school year and that drill-and-practice worksheets were a part of classroom instruction at that time. The data also indicated that the teacher felt pressured to cover the material in the textbook and advocated methods of instruction were the use of whole-group-direct instruction, individualized instruction and drill-and-practice.

The typical lesson that was described by this sixth grade teacher matched the method of instruction suggested by and provided in the *Addison-Wesley* instructional materials. The sixth grade teacher described her typical lesson as follows: “. . .after I teach a lesson and tell the students what I want them to do, and I ask, ‘Any questions?’ Which they won’t answer. When they get started, I go around and see if there are some questions and just to make sure that they don’t have any. I do whatever needs to be done that day” (p. 9).

In the following statement the same sixth grade teacher explained how having students work the textbook arithmetic problems at the board improved the students speed and accuracy with computation. The teacher’s comments follow:

First of all, they love writing on the board. Second, for some odd reason, a child who does the work on the board can understand it and do it more quickly than if he just works on paper, and I cannot explain that. I can have children work problems wrong on their paper, specially in division, and I send them to the board and they work it. I don’t know what it is about the board, and it is a good opportunity for each of them to let me see what they are doing before they start writing it on paper. (p. 4-5)

This statement provided a description of the type of drill-and-practice mathematics instruction that was used with the *Addison-Wesley* textbook to teach computation skills during the 1991-92 school year.

The same sixth grade teacher made the following comment to explain why she liked to use whole-group-direct instruction for teaching mathematics. She stated, “. . .it is easier for me. I just think with the whole group, and the larger group, I can manage focusing on one thing. It is easier for them to concentrate than if you have little groups all over the classroom. . .” (p. 8). This statement indicated that this sixth grade teacher preferred using the method of instruction described in the 1991-92 instructional materials.

While talking about how his mathematics instruction had changed, the other sixth grade teacher described mathematics instruction during the 1991-92 school year in the following way: “. . . I used to have them [students] in lines and in straight rows and give them class work and let them do the class work and take up the papers and check the papers, and give the papers back. . .” (p. 15). “I don’t use as much from the book, like for homework assignments. I used to, I used to assign a page for them to do, and to come back, and check it the next day, and every now and then I still do. . .” (p. 19). This comment painted a picture of the traditional classroom with the teacher in the front of the room facing straight rows of desks where students sat quietly listening, watching, and then independently practicing their mathematics skills, and students’ questions were addressed to the teacher. The teacher was responsible for explaining the lesson and for checking the students’ work and for answering questions.

The former Pleasant Middle School Principal, described the mathematics instruction used during the baseline school year while he explained why the middle school was selected to participate in the V-QUEST Lead Teacher program. His description confirmed that whole-group-direct instruction, individualized instruction and drill and practice were the predominate methods of mathematics instruction used during the 1991-92 school year. He stated, “I think there was a real concern. . .the concerns that there was still a very traditional approach to the math and science, still a lot of lecture. It wasn’t student involvement, very limited hands-on. The science equipment that was there was less than current, ah, the math again was a very traditional approach to doing business. Very clearly defined, these are the SOLs, and that’s what we did, and we didn’t do anything else” (p. 3).

Later in his interview while responding to a question about cooperative learning and mathematics instruction, the former Principal of Pleasant Middle School described the mathematics instruction he observed in the 1991-92 classrooms for comparison purposes in the statement that follows:

It was really interesting to watch because the first year I was there about the best description I could give, and I was in the classroom observing, was traditional, high-school teaching, and that’s not a put down to high-school teachers. It was very much lecture. You could almost set your calendar to

what day of the week it was as to what was going on in the classroom. If you were in there on a Friday, it was going to be a test. If it was a Thursday, it was going to be a pretest. If it was Monday, it was introduction. I mean that part was very traditional approach to education. . . . (p. 17)

Again the Principal's data supported that whole-group-direct instruction, lecture, was the predominate method of instruction used during the 1991-92 school year, and the traditional use of assessments indicated that procedural knowledge and computation skills were the focus of that instruction.

The County's Director of Elementary and Middle School Instructional Programs described the mathematics instructional practice while explaining the difference between the V-QUEST Lead Teacher's instruction and the previously used mathematics instruction, ". . . I think telling is his [mathematics lead teacher] **not** his first resort, and I think that's the difference, because in many classes at [Pleasant] Middle School telling is the first and only resort, the only strategy that they [mathematics teachers] know how to use. . ." (p. 24).

Both the former Principal's and Director of Elementary and Middle School Instructional Program's comments indicated that mathematics instruction during the 1991-92 school year was not based on a problem-solving approach and that it was not student centered. The data support that a combination of whole-group-direct instruction, individualized instruction and drill and practice were the most commonly used methods of instruction. The teacher interview data indicates that the teachers used the *Addison-Wesley* instructional materials for mathematics instruction during the 1991-92 school year, and descriptions of the lessons indicated that the materials were used as designed and recommended. The data also indicated that methods of instruction matched the curriculum design, and administrative expectations. The classrooms were teacher centered and discourse was teacher directed and dominated by teacher talk.

The role that problem solving plays in mathematics instruction has a significant bearing on the type of instruction used in the classroom. So far, the curriculum content and instructional materials and interview data have indicated that procedural/instrumental knowledge was the main focus of mathematics instruction during the baseline-data year of 1991-92 and that whole group direct instruction, individualized instruction and drill-and-practice were the predominate methods of instruction in use. A more in-depth analysis of problem solving was indicated as necessary after the presentation of the state's seventh and eighth grade problem solving SOLs, 7.20 and 8.22, and this analysis will serve as support for the conclusions made about the focus and methods of instruction that were in place during the 1991-92 school year. The next set of data presents an analysis of how problem

solving was used in mathematics instruction and presented in *Addison-Wesley's* instructional materials.

### Problem Solving Data: Artifacts

Word problems and problem solving are curriculum components included in both the 1988 SOLs and in the NCTM recommended changes for mathematics instruction, and they are a significant part of the data analysis for documenting change in mathematics instruction, therefore baseline data related to mathematics instruction and word problems are essential. The SOLs dealing with problem solving provided for the possibilities of mathematical application and critical thinking opportunities in mathematics instruction. The textbook lesson example presented in the analysis of the instructional design of the textbook included a word problem about rivers in the anticipatory stage of the lesson and two word problems in the independent practice portion of the lesson. It is obvious that solving word problems was a part of mathematics instruction during the 1991-92 school year, but the instruction related to problem solving was consistent with the instructional practice for all other skills or objectives. Data that support this conclusion are provided by the review of the instructional materials and by teachers' statements.

Since the objectives from Chapter One of *Addison-Wesley's* seventh grade textbook were previously provided, this same chapter will be used to illustrate the use of word problems in mathematics instruction. The majority of the lessons in chapter one have two word problems included at the end of the independent practice section, and most of the lessons opened with a word problem for the anticipatory stage of the lesson. A few of the lessons in Chapter One have no word problems, while lessons about problem solving have only one variety of word problems. There were six objectives identified for Chapter One, and each objective had at least one lesson while some had two different lessons, for example the objective to add and subtract whole numbers was presented in two lessons, one on addition and one on subtraction, thus there were fifteen lessons in Chapter One. Following is a break down of the number of lessons that had at least one word problem in the anticipatory set or the instructional set of the lesson: eleven out of fifteen lessons begin with a word problem in the anticipatory set of the lesson, while only four lesson included a word problem in the instructional portion of the lesson. Six of the fifteen lessons included two word problems at the end of the independent practice assignment, three lessons contained no word problems in any part of the lesson, and five of the lessons focused solely on one type of word problem. These lessons are used to document the instructional strategies recommended for teaching problem solving .



The objective of lesson eight in Chapter One was to solve word problems using the 5-point checklist. This is the first lesson in the text about solving word problems, and it is organized just like the example lesson with the seven step lesson plan. Ideas for getting started provided the following suggestion for the anticipatory stage of the lesson:

Display questions like those below. Substitute the names of some of your students to create more interest.

1. How much taller is Michelle than Diane?
2. What is the total weight of Jack and Fred?
3. Who lives closer to school, Otis or Sonya? How much closer?

For each question ask, “What data or numbers do we need to know to answer the question?” and “What should we plan to do to find the answer?” (p. 16)

After focusing the students’ attention on two aspects of problem solving, identifying the data needed and making a plan, the teacher explains that today they will learn to solve word problems using the 5-Point Checklist. Then the students are directed to study the 5-Point Checklist at the top of page 16 in their textbooks.

There is a word problem written underneath the 5-Point Checklist, and this problem is worked out in steps so that all five points of the checklist were illustrated on the first page of the lesson. This was the example problem provided for the instructional portion of the lesson. The recommendations for lesson development provided in the teacher’s manual suggested that the teacher explain the following information to the students:

. . .these are not rules for solving word problems—they are points that will give the students a systematic plan to use when trying to solve word problems. Then use the problem at the top of the page to illustrate the use of the 5 points. Stress these ideas:

1. In order to understand the question, students must read the problem carefully. The question asks students to find something, but they should be aware that it may not always be phrased in a question format.
2. The data for a problem may be listed separately (as in the motivational problem at the top of the page), it may be included in the statement of the problem, or it may be obtained from sources outside the problem.
3. The plan usually involves the decision to use one or more mathematical operations to solve the problem. Some problems, however, do not require the use of a mathematical operation.

4. To find the answer, we usually need to do some calculating. The answer should be the answer to the question in the problem. For example, the answer to the motivational problem is “425 calories” not just the number 425.

5. Check back involves such things as estimating the answer, rechecking computation, and/or rereading the problem to see whether the answer seems reasonable. (p. 16)

After the teacher’s explanation of how to use the 5-Point Checklist, the students were to use the steps to solve two word problems that were provided in the textbook as the guided-practice portion of the lesson. This was the only part of the lesson that encouraged the teacher to use any form of student discussion, and the directive for this discussion was provided by the following statement: “Have students solve the two problems at the bottom of the page. Discuss how they used the 5-Point Checklist to solve the problems” (p. 16). Students were not expected to reason or think about alternative-problem-solving methods they were expected to apply the steps as the teacher and textbook instructed.

As in all the lessons in the *Addison-Wesley* textbook guided practice were followed by the assignment of independent practice problems. For this lesson there were ten word problems included in the independent practice section, and since this lesson immediately followed the lessons on addition and subtraction of whole numbers all of the word problems were simple addition or subtraction problems. Seven of the problems were addition and three were subtraction. Although the problems did make a connection to real life, finding the number of calories consumed for breakfast, lunch, and dinner, none of the problems required the use of more than one operation, and all of them contained a key word or phrase (i.e. total, how many more, how many in all) in the problem to indicate what operation was needed to solve the problem. None of the problems were open-ended type problems with more than one solution method or more than one possible solution.

Students were expected to rigidly follow the five problem solving steps by writing down an answer for each of the five steps in the check list. As a matter of fact the reteaching suggestion for this lessons recommended that the teacher provide the students with a copy of the Problem-Solving Worksheet from the *Teacher’s Resource Book* (p. 287) so that the students could record the information as the teacher showed them how to work through the steps. The worksheet had the five steps highlighted at the top of the page with the rest of the paper laid out so that the students could record the teacher’s example underneath each step. There were directions written beside each step as follows:

1. QUESTION: Restate the question in your own words.
2. DATA: What data is needed to solve the problem?

3. PLAN: What operation or strategy can be used to solve the problem?
4. ANSWER: Write your answer here.
5. CHECK: Read the problem again. Does your answer make sense? Is the computation correct? (p. 287)

There was one correct response for each problem, and the students were not encouraged to discuss their thinking, to explain their solutions, or to use calculators. The instructional focus was on following the five step procedure outlined in the lessons, and on working computation problems to get the correct answers. These word problems were not designed as problem-solving challenges to develop mathematical reasoning but as practice problems for computation and for mastery of the 5-Point Checklist to solve problems.

The second word-problem lesson in Chapter One focused on step one of the 5-Point Checklist, understanding the question. In this lesson students were provided the word problem's data, but the question was missing. They were expected to write a question to fit the data, and then answer their question. There were eight problems in this assignment, and all of them provided data that best fit an addition or subtraction question. Problem two was randomly selected as an example, and it follows:

2. Roberta has saved \$57 to buy a new bicycle. The model she would like to buy costs \$139. (p. 20)

In NCTM (1989) *Curriculum Standards* it was recommended that increased attention be given to investigating and formulating questions from problem situations, but at the same time it recommended that there be a decrease in the use of problems categorized by types for mathematics instruction (p. 70-71). Since all of the word problems in this exercise were addition or subtraction questions, writing a question to fit the data presented little challenge and consequently little or no critical thinking was required to solve the problem, thus the word problem assignment was little more than computational practice.

The objective of this lesson was to solve word problems focusing on understanding the question (p. 20). Two features of this lesson indicated that accuracy in computation received as much stress as the logical reasoning objective. (1) The use of calculators was not recommended for this problem solving lesson. (2) When the assignment was completed, the teacher was expected to check the student's work for reasonable questions and accurate computation. After checking the papers, the teacher was directed to select several student-created questions to use as examples for the purpose of explaining reasonable questions. Here again, the teacher was expected act as the mathematics authority, and the teacher was expected to explain the mathematical thinking and reasoning involved in the lesson while the students listened passively.

The third problem-solving lesson focused on using estimation to determine the reasonableness of the exact calculations. In this lesson the students were expected to estimate an answer for a given word problem, then compute the exact answer and check to make sure the two answers were close to one another. For this lesson there were two acceptable methods of estimation: (1) front-end estimation and (2) rounding off numbers. Using alternative methods for problem solving and applying estimation are both desirable features of a word problem lesson, but instead of letting the students determine which estimation method would work best, the teacher was instructed to assign the rounding method of estimation for the odd-number problems and the front-end method for the even-numbered problems. Therefore, there was only one correct method of estimation, one correct estimate and one correct exact solution for each of the eight problems in the independent practice exercise.

As was true of all the other problem solving lessons in this chapter, all eight problems involved addition or subtraction of whole numbers, and the use of calculators was not recommended. Problem number eight was selected as an example of this set of exercise problems for two reasons: (1) it is representative of the “type” of addition and subtraction word problems included in the exercise, and (2) when compared to the example from the previous lesson it illustrates the repetitious nature of the *Addison-Wesley* instructional materials. Problem eight from the Problem Solving: Using Estimation lesson follows:

8. Phillip is saving to buy a bicycle that costs \$169. He has saved \$78 so far. How much more does he need to save? (p. 21)

Again, due to the problems being organized by operations, and methods of estimations being assigned, there was little thinking or reasoning required by the students. As in the previous word problem exercises all of the questions contained key words or phrases (i.e., What was the total . . . , How much more . . . , Does she have enough . . . , What is the total . . . , How many empty seats . . . , How much in all . . . ) to indicate which operation was needed to solve the problem. None of the problems contained any extra or missing information, and none of the problems were open-ended. Students were expected to practice the two methods of estimation and use those to check the reasonableness of their computations. The design and content of the lesson conveyed that estimation was important because it provided a method for checking the accuracy of paper-pencil computations, which serves to verify the importance placed on teaching and maintaining arithmetic procedures through written practice in the 1991-92 school year.

The fourth word problem lesson focused on the second problem solving step, identifying the data needed to solve a word problem. After the term “data bank” was introduced and explained to the students, they were expected to use the data bank in the

back of the book, page 426, to find the data necessary for solving the six word problems included in the independent practice exercise on page 23. These word-problems did connect mathematics to real world data about the numbers of AM and FM radio stations in different states, but, as in all the other word-problem lessons in this chapter, all six problems involved either addition or subtraction of whole numbers, questions contained key words or phrases, the use of calculators was not recommended, and the students were instructed on exactly where to find the data needed and how to use the data to solve the problems. With little or no critical thinking needed to solve the problems the exercise on finding data becomes another paper-pencil computation practice in addition and subtraction of whole numbers.

The fifth and last word problem lesson in the chapter taught the problem solving strategy of “Guess and Check” as a method for solving nonroutine word problems. This lesson was organized like all the other lessons in that there was an example of the strategy for the teacher to explain to the students, then there were guided practice problems for the students to work through to practice following the steps that the teacher provided during the instructional part of the lesson. During the guided practice portion of the lesson, the teacher was instructed to tell the students how to determine when their guess was too large or too small (p. 24). Guided practice was followed by independent practice, which included only two nonroutine addition word problems. Since the problem solving strategy had been demonstrated and the mathematical reasoning and thinking had been explained by the teacher, the student’s task was to practice using the Guess-and-Check strategy to solve the two nonroutine problems provided.

The textbook was organized so that a different problem solving strategy was taught at the end of the first nine chapters. At the end of chapter two students were taught the problem solving strategy of Making an Organized List, at the end of chapter three Find a Pattern, chapter four Draw a Picture, chapter five Work Backwards, chapter six Solve a Simpler Problem, chapter seven Make a Table, chapter eight Choose the Operation, chapter nine Use Logical Reasoning, and then chapters ten to sixteen all ended with a word problem lesson titled “Using the Strategies”. At the top of each of these pages all the previously taught strategies were listed and a check mark was placed beside the strategy that should be used to solve the problems on that page.

This shows that *Addison-Wesley*’s word-problem-instructional lessons were organized and presented by categories. Word problems were categorized in the four ways that follow: (1) routine or nonroutine problems, (2) arithmetic procedures, (3) types of numbers i.e., whole numbers, fractions, decimals, and (4) problem solving strategies. This method of organization facilitated the instructional methods of showing and telling the students how to solve routine and nonroutine word problems. All the different strategies

were presented separately with matching sets of independent practice problems so that students could practice for mastery of each strategy. The focus of problem solving instruction was to teach the problem solving strategies rather than to challenge the students and develop their mathematical logic and reasoning skills.

Since the use of calculators was not recommended for any of the problem solving lessons in the textbook, computation remained a significant part of all the problem solving lessons. To emphasize the importance placed on arithmetic procedures, all of the word problems throughout the text were organized according to the arithmetic procedure being taught in that chapter e.g., if a word problem was included in the division of decimals lesson then the student knew the word problem would be solved with that operation. All of the word-problem lessons followed the same lesson-plan design: the teacher taught the procedure, explained any mathematical reasoning involved, assigned independent practice and monitored progress by checking answers for accuracy. Alternative solutions or problem solving methods were not encouraged, and students were given little opportunity to discuss mathematical thinking. Teaching problem-solving strategies was an integral part of the mathematics curriculum in 1991-92, but encouraging logic and reasoning, developing mathematical communication and understanding by having students justify their answers or problem-solving strategies were not components of problem-solving lessons during the 1991-92 school year. Additional support for the conclusions about problem solving and mathematics instruction was provided by the teacher interview data which are presented next.

#### Problem Solving Data: Interviews

In the teacher interview data, teachers talked about using the textbook's instructional plans for teaching problem solving, and they talked about how problem solving and mathematics instruction had changed which provided verification of how problem solving was used in the 1991-92 mathematics classrooms. The interview data also verify that emphasis was placed on teaching computation skills, and that the purpose of mathematics instruction during the baseline year was to teach arithmetic procedures and computation skills, therefore the amount of instructional time spent for problem solving was automatically limited. As the teachers talked about how their instruction had changed, they talked about how they used problem solving and computation during the 1991-92 school year and this provided evidence that the teaching of computational skills was the focus of instruction, thus teaching problem solving and reasoning skills were not the emphases of mathematics instruction in the baseline school year.

When the lead teacher was asked if use of problem solving in mathematics instruction had changed, the lead teacher said, “Some of it I have always done, even from the beginning. . . I do more non-routine-type problems instead of just the old standard. . . . I do more writing now than I have ever done, that’s for sure. Kids do more writing. . . . They work these problems out, but they have to write an explanation” (p. 12). This eighth grade teacher’s comment supports that the word-problems used during the 1991-92 school year were old-standard routine word problems as described in the analysis of *Addison-Wesley’s* instructional materials.

As the lead teacher described the balance of time between focusing on understanding basic skills versus reasoning and logic, he made the statement that follows:

When I started the year off I wasn’t going to do basic skills at all. That whatever we did was going to be directed, so we could stop and take care of fractions, and when we do this— it will take care of decimals, but in midstream I decided I had to change and do, and did away with my thinking type stuff because the kids couldn’t handle that because their basic skills were so limited, so I had to spend more time on basic skills. Boring worksheets, I don’t know what else to do with basic skills, if we did an activity that required fractions they couldn’t do the activity because they couldn’t do the arithmetic. I don’t know what to do. (p. 13-14.)

Here the eighth grade teacher described the necessity of using drill-and-practice worksheets to teach arithmetic-computation skills. This statement indicates the importance placed on drill-and-practice methods of mathematics instruction when the educational objective is to teach arithmetic-computation skills and procedures. In 1991-92 at Pleasant Middle School the mathematics curriculum and instructional materials in place both focused on teaching computation skills and procedures. The lead teacher’s description of instruction used to teach computation provides support that in 1991-92 traditional methods of instruction were the predominate methods of instruction used in Pleasant Middle School’s mathematics classrooms.

The other eighth grade teacher described the focus of mathematics instruction in 1991-92 in the following statement which was made while talking about how her methods of instruction had changed since the baseline year. “. . . There is also a difference in content. I don’t stress computation so much as I used to. A lot of times, by the time they get to the eighth grade, they resent practicing division, multiplication, you know if they haven’t learned it up to that point, you know, I am just kind of— here is a calculator. I don’t want the problem solving to be limited by their computation. You know, if they have the problem

solving skills, I want them to use a calculator” (p. 9). According to this eighth grade teacher the focus of instruction during the baseline year was on computation.

When one of the seventh grade teachers was asked if she had always used the problem solving approach to teach mathematics, she said, “That is something that I probably, is one of the more difficult things to use, and **no**. I am more new in that area. . . . I don’t feel the need to continue pushing to cover more material, you know.” This comment indicated that using the problem-solving approach to teach mathematics was a new teaching strategy, therefore it was not in use during the 1991-92 school year.

One of the sixth grade teachers talked about how she used word problems in opening her mathematics lessons, and the description matched the direct instruction for teaching problem solving described in the *Addison-Wesley* instructional materials. “Well, I begin with, of course, the lesson in the book, and as I go through there is usually something that comes up that one of the children will need me to help with, and I go ahead and include that in my lesson plan for the entire class. . . if we have a problem then I stop where I am, and we will do two or three more practices. . . .” (p. 3) A typical mathematics lesson for this sixth grade teacher started with the teacher selecting students to read the introductory word problems from the textbook, and then those problems were used as examples for whole group direct instruction on the computation needed to solve the problems. In the following statement the teacher explains why she had students read the problems: “Because they pay more attention when the other students are reading. If I read they may listen, or they may not, but then they don’t notice when they are called on. So they pay more attention, and they like to read aloud” (p. 5). These data support that the focus of problem solving for this mathematics lesson was on teaching procedures and computational skills rather than on involving the students in thinking and reasoning. The teacher explained how to solve the problem and the students practiced the procedures while the teacher monitored and provided independent instruction as necessary. This lesson was from the *Addison-Wesley* textbook, and it provided an example of the traditional methods of instruction used in the 1991-92 mathematics classrooms.

When asked if anything about his mathematics instruction had changed, the other sixth grade teacher said, “. . . My own method itself has not changed a whole lot. I guess, I don’t follow as strict or ridged lesson plan now as I use to” (p. 3). “. . . I do more grouping than I did in the past. I use more of the cooperative learning and more of the Paideia types of activities than I used to. I used to have them in lines and in straight rows and give them class work and let them do the class work and take up the papers and check the papers and give the papers back. . . .” (p. 15) “I don’t use as much from the book, like for homework assignments I used to, I used to assign a page for them to do and to come



back and check it the next day, and every now and then I still do. . .” (p. 19). “. . . I think before, especially with the block, we only had a 45 minute block, and I found myself talking more than they had to time to work, and . . . I was going over it, talking more, and I got to where I thought I was going to beat my head against the wall. I wasn’t getting anywhere” (p. 12). These data indicated that in 1991-92 this sixth grade teacher used traditional methods of instruction in his classroom. He followed the textbook’s lessons and used whole-group-direct instruction and independent practice for all of his mathematics lessons including problem solving.

Although the evidence presented for problem solving instruction indicated that technology was not used with the problem solving lessons contained in the instructional materials, the County’s seventh grade curriculum and the state’s eighth grade SOLs did mandate that students learn how to use calculators and technology, and the *Addison-Wesley* instructional materials included a technology strand. Since the use of technology in mathematics instruction was one of the methods of instruction identified as useful for documenting change, establishing baseline data for how technology was used in mathematics instruction during the 1991-92 school year is an essential component of the study. The analysis results of *Addison-Wesley’s* technology related instructional materials presented next provides significant baseline data.

#### Calculator Data: Artifacts

In the *Putting Research into Practice* section of the textbook a question about the negative effects of calculators on mathematics instruction was addressed and the opening and closing sentences of *Addison-Wesley’s* response follows:

Although learning computational skills is one of the primary tasks of math instruction, it is essential to recognize that paper and pencil computation is neither the only, nor always, the most efficient method for solving problems. . . .Calculator skills should be taught in addition to, rather than instead of, computational skills, for specific educational goals. (p. T26)

These statements were in alignment with the data presented from both the County’s curriculum guide and the SOLs concerning the use of technology in mathematics instruction. All three data sources suggested that calculators can be useful tool in mathematics, but they cannot and should not replace mastery of paper-pencil arithmetic-computation skills. Assessment data presented in the next section verify that the use of calculators was not permitted on any of the local, state or national mathematics assessments therefore, it stands to reason that use of calculators would not be encouraged in mathematics instruction until students could do arithmetic computations quickly and accurately, and even

then drill-and-rote practice without a calculator was suggested for maintenance of arithmetic computational skills.

An analysis of the seventh grade *Addison-Wesley Mathematics* textbook provides data useful for establishing baseline data concerning the use of technology in mathematics instruction during the 1991-92 school year. There were eight calculator activities included in the students' textbook, 14 calculator-assisted problem solving challenges provided in the seventh grade teacher's manual, and 16 calculator games or activities were included in the textbook's supplemental resource materials, one per chapter. All of the calculator activities in the student's textbook had the same type-lesson design as the other instructional materials. The calculator lesson started showing students what buttons to push on the calculator, and this was followed by guided-practice problems and an independent-practice exercise. In the student's textbook there were three different types of calculators activities dispersed as follows: one each in chapters one, two and three, two in chapter seven, and one each in chapters nine, fifteen and sixteen. Three of the calculator activities were Think Math activities, three were enrichment activities and two were independent-practice assignments. An example of each type of activity is provided to illustrate how the calculator activities were used to reinforce arithmetic procedures rather than to encourage problem solving.

The first example is a Think Math problem from the third chapter. This Think Math problem was at the bottom of the page and followed 28 independent practice problems that involved finding the quotients and remainders with 3-digit divisors. After completing the 28 division problems using paper and pencil the students moved to the following calculator challenge problem:

### Think Math

#### Calculator Division

You can use a calculator to find the whole number quotient and the remainder for  $377,809 \div 689$ .

Study the method below. Follow the steps and use a calculator to do exercises 13-20 on this page.

Enter	Press	Display	Comment
377809 / 689	=	548.34397	Decimal quotient
548	M <sup>+</sup>	M548	Enters whole number part of the quotient into the memory.
377809-(689 x MR)	=	237	Remainder (p. 77)

This example shows that there was no problem-solving challenge involved in this calculator activity. After the students were shown exactly what to do and practiced the steps in two guided-practice problems, nine independent practice problems were assigned. The nine problems in the independent practice exercise were all long-division problems from the paper-pencil computational independent practice. The purpose of the calculator lesson was to help students become familiar with the functions of the calculator, and to reinforce their understanding of arithmetic procedures. This activity was representative of the other two calculator Think Math activities provided in the textbook. Application of the calculator in a problem-solving situation was not present in any of the Think Math activities.

The second calculator lesson example was randomly selected from the three calculator enrichment opportunities offered in *Addison-Wesley's* instructional materials. This enrichment calculator activity was presented at the end of Chapter Seven with directions to the teacher that were written as follows:

This page is intended for those students who successfully completed the Chapter Review/Test on page 189. You may wish to assign this page as independent work while you use Another Look exercises to reteach the basic concepts and skills of the chapter. (p. 191)

This directive again illustrates the importance placed on mastery of basic arithmetic procedures and computation skills, and reinforces that the use of calculators in mathematics instruction was not encouraged until after mastery of computational skills. As instructed the “successful students” worked independently on the calculator enrichment activity that follows:

#### Enrichment

**Number Relationships** Finding the greatest common factor of two large numbers can be difficult. The direction boxes below give a method that will make the problem easier. You may want to use a calculator.

What is the greatest common factor of 11,039 and 3,458?

Divide the larger number  
by the smaller number.

$$\begin{array}{r}
 \phantom{3,458} \overline{) 11,039} \\
 \underline{10\ 374} \\
 665
 \end{array}$$

Divide the first divisor  
by the first remainder

$$\begin{array}{r}
 \phantom{665} \overline{) 3,458} \\
 \underline{3\ 325} \\
 133
 \end{array}$$

Divide the second divisor  
by the second remainder

$$\begin{array}{r} 5 \\ 133 \overline{) 665} \\ \underline{665} \\ 0 \end{array}$$

Continue the process  
until the remainder is 0.  
The last divisor is the GCF.

The GCF of 11,039  
And 3,458 is 133

Check

$$11,039 = 133 \times 83$$

$$3,458 = 133 \times 26$$

The GCF of 83 and 26 is 1, therefore 133 is the GCF of 11,039 and 3,458.

(p. 191)

After this lesson was presented the students were given seven problems to practice this procedure. The students were not asked to explain why this worked or to think about why the GCF of 83 and 26 being 1 meant that the GCF of 11, 039 and 3,458 was 133. As in the Think Math calculator activities, there was no problem solving involved in this enrichment calculator lesson. This activity was a typical example of the calculator-enrichment activities provided in the textbook, and the objectives of all the activities were to help students become familiar with the functions of the calculator and to reinforce arithmetic skills. The statement included in the directions for modeled problem that– “You may want to use a calculator” (p. 191). hints that calculators may be useful time saving tools in mathematics, but the main task of the lessons remained practicing the steps to a provided procedure.

The third type of calculator activity present in the textbook was using calculators to complete two independent exercise assignments. The first was an independent exercise which involved using the guess-and-check problem-solving strategy to find three prime factors of given numbers and the second was using the calculator to find unit prices. In both instances the students were told how to use the calculator to solve the problem thus, any the problem solving challenge was eliminated from the lesson, and the students were to practice the provided procedure. The calculator lesson for finding unit prices follows:

### Problem Solving: Using a Calculator

Question
Data
Plan
<b>Answer</b>
Check

Mrs. Ramberg shops at a store that shows unit prices on all grocery items. What is the unit price on a 7-lb bag of pancake mix that sells for \$3.92?

To find the unit price, divide the total cost by the number of units.  
Use a calculator.

$$\text{Unit price} = \frac{\text{total cost}}{\text{number of units}} \quad \leftarrow \text{(pounds)}$$

$$\text{Unit price} = \frac{\$3.92}{7} = \$0.56$$

The unit price is 56 [cents] per pound.

$$\begin{aligned} \text{Unit price} \times \text{number of units} &= \text{total cost} \\ 4.9 \text{ [cents] per fl oz} \times 32 \text{ fl oz} &= 156.8 \text{ [cents]} \\ &= \$1.57 \quad \leftarrow \text{(Rounded to the nearest} \\ &\text{cent.) (p. 404)} \end{aligned}$$

After this lesson was demonstrated and explained by the teacher, there were six guided-practice problems for the students to work through with the teacher's assistance, and then eight independent-practice problems followed. There were no problem solving challenges involved. All the students had to do was determine what the facts were and then plug the numbers into the given formulas. This activity did provide the students with an application for rounding off numbers to a given place value, but the calculator part of the lesson was simply to practice the procedures that were taught: divide one number by the other or multiple one number by the other. Since there were only two instructional lessons out of the entire book that involved the students in using calculators to solve problems, it is obvious that the major emphasis of the instructional materials was on students working problems on paper and not on applications of the calculators in problem solving.

In addition to these eight lessons there were 140 problems provided in the back of the teacher's manual that were suggested for use with calculators. These problems did offer problem solving challenges that involved the use of the calculators, but there was less than one problem per chapter offered, and it was suggested that these problems be used as enrichment extensions– for the “successful students.” These problems were not essential components of the lessons, and their use was not intended for all students. Again this illustrates that the use of calculators was not an essential part of basic mathematics instruction, and that the major role that calculators played in mathematics instruction was providing enrichment experiences for those students that demonstrated mastery of their arithmetic-computation skills.

Additional support that calculators received limited use in mathematics instruction during the 1991-92 school year was provided by the supplemental instructional materials titled *Addison-Wesley Mathematics Calculator Technology*. There were 16 calculator activities included in this set of supplementary materials and the purpose of all 16 activities was described with the following sentence: “**Purpose** To help students become familiar with the functions of calculators” (p. 190). For example the activity for chapter one, which was about addition and subtraction of whole numbers, was *A Number Maze*, and the students were expected to use a calculator to find the sum of the numbers on the shortest path from start to finish that did not cross any solid lines. Two of the sixteen supplemental calculator activities were missing from the materials being analyzed, but results of the analysis for the fourteen activities that were intact provided the following data: five of the calculators activities were exercises like the number maze (practice computation without any problem solving), one of the activities was a game designed for partners to play which involved adding decimals to make a sum of ten, five of the activities involved using the problem-solving strategies taught at the end of the chapter (two used finding a pattern and two used guess-and-check, and one used completing a table), three were problem-solving activities that involved applications of geometry concepts such as finding the area of a square that was not inside a circumscribed circle.

To summarize, eight out of fourteen of the supplemental calculator activities were designed to involve the students in applying calculator skills to solve problems, but, like the calculator assisted problem-solving challenges in the back of the teacher's manual, these supplemental materials were not part of the basic-mathematics lessons. There was a note to teachers written at the bottom of each Chapter Review/Test that suggested these calculator activities be used as enrichment to close the chapter, therefore only the students that had mastered the arithmetic skills taught in that chapter would be exposed to these calculator activities. Although there were eight calculator instructional activities that involved problem

solving included in this set of materials, the calculator remained strictly a supplement to mathematics instruction rather than a part of mathematics instruction.

Even if a teacher used every calculator activity and problem in the instructional materials, the students could only participate in 38 calculator related lessons. Thus, out of 180 days of instruction at best 21% of that instruction could have involved using a calculator. This amount of calculator use in the classroom was highly unlikely for four reasons: (1) limited access to classroom calculators (there was one class set of twenty-five calculators per grade level that could be checked out from the school library) (2) limited amount of time for mathematics instruction (classes were 45 minutes in length) (3) emphases placed on mastering basic-arithmetic skills in the State and County curriculum guides and (4) emphases placed on mastering basic-arithmetic skills by the state and national assessments. In 1991-92 mathematics instruction was procedural-based direct instruction, followed by paper-pencil-practice problems, and the use of calculators during instruction was rare. Additional support for these conclusions is provided by the interview data related to calculators.

#### Calculator Data: Interviews

Three sources of interview data, teacher, Principal, and Division-Level administrators, provided statements that triangulate on three significant points about the use of calculators and mathematics instruction during the 1991-92 school year, and those three points follow:

- (1) the use of calculators was not encouraged for mathematics instruction.
- (2) the supply of calculators was limited, one classroom set for at least ten mathematics teachers in the building.
- (3) the use of calculators for mathematics instruction was rare in the 1991-92 mathematics classroom.

The teachers comments about the use of calculators and mathematics instruction open with the lead teacher answering the question if the County supplied the students with calculators.

The lead teacher said, “NO.” “We **require** the students to have them, but they don’t” (p. 4). When asked if he thought calculators should always be available for mathematics students, he said, “**NO, no.**” When asked to explain why, he said, “ Because if they have a calculator they are not going to do any estimating” (p. 14).

During his V-QUEST Lead Teacher interview the lead teacher was asked if he thought that the implementation of the new SOLs would encourage change in the way mathematics is taught, and he said, “I hope so. The way mathematics is taught has got to be

changed. It's not meeting the needs of a technological society today. We still have teachers who emphasize computation" (p. 8).

The seventh grade teacher made the comment that follows concerning the use of calculators and mathematics instruction:

. . .I, personally, do not think that they should have them [calculators] all the time. I think they have become very dependent. . . . I think kids need to learn basic mathematics. The students do not know their multiplication facts, I would say, better than 50% of the students in my class do not have immediate recall of multiplication facts. Well, to me, you can't do estimation or problem solving or shop at the Wal-Mart store without having immediate recall. There is a place for calculators. (p. 4)

The sixth grade teachers' statement about the use of calculators for mathematics instruction follows:

We don't use them [calculators] everyday. I have lots of worksheets though cause they are fun to work with. I don't want, I know that later on it is OK to use them [calculators],but when we take the Passport Literacy Test they have to know these operations, they cannot use a calculator, and doing some fun games with them. It's a particular thing it's not everyday. . . . They like to check their work, especially the written problems or the big problems, and I let them do that. (p. 7)

The former Principal of Pleasant Middle School stated that after participation in V-QUEST they purchased some instructional materials. Following is his comment concerning the purchase of calculators. The former Principal stated:

. . .we started purchasing materials that were needed. We started, I reckon, targeting money that was needed. There weren't a lot of any real math materials, within a year every math teacher had a classroom set of calculators. Prior to this I think there was maybe a set for the entire school. . . . (p. 9)

This purchase of calculators was made in the 1993-94 school year, after the teachers and their Principal participated in the Clinch Valley V-QUEST Lead Teacher training program in the summer of 1993.

The Associate Superintendent of Schools, made the following comment about the use of calculators in mathematics instruction:

Again I think it's like computers, that we're sticking our head in the sand if we do not provide options for students in learning to use the calculators, but I still feel that youngsters **have** to learn the basics that they **have** to master



the computation skills, and that we **can't** just give them a calculator, and never teach them the basic skills. For example, right now our math computation scores at the middle school level are not good. We have 142 eight graders going to the ninth grade next year scoring below the 25th percentile in math computation. Now, you know, the only way that we're going to handle that is to make sure that children have mastered the basic skills. We can't just rely on their using a calculator to do basic skills. As important as I think calculators are they have to still master the skills, and I think a balance between those two things is extremely important. (p. 6)

When asked if the current used of calculators in mathematics instruction matched expectations the Associate Superintendent of Schools stated:

Probably not. I'm not sure we have the numbers or the types of calculators that we need. Again I think it's one of those program decisions that we need to make were we set the parameters, and the teacher kind of flushes out the instructional part of that, but I'm not sure we have a real good handle on what kind of calculator we're using and what kind of skills we expect the child to master, and again that's one of the things that will be outlined the curriculum guides that are finished by the end of next year. . . . I see a few more orders coming through, but, again, I'm not sure if that is consistent from classroom to classroom. (p. 7)

The Superintendent of Schools had the following to say about the use of calculators and mathematics instruction:

We have no division barrier against using calculators in the classroom. What we do have is a philosophy that states with a basic mastery and understanding through manual calculations. Traditional calculations being taught first, and then relying on the calculator as a tool, but I still believe in the basic mastery of memorization of the multiplication table for example. Being able to do short and long division and the basic math functions, addition, subtraction, and manipulating decimals. I believe children need to be taught how to do that with pure old paper and pencil and then once the mastery is proven and demonstrated to be able to use a calculator to speed up that process whenever necessary. I do believe in the early grades we need to rely more heavily on basic mastery in a traditional sense and then as children get more comfortable, and we're comfortable that they've mastered the material, then I think calculators can be used as a tool. It's speed, as well as accuracy later, but I think you need to understand the basic concept first. .

. . Well the power will go out sooner or later [laughs out loud] and you may or may not be frozen in time if you don't know the basic concepts. (p. 11-12)

When asked if he thought there should be a classroom set of calculators available in every middle school mathematics classroom the Superintendent of Schools said, **NO, no** I don't. Not at this time. I think sets of calculators can be bought, but I don't know that one per child is necessary. I think they can be available in a classroom in sets of six. Maybe one calculator per three children available in a table setting as you're doing work you need to get up and check something, what have you. The rate of use I would be concerned about. Again, as we move into higher-grade levels and they've demonstrated mastery of the basic concepts they can begin to rely more heavily on that tool. I think if you have it there on each child's desk there's going to be a tendency to quote to play with it, manipulate it, use it in ways that you didn't intend, and I think it can be a distracter if your not careful. . . .we need to all realize that it is a wonderful instrument, and it should be used openly and comfortably and easily accessed as we move through the curriculum, but I do still believe in the early grades being a time were we master the concepts and the traditional methods. . . . That's what I believe. (p. 12)

These evidence indicated that the mastery of procedural knowledge and computational-skills lessons were designed to match instruction that was teacher directed and focused on teaching procedural knowledge and computational skills for mastery. Evidence from the analysis of *Addison-Wesley's* instructional materials and interview data strongly support that during the 1991-92 school year the predominate method of instruction used in the classroom was a combination of direct instruction, individualized instruction, and drill and practice. However, technology instructional materials that were not textbook related were used for mathematics instruction during the 1991-92 school year, and results of the data analysis for the technology mathematics instructional materials is presented next.

#### Technology Data: Artifacts

There were few instructional resources available to the classroom teacher other than the textbook, but the County had, through a public bond that was approved in the 1990 election, secured funds for a major investment in technology, and Pleasant Middle School along with every other school in the County received a Josten Computer Lab. Josten Computer Labs were designed to provided individualized computer assisted instruction programs for sixth, seventh and eighth grade in Language Arts, Social Studies, and

Mathematics. (Software for science was not ready at the time.) Mathematics education was targeted for improvement, and the goal was to use computer assisted mathematics instruction to improve student performance in Mathematics.

Pleasant Middle School's Josten Computer Lab, which was referred to as WICAT (With Individualized Computer Assisted Teaching) by the County employees, consisted of 31 student terminals and two computers manned by the lab technician. The two computers operated by the lab technician were the servers, thus none of the 31 student terminals had hard drives. There were no modems, and the computer-assisted-instructional software that was installed during the 1991-92 school year was observed to be set up basically like pages of a traditional-mathematics textbook. Examples of how to work or solve a problem were provided and then ten to twenty practice problems were provided for the students to practice the procedure or skill. Sometimes the practice problems were set up with multiple choice answers and sometimes they were fill in the blank. A student would work the problem and then receive immediate feedback of yes the answer is correct or no the correct answer is. . . . If the student's performance on the given set of problems indicated that he or she had satisfactorily mastered that objective, then the computer would automatically move to the next assignment in the list. If the student did not achieve a mastery level score then additional examples of how to work the problem were provided along with an opportunity to rework the practice problems to earn a better score. The teacher was responsible for selecting the assignments and determining the achievement level needed to demonstrate mastery of an objective.

Large three-ring notebooks which contained copies of the all the available computerized lessons were shelved in the computer lab, and were available for the mathematics teachers to use for planning. Teachers provided the computer lab manger with a list of the mathematics lessons that they planned for their students use, and the lab manager was responsible for loading the appropriate software and making the requested lessons available to each student. Before purchasing the system it was determined that the mathematics instructional materials provided by the Josten company were in alignment with the 1988 SOLs, and therefore, it offered instruction and practice for all arithmetic procedures and operations, and for geometry, probability, and some basic algebra.

One of the primary goals for the major investment in technology was to improve students' test scores in mathematics, therefore mathematics classes received top scheduling priority. The optimal length of time suggested for computerized instructional sessions was 20 minutes, and optimal use of the lab meant no down time or unused terminals, therefore the instructional day was divided into minute 20 minute blocks of time, and the mathematics classes were rotated by teacher through the schedule. This schedule, which provided for

equitable use of the computer time, allocated approximately 60 minutes of computer time a month for each student.

### Technology Data: Interviews

The Director of New Initiatives, the eighth grade lead teacher, and the former Principal all made comments to the effect that the hardware nor software had changed in the WICAT computer lab since its installation during the 1991-92 school year, and these statements are provided first in the data presentation. Since there were no changes made in software or hardware to the WICAT computer system, interview data from the teachers, school Principals and Division Level administrators concerning the WICAT computer lab are used retrospectively to document the materials, method of instruction, and purpose of the computer assisted instruction that was in place and used for mathematics instruction in the WICAT computer lab during the 1991-92 school year.

The Director of New Initiatives' statements concerning the use of the WICAT computer lab for mathematics instruction follow:

We're about to have a meeting with all the Principals to look at new directions for the WICAT lab. That kind of software, we know, functions best for remediation, and right now every child gets the same amount and exposure, and I think it could be used more effectively.

Interviewer: Is that pretty much the way it has been used from the start?

The Director of New Initiatives: Yes. That was kind of a contract, I think, with the voters, cause that's how it was sold. . . . (p. 5)

When asked if she would recommend this computer system to another school district, she made this comment which contains a description of the purpose of the computer-assisted instruction. The Director of New Initiatives comment follows:

Well I would tell them what do you want to use it for, and if they were trying to mirror our system, I would say we wouldn't mirror our system now a days. That isn't a wise use, knowing what we know now. I think it was a good decision at the time, but times have changed, and we know different things. That kind of instructional software works best with the bottom quartile. We know that, that's what research has told us. So for a school system looking into it we would say, that's how it's going to be focused, I mean, that's how it should be focused on the bottom quartile. . . . (p. 6)

The lead teacher was asked if there were any new instructional programs provided for the WICAT computer lab since 1991-92, and he stated, "Not to my knowledge" (p. 5).

This interview exchange with the mathematics lead teacher contained details that describe the type of computer-assisted instruction that was available, and that exchange follows:

Interviewer: Is the WICAT computer lab still basically drill, drill-and-rote practice?

Eighth grade lead mathematics teacher: Well no, there are other things in there that if you **search** you can find them. She [computer lab technician] trained me how to put my assignments on, so I was able to go in and look at the whole software capability, and I found things that were just great in there. Proof sequences that I assigned to certain students; not all the students. There's some advanced algebra skills that I found in there that we didn't know about. She didn't even know, so there's a lot of things I found that I can use for enrichment. I teach lessons in WICAT. I mean we have drill in there, but there are times they are doing something in the classroom that corresponds to what we're going to do in WICAT, and I can actually go in there and teach a lesson and have them work on it right then. . . . (p. 5)

The former Principal talked about the first year that the WICAT computer lab was in Pleasant Middle School in the comments that follow:

First year we were trying to get the thing up. Our lab had more problems than anybody's, and it stayed down more than it was up. First year I was there, I thought it was the biggest waste of money that the County ever administrated. It never was utilized the way I would have liked it. It was still being used for drill-and-kill. It was not being used to allow students to expand themselves, and it was frustrating, I know, for the upper-level kids. Again they were locked into the drill-and-kill, and probably from that, the one thing that I would really, well brought with me to this job [Principal of an elementary school in the County] is, if we've got a child here that has shown mastery at a particular level we're not holding them back. . . . (p. 11)

One of the seventh grade teachers described how she used the WICAT computer lab for individualized computer assisted instruction in the comment that follows:

. . .they [students] all have quote the same assignments. Now depending on scores, and ability of the kids, I can let them go ahead, skip assignments. All I have to do is just say, don't do that. I also have assignments in for higher level kids only they are science related. They're not even math, but a whole segment of really they're GED, high-level-science problems. So, frequently those kids, if they have gotten the math concepts that we're working on, they

show me when they finish, I'll say, go into science which is more challenging for a lot of them. (p. 14)

The next quotes are taken from the school and Division Level administrators' interview data related to the use of technology for mathematics instruction. When asked to describe how technology was used in mathematics education at Pleasant Middle School the Principal said, “. . .the Josten Lab is it, with exception to what [the lead teacher] gets off VA PEN at home, but the Josten lab is used for remediation. . .” (p. 4). The former Director of Secondary Education and Gifted Program, discussed the WICAT computer lab and mathematics instruction saying:

It's archaic, that is obsolete. I'll just simply say that. Now what is the problem is that you've got a lot of money invested in that, so I go back to that philosophy that we originally put into that plan. We had sketched out in there at least the broad philosophical outlines, not the action plan, but the philosophical outlines, that you would recycle equipment when it became out of date or you step down it's use. It doesn't wear out it's just the memory is too sluggish, the networking is too sluggish, but you can use those for all kinds of things. Drill-and-practice program perhaps working at the lowest level of how we know people learn—period. It's a learning strategy, more that we are brutalizing the memory ah, people remember best when they activate chemical memory not just electrical memory, and I think that ah, we have to have an emotional assist to help you really track something for long term memory. You can hardly every get that reaction from drill-and-practice. People who are having problems developing a skill whether it's in mathematics or language arts need and enriched environment not a paired down environment. (p. 13)

The Coordinator of Elementary and Middle School Instructional Programs, discussing WICAT and mathematics instruction made the comment that follows:

OK, I don't particularly like the way we're using it now. I don't think the WICAT concept is a productive effective concept. It's intended for remediation, and if we could find a way to remediate the lower quartile without attaching the stigma of pulling them out and taking them someplace else that would be well and good, but to have everybody sit there and go through this drill-and-kill, I don't believe it's productive. . . . (p. 7)

The Associate Superintendent of schools comments about the WICAT computer lab provide information concerning the future and past uses of the lab for mathematics instruction. Her statement follows:

I would like to see computers in the classrooms, and not in the labs, and right now the way it's housed at [Pleasant] Middle School is basically in a lab, and I would like to see those computers in the classrooms, and not just one computer. I would like to see a minimum of six in every math teachers classroom. . . . We're having major discussion about that [how the WICAT lab is used] now. In fact, this past Monday we meet with all Principals to look at the use of the Josten WICAT lab, and to begin to make some decisions about how we need to change that. Although, I think we've used it to the best advantage that we could, you can't do much if you only go in there once a week for twenty minutes. You're going to have to have more access time if it's going to make a major difference, and ah, the information that's in there for all our Josten WICAT although, there are things like Algebra I or whatever, probably we need to look at selection of software that would better meet the needs of students at middle school level. (p. 4)

The Superintendent of Schools discussing the WICAT computer lab made the following statement:

Well that's a good question because right now our staff is reviewing the current methods that we are using with the WICAT lab. Ah, we don't think it has been as effective as maybe we thought it would be in a lab situation. I don't believe all students have to have the same dose of medicine, ah, when they sit down in front of the computer the teacher still has to tailor the program for each individual student and not assume that everybody's on the same level moving at the same rate. I think that in a lab setting, I do believe it's better geared toward remediation and ah, and we've relied too much on it to do everything for everybody. (p. 9)

All of the Division Level administrators, and both the current and former Principals of Pleasant Middle School, described the purpose of the Josten WICAT lab's assisted mathematics instruction as remedial mathematics instruction, yet every student went to the lab about once every two weeks for twenty minutes of instruction during the 1991-92 school year. Both the Directors of Secondary Education and New Initiatives agreed that the system was out of date and that its usefulness was limited to remedial instruction for students. The Superintendent and the Associate Superintendent both agreed that use of the WICAT computer lab needed to be studied and changed so that everyone was not getting the same "dose of medicine". Teachers, Principals and Division Level administrators all agreed that the Josten Computer Lab was used for drill-and-practice of mathematics objectives.

When the artifact and the interview data are combined, there is strong support for the conclusions that a substantial amount of money was spent on technology that focused on improving students' computation scores on the ITBS and LPT assessments. The Josten computer lab was used for mathematics instruction during the 1991-92 school year, and its purpose was to provide additional drill-and-practice on arithmetic procedures and computation skills for all students. County administrators invested a great deal of time researching computer systems, and convincing the public to support a bond referendum to finance the purchase of a computer lab for every school in the County. The success of this initiative indicated that mastery of arithmetic procedures and computation skills was viewed as a top priority for mathematics instruction during the 1991-92 school year and that emphasis was placed on the use of individualized drill-and-practice as effective mathematics instruction.

#### Baseline Data: Instructional Materials Artifact and Interview Summary

Analysis of the textbook materials data related to discourse provided evidence that mathematics instruction focused on teaching arithmetic procedures and computation skills through rigidly traditional methods of teacher-directed whole-group instruction, individualized instruction and drill and practice. The seven step lesson plan provided detailed evidence that lessons were teacher centered and teacher directed. In the lesson plan time was provided for the teacher to tell and show the whole group how to do the mathematics skill or procedure that was being taught, and time was provided in the lesson for individualized instruction, for students to ask the teacher questions, and for independent practice. The use of small group, or partners was not included in mathematics instruction, and none of the steps in the lesson plan were designed to encourage students to explain their thinking or reasoning. Explaining was the teachers' responsibility. Questions included in the scripted lesson that were designed to get the students involved in the lesson were low-level factual-type questions that required only one word or short answer type responses from the students. Discourse was teacher directed, and teacher centered in the mathematics instruction used during the 1991-92 school year.

This type of discourse matched the instructional goals of teaching arithmetic procedures and computational skills. The artifact data provided evidence of that the *Addison-Wesley* textbook and its related materials were the only instructional materials available to the 1991-92 mathematics teachers. An analysis of the textbook concluded that the instructional materials were behaviorist in nature and that they encouraged the use of traditional methods for mathematics instruction. The textbook analysis results showed that the mathematical content was based on a spiraling curriculum design with at least 70% of



the each year's content consisting of previously taught material. This indicated that maintenance of the arithmetic procedures and computational skills were an important instructional goals. An analysis of the textbook's recommended mathematics lesson plan showed that mathematics was taught as isolated skills that were presented in a sequence of two-page lessons provided by the textbook. Students were encouraged to demonstrate their understanding of mathematics through accuracy in written procedures. Student-to-student discourse was not encouraged or included in mathematics instruction during the 1991-92 school year.

Interview data from the teachers at every grade level, the Principal and the Director of Instruction contained comments about the teachers telling their students what they need to know, lecturing, or the use of whole-group instruction. Teachers talked about feeling pressured to cover the material in the book, and they talked about how they used the textbook for mathematics instruction. The instructional class periods during the 1991-92 school year were 45 minutes, and the objectives to be covered were clearly indicated by the SOLs and presented in *Addison-Wesley's* instructional materials. Teachers from each grade level provided descriptions of mathematics instruction that matched the lessons provided by the instructional materials, and the Principal described the mathematics instruction that he observed during the 1991-92 school year as traditional high school mathematics instruction, lecture.

Both the interview and artifact data supported the conclusions that during the 1991-92 school year teachers used a combination of whole-group instruction, individualized instruction and drill-and-practice for mathematics instruction. Teachers were responsible for telling the students what they needed to learn, and students participated by answering factual-type questions and by doing written practice. Mathematics knowledge was divided into chunks of arithmetic procedures or computation skills and presented to the students for memorization, therefore students were not encouraged to communicate about mathematical reasoning or thinking. Students were encouraged to ask the teacher questions while working on independent practice. Individualized instruction was the responsibility of the teacher, and instructional materials were included with the textbook for reteaching and for extra written practice. The discourse planned for and used during the 1991-92 instructional year was teacher center and teacher directed.

The textbook problem-solving analysis showed that the textbook was organized so that a different problem-solving strategy was taught at the end of each chapter two through nine with the following problem-solving strategies respectively: (1) Making an Organized List, (2) Find a Pattern, (3) Draw a Picture, (4) Work Backwards, (5) Solve a Simpler Problem, (6) Make a Table, (7) Choose the Operation, (8) Use Logical Reasoning. Chapters

ten to sixteen all ended with a word problem lesson titled “Using the Strategies.” At the top of each of these pages all the previously taught strategies were listed and a check mark was placed beside the strategy that should be used to solve the problems on that page.

This showed that *Addison-Wesley*'s word problem instructional lessons were organized and presented by categories. Word problems were categorized in the four ways that follow: (1) routine or nonroutine problems, (2) arithmetic procedures, (3) types of numbers e.g., whole numbers, fractions, decimals, and (4) problem-solving strategies. This method of organization facilitated the instructional methods of showing and telling the students how to solve routine- and nonroutine-word problems. All the different strategies were presented separately with matching sets of independent-practice problems so that students could practice for mastery of each strategy sequentially. The focus of problem-solving instruction was to teach the problem-solving strategies rather than to challenge the students and develop their mathematical logic and reasoning skills.

Since the use of calculators was not recommended for any of the problem-solving lessons in the textbook, computation remained a significant part of all the problem-solving lessons. To emphasize the importance placed on arithmetic procedures all of the word problems throughout the text were organized according to the arithmetic procedure being taught in that chapter i.e., if a word problem was included in the division of decimals lesson then the student knew the word problem would be solved with that operation. All of the word-problem lessons followed the same lesson plan design, the teacher taught the procedure, explained any mathematical reasoning involved, assigned independent practice and monitored progress by checking answers for accuracy. Alternative solutions or problem solving methods were not encouraged, and students were given little opportunity to discuss mathematical thinking. Teaching problem-solving strategies was an integral part of the mathematics curriculum in 1991-92, but encouraging logic and reasoning, developing mathematical communication and understanding by having students justify their answers or problem-solving strategies were not components of problem-solving lessons during the 1991-92 school year. Additional support for the conclusions about problem solving and mathematics instruction was provided by the teacher interview data.

The artifact and interview data related to problem solving showed that all of the mathematics teachers used direct instruction and drill-and-practice to teach mathematics in the baseline year. One of the eighth teachers described drill-and-practice as the preferred method of teaching basic arithmetic skills, and two of the sixth grade teachers provided descriptions of mathematics instruction used for teaching computation procedures and problem solving that matched lessons contained in the *Addison-Wesley* textbook. Both seventh and eighth grade teachers commented that they focused more on teaching

computational skills during the 1991-92 school year, and they indicated that learning to use the problem-solving approach to instruction had presented a new challenge for them, and all the teachers' data indicated that teaching basic computation was the focus of classroom instruction prior to implementation of block scheduling in 1993-94. Therefore, the teachers' interview data supported that use of routine word problems for mathematics instruction as described and suggested by the *Addison-Wesley* instructional materials was typical of instruction in the 1991-92 mathematics classrooms.

Interview data from the teachers, Principals and Division-Level administrators concerning the use of calculators strongly supported that teachers were not encouraged by educational policy, practice, or administration to use calculators for mathematics instruction. Several comments mention that calculators were not part of the mathematics classroom's instructional supplies during the 1991-92 school year. The administration definitely did not view the use of calculators as a necessity for improving mathematics instruction, and administrators and teachers voiced concerns about students becoming calculator dependent or that the use of calculators in mathematics hindering mathematics education.

Another fact that supported the conclusion that calculators were not used for mathematics instruction during 1991-92 was that mathematics classes were only 45 minutes long, and since teachers were mandated to teach the SOLs, and pressured to improve student performance on the Division- and the State-Level assessments, there was limited time for the use of calculator activities in mathematics instruction. Analysis of the State and County curriculum guides showed that expectations and guidelines for use of calculators for mathematics instruction in 1991-92 were extremely limited, and all of the data sources concurred with the Associate Superintendent's and the Superintendent's comments, which indicated that basic skills should be mastered before calculators are used for mathematics instruction.

In the analysis of *Addison-Wesley's* instructional materials it was noted that some enrichment-calculator problems and activities were included, but when all of the evidence compiled, it is highly unlikely that many of these calculator activities were actually used for classroom instruction during the 1991-92 school year. Evidence supporting that there was limited used of *Addison-Wesley's* calculator activities for mathematics instruction during the baseline school year follows:

- (1) there was a limited supply of calculators.
- (2) the use of calculators was not encouraged for mathematics instruction by the Division and State policies or administrators.
- (3) the use of calculators was not permitted on either of the Division or State Level assessments,

(4) the use of calculators in the instructional materials was limited to enrichment activities or calculator function exercises.

(5) the interview data documented that teachers did not use calculators for mathematics instruction during the 1991-92 school year.

(6) 45-minute-class periods limited instructional time.

In turn, this calculator evidence supported that the emphasis of mathematics instruction was on arithmetic procedures and computational skills and that direct instruction, individualized instruction and drill and practice were the predominate methods of mathematics instruction used in the 1991-92 mathematics classroom.

The instructional materials artifact and interview analysis have established the following data to support the conclusions made about the methods of instruction used during the 1991-92 baseline school year. (1) The *Addison-Wesley* textbook and its related materials were the only instructional materials available to the 1991-92 mathematics teacher, (2) The class periods were short, 45-minutes. (3) The teachers used the *Addison-Wesley* textbook and its related resources for mathematics instruction. (4) Both the County curriculum and the SOLs focused on teaching procedural knowledge and computation skills (5) Both the County and State policies encouraged the use of traditional methods of behaviorist instruction. (6) The Principal and Superintendent encouraged the use of traditional methods of classroom instruction. (7) The *Addison-Wesley* textbook provided for and encouraged the use of traditional methods of instruction.

An analysis of *Addison-Wesley* textbook that focused on lesson plans and discourse, and use of calculators and problem solving for mathematics instruction provided the following results about the methods of instruction used during the 1991-92 baseline school year. The *Addison-Wesley* instructional materials:

(1) promoted teacher centered discourse. In the seven-step lesson plan design, which was teacher centered, teachers were responsible for explaining all the mathematics objectives through whole group and individualized instruction and for providing and monitoring independent practice.

(2) encouraged practice and review for maintenance of previously learned mathematics objectives. *Addison-Wesley*'s instructional materials were based on the concept of a spiraling curriculum, and on average 81% of the mathematics objectives in the sixth, seventh or eighth grade textbooks were review material for practice and maintenance of previously learned procedural knowledge or computation skill.

(3) emphasized mastery of procedural knowledge and computational skills. At least 70% of the objectives contained in the curriculum content were procedural knowledge of computation skills.

(4) facilitated learning mathematics as isolated rules and procedures. Mathematics objectives were organized by computation skills or procedures which were to be mastered before moving to the next objective.

(5) facilitated and encouraged individualized instruction. The resource materials provided multiple practice exercises and assessments for each objective. Enrichment materials were provided for the students that achieved mastery and reteaching materials were provided for the students that needed more work.

(6) placed limited emphasis on critical thinking skills. As a result of the suggested method of instruction, teach by telling, and the organization of word problems for presentation in the instructional materials by computation operations, little problem-solving challenge remained for the student.

(7) limited the use of calculators for mathematics instruction. The use of calculators was limited to enrichment activities or calculator function exercises.

(8) limited the use of computer technology for mathematics instruction. Instructional activities for Computer Technology were limited to developing basic computer literacy “without the necessity of a computer terminal,” reading and writing BASIC computer program language.

Both the textbook and nontextbook, technology, related instructional materials’ data supported the following conclusions about mathematics instruction during the 1991-92 school year. (1) Both sets of instructional materials emphasized mastery of arithmetic procedures and computation skills in isolation, and consequently emphasized mathematics instruction that focused on instrumental understanding. (2) There was limited access to technology for mathematics instruction. (3) The use of technology for mathematics instruction was subordinate to mastery of arithmetic computation. (4) Drill and review practice were viewed as important to learning mathematics. (5) Whole-group direction instruction by the teacher, individualized instruction and independent written practice were inherent to mathematics instruction in the 1991-92 classroom.

#### Baseline Data: Mathematics Assessment

The artifact and interview data have established the curriculum content and nature of the instructional materials in place during the 1991-92 school year. The analysis results of the artifact and interview assessment data are presented next to complete the triangulation of data in support of the conclusions made about mathematics instruction in 1991-92. The analysis of assessment data are presented in three parts. For the sake of continuity, the analysis of *Addison-Wesley*’s methods of assessment will be presented first. The analysis

of Division-Level assessment data is presented second, and the analysis of State-Level assessment data is presented last.

#### Classroom Assessment Data: Artifacts

An analysis of the assessment materials included in *Addison-Wesley's* instructional materials provided further evidence to document that State and County administrations, and thus, the mathematics teachers placed a heavy emphasis on procedural understanding and that direct instruction, individualized instruction, and drill and practice were the predominate instructional strategies used during 1991-92. Since what is tested indicates what curriculum content is valued and important in learning mathematics, an analysis of *Addison-Wesley's* assessment test items provides data to document exactly what mathematics content was emphasized during the 1991-92 school year. Also, since the method of assessment should match the method of instruction, an analysis of methods and types of assessment used with the *Addison-Wesley* instructional materials provided data to verify conclusions about the methods of instructions used during the 1991-92 school year.

First, results of the analysis of the methods and types of assessments provided by *Addison-Wesley's* instructional materials is presented. These data also include the textbook's stated purpose for the assessment materials and suggested uses for the materials. Second, after the purpose of assessment and the various types and methods of assessment are established, results of the content analysis of the assessment data will be presented. Goals for the second part of the assessment data analysis were to (1) establish the percentage of the assessment items that were focused on computational procedures or problem solving, (2) establish what mathematics curriculum content was emphasized by assessment materials.

Methods or types of assessment. For each chapter in *Addison-Wesley's* textbook were three different chapter tests were provided. There was a free-response Chapter Review/Test provided in the textbook at the end of each chapter, and there were two alternate assessments provided for each chapter in the Assessment section of the *Teacher's Resource Book*. One of these tests used a multiple-choice format and the others used a free-response format. In addition to these assessments, there was a Mid-Year Test, End-of-year Test, and Basic-Facts Tests. All of these assessments were paper-pencil types of assessments, none of them permitted the use of calculators, and they all were presented as options for evaluating students' mastery of chapter objectives.

As described in the teacher's manual the Chapter Review/Test exercise emphasized the major concepts and skills presented in the chapter, and the exercise could be used as a

review assignment or a test (p. 25). On the back page of each of these Chapter Review/Tests was a reteaching exercise called Another Look. These exercises had example problems worked on the left side of the pages with additional practice problems for each **procedure** to the right of the examples. Comments from the *Addison-Wesley* teacher's edition about the Another Look exercise that corresponded to Chapter one's Review/Test stated the following:

The exercises on this page are intended for those students who experienced difficulty with the Chapter Review/Test on page 25. Should students require reteaching of these key concepts and skills, please refer to the teaching notes below. Otherwise, the Another Look exercises can be assigned as independent work, with students using the accompanying sample problems and hints as guides. (p. 26)

This comment clearly indicated that students were not expected to fail the test. Since reteaching and additional practice were expected to take place for the objectives that were not mastered on the first assessment, there were additional assessment materials available in the teacher's resource materials.

The purpose of the assessment materials that accompany the textbook was provided on the first page of the assessment resource materials as follows:

**Purpose** To provide options for evaluating students' mastery of chapter objectives

Criterion-referenced chapter tests are provided in two forms—multiple choice and free responses. The items on the two forms of the tests have a one-to-one correspondence in level of difficulty, so that the two test can be used as pre- and post-tests. Charts in the answer section correlate the test items to the chapter objectives and to the related text pages.

Basic-fact, mid-year, and end-of-year tests are also provided. . . . (p. 1)

This statement indicated that multiple assessment materials were available for each chapter, and that assessments were designed so that mastery of each objective in the chapter could be verified. Both are features of assessment materials that facilitate individualized instruction for mastery of targeted objectives.

Pre-test assessment materials facilitated individualized instruction by providing data for teachers to determine what objectives or skills needed to be taught and reinforced with practice and/or enrichment assignments. The availability of multiple post-test materials also facilitated individualized instruction by reducing the amount of time the teacher spent on creating teacher made assessments. As mentioned in the previous paragraph, if the students

were not successful, then reteaching materials were provided along with additional post-test materials.

In addition to the assessment materials the *Teachers Resource Book* also provided a section on record keeping, which contained among other items a Student Profile Chart. This chart provided a record keeping system for documenting student's progress in mastering the individual objectives contained in each chapter. The chart was organized by chapters and listed each objective along with the number of test items contained on the corresponding chapter tests. The number of test items for each objective on each test was provided as the denominator for a ratio of the number of items correct to the number of items possible, thus permitting the teacher to keep a record of individual student's progress. The last two columns of the chart were titled: (1) Needs More Work, (2) Accomplished. Again this supports that mathematics instruction emphasized mastery of the curriculum objectives and that assessment materials that facilitated individualized instruction were provided by the 1991-92 *Addison-Wesley*.

The purpose of assessment statement also indicated that special materials were available for testing basic-facts. These materials consisted of 400 basic-fact problems. There were one-hundred problems each on addition, subtraction, multiplication and division designed to test the student's speed and accuracy of memorized basic facts. The inclusion of these assessment materials emphasized the importance placed on quick recall of basic facts and also indicated that drill-and-rote practice to maintain previously taught basic arithmetic facts played an important role in teaching mathematics.

What was noticeable about the types and methods of assessments was the lack of variety in the methods of assessment. Although there was one multiple-choice format offered in the resource assessment materials, it was still limited to paper-pencil mathematics, but instead of the student writing the correct answer he or she selected the best answer. The purpose was to provide students practice using the standardized-testing format. There were no projects, presentations, demonstrations or applications of skills learned, no portfolios, journals or learning logs only paper-pencil written assessments were provided. Some informal (formative) evaluation was suggested during the guiding practice portion of the lesson, but this information was to be used for individual instructional planning rather than assessment of the student's progress (summative).

The following information was included in the teacher manual's materials about assessment:

**Assessing Skills** Built-in reviews at the end of each chapter provide the evaluation options you need for testing student comprehension and skill proficiency.



- *Chapter Tests* review skills of the chapter.
- *Cumulative Reviews* check on retention of previously-learned skills.
- *Item Analysis Charts* correlate test items with learning objectives and pages where the skill was taught.
- *Assessment Options* list pages for comparable Teacher's Resource Book tests in alternate forms.

**Following Up** Follow-up pages at the end of each chapter offer exercises for reteaching and enrichment so you can individualize.

- *Another Look* reteaches key skills for students who need more help with the chapter objectives.
- *Enrichment* provides a challenge for students who have mastered the skills of the chapter. (p. T12-13)

The methods of assessment were designed to match the suggested method of instruction. Teachers were expected to provide whole-group and/or individualized direct instruction as needed, and the students were expected to practice the skills taught by doing independent written practice. After sufficient practice the students were expected to demonstrate mastery of the skills taught by successfully completing paper-and-pencil problems about the individual objectives covered in the chapter, and if students were not successful then more individualized instruction, and reteaching were provided, and this was followed by another paper-pencil -type assessment.

Assessment content analysis. Analysis of the content of Addison-Wesley's assessment materials consisted of three parts. First, was an analysis of the overall design of the tests which focused on the number of problems and the method of organization used. The number of problems was significant because it shows whether the tests were designed to match drill-and-rote practice method of instruction or not. An analysis of the organization of the test items indicates if assessments were designed to test objectives independently, which is useful for assessing procedural or instrumental understanding, or if assessments were designed to assess conceptual and procedural understanding through application problems and problem solving challenges, which facilitates assessing relational understanding.

The second part of the assessment content analysis focused on classifying specific test items as computation problems, word problems, or other type problems. This analysis provided data specific to curriculum content because what was tested was what was valued and emphasized as important in learning mathematics. The curriculum content that was tested indicates the curriculum that was taught. Third, after the test items were classified the

word problems were categorized as routine or nonroutine problems. This analysis provided data pertain to curriculum and methods of instruction. If the word problems were routine and organized by specific objectives (i.e., addition of decimals, multiplication of fractions etc.), then they were designed to facilitate assessment of procedures and accuracy of computation. If the word problems were nonroutine and created challenges for application of objectives, then they were designed to facilitate assessment of conceptual and procedural understanding as well as development of logical reasoning skills. Results of the assessment content analysis are presented next beginning with the Chapter Review/Tests that were contained in *Addison-Wesley's* textbook.

An analysis of the Chapter Review/Tests included in *Addison-Wesley's* seventh grade mathematics textbook provided the following data which supported that computation procedures and arithmetic skills were the main focus of all the textbook assessment materials. Since Chapter 15's Chapter Review/Test was missing only fifteen of the sixteen tests were included in this analysis. However, the findings were consistent enough to predict that Chapter 15's Chapter Review/Test's design would have been similar to the other fifteen assessment instruments included in the textbook. Chapter 9's Multiplication and Division of Fraction Chapter Review/Test was the longest test with 42 problems, and the Chapter Review/Test for Probability, Statistics, and Graphs, Chapter 14, had the least number of problems, 17, which made the range for the number of problems included on the Chapter Review/Tests 25 problems. The mode for the number of problems on the Chapter Review/Tests was 26 problems, and the mean and the median of the data set were both 29 problems. (See Appendix V for the complete data set.)

All of the Chapter Review/Test assessments had the test items organized by objectives, which were listed in the same order as they were presented in the chapter. This method of organizing the problems by objectives, and the average of 29 problems per test indicated that assessments were designed to test accuracy of computation, and procedural understanding. Alone, these data results do not provide conclusive evidence; therefore' additional data from the analysis of assessments' contents and the subsequent analysis of the type of word problems used for assessment were needed to triangulate and support these findings.

The item content analysis of the Chapter Review/Test materials was based on the classifying each problem on the test as one of the following types of problems: procedural, conceptual, or word problem. If solving the problem involved reading an English statement other than the directions, then it was classified as a word problem. Word problems were sorted out to provide quantitative data, and for classification as routine/procedural or nonroutine/conceptual and/or procedural. Problems classified as procedural assessed

memorization of basic arithmetic facts, traditional arithmetic algorithms, mathematical symbols, rules, facts or procedures. The different types of problems that were classified as procedural problems in this analysis included the following: computation, identification, fill in the blank, write the numeral for the word name, rounding off, and formula problems. Problems classified as conceptual assessed reasoning, logic, relationships, or critical thinking, and the problems that were classified as conceptual follow: using diagrams to express decimal and fraction values. Results of the word problem analysis are presented first.

Results of the word problem assessment data analysis were consistent for 14 of the 15 Chapter Review/Tests analyzed. Chapter 14's assessment on Probability, Statistics, and Graphs proved to be an outlier in the data set with 100% of its 17 problems being word problems, since this outlier would skew the mean for this set of data, it was not included in the calculations for finding the mean. Excluding Chapter 14, there was an average two word problems per test. The modes for this set of data, happening three times each, were 2 and 3 word problems per test, and the median was two problems per test. Out of 431 assessment problems 57 of them were word problems. The low percentage, 13%, of word problem test items supports the conclusion that during the 1991-92 school year there was little emphasis placed on the use of word problems for mathematics instruction.

Additional support for this conclusion is provided by the analysis results of the types of word problems included in the Chapter Review/Tests. All of the word problems were routine type problems that could usually be solved in one step. If the lesson was about multiplication of decimals, then the word problems included on the test required multiplication of decimals to solve the problem. None of the problems had missing information or too much information, and none of them required applications of the problem solving strategies included at the end of each chapter. The word problems were designed to assess the students ability to set up and solve computation problems, and since the operation needed to solve the problems always matched the operation in the computation part of the tests, there was little mathematical reasoning or thinking expected of the students.

To provide examples of the routine nonchallenging problems included on all of the assessment materials, except Chapter Six's Chapter Review/Test which had no word problems, four word problem test items were randomly selected from the seventh grade *Addison-Wesley* textbook for presentation. The examples were randomly selected by closing the book and letting it fall open, and then the last word problem of that chapter's Review/Test was selected as an example. The four word problem example test items follow:

[Example one is from Chapter 11 titled Ratio and Proportion.]

22. Kindu drove 170 km in 2 h. At this rate, how far will she drive in 3h? (p. 289)

[Example two is from Chapter 4 titled Multiplication of Decimals]

31. For a 4-line advertisement, a newspaper charges \$1.46 per line for each day. What is the cost to run the advertisement for 5 days? (p. 111)

[Example three is from Chapter 8 titled Addition and Subtraction of Fractions]

34. A recipe calls for  $3\frac{1}{2}$  c of flour. Penny has only  $2\frac{2}{3}$  c of flour. How much more flour does she need for the recipe? (p. 219)

[Example four is from Chapter 13 titled Circles and Cylinders]

26. An irrigation tank is a cylinder with a diameter of 8m and a depth of 2m. What is the volume of the tank? (p. 339)

The limited number and type of word problems included on the chapter assessments, along with their organization by computation operations, not only indicated that problem solving did not play a significant role in mathematics education, but suggested how problem solving was taught in the 1991-92 mathematics class.

There were two word problems included at the end of each independent practice, just as there were two to four word problems included at the end of 90% of all the Chapter Review/Tests. Assessments matched the instructional materials, and instruction matched the expected outcomes. These results indicated that problem solving was taught just like any other objective. The teacher worked examples, explained how to solve the word problems and emphasized the key words in the problem that the students needed to learn. Thus, the word problems included on the assessments were not designed to assess students' ability to apply the mathematics objectives taught in the chapter, but to assess their memorization of mathematical key words, procedures, and computation accuracy.

There were two alternate assessments provided in the *Teacher's Resource Book*, and the following information about those tests was provided by an Assessment Options paragraph that was included in the bottom left corner of every Chapter Review/Test in the textbook. The Assessment Options paragraph stated the following:

If you use the Chapter Review/Test as a review assignment, you may wish to use the free-response test or the multiple choice test to evaluate mastery of the chapter objectives. The items on these tests have a one-to-one correspondence in terms of content and level of difficulty. A correlation of test items to objectives and student test pages is provided in the Management Guide. . . (p. 25)

This statement verified that the Free-Response and Multiple Choice alternate assessments followed the same format as the Chapter Review/Tests and contained similar type problems, and results of the test item analysis proved to be consistent with these expectations. Six of the Free-Response and four of the Multiple-Choice assessments were missing from this set of data, but the tests that remained intact provided conclusive data that all three assessments were designed for the same purpose: to assess accuracy of computation and procedural knowledge. The results of the test item analysis for all three assessments is presented next in Table 16.

Although there is a slight variance in the percentages, which is attributed to the missing assessment data, conclusive evidence is provided for the conclusion that *Addison-Wesley's* instructional assessment materials were designed to assess computation accuracy and procedural knowledge. Approximately 84% of the test items were procedural problems, 2% were conceptual, and 14% were routine type word problems. The fact that at least 78% of the test items assessed accuracy of computation and procedural knowledge alone indicates that computation and procedural knowledge were the focus of mathematics instruction during the 1991-92 school year. When these data results are combined with the facts that 100% of the word problems contained on the assessments were routine type word problems that were organized by computation procedures, and at most only three percent of the test items assessed conceptual understanding, the evidence strongly supports the conclusion that the focus of the *Addison-Wesley's* assessment was on computation skills and procedural knowledge and was designed to match the curriculum content and instructional methods provided in the textbook.

Table 16  
Addison-Wesley Assessment Test-Item Analysis

Assessment	Percentage Procedural	Percentage Conceptual	Percentage Routine Word Problems	Percentage Nonroutine Word Problems
Chapter Review/Test	86%	3%	11%	0%
Multiple-Choice Format	84%	1%	15%	0%
Free-Response Format	78%	2%	20%	0%

All of *Addison-Wesley's* assessment materials analysis results supported that the assessment materials were designed to assess computation skills and procedural knowledge. Analysis of the methods and types of assessment provided the following evidence:

- (1) The methods of assessment provided by the textbook materials were limited to paper-and-pencil tests.
- (2) The use of Calculators was not a part of assessment practices.
- (3) There were only two types of assessments: Free-Response and Multiple-Choice Formats.
- (4) There were three different assessments that had a “. . .one-to-one correspondence in terms of content and level of difficulty. . .” (p. 25) for each chapter in the textbook.
- (5) There were special assessments included which were designed to evaluate recall of basic arithmetic facts.
- (6) The purpose of assessment was to evaluate students' mastery of chapter objectives.
- (7) There was a Student Profile chart provided for recording objective-specific and chapter-specific test results for each student.

Results of the analysis of the content of the assessment materials added the details that follow:

- (1) All of the assessment test items were organized by objectives.
- (2) The average number of test items was 32.
- (3) Eighty-four percent of the test items were classified as procedural.
- (4) Fourteen percent of the test items were classified as routine word problems.
- (5) Two percent of the test items were classified as conceptual.
- (6) The tests were criterion-referenced.

These data results indicated that assessment focused on evaluating accuracy of computation and procedural knowledge. The fact that the tests were criterion referenced indicated that the assessments were specifically designed to test what was taught, which supports the conclusion that computation skills and procedural knowledge were the main focus of mathematics instruction during the 1991-92 school year. As described the method of instruction that matched this type of assessment best was a combination of direct instruction, individualized instruction, and drill-and-rote practice.

#### Classroom Assessment Data: Interviews

While answering questions about the type of assessments used or changes in their assessment practices, teachers provided the following information about the methods of assessment they used during the 1991-92 school year. All of the teachers indicated that they used paper-pencil test included in the *Addison-Wesley* textbook materials. The first set of interview data presented are from the eighth grade teachers.

In two different interviews the eighth grade lead teacher stated that he used the paper-and-pencil textbook provided tests. In his first interview he stated, “Well, I used standard paper-pencil textbook tests . . .” (p 18). and in his second interview he stated again, “Well, basically I was always a paper-pencil type of person, even if a kid did projects they had paper-and-pencil tests,. . .” (p 11). The other eighth grade teacher made the following comments about the changes in the methods of assessment that she used in the classroom: “In terms of tests, they are probably not a whole lot different, other than I might ask application type questions, and they will usually be bonus questions. . . . Occasionally, I will organize a test differently, rather than having them just work problems or fill in the blank, or something like that . . . I might have them classify expressions as the difference of two squares or polynomial square. . .” (p. 10).

The seventh grade teacher’s comment about assessment was short and to the point, stating, “I basically am still using a chapter test.”

Interviewer: “A paper-pencil textbook format?”

Seventh grad teacher: “Yes.”

As one of the sixth grade teachers described the difference between a quiz and a test she provided data that indicated she used the assessment materials provided in the textbook with the following comment: “. . .a quiz is just a small little thing that I make up. The test would be the test that the book has included. Sometimes the chapters are so long that I will teach half of the chapter, and we will have a test on that, and then I will teach the other half and will have a test on that. So there are two separate tests because they are just so long, and it is sometimes, by the time we get to the end of the chapter and if you want them to be able to do the test, you are going to give them a test, before you give them a test” (p. 11).

The other sixth grade teacher, while talking about how he used test grades to evaluate students progress, also shared that he used the textbook provided test materials. Following is his statement about grades: “. . .[I use] my sense of evaluation of what I see, and hear for one. I also use the test they [textbook] have. I use the review. I use more of the review than the test. I don’t weight my tests like other people do, and make them more important than the other assignments. . .” (p. 19).

This interview data indicated that in 1991-92 all of the teachers used the textbook assessment materials to evaluate their student’s progress in mastering the objectives taught

in that chapter. Since these interview data indicated that teachers were using assessments provided by *Addison-Wesley's* instructional materials during the 1991-92 school year, and an analysis of those materials showed that at least 85% of each test was focused on assessing basic arithmetic skills, further evidence is provided that supports that during the 1991-92 school year mathematics teachers were teaching and assessing procedural knowledge and computational skills.

Classroom level assessments were not the only assessments that influenced curriculum content and methods of instruction. There was a Division-Level standardized assessment and a State Level literacy assessment to consider also. In the next section an analysis of the Iowa Test for Basic Skills (ITBS), which was the standardized test instrument used in the Pleasant County School System during the 1991-92 school year, will be presented.

#### Division-Level Assessment: Artifacts

Data from two different ITBS informational documents provided evidence that at least 60% of the items on the national norm ITBS test assessed computation skills and procedural knowledge. Both documents were provided by a seventh grade teacher, and presented data about how the ITBS test related to the seventh grade. One document provided a correlation between the seventh grade SOLs and the ITBS test items. The other document presented the national-norm scores for each section of the test and for each test item for seventh-grade students. First data from the norm scores document is presented to provide evidence of the percentage of the test items that focused on assessing basic arithmetic procedures and computation skills. This document provided data of interest to teachers responsible for the mathematics instruction of students preparing to take the test. Along with the norm score for each test item for students taking the test in the fall, mid-year or spring of their seventh grade year, the document also provided the number of each skill-coded item included on the test.

A general overview of this test-item-analysis document showed that there were three different areas of mathematics assessed by the ITBS test: Math Problem Solving, Math Computation and Math Concepts. There were 30 questions in the problem solving section of the test, 42 in the math computation section and 41 in the math concepts section. Based on this information only 37% of the test items focused on computation, but the use of calculators was not permitted on this test unless an exception was stipulated on a Special Education Student's Individual Educational Plan. Taking this into consideration, an analysis of the test items included in the Math Problem Solving and Math Concepts sections of the test brings the number of computation problems up considerably. Of the thirty problems in



the math problem solving section document, ten were single-step problems of which seven problems involved whole number operations (three addition, one subtraction, one multiplication, two division) two fraction problems (one multiply, and one divide) and one percent problem (multiplication). There were 20 multiple-step problems and of those 14 involved whole number and decimal operations and the other six involved operations with fractions and percents. All 30 of these problems involved computation.

The Math Concepts section of the test included six problems about number systems (place value, expanded notation and properties) seven problems about equations and inequalities, five problems about whole numbers and integers (factors, prime number, estimating, rounding and negative numbers) eight fraction problems (part of a whole, relative values, equivalent fractions, common denominator, operation, ratio and proportion) eight decimal and percent problems (reading and writing, relative values, operations, rounding, equivalence, probability and statistics) and seven geometry and measurement problems (length and weight, geometric figures, area and perimeter and surface area and volume). Computation was required to solve at least 14 of these problems.

When the test item analysis results were combined for all three sections, the percent of items that assessed computation skills increased considerable. Of 113 test items 86 required computation to solve the problems. That put the percentage of computational test items on the ITBS test up to at least 76%. Additional support for this conclusion is provided by the other ITBS related document, *Correlation of Standards of Learning Objectives to the ITBS*.

This document listed all the seventh grade standards of learning on the left side of the paper and all the ITBS test items correlated with each SOL on the right side of the paper. An analysis of the seventh grade SOLs showed that eighty percent of the objectives were about mastery of arithmetic procedures and computation. In this correlation document 72 of the 113 ITBS test items were correlated with eighteen of the seventh grade SOLs. There were no problems that correlated with SOL 7.13 The student will express common fractions having denominators of 2, 3, 4, 5, 8 and 10 as decimals, 7.15 The student will measure length in each of the following units: inches, feet or yards; centimeters or meters. 7.19 The student will construct a broken-line or bar graph, and 7.22 The student will determine if a given problem includes sufficient data to solve the problem or contains unnecessary information for solving the problem.

The only SOL that the ITBS test items were correlated with that was not categorized as mastery of basic arithmetic skills objective was SOL 7.21 The student will solve problems dealing with everyday situations requiring the use of addition, subtraction, multiplication, and division of whole numbers and decimals; and addition , subtraction and

multiplication of fractions. But again, the students were not permitted to use calculators on this test so even these problems assessed a student's ability to perform computation. Therefore, based on this document at least 76% of the ITBS test items assessed computational skills. Historically teachers have been encouraged to improve test scores; therefore, there was a direct link between the content of the ITBS standardized test and the content of mathematics instruction in the classroom. Since computation skills and procedural knowledge were primarily what was assessed at the Division Level, it was the mathematics teacher's responsibility to teach computational skills and procedural knowledge. An analysis of State-Level assessment practices presented next concludes the presentation of assessment artifact data analysis results.

#### State-Level Assessment: Artifacts

The state's mathematics assessment instrument was the Literacy Passport Test (LPT), which was designed to test for minimum competencies that were set by the SOLs. An analysis of it and its related educational mandates provided the information that follows. Since the use of calculators was not permitted on the LPT, and the LPT was designed to be in alignment with the state's SOLs, at least 80% of its test items assessed computation or procedural knowledge. The practices and educational mandates related to the state's LPT assessment provide evidence concerning the method of mathematics instruction expected in the classroom.

Along with the LPT came the establishment of criteria to identify students that qualified for State remedial services. Several different indicators were used to identify remedial students such as teacher recommendation, and grades, but the State remedial list of students for mathematics consisted of any student who had not achieved the state's criterion level on the sixth-grade Literacy Passport Test or who scored in the lower quartile on total math on the Iowa Test for Basic Skills (ITBS) nationally normed test given in the fourth grade. Therefore, the state's remedial mathematics students were students who had not memorized computation procedures, or basic arithmetic facts or rules

According to the State mandate, teachers were expected to provide individual Developmental Educational Plans (DEP) for all of their mathematics students that were identified as at-risk remedial students. The ultimate goal of all these plans was for students to pass the state's Literacy Passport Test. Since the purpose of the Literacy Passport Test was to assess minimum competency, and it was designed to be in alignment with Virginia's 1988 mathematics SOLs, to meet this goal students needed to improve their computation skills and master procedural knowledge. This unfunded State mandate legally required teachers to provide individualized instruction for the identified State-remedial students.

Thus, the State Department of Education placed a great deal of importance on individualized instruction to improve students performance in mathematics.

The LPT test was given for the first time in sixth grade, and then it was given at the end of every school year thereafter until a score of at least 140 was obtained. Before a student could graduate from high school he or she was expected to demonstrate mastery of the minimum competencies of mathematics which meant being proficient with the arithmetic operations and procedures for fractions, decimals, whole numbers and percents without the use of a calculator. Thus, in addition to individualized instruction there was a necessity of drill-and-rote practice to ensure mastery and maintenance of computation skills and arithmetic procedures.

#### Division- and State-Level Assessment Data: Interviews

The next set of interview data are teacher and Division and State Level administrators comments that concerned how instructional practice was influenced by the required State and Division Level assessments. There were no questions directed to the teachers specifically about these assessments, but during the interviews the following few comments were shared.

While explaining why a particular homework assignment had been used, the eighth grade lead teacher indicated that it was to prepare students of the ITBS test. His comment follows: “The decimal [homework assignment], because we were getting ready for the ITBS test. The scientific notation, because they had done it previously, and they were still having problems. . .” (p. 15).

In the next statement the lead teacher was talking about the amount of time provided for classroom instruction by the implementation of block scheduling: “. . . I mean we are up moving around most of the time, but if we have to sit for drill-and-practice for like the ITBS its horrible” (p. 6). The ITBS test focused on evaluating computation and arithmetic procedures and the lead teacher made the following comment about teaching such skills: “. . . Boring worksheets, I don’t know what else to do with basic skills. . .” (p. 14).

One of the sixth grade teachers indicated that her hesitation to use calculators for mathematics instruction stemmed from the necessity of mastering the skills for the state’s LPT test. Following is the sixth grade teachers statement: “I don’t want, I know that later on it is OK to use them [calculators],but when we take the Passport Literacy Test they have to know these operations, they cannot use a calculator. . .” (p. 7).

The Associate Superintendent, referred to the middle school’s ITBS scores while discussing the use of calculators in mathematics instructions stating , “. . . For example right now our math computation scores at the middle school level are not good. We have

142 eight graders going to the ninth grade next year scoring below the 25th percentile in math computation. Now, you know, the only way that we're going to handle that is to make sure that children have mastered the basic skills. . ." (p. 6).

The Coordinator of Elementary and Middle School Instructional Programs, made the following statement about instruction and standardized testing: "I think, probably the standardized test drives more of the curriculum in most of our subject areas in most grades" (p. 19).

When the Director of New Initiatives was asked about the role of standardized tests in mathematics instruction she stated, "They [standardized test scores] play a major role. They do because, of course, the state's saying that schools are going to be funded on those scores, and we have a special board meeting where ever school is going to be presenting their scores, and what they plan to do about it. . ." (p. 18).

When the Superintendent of Schools was asked if there was anything specific that he would like the mathematics teachers to work on, he said:

**OH yes.** We have that as one of our major goals for next year, is to address what appears to be gaps in our testing program in our curriculum, computation in particular is a weak area that has been identified across grade levels in mathematics, and we've asked our teachers, we've got a mathematics committee working on the problem to examine, you know, why that is and what we need to do to correct it. Certainly we're concerned that our math scores are not as high as we'd like to see them compared to other disciplines, and especially in the area of computation we're **real** concerned. (p. 18)

Later in the interview while the Superintendent was talking about mathematics reform at Pleasant Middle School, he stated, ". . .I am aware that the computation scores are the lowest in the County and we're concerned about that" (p. 31).

The State Department of Education's Principal Mathematics Specialist K-8 (referred to hereafter as State Department Specialist K-8) made the following statement about assessment and instruction during her interview:

. . .I am sick of seeing the chalk-and-talk, you know, the sage on the stage. We need that guide on the side kind of thing. Of course, the thing that's going to change or have the most impact, of course, is the assessment. The assessment is going to change what happens, and if the assessment doesn't live up to what the standards say then we've lost the battle. So it's really the assessment will be the most, will have the most impact. We can tell teachers

they should do hands-on science or hands-on math, they should use manipulatives. We can talk till we are blue in the face, but until the kids are actually accountable for that kind of approach to learning and that kind of approach to assessment, until the assessment is aligned with those kinds of instructional approaches, I'm not sure we're going to win the battle. . . (p. 10)

When the interview data are combined with the analysis of the ITBS and the LPT assessment artifact data, and the fact that the County made a major investment in computer technology to improve basic computation skills, preparation for the ITBS and LPT assessment proves exert a major influence over classroom instruction. These data provide support for the conclusion that teachers were strongly encouraged to use a combination of whole-group instruction, individualized instruction and drill-and-rote practice to improve students' performance on the Division- and State-level assessments. In 1991-92 Division and State level assessments focused on mastery of basic arithmetic skills, which supports the conclusion that the majority of mathematics instruction was designed to teach procedural knowledge.

According to the Superintendent's and Associate Superintendent's comments basic arithmetic skills remained a serious concern for mathematics instruction. The mathematics instructional materials, the curriculum, and both the State and Division Levels' assessments and the County administrators promoted mastery of basic arithmetic skills, and the Principal Mathematics Specialist for the State Department of Education concurred that with these assessments in place the teachers were strongly compelled to teach mastery of basic arithmetic skills.

Additional support for the conclusion that assessments influence the methods of instruction used in the classroom is provided by the following passage taken from Constance Kamii and Barbara Lewis' (1991):

The *Curriculum and Evaluation Standards* (NCTM 1989) states that if we want to improve the nation's mathematics education, it is necessary to change the current method of evaluation that depends on standardized achievement test. The National Research council (1989) is even more explicit about the harmful effects of achievement testing. Among its criticisms are the following (p. 68):

- Tests become ends in themselves, not means to assess educational objectives. Knowing this, teachers often teach to the tests, not to the curriculum or to the children.
- Tests stress lower-rather than higher- order thinking. (p. 4)

In addition to supporting the conclusions of this portion of the study these data also support the results of the analysis of the ITBS artifact data which stated that at least 75% of the test items assessed computation—lower-order thinking.

#### Baseline Data: Mathematics Assessment Summary

The teacher interview data established that textbook assessments were used in all three grade levels during the 1991-92 school year. All three sets of artifact assessment data, textbook assessment materials, Division Level, and State Level, indicated that the purpose of assessment was to evaluate computation skills, and procedural knowledge. In 1991-92 the design and purpose of assessments that were used in the classroom, for national-standardized assessment and State-Level assessment were in alignment with the State- and County-curriculum mandates. These data also provided evidence of the type of mathematics instruction that was expected in the classroom. All three levels suggested the use of individualized instruction and independent written practice to improved performance in mathematics, and teachers were expected to explain, demonstrate, and tell the students exactly what they needed to know.

At the Classroom Level the instructional materials provided three similar tests for each chapter and a record keeping chart for documenting individual needs and mastery of each objective. The instructional materials were designed to facilitate individualized instruction and retesting as needed. Directives for the states' LPT provided that students take and retake that test once a year until mastery was achieved, and the Division Level's ITBS data were used primarily to help identify the State-remedial students. The State Department of Education mandated individual DEPs be created for these students and filed as a part of their permanent records. Individualized instruction was encouraged by the administration for improvement in mathematics, and frequent review was built into the spiraling curriculum and the assessment materials. Practice for maintenance of computation and procedure skills was considered as important to mathematics instruction as initially learning the skill. Teacher and both levels of administrative interview data supported that the Division- and State-levels of assessment focused on arithmetic procedures and that improving test scores was an emphasis of the administration. Since computation and procedures were the focus of assessment, the use of calculators for mathematics instruction was not strongly encouraged nor practiced in 1991-92 mathematics classrooms.

The purpose and design of all three levels of assessment matched the State and County curriculum. Curriculum content was organized in chunks of mathematical procedures with a suggested sequence of presentation, and assessments contained test items designed to evaluate those isolated chunks of mathematical-procedural knowledge. The

instructional materials approved by the State, and selected and adopted by the County as the instructional materials that best matched the assessment expectations and curriculum mandates was the *Addison-Wesley Mathematics* series, which featured assessments and methods of instruction that focused on mastery of procedural knowledge and computation skills. Thus, the types and methods of assessment used in the Classroom, and at the Division and State Levels strongly supported that the predominate method of instruction used in the mathematics classroom in 1991-92 was whole-group-direct instruction, individualized instruction and independent practice.

#### Conclusions Baseline Data: Mathematics Instruction

The five different sources of artifact data, County curriculum guide, SOLs (1988), *Addison-Wesley* textbook materials, State Level Passport Literacy assessment, and Division Level ITBS assessment related documents, all provided data that documented the curriculum content, design of the curriculum, instructional materials, and assessments were all in alignment, and that the recommended instructional practice to meet the objectives of the curriculum was outlined by the *Addison-Wesley* instructional materials and encouraged by both State- and Division-Level administrators, and policies.

The purpose of classroom instruction during the 1991-92 school year was to teach mastery of computation and procedural skills, and *Addison-Wesley Mathematics* instructional materials were researched based instructional materials designed for that purpose. Madeline Hunter's seven step lesson plan was used as a model for the best instructional lesson plan, and scripted lessons for whole-group-direct instruction were included for every objective. Resource materials were provided to supplement whole-group instruction with independent instruction and individual practice or enrichment as needed. At least 75% of the SOLs and the County's curriculum were objectives that involved mastery of arithmetic procedures, and both the State and County policies encouraged teachers to teach computational skills. Local, state, and national assessments evaluated students' mathematical abilities by testing computation skills and mastery of procedural knowledge, and teachers were strongly encouraged to improve those scores. As a result, the use of calculators was not recommended for mathematics instruction during the 1991-92 school year.

Analysis results of the artifact and interview data were combined to provide a description of mathematics instruction used during 1991-92 school year. First, the artifact established that at least 75% of the mathematics objectives contained in the State- and County-curriculum guides focused on mastery of arithmetic procedures and computation skills. Second, an analysis of the *Addison-Wesley* mathematics instructional materials,

which were adopted and purchased for the purpose of mathematics instruction in 1989, documented that the instructional materials were in alignment with and promoted instruction compatible to the County's curriculum guide and the State's SOLs. Third, the interview data documented that *Addison-Wesley*'s materials were used for instruction during the 1991-92 school year.

Fourth, the results of the analysis of nontextbook instructional materials, technology, indicated that the County had invested heavily in a self-contained computer lab for the purpose of individualized drill-and-practice mathematics instruction for improving students' computation-assessment scores. Fifth, analysis of calculator instructional material data documented that access to calculators was extremely limited and that the use of calculators was not encouraged for mathematics instruction. Sixth, analysis of Classroom, Division and State Level assessment data provided evidence that indicated that mathematics assessments focused on evaluating the procedural knowledge and computation skills mandated by the SOLs, and that the methods and types of assessments were compatible with the methods of instruction promoted by the Addison instructional materials, the WICAT computer lab, and Division- and County-level policies and administrative expectations. Seventh, interview data established that the teachers did rely on and follow the textbook's lessons for mathematics instruction, and that the textbook's test materials were used for assessment in the classroom. Eighth, results of all of the components of mathematics instruction, curriculum, assessment, and instructional materials encouraged or recommended the use of direct instruction, independent instruction and drill and practice as the best methods of instruction.

These data results provided evidence that supported that the *Addison-Wesley* instructional materials were the only instructional materials available in the classroom in 1991-92. So, even if the use of calculators had been encouraged, the classrooms were not supplied with them; therefore, it was impossible for calculators to be used as a part of daily mathematics instruction. Data were also presented to document that the teachers had 45 minutes for mathematics instruction and that there was pressure from the administration to improve test scores on both the Literacy Passport test and the ITBS standardized test; therefore, it is highly probable that teachers spent their class time teaching the basic arithmetic skills that these tests assessed. Interviews concerning the use of technology in mathematics instruction also provided support for the conclusion that mastery of procedural knowledge and computation skills were the focus of mathematics instruction during the 1991-92 school year.

The artifact and interview data provided evidence that in 1991-92 mathematics teachers were using direct instruction to show and tell the students the procedures that they needed to learn. Learning mathematics meant practicing the procedure enough times to



commit it to memory, and then being able to demonstrate mastery of that procedure by working problems on paper and getting correct arithmetic answers. Even mathematics instruction and assessment on problem solving boiled down to computational practice. The students were expected to copy the procedure demonstrated and explained by the teacher and then practice that procedure by working a set of related practice word problems. Arithmetic procedures and computation skills were taught in isolation, and problem solving, reasoning, communication and thinking were not major components of mathematics instruction during the 1991-92 school year. The teachers did the talking and students were expected to listen, copy, practice and internalize what the teacher had instructed. Students directed their questions to the teacher, and the teacher and textbook were the mathematics authorities in the classroom.

Although, during the 1991-92 instructional year the teachers were organized as interdisciplinary teams with individual- and team-planning times scheduled into the day, traditional-mathematics instruction was the most commonly used method of instruction in the classrooms. Whole-group-direct instruction, individualized instruction, and drill-and-rote practice were the predominate methods used for mathematics instruction, and the desired outcome was mastery of arithmetic procedures and computation skills. Since the focus of instruction was procedures and computation skills, and there was limited access to calculators, the use of calculators in mathematics instruction was minimal. The classroom was teacher centered and discourse was teacher directed. Students were expected to be, and were treated as, passive learners. Developing reasoning and thinking skills were not the focus of mathematics instruction, and the technology that was available for mathematics instruction was used to supplement the classroom instruction with more individualized instruction through drill-and-rote exercises. Mathematics instruction during the 1991-92 school year looked pretty much as it was described by one of sixth grade teachers: students seated in straight rows, listening to the teacher talk and practicing the procedure taught. With the documentation and establishment of the baseline data completed the next step in the presentation of Level II data analysis is to document and track any change in instructional practice from 1991-92 to 1995-96 school year.

#### Documenting and Tracking Change from 1991-92 to 1995-96

A combination of artifact and interview data are used to document and track educational reforms initiated at any time during the time frame of the study beginning with the baseline year 1991-92. The information is presented through the words of the participants as much as possible and focuses on changes in the daily schedule, the

mathematics curriculum, organization of the academic teachers, methods of instruction, instructional materials, and methods of change. The tracking change data for 1991-92 opens with a document that outlined the expectations of Pleasant Middle School as a Vanguard Middle School for the State of Virginia, and moves through the subsequent years of the study, sequentially documenting change and tracking change initiatives through the 1995-96 school year. Although many of the change initiatives, such as restructuring the middle school, were not limited to mathematics specifically, all of them had the potential to impact mathematics teachers and on mathematics education.

### Documenting and Tracking Change: 1991-92

As described in the research setting information of the baseline data, in 1991-92 Pleasant Middle School was in its second year functioning as a restructured middle school with the distinction of being designated a Vanguard Middle School for the State of Virginia. With the Vanguard School designation came responsibilities, and those responsibilities were outlined in a State Department of Education's document titled Essentials for Vanguard Schools which was shared with the faculty in a letter from the Principal. Contents of Essentials for Vanguard Schools follows:

Vanguard Schools will work toward the implementation of these essentials for middle school education:

In-depth knowledge of the needs and characteristics of early adolescents, and of their implication for teaching and learning.

A curriculum based on the needs of early adolescents.

Success for all students, with emphasis on at-risk students.

Interdisciplinary teaming of teachers.

Advisor / advisee programs.

Teacher involvement in decision making.

Productive use of instructional technology.

Students being healthy for learning.

Engaging parents in their children's education.

Connecting schools with their communities and community resources.

Career development.

Vanguard Schools will work with the Department of Education in:

Curriculum development.

Serving as a dissemination site for successful practices.

An information and support network.

Disseminating essential practices. (Principal, personal communication, July 17, 1989)

Implementation of the recommendations for restructuring the middle school were obviously taking place for the school to be designated as a Vanguard Middle School. As stated in the mathematics instruction baseline-data section, the school had just made a schedule change to a seven-period day to provide academic teams of teachers a team-planning time. Teachers were encouraged to change their methods of instruction from direct instruction to the use of cooperative learning and interdisciplinary instructional units. Throughout the year teachers were provided various educational articles by the Principal pertaining to interdisciplinary teaching, and teachers were encouraged to discuss these articles during their team meetings. The goal was for each team to implement at least one interdisciplinary unit each semester. Following is a list of the articles that one teacher had received and filed from that year:

Garman, D. & Levertz, F. (Ed.). (1991). ...Teacher Today (Vol. 6, No. 3) Glen Ellyn, IL: The Institute for Educational Research.

Fogarty, R. (1991). Ten ways to integrate curriculum. Educational Leadership, 10, 61-65.

Appalachia Educational Laboratory. What we know about mathematics teaching and learning (The Link Vol. 10. No. 4). :Author.

Willis, S. (1992). Mathematics education standards 'revolution' takes hold. Association for Supervision and Curriculum Development, 1, 1-6.

Beane, J. (1990). Rethinking the middle school curriculum. Middle School Journal, 5, 1-5.

Willis, S. (1991). Teaching to the brain. Association for Supervision and Curriculum Development, 33 (8), 1-2.

Willis, S. (1992). Cooperative learning shows staying power. Association for Supervision and Curriculum Development, 34 (3), 1-2.

Doyle, D. (1992). The challenge, the opportunity. Phi Delta Kappan, 3, 519-520.

Gatto, J. (1991). Why school don't educate. Networker, 9, 55-59

Before the articles were copied and given to the teachers, passages were underlined or starred by the Principal as significant points, and suggested topics for team discussions. were provided. There were no supporting data provided by the teachers' interviews or

artifacts to document those discussions took place. However, these artifact indicate that changing instructional practice was encouraged by State-Level administrators and the school's Principal. The data also indicate that the Principal took a leadership role in the Vanguard restructuring process. Nowhere else in the interview and artifact data was there any reference to *other professional development opportunities provided* for the teachers in terms of changing their instructional practice during the 1991-92 school year.

### Documenting Mathematics Curriculum Change Initiative

What did evolve during the 1991-92 school year was a Core Curriculum Committee to investigate what was being taught in mathematics classes and to restructure the curriculum. A copy of the agenda of the first Core Curriculum meeting of the two middle schools provided data concerning when this meeting was held, who was present and what the goals were. The first meeting was held on February 12, 1992, and the Principal opened the meeting with a statement of purpose. The committee was directed to write a Core Curriculum proposal for mathematics that supported the following:

- (1) Compliance with the philosophy of a restructured middle school. (Vanguard)
- (2) Curriculum content that is research based.
- (3) Quality and equity in the proposed curriculum that is appropriate to all early adolescent learners.
- (4) A curriculum approach that lends itself to meaningful assessment. (Core Curriculum Agenda, February 12, 1992)

Grade level teams of teachers were organized to work on the Core Curriculum project, and one of the sixth grade teachers, the seventh grade teacher, and both of the eighth grade mathematics teachers from this study participated in the project.

This committee met six times during the 1991-92 instructional year, and following are the dates of those meetings: February 12, February 26, March 11, March 18, March 20, March 26, and on March 3, 1992. Members were encouraged to participate in a teleconference provided by the State Department of Education titled "Benchmarks for the Common Core of Learning" under the leadership of the State Department's Specialist K-8. At the second meeting the committee set as it goal to design a new curriculum that would accommodate collaborative teaching, integration of the curriculum in interdisciplinary instructional units, writing to learn, and cooperative learning, a curriculum that would support computer technology and calculators to be used by all students and algebra offered to all students. There was a consensus among the committee members that the new curriculum should be based on the recommendations of the NCTM *Curriculum Standards*.

On March 26, 1992, the committee presented the Math Core Curriculum to the administration. Following is a copy of the committee's presentation:

[Pleasant] County Middle School Mathematics Curriculum

The [Pleasant] County Middle School mathematics curriculum will be based on the National Council of Teachers of Mathematics standards for the improvement of mathematics instruction. The standards call for the use of calculators and computer technology available in all classrooms, use of cooperative learning and collaborative teaching, and the frequent use of manipulatives in both the instructional and evaluative processes. An interdisciplinary approach to mathematics will provide students with the mathematical thinking skills necessary to solve problems that may arise in other subject areas.

For mathematics learning to change in a positive manner, a strong commitment on the part of teachers will be essential. Even so, dramatic changes will not occur overnight. Furthermore, teachers alone cannot accomplish this. They must have the long-term support and adequate resources provided by building Principals, the school board, and the community.

Learning mathematics in the prescribed manner will require manipulative materials and technology (a calculator for each student and at least one computer per classroom). For students to learn cooperatively, some changes in the learning environment are necessary: desks or table that provide a level surface and, in some instances, sound-proofing and/or carpeting.

Another need will be training in new instructional management systems. Inservice from teachers practicing these teaching methods would be helpful. Also beneficial, would be summer inservice time for working up instructional units.

With strong commitment and with everyone working together, we feel that this innovative direction in teaching of mathematics can provide quality and equity in mathematics learning for all our students. (Core Curriculum Project 1992)

This meeting ended with a unanimous agreement among the teachers and administrators to implement this curriculum and work to improve mathematics instruction in the middle schools. (A copy of the Core Curriculum written for the seventh and eighth grades is available in Appendix W.)

The data presented (1) support conclusions formulated from the analysis of the baseline data about the methods and content of mathematics instructions that were used during the 1991-92 school year, (2) indicate that the need for reform of mathematics instruction was evident to the teachers and administrators, (3) indicate that the teachers were involved in the decision making process, and (4) indicate that the teachers and administrators were knowledgeable of the NCTM's research based recommendations for reform of mathematics instruction.

With the changes in the curriculum design and content came recommended changes in methods of instruction and instructional materials. Changes related to methods of instruction were recommendations for the use of interdisciplinary teaching units, collaborative teaching, cooperative learning, and a focus on problem solving. Changes related to instructional materials were the use of calculators and technology for mathematics instruction, and the use of manipulatives for instruction and assessment. There were also specific statements made about the need for inservice training, time for teachers to work together and plan, administrative support, and changes in the physical classroom environment.

#### Documenting and Tracking Change: 1992-93 School Year

In 1992-93 the Core Curriculum was published in poster form, and all teachers received copies to post in their classrooms, but *no follow-up meetings were conducted* and enthusiasm for reform waned. The following interview data are offered in support of this statement. When asked if any progress had been made in reforming mathematics curriculum the mathematics, lead teacher said, "Hmmm, the Core Curriculum that we worked on however many years ago, I don't know when it was, no nothing other than that. . . and nothing became of that" (p. 6).

The other eighth grade teacher made the following comment about the Core Curriculum while responding to a question about being in control of her professional life with respect to curriculum and materials: "Well, I really feel like I have a pretty good amount of freedom; of course I try to stay within the NCTM *Standards* basically, because our County guidelines [Core Curriculum], we worked on those together; they were pretty much based on that, and, you know, other than that meeting the needs of my students. Those are the things I take into consideration. I don't think anybody, you know, would tell me you can't teach that because it is— whatever" (p. 15).

The State Department Specialist K-8 interview data provided the reason why there was no real follow-up on implementing the County's new Core Curriculum. While

discussing the decision to rewrite the Standards of Learning, she explained the demise of the Common Core Curriculum project as follows:

. . .what had happened here at the Department is while we were under the Wilder administration of course we were working on a Common Core of Learning, and that was withdrawn by Wilder. I don't know what year, 93 or so, and ah because there are lots of reasons so, I won't say why, but it was politically charged, and so consequently when we got a new governor, and we got a new [State] Superintendent. They went after a new approach, and ah, so they went back to the Standards of Learning approach, and the last time the Standards of Learning had been dealt with was in 1988, and what we were going after was a revision to the Standards of Learning rather than talking about a totally new program—because obviously that's what the Common Core was, and people were certainly opposed to something totally new. So, some transitions or revision people were more willing to accept something of that nature, and one other issue was that it was felt that the Common Core was being developed here at the Department, and so we wanted to get away from that image, and so what we did was we ah, put it out to school division to develop, and so therefore, Fairfax was selected as the school division to develop the math Standards of Learning. . . (p. 2-3)

In the review of the artifact data at the Building Level for the 1992-93 school year, there was a noticeable **lack** of any documentation of funds being spent on inservice training, release time for teachers, summer workshops, conference attendance, or new instructional materials such as calculators or mathematics manipulatives for the classroom. Since there was lack of support at the State Level for the Common Core Curriculum, and there were **no** follow-up sessions, inservice training, or new instructional materials purchased at the Division Level, the support described by the teachers as essential for the implementation of the Common Core Curriculum was not provided. The limited amount of interview data pertaining to the Common Core Curriculum supports its lack of significance and impact on mathematics instruction. The *Addison-Wesley* textbook was still in use, the 45-minute seven-period schedule was still in place, and none of the assessment practices had changed, therefore once the posters of the new Common Core Curriculum were posted in the classrooms mathematics instruction continued as usual.

#### Documenting Change and Mathematics Instructional Materials 1992-93

The Core Curriculum and the NCTM *Standards* did however have an impact on textbook adoption that took place during the 1992-93 school year. This statement is

supported by interview data from all levels of the study beginning with data provided by the State Department of Education's Associate Specialist (referred to here after as State Department Associate Specialist) for instructional media and training. While discussing the NCTM *Standards* influence on the writing of the new SOLs, she made the that follow remarks:

They were the flagship. They were the instigator, NCTM, and they got into it quite early in order, and I believe, that is why the NCTM *Standards* have had possibly greater impact than any of the standards in other academic areas. . . . They had a great impact even in our last mathematics adoption, textbook adoption, which was 1992-93. (p. 2)

The State Department Associate Specialist then discussed how the State Department's role in textbook adoption had changed saying:

Well, here to fore the curriculum areas in the Department of Education have set up and developed their own criteria for selection of instructional material with a lot of local input, ah, these criteria have been field tested, and then sent to publishers to let publishers know what Virginia wanted in the way of instructional materials; however, with the last science adoption and then [State Superintendent's] administration, the sole criteria for selection now is only the Standards of Learning. There are no other criteria for selection used in this administration. So the only thing we publish now is the evaluation profile on each item submitted for adoption which states their percentage of correlation for that textbook or for that particular instructional material. . . . The sole criteria [sic] was percentage of correlation to the revised Standards of Learning and no other, and for those of us in education that should send up a flag, in that, those are minimal standards, and we encouraged localities to select only those materials on the State Contract list ah,— that were highly correlated to the Standards. Now we do not publish a recommended list any more, only a State Contracted list. So that any item submitted for review and evaluation is placed on six year State Contract, and we don't say whether it's recommended or not. (p. 3-4)

We're leaving more decisions up to the localities about what they do with the funding, and all we're doing is encouraging them to adopt materials which have shown a high correlation. What we do at the departmental level, we validate and analyze the publishers' correlation's that are furnished with each item submitted for adoption, and we pull together teams of educators throughout the State and bring them to a summer workshop to validate the



publisher's correlation. Which is only saying, looking at the publisher's correlation and saying yes on this page and this page these is a correlation. . . the last mathematics adoption that I mentioned, '92-'93, those criteria for adoption were based on the NCTM *Standards*, and most publishers have adhered to the NCTM *Standards* in producing new instructional materials. (P. 7-8)

At the school level the former Principal stated the only directives he received about textbook adoption were that there needed to be written evaluations completed for each set of textbook review materials. The only textbooks that would be considered for adoption were those on the state's list, and there had to be a consensus between all grade levels in both middle schools (p. 16). With these directions the teachers were given the task of selecting the mathematics textbook that would be used for the next six years.

The lead teacher interview provided a brief description of the textbook adoption process in the statement that follows:

Let me think. We started with teams of teachers from each grade level reviewing the textbooks for their own grade level, and every teacher had to write up an evaluation of every textbook they [sic] reviewed. That took us months, but when we finished doing that we started meeting to discuss our results. I can't remember how many times we meet, but we meet several times after school, just the teachers from our school, and then we meet several times with the teachers from the other middle school. The seventh and eighth grade teachers all agreed right off that *Glencoe* was our pick, but the sixth grade teachers wanted something else. I think it was *Heath*. I really don't remember, but we finally convinced them that the *Glencoe* textbook had more to offer than any of the others. It was the only one designed specifically for middle school, and it was correlated with the NCTM Standards. (p. 2)

There were no recorded minutes for any of these meetings, and the written reviews of the textbooks were collected by the Principals and given to the County's Director of Curriculum and Instruction. Since this position had been filled by a new person the year after the textbook adoption process had taken place, she could not provide any artifact data to document this process, but the fact that the *Glencoe* textbooks were being used in all of Pleasant Middle School' mathematics classes during the 1995-96 school year provided supporting evidence that the textbook adoption process resulted in the adoption of the *Glencoe* textbook series.

The former Principal described his leadership role in textbook adoption with the following comment:

A couple of years ago when textbook adoption was coming up I really encouraged the teachers to buy a classroom set and use the rest of the money for other materials. Every student doesn't need a book, there are other ways of approaching it. I think textbooks, number one they gouge us on the prices. There are a lot of ways that you could still get the same information across to kids without the use of a formal textbook. So for myself I've probably come full circle on textbooks. I used to think if I didn't have that teacher's manual in front of me I couldn't teach, and now I realize that good teaching can take place with no textbook. (p. 16)

Interview data from the teachers also provided a few comments related to textbook adoption. The eighth grade teacher stated, "The *Glencoe* textbook that we adopted, I am really pleased with it. I think the activities offered are very appropriate and it gives teachers lots of ideas as far as activities and things to do" (p. 13).

One of the sixth grade teachers said, "No, I did not recommend adopting the *Glencoe* textbook. It is too difficult for the students. It is wonderful for above average students, but it is too difficult for the average student" (p. 15).

The other sixth grade teacher made the following comment: "Yeah, I like the book [*Glencoe*] we adopted. It has got a lot of application to it, and it has so much in there that you can't do it all, and if you are looking for something that really is practical that does, not just mathematics, but goes outside the realm of a math class that book does it. It has got a lot of practical uses. It has got a lot of labs in it. A lot of learning techniques and skills in it. There is [sic] a lot of things you can do with that book" (p. 24-25).

Adoption of the new textbook material was the only school level instructional materials initiative that was remembered, or that could be documented for the 1992-93 school year. The seven period day schedule with 45 minute classes was in its second year; extended learning, and advisory groups were still functioning, and the WICAT computer lab was being used by all mathematics teachers for computer-assisted instruction. The teachers were supposed to be working on developing interdisciplinary instructional units, but there was no documentation to show that this had happened that year. Data indicated there was no follow-up on the implementation of the Core Curriculum other than asking the teachers to display the Core Curriculum posters in their rooms.

#### Documenting New Change Initiatives for Mathematics Instruction in 1992-93

At the end of the 1992-93 school year, V-QUEST Lead Teachers were selected and informed of the two-week Lead Teacher training program that they would be attending during the summer of '93. Therefore, work on mathematics reform initiatives at the Division and State Levels had to have taken place during the 1992-93 school year. As described in Chapter I, V-QUEST was a State Systemic Reform movement funded by the National Science Foundation. The State Department's Mathematics Specialist for the Secondary Division described her role in the V-QUEST program saying, "Well I was one of the original writers of the proposal that was funded back in 1992, and after it was funded I moved into the position of liaison for the preservice and inservice component, but still have some role serving as consultant for the other components, sort of as internal control person. . ." (p. 2).

The State Department's Associate Specialist made the following statement about the state's reform initiative:

V-QUEST was a systemic movement which incorporated process as well as the high academic content standards. . . . Well you see, there's so much in the V-QUEST work. It was based on the constructivist philosophical research, ah we got into integrated assessment, alternative assessment, as assessment should be integrated throughout the instructional process, the scientific process, inquiry oriented, ah students are encouraged to pose questions. The whole constructivist philosophy—dropping kids into an occurrence or a happening to let them become inquiry oriented. . . (p. 5-9)

The Superintendent of Schools explained why the County made the choice to get involved with the V-QUEST reform movement in the following interview exchange:

Superintendent of Schools: It coincided with our vision for reform in the County.

Interviewer: Did the need for mathematics reform influence this decision?

Superintendent of Schools: **Yes, yes.** Mathematics, science, technology were all sort of intertwined as we began to examine types of changes that were most effective in schools. It became apparent that the most significant demands that society was beginning to make on use and of our kids involved the area of, the areas of science, mathematics in particular, and the use of technology in general, but specifically within those two domains. We felt like that's were our major thrust needed to start. Reading and writing are always going to be important, communication skills, thinking skills all of that is assumed here, but the major reform effort in our opinion had to start with

mathematics and science and that's where V-QUEST we felt would be a good partner.

Interviewer: Was there a particular reason that the two middle schools were chosen to participate in the first year?

Superintendent of Schools: I believe that was the way our grant was written in coordination with the Radford University at the time, and ah, and it was fine. I mean we could have begun that effort just about anywhere, but we felt like the middle school was as good a place as any to start.

Interviewer: Did you play a strong role in getting the County to pursue this endeavor?

Superintendent of Schools: Well I think whether you want to be or not ah, when you're the Superintendent of Schools very little gets approved or signed off unless you are aboard, and I certainly was abroad, and I felt like I was a leader. I was on one of the statewide steering committees for V-QUEST. I was involved in the leadership component of V-QUEST, and we also were identified by V-QUEST as one of the, I think six sites, [Pleasant County] was one of the six sites in Virginia which they felt had all six, I believe it was six components, in place as far as the restructuring, but the six components were not in place in all school divisions that were participating in V-QUEST, but in some sites they were, and we were identified as one of those sites where most of those components were in place are being put in place.

Interviewer: Did you do anything in particular to encourage the middle schools to participate?

Superintendent of Schools: Well, simply meeting with Principals, identifying teachers that were interested and motivated to participate as lead teachers in the training. Ah, and provided support and assistance for those that would be willing to do that.

Interviewer: . . .who was responsible for the selection of the lead teachers, just focusing on [Pleasant] Middle School did you play a role in selecting those teachers?

Superintendent of Schools: Well, we approved recommendations made by the Principal. (p. 5-6)

The grant written with Radford University that the Superintendent of Schools mentioned in this interview was part of the Preservice Inservice Component of V-QUEST and not the Lead Teacher Component. The State Department's Principal Specialist K-8

discussed this grant in her interview while explaining how the State provided technical assistance for mathematics teachers saying:

Well, [Pleasant County] was involved in V-QUEST in several ways. Obviously Lead teachers, and they were also involved with the Preservice Inservice Component working with Radford. Ah, [Pleasant County] was also involved back in the early '90s doing some work with restructuring ah, elementary schools. While we did not give them a demonstration grant, they did ah, receive some money from the Preservice Inservice grant at Radford, some money to help build up their Math Science Technology School-within-a-School program, and [Pleasant County] receives their share of the State funds and federal funds just as everyone else. (p. 10)

Pleasant County's former Director of Secondary Education and Coordinator of the Gifted Programs (DSE/G) also talked about this School-within-a-School program as she described her job related responsibilities in the interview exchange that follows:

. . .in the last five years that I was there things broadened a little bit, and my position was defined more as Director of Secondary Ed and Coordinator of Gifted Programs. So middle schools were kind of in the secondary category, so I sort of worked across subject areas at that point, and then we developed a department that was kind of unique to that, well to public schools which was Research Development and Technology. . . .and so the primary responsibility of that department was to sponsor new programs and get them initiated, and at that point we were working K-12, and the most notable project that took the attention of that department in the later part of my tenure there in [Pleasant County] was the development of the demonstration school at [Duncan] Elementary. The other really significant project that again was most recent in history was the work of the Futures Task Force to kind of gather information about what had been occurring nationally in terms of standards development across the curricular areas and in trying to kind of look at what future projections might be, and that was ground work that was going to be laid for helping the County look at all kinds of building projects or whatever else might develop that would effect schools in [Pleasant County] with the idea of systemic change.

Interviewer: Did you have a role with getting the County involved with the V-QUEST Systemic Reform movement?

DSE/G: Yes, sort of almost after the fact, but once V-QUEST was in motion. I was involved and our whole department because again that was a

responsibility of that Department of ah, Research and Development was to sponsor new programs and the V-QUEST Lead Teacher program was seen as a new movement.

Interviewer: Do you think that the need for mathematics reform influenced getting involved in that program?

DSE/G: Yes, I think it did. I think that one of the real policies that the school board was interested in, at that point, was reforming science, math and technology. I think that was one of the reasons that they wanted that particular department developed that, although it worked across curriculum areas, I think there was always a kind of real emphasis on science, math and technology and those three things were always referred to together; they were like a triplet.

Interviewer: Do you know who made the decision; was the decision a collective decision?

DSE/G: I really think it was. I think being that it seemed to be part of a national movement and the standards that had been developed by the National Council of Teachers of Mathematics, I think, even before the Science Standards, kind of led us in that direction. It wasn't other areas that we didn't want to focus on them, but we had some standards and so forth to base staff development on.

Interviewer: Do you think there was any particular reason for choosing the two middle schools to participate in the first year of the V-QUEST training, the lead teacher part of the training?

DSE/G: Right, I think the two things, if I'm recalling, is the two things that made us feel the middle schools might be the place to begin is that we did have defined mathematics and science departments there, and we felt that we had people that were organized in such away in terms of team structure within the schools to be able to follow-up and take advantage of some of the knowledge and training that would be available in V-QUEST, and they would have the structures to support that during the year which might not have already been there at the elementary level and would have to be developed. The administrative support seemed to be pretty strong at the middle schools already for wanting to get involved in this, so we felt teachers would not be just dropped back there without any kind of collegial support or administrative support. . . .the Principals filled out the lengthy application form. Now, when we were looking at criteria for selecting lead teachers I

think that was a joint decision between, really it involved my discussing that with the Principals, if I remember correctly. One of the catch 22 things. . . what happened was that sometimes we couldn't go by just looking at the criteria, now that happen to us more at the elementary level than at the middle school level, but we had to go with finding who might be available to attend the workshops during the summer. (p. 2-4)

Pleasant County's Director of New Initiatives indicated that the County administration supported the V-QUEST reform movement stating the following:

Well they [County administrators] were willing to support the V-QUEST project, and in fact they made a five year commitment. . .They are certainly willing to commit the Eisenhower money to that kind of thing. (p. 20)

The County's Associate Superintendent described her job responsibilities and her involvement in the V-QUEST Lead Teacher program in the following statements:

Interviewer: With your curriculum role, what responsibilities do you have for the mathematics instruction at the middle school level?

Associate Superintendent: My role basically is to oversee the coordinators of those programs so that every decision that's made eventually funnels back through my office. Ah, at the decision level.

Interviewer: Did you play any role in getting the County involved with the V-QUEST Systemic Reform movement?

Associate Superintendent: Ah, I was aware of that whole process as it evolved as it related to this office through other coordinators and supervisors, yes.

Interviewer: Do you think the need for mathematics reform played a role in getting involved in this program?

Associate Superintendent: Yes.

Interviewer: Were there any particular reasons that you know of that the two middle schools were selected to begin the training?

Associate Superintendent: These are my thoughts. I think we began to see a real need for a program that funneled children through into the high school so that they come out at the other end with like skills. We were afraid that we were going to begin to see too much fragmentation because of differences in programs, and we wanted youngsters coming out of the middle school with similar skills because they are all going into one high school program, and we knew that teachers still needed the flexibility of using their own initiatives and trying new strategies, but we felt that the parameters of the programs had

to be more clear cut. . . . There were discussions with the Principals, and direction given as we began to look at V-QUEST, and we encouraged the middle schools both to become involved in that program.

Interviewer: Did you play any role in the selection of the lead teachers from these schools?

Associate Superintendent: That was done collaboratively between the coordinators and supervisors and the Principals of the schools. (p. 2-3)

The Principal of Pleasant Middle School during the 1992-93 school year provided the following recollections about the initial involvement with the V-QUEST Lead Teacher Program and about the selection of lead teachers. The Principal's interview exchange follows:

I'm trying to remember now. I know I attended some of the early meetings, but I can't remember if the decision had been made prior to me coming on board or if it was one, I think I had done some preliminary reading on it, and talked with ah [Director of Secondary Education and Coordinator of the Gifted Programs], and told her I was real interested in it, and I think from there we kind of started looking at it. I'm trying to go back in my memory. I probably had some initial input. I **know** that I had the opportunity to pick the teachers that were going to be lead teachers. So yeah, I'd say I had, the more I think about it, I had a great deal of involvement. **Lots of paper work.**

Interviewer: Do you think there was a reason that the middle schools were selected to participate in the first experience?

Former Principal: I think there was a real concern. My concern, if I remember correctly, this came about towards the end of the second year I was there ah, the concerns that I had— still a very traditional approach to the math and science still a lot of lecture. It wasn't student involvement very limited hands on. The science equipment that was there was less than current ah, the math again was very traditional approach to doing business. Very clearly defined, these are the SOLs and that's what we did, and we didn't do anything else.

Interviewer: Ah, You said that you were the person that selected the lead teacher representatives, is there any particular reason that you selected the two folks that you did?

Former Principal: Leadership, the two people I selected were ones that I felt were the most willing to accept change, were willing to put in the extra time



that it was going to require. They were both ones that through conversations you could tell that they weren't real satisfied with what was going on currently. So, those things entered into it. It was discussion with people at the central office as to who might be best in that building as far as lead teachers went. I don't regret for one minute the selections that were made. (p. 3-4)

Comments from the middle school's two lead teachers complete this section of data about the initiation of the V-QUEST Lead Teacher movement and the County's involvement. When the Science Lead teacher was asked if she had volunteered for the job or was selected, and her response follows:

Our Principal asked [the eighth mathematics teacher] and myself in the office, and we thought we were in trouble, that a parent had called or something, and he sat down and explained what the program was, and that we were to represent our school, and that we couldn't wiggle out of it— at **all**, and that we **had** to say **yes**. . . . We were told that we were going to Williamsburg, and that there would be a lot of time to shop at the Pottery, and we did not go to Williamsburg. We went in the opposite direction, and we were told that it would last five years, and that we would have to come back and share whatever we had learned with the other teachers, and we did not go to Williamsburg, and we did not do a lot of shopping. No, we were not allowed to wiggle out of it or say no thank you at all. (p. 5-6)

The mathematics lead teacher's recollection of being selected as a V-QUEST teacher was similar to the science lead teacher's, and his comments follow:

Well, [the Principal] called us, the science teacher and me, to the office, and **told** us that we would be representing [Pleasant] Middle School in the V-QUEST Lead Teacher training program. He told us that we would be going to Williamsburg for two weeks and made it sound like that we would have a lot of free time to do fun things. **HA!** He also said that it would be a five year commitment, and that we would be expected to do a lot of extra work and share what we learned with the rest of the faculty. He **wouldn't** take **no** for an answer, and he said he was counting on us to go and do this for the school. So I did. (p. 1)

The State, Division and School Level interview data provide evidence that all three levels were aware of the need for reform in mathematics education, and that the NCTM *Standards* had provided a direction and a focus for reform initiatives. Obviously for the seven components of the V-QUEST reform movement to be implemented in the summer of

1993 work on the grant proposal had to have begun at least a year in advance. Therefore, at the State Level in 1991-92 and 1992-93 there was action taken to initiate and lead a reform effort not just in mathematics education but in Science, Mathematics and Technology together. Another significant feature of the reform effort was the method of reform; there was a great deal of importance placed on training the teachers to implement the reform at the local level therefore, there was commitment from all three Levels Building, Division and State. Never before had all three levels joined forces in such a unique joint effort to change educational practice. The data from the Division and Building Level interviews indicate that there was support for participation in the lead teacher Training program and that they had made a five year commitment to the program.

In the summer of 1993 the lead teachers attended their two-week Lead Teacher Institute in Clinch Valley. A description of the lead teacher component of V-QUEST and its goals was provided in Chapter I, but a brief summary of the two-week institute at Clinch Valley is presented before the teachers' and Principal's interview data related to this experience is shared. The Clinch Valley institute started on Sunday, July 18, 1993, and lasted until Friday July 30, 1993, and as stated in the V-QUEST Lead Teach Institute Information Sheet the summer institute focused on the following topics:

1. Leadership
2. Mathematics and Science Pedagogy
3. Mathematics and Science Content
4. Integration of Mathematics and Science

The lead teachers spent six hours each day in sessions related to the those topics Monday through Friday, and during the second week their Principal participated in the two days designated for Principals and Central Administrators. The Principal arrived on Tuesday evening and attended a two hour session that provided an overview of the lead teacher program, a schedule of events for Wednesday and Thursday, and an overview of the Administrative Component. The culminating activity for the teachers and their Principals on Thursday afternoon was to brainstorm ideas about what needed to be done to reform instructional practices at their school and then write a set of Goals and delineate specific tasks to accomplish those goals. The documents that resulted from the work of Pleasant Middle School's two lead teachers and their Principal were provided by the science lead teacher. There were five documents in this set of artifacts all titled Lead Teacher Roles & Responsibilities, and each document had a given Function which left the Goal and Task portion of the document for the lead teachers and Principal team to complete. The five functions were (1) Curriculum Design, (2) Curriculum. (3) Staff Development, (4)

Materials and Equipment, and (5) Other. Following are goals and related tasks that resulted from this group's brainstorming session:

#### Lead Teacher Roles and Responsibilities

Function: Curriculum Design

Goal: Math and Science integration

Specific Tasks:

1. Coordinate activities by grade level so activities are not repeated.
2. The elementary schools and the two middle schools need to work together to coordinate curriculum.
3. Model the integration of math and science in our own settings.

#### Lead Teacher Roles and Responsibilities

Function: Curriculum Content

Goal: Hands on, Minds on

Specific Tasks:

1. Integrate Math and Science with home, school and community.
2. Develop a plan to promote this hands-on minds-on instruction

#### Lead Teacher Roles and Responsibilities

Function: Staff Development

Goal: Disseminate Information to math and science teachers

Specific Tasks:

1. Introduce V-QUEST teachers to the School Board as Lead Teachers backed by the administrators in order to request funds and release time for planning and implementing staff development.
2. Invite knowledgeable guest speakers for workshops.
3. Encourage teachers to visit and observe other schools or teachers.
4. Encourage teachers to attend math and science conferences.
5. Conduct workshops on integrating math and science.

#### Lead Teacher Roles and Responsibilities

Function: Materials and Equipment

Goal: Improve Technology

Specific Tasks:

1. VA-PEN— dedicated phone lines for modems in each classroom.

2. Develop business partnerships.
3. Investigate sharing of Community College and University resources.
4. Use mobile unit to transport materials and equipment between schools.

### Lead Teacher Roles and Responsibilities

Function: Other

Goal: Promote enthusiasm

Specific Tasks:

1. Be a model.
2. Be a resource person.
3. Plan and present inservice.
4. Get a copy of V-QUEST's application for other elementary schools.
5. Use the newspaper/publicity.
6. Use the "blow up the Superintendent" activity to introduce Lead Teachers to the board.
7. Be child oriented.
8. Need release time to plan.
9. Get open communication with all [Pleasant] County Schools and make presentations.
10. County wide Awareness.
11. Set an August Meeting.
12. Do a needs assessment and inventory.

The following interview exchange from the former Principal's interview data provided his recollections of that experience as follows:

Interviewer: Your lead teachers participated in their first two week institute during the summer of 93, and during this time Principals were expected to participate in two days of activities and inservice, as the Principal of [Pleasant] Middle School did you attend this V-QUEST institute?

Former Principal: Yes I did, Clinch Valley. . . .Number one it's the first time I'd ever been to Cinch Valley in my life so that was an experience in itself. Not knowing the housing accommodations that had been provided for the faculty members we were put at the Holiday Inn and I can remember showing up that first day, and thought that I was going to be lynched

probably when they found out that I was staying at the Holiday Inn, with air conditioning, decent food and all that good stuff. What I saw was two people worn out, exhausted, but excited. They couldn't stop talking. It was like, Mr. [Principal's name] we got to hit you with all this stuff here's this and this and this. It was really one of those things, I don't see it very often in the position that I've got, but something took place in that two weeks, and teachers, again, were just really charged and just couldn't wait to get going. I know when we meet with the entire group from [Pleasant] County it was just, a real; a real strange feeling. It just was that thing you could tell, yeah people were exhausted they'd been through an awful lot, nerves were on edge, but at the same time they were really excited about what was going on.

Interviewer: Did you all work on any plans together for improving mathematics and science instruction while you were there?

Former Principal: One of the first things probably we did was we started talking about OK what do we need as a school, what are the needs that are going to address the most kids? We realized we needed more hands-on equipment, materials. It was going to be a thing of having to come back, and I reckon select and choose the teachers that we targeted knowing that there were going to be some strong resistance. It was a thing of coming back and making a plan to inventory everything and get a feel for what we did need. So a lot, I won't say a lot, but what money I could free up were targeted for math and science instruction. (p. 5-6)

Although not quite as detailed, the science lead teacher's comments about her two weeks at V-QUEST in Clinch Valley contained the same enthusiasm for the experience. The science lead teacher's statement follows:

It [V-QUEST] made me feel better about what I was already doing, cause I was doing a lot of hands-on things, but the enthusiasm and the spirit of V-QUEST has been so positive, and it had been wonderful to meet everyone at these different conventions, and it was just so exciting to see our friends, particularly in the Clinch Valley Middle school group. . . . Meeting those people was just one of the most positive things that have happened to me. . . . and [named two V-QUEST instructors], and all of them. They continue to stay in touch with us. We can call them night or day and ask them any questions at all, and they send us activities, or they answer our questions. You know if we say we are having a hard time, how should we handle this? They are marvelous, absolutely marvelous. (p. 6)

The mathematics lead teacher stated the following:

—I'll tell you the biggest thing that came out of V-QUEST was it said to me hey XXX you are actually doing what you are suppose to do! Feel **good** about it. I always felt bad that I wasn't (trails off) So, it made me more confident. (p. 7)

V-QUEST was a positive experience for everyone involved. The lead teachers and their Principal worked together to made plans for what they were going to do to promote reform of mathematics and science instruction. The State and the County provided the opportunity for the teachers and Principal to participate, and the administration promoted and supported the reforms encouraged by the V-QUEST project. The NCTM *Standards* provided the guidance for instructional reform and V-QUEST was the vehicle.

#### Documenting and Tracking Change in 1993-94

This next set of data focuses on new reform initiatives for the 1993-94 school year, and tracks the progress of the following reform initiatives: organization of instructional teams, use of interdisciplinary instructional units, Mathematics Core Curriculum, instructional schedule, use of technology, instructional materials, site-based management, restructuring of the middle school and administrative support for reform.

Three major changes occurred during the 1993-94 school year that were pertinent to the reform of mathematics education, and this section will provide evidence to document those changes. First, details concerning mathematics curriculum changes at the State Level will be presented. Second, documentation of Division level changes related to the V-QUEST Lead Teacher reform movement are presented, and third change data pertinent to school level reform initiatives are presented. Change data at the school level include details of the activities of the two V-QUEST Lead Teachers, and the replacement of *Addison-Wesley* instructional materials by the newly adopted and purchased *Glencoe* instructional materials. Interview and artifact data are use to document the use of these materials, the method(s) of instruction promoted by and the mathematical content included in these instructional materials. An analysis of *Glencoe*'s mathematics instructional materials' provided information about recommended methods of instruction, curriculum content and theories of learning. *Glencoe*'s analysis results are compared to the *Addison-Wesley* instructional material's analysis results to document any changes in mathematics lessons, content, or methods of instruction. Finally, data related to tracking the change initiatives already in progress will be presented.

#### Documenting and Tracking Change at the State Level 1993-94.

While discussing the rewriting of the state's SOLs, the State Department's Principal Specialist K-8 provided information that indicated the Common Core of Learning Curriculum proposal was quietly withdrawn by its sponsor, Governor Wilder, during 1993. This meant that during the 1993-94 school year the 1988 SOLs were the state's mandated mathematics curriculum, and although the County had designed a new curriculum based on the NCTM *Standards* and the Common Core of Learning, the teachers were mandated to teach the state's 1988 SOLs that were still being assessed by the State's Literacy Passport Test and the nationally normed ITBS standardized test.

The State Department's Principal Specialist K-8 comment about the demise of the Common Core of Learning presented earlier provides evidence that in 1993-94 the State was committed to rewriting the Standards of Learning. In those comments she explained the process that the State used for rewriting the SOLs as follows:

. . . it was felt that the Common Core was being developed here at the Department, and so we wanted to get away from that image, and so what we did was we ah, put it out to school divisions to develop, and so therefore, Fairfax was selected as the school division to develop the Math Standards of Learning, ah, and then they went out requested from other school divisions help to develop these SOLs, and about thirty other divisions participated, and participation meant that they sent some of their teachers to participate in the writing. Now [name] who is the ah, Principal Specialist for Secondary Math was the one person from the Department selected to work on that project, and so that project began in the summer, the summer of let's see, what was that about ah, '94, yeah the summer of '94. (p. 2)

The Principal Specialist K-8 described how the participants for the collaborative writing committee were selected and organized:

. . . at the department ah, we were asked to make, the people here were asked to make recommendations of who they would like for the leadership of this, and of course we made recommendations based on what we had seen in terms of the curriculums they already have in place. So, we wanted to get to ah, school division who had something that was already aligned or making progress towards the NCTM *Standards* ah, to head up the math, and Fairfax had a curriculum that they had been revising that implemented all the ideas, the problem solving, and the communication, the reasoning skills and the connections, and there were others we recommended, but Fairfax did accept.

Well first of all um, let's see we would have to go over that, I think, a letter did go out to, from the Superintendent, asking school divisions if they

were interested in participating as a leader for the project, but of course we had also told the Superintendent who we thought would be a good leader. So, I mean, I'm sure the Superintendent called the school division's Superintendent and nudged them on saying we [laughs as she says this] need your leadership here because we want the best product. Obviously the small school divisions who do not have like specific math specialist, they couldn't lead that kind of project. We had to go to a school division who had the resources, and you know who already had been involved in the process themselves. Curriculum development, or standards development is a big project, and so we needed a school division that had some resources. So, if you think about the four school divisions that got them, which was ah, Fairfax, Prince William, Newport News and Virginia Beach, I mean they are big school divisions which have lots of resources. You couldn't get like a Hopewell to deliver. It just isn't, or [Pleasant] I mean it's too small. . . .

. . .and so of course teachers were selected. We came up with a list of people, like who had won the presidential awards, people who had been nominated for those presidential awards in math and science. People who had, you know, started off with lead-teacher projects, people who had identified themselves already as teacher leaders. Maybe serving on VCTM or on the Board, or people who had spoken recently so, we combed through all those kinds of things to identify possible teachers to, even though I think people volunteered, you know there had to be some kind of match. You can't take a volunteer who hasn't been doing anything. You know you want to take someone you know who is current on issues in math education and you would look to those kind of indicators as to someone who was current. (p. 5-6)

They kicked that off up at Graves Mountain Lodge, and they worked for about a week on writing the curriculum. I'm sure they were given, [Principal Specialist for Secondary Math] probably gave them an overview, Ah, we dealt, she was very instrumental here in the Department in making them move to a grade level model rather than a set of grades like the NCTM *Standards* are set up on with a K-4, you know 5-8; 6-12, which is how the Common Core was going there were standards associated with each Common Core. You know, it was going to be a range k-4, anyway she was insistent, and I know like the Science people were very opposed to that, but the end result was all four sets of standards were written at grade levels so



we have k-8 grade level standards, and they had teachers from those grades working on this. They had ah, team leaders for ranges of grades as I understood it, and they produced the document, and they produced a draft which then went out to lots of educators, NCTM, VCTM members, ah, the math leadership in the State, and a variety of other people for their input. . . . (p. 2-3)

The Principal Specialist for Mathematics (9-12) statements supported the time line and process described by the K-8 Principal Mathematics Specialist. Although the 9-12 Principal Specialist for mathematics would not provide any details about the withdrawal of the Common Core of Learning, she did provide the information that follows:

Well hum, the last time we wrote Standards was in 1988, and a lot of things have happened since 1988, and ah, the NCTM *Standards* came out , we've had some ah, state studies that we've conducted, and also the role of technology has changed in mathematics. I don't think that anyone disagreed that it was time for an update. [Laughs in the last part of this.]

Interviewer: And that decisions was made about two years ago, is that right?

Principal Specialist for Mathematics 9-12: It was made in 1994 soon after Dr. Boser came into office. (p. 2)

Her description of the SOL rewriting processes follows:

It was back in April and May of 1994 that we really started serious discussions about revising the Standards. In April we contacted all the school divisions in Virginia to see who would want to lead a revision process in each of the four core disciplines. In May we selected, what we called, a lead school division to lead the process, to manage the process, but to involve people statewide to make sure the various organizations and special interest groups were involved in the process. So, in May we contracted with school divisions to lead the process, and in June and July, a planning committee in mathematics was convened that consisted of representatives from the school divisions who said they were willing to lead the process, but weren't chosen to lead the process. Fairfax County was chosen as the lead school division, but Fairfax chose to involve all those who expressed a desire to be involved in the process so, from there we went from a planning committee of a small group to a larger group of teachers in July who came together for four days to revise the 1988 Standards of Learning. (p. 2-3)

As the State Level administrators' interview data indicated, Fairfax County was given the leadership responsibility for overseeing the process of rewriting the state's SOLs,

and the Mathematics Coordinator for Fairfax County took that leadership role. He provided an overview of that task in the comment that follows:

Ah, Fairfax was as you know the SOLs were farmed out to different school districts and Fairfax was given the responsibility for leading the development of the mathematics SOLs. So myself and [name] who is the Director for Planning in Fairfax County were assigned to head that task. So we coordinated the effort. We invited people to sit in on the writing teams to participate in the project at different levels. We organized the meetings we did the editing the whole schmear. (p. 2)

He also provided details concerning the process:

In the very beginning the State sent out a survey to all the school districts, and they gave them a choice of participating in the process in one of two ways: they could either try and lead a project, or they could just work on a project, and what we did, we invited all of those school districts that said they were interested in mathematics to send us a person. If it was a school district that said they wanted to work on the project, we asked them to send us a teacher to work on a writing team. If it was a district that said they wanted to help lead the project, we ask them to send us a person who would serve as a team leader, and then we went back and we reinvited every other school district in the State to give them a second chance, and we had something like ah, you know the numbers probably not going to be right, but fifty-five or fifty-six different school divisions that actually sent us a person to work on a project, and it was really spread out all over the State. We had a map once so, we put little pins in it to show where the people came from, and it was a very wide, wide spread ah, and bigger districts did not get anymore people than smaller districts. Like Fairfax County had one teacher. (p. 7)

. . . it was at least two and a half years ago, and maybe even more that, but every school district in the State of Virginia was given an opportunity to express an interest in working on this project. We invited all of those school districts to send us a teacher to serve on a writing team. Ah, sometime in the spring, and you're going to have to go back and look at calendars because I think it was really like a two-full-year process, but in the spring of one year we held a number of meetings with interested groups, community groups, teacher organizations, professional organizations and the like, just to get initial recommendations for what these standards ought to look like.

We had Jim Gates from the National Council of Teachers of Mathematics address the group. We had Jack Davis who was the Superintendent of schools in Virginia when the first SOLs were developed also address the group, then we went in the summer, that summer we took the teachers from all of these districts that they sent us, and went away for a week to a mountain top, on top of Grave's Mountain. Split these folks into different writing teams. There was a K-2 writing team, a 3-5 writing team, a 6-8 writing team, and then a high school writing team, and they were given copies of the old SOLs ah, the National Standards of Mathematics, ah a number of other states' Standards, and they had a team leader who also was from one of the participating districts, and they wrote a first draft of the Standards of Learning. —I didn't do any of the initial writing. I more or less went from group to group and played devil's advocate and had them write although I was involved in the revision writing. (p. 3)

The teacher participant in this study, who was an Appalachia Educational Laboratories (AEL) Training Team Leader for the region that included Pleasant County and who participated in writing the revisions for the state's Standards of Learning, provided the following information concerning her involvement in the SOLs revision process. She described how she got involved in writing the SOL revisions in the following comment:

Recommendations were made to the State Department. The State Department contacted each of the school divisions if they knew someone who had been very actively involved that they felt like would, you know, be a good writer, ah would certainly be an asset to the team. They called the school divisions, and they discussed this with someone from the school division personnel or Superintendent, or Superintendent's assistant. It varied from division to division and ah, they asked these people to apply. Now I'm not sure how many people were asked in each school division ah, once the school division said yes they were interested in being involved in the process then recommendations of a writer was given to the school or school division's selected a person, if there wasn't someone that they knew or had worked with, and I do know that I was recommended. I don't know who from, but my name was mentioned to the people at my school division, and I was the only person, they called me and asked me to do it, and I do know that was the only person from my division that was asked to do this, and any school division that agreed to participate they did select a person from that division. (p. 8)

The AEL Team Leader provided an overview of the process in which she participated:

. . . we spent a week at a lodge with no television, no telephones, (laughs) working from very early morning to late in the evening discussing, agonizing and ah, what I think was a really really good piece of work. . . . (p. 4)

Ah, well there, in each group, ah now the secondary I'm not just exactly sure how many people there were because of the different subject areas. For the middle school there were ah, about fifteen people most of these people had a specific grade level area of expertise, had extensive experience in teaching that grade level. Almost each of the grade levels there were probably three or four people that, that was their area of expertise. There were three or four fifth grade, three or four sixth grade, three or four, I believe maybe three seventh grade, and I believe three eight grade teachers. They had ah, a lot of experience, and I remember ah [named a participant] commented that the number of years teaching experience collectively with the whole writing team including elementary, middle and secondary was something like two hundred and fifty years. [Laughs] So there was a lot of experienced people with a number of years teaching experience, and most of these people were considered leaders in mathematics in their school division. There was a cross section of people from the State. There were people from the Southwest, from the Central, from South Side, ah, the Eastern Shore, Virginia Beach area and Northern Virginia. Ah, there was a real cross section of people there with different socio-economic conditions in their school areas, some from very affluent school divisions, some from real struggling school divisions so, it was a real cross section representation.

In the middle school we looked at the NCTM *Standards* as our base line and we also looked at the old the '88 Standards of Learning. We looked to see how well these correlated ah, what the NCTM *Standards* suggested as appropriate for that grade level, and I think the NCTM *Standards* were pretty much accepted as the guideline or the base line for each of the areas, the elementary, middle and the secondary. Ah, and we took each one of those and looked at them, after we came up with the strands that we wanted ah, and this was one that was discussed a lot with the elementary and the middle were the strands that we wanted to look at, and then we looked at how the '88 Standards fit into those strands. One of the things that we looked at rather than doing ah a separate strand for problem solving— this was a lot,

we had a lot of discussion about the problem solving, because it tended to be taught as an isolated skill in the past, and not just through the standards, but in classroom practice most of us had observed this. Most of us had done it ourselves you know we had not ah I guess done as good a job as we should embedding problem solving into every lesson or every instructional plan that we had, and so this is one of the things that we talked about, and so we went back and looked at problem solving, making connections and communication.

This was another thing that we looked at very carefully was the communication and ah, the way that ah, teachers communicated ideas to students very often would be misleading, and ah, the vocabulary that was used, it was not consistent, and that was one of the things that we wanted to at ah, the communication was the consistency of vocabulary to be sure that everybody was calling everything by the same name, and ah, because that's very confusing to students, and this was one of the things that we hear very often: that ah, in elementary school there was not a lot of correct vocabulary being used and students come to the middle school, and when they do begin to hear more of a mathematics language being used, ah, they were confused, and they, ah, once they would see they'd oh, you mean so and so. So this is one of the things that we looked at we wanted to be sure that the language the mathematics language was consistent across all three areas. And ah, we made a comparison, and we looked at what was in the old that was good. You know, we didn't throw out the baby with the bath water. We looked, we took all of the things that we thought were good, pulled those out and then expanded or moved them around or incorporated them, and again the language, we did change some of the language to what we felt was more appropriate.

Ah, after all of this was done with five through eight, then we meet the K-four people. We looked to see how these, ah, what the fit was. Is there a good transition as we're going from grade to grade? And then from the elementary to the middle school, and then after we did that, then we meet with the secondary teachers, ah we looked to see what, how the fit was there if there was a good transition. If they were getting all these basic things that they were going to need to be able to be successful when they went into their algebra, their trig, their calculus, and so forth. And then after doing this we found out all our mistakes we sent back, and we went back through each of

these, and we did some rewriting and did a lot of brain storming and ah, bounced a lot of ideas off of [Principal Specialist for Mathematics] who was real helpful very helpful. She didn't give any opinions. She was just, when we asked she would respond to our comments.

Interviewer: Was she involved in the writing?

AEL Team Leader: No she was there as an advisor only. [Mathematics Coordinator for Fairfax County] was real involved, and he was really good with the middle school. Ah, we did a lot of discussion with him, and particularly in making this smooth transition from elementary to middle. This seemed to be one of the real big, because a lot of things, we felt like we made suggestions and things that needed to be moved from one grade level to another to be able to have a little more cohesiveness in the transition, and some of the things, and we did move some skills down from middle school to elementary— not a lot. We moved within the middle school, we moved some of those skills around, but not a lot, but some and ah, then we moved a few things up. A couple of things that were in seventh grade we felt like it was a better fit with eighth grade just couple, you know, not anything real major, but, you know, just a few little moves like that to make a little smoother transition. . . . the writing was the summer of ninety four. . . (p. 5-8)

#### Documenting and Tracking Change at the Division Level in 1993-94

In the 1993-94 there was a move from *Cooperative Discipline* method of classroom management to Glasser's *Quality Schools*, and at the beginning of the school year a *Quality Schools* book had been purchased and given to each middle school teacher. Teachers were instructed to read the first three chapters, and they were assigned to small groups for the purpose of discussing what they read. These discussions were scheduled to take place after school once a week for a month. After the teachers had read and discussed those first three chapters, any further participation in the program was suppose to be on a volunteer sign-up bases, and in the spring of 1994 training in Glasser's *Realty Theory* was offered for the County's teachers.

In reference to the move to Glasser's *Quality Schools* method of classroom management the mathematics lead teacher stated the following:

We were told to get on board **or get out**, so we read the book. We **signed** the contract! We have **discussed** the book, and we are continuing to discuss

it. . . It's wonderful, I read it when it was first given to us, and I agree with most of what he [Glasser] says, but not everything. (p. 8)

When the female sixth grade mathematics teacher was asked if she was trained in *Quality Schools*, she said:

No, we read the first three chapters, and after that we weren't required to read anything else, and I didn't. (p. 13)

The male sixth grade teacher stated:

. . . I haven't gone through the *Quality Schools*, and that is only because the class they had was filled, and I had signed up for it, and [pleasant middle school Principal] asked if I could do it later, because they needed the space for some other people, and I said sure. (p. 25)

The female eighth grade mathematics teacher indicated that she participated in the *Quality Schools* training during the summer of 1995, and the two seventh grade mathematics teacher made no reference to the *Quality Schools* program, but the interview data supports that the *Quality Schools* program was introduced into Pleasant Middle School during the 1993-94 school year.

The Superintendent referred to the *Quality Schools* training in his interview while talking about reform and budget matters saying:

For example the *Quality Schools* training that we're putting teachers through— how many teachers per year will go through this program because it's a certain cost per person. We have to estimate how many we'll have and build that into the budget, and we do that not only for *Quality Schools*. (p. 14)

When the Superintendent was asked if the County maintained a professional library for the teachers, his response contained a reference to the *Quality Schools* books purchased for the teachers. His response follows:

No, we depend on our librarians, and the requests that come to them for materials, for them to get together and decide what they need. [Named the Director of New Initiatives] helps us with that, and occasionally we will ah, we will order materials such as *Quality Schools*, pay for it and send it out to the faculty, and ask that they read it, discuss it, as it fits into a division goal. (p. 17)

The Coordinator of Elementary and Middle School Instructional Programs wrote in the middle school's restructuring proposal that the restructured middle school program was consistent with County's continuing efforts to improve schools. She listed seven improvement efforts in which the County was participating, and number seven on that list

was the *Quality Schools* program. The presentation of this restructuring plan to the school board included a reference to staff development in Glasser's *Realty Therapy* in the spring of 1994 being continued into the spring of 1995. These artifact and interview data substantiate that the *Quality Schools* program was introduced into the school system during the 1993-94 school year with the support and leadership of the County administration.

#### V-QUEST Lead Teacher Activities at the Division and State Level

The lead teachers and their Principal developed a plan for implementing reform at their school, and the first step of that plan was enlisting the School Board's support. The objectives were to inform the School Board of V-QUEST's reform initiatives and to promote the V-QUEST Lead Teachers as change agents for this reform movement. Although funds were appropriated for release time for the lead teachers to work together to plan and implement reform initiatives, there was no evidence to support that a presentation was ever made to the School Board. The only newspaper article found related to V-QUEST was titled "Five [Pleasant] County Schools and 20 teachers participate in V-QUEST Lead Teacher Institute". But since release time was funded for the lead teachers and participation in the V-QUEST Lead Teacher Institute had been publicized indications were that the School Board, and the Division and School Level administrators all strongly supported the V-QUEST reform movement.

The Director of Secondary Education and Coordinator of the Gifted Programs had served as Pleasant County's administrative contact person for V-QUEST, but in 1993-94 she left the County to take a position with Virginia Tech and to serve as the Coordinator for the Administrative Component of the V-QUEST reform initiative. Therefore, in 1993-94 the Director of New Initiatives became the Division's V-QUEST contact person. One of the contact person's V-QUEST duties was to coordinate the lead teachers' monthly meetings, which were held at the School Board office. According to the Director of New Initiatives, the administration agreed to support the V-QUEST Lead Teachers for two days a month of release time, and these funds were appropriated for 1993-94 and 1994-95 school years (p. 20). Later in the interview she talked about what the lead teachers did with this release time as follows:

Interviewer: In your role as the V-QUEST contact person did you arrange any inservice or staff development utilizing your V-QUEST Lead Teachers?

Director of New Initiatives: We tried to have something once a month that first year and the second year [the Gifted Resource Teacher k-5] took it over and she also meet with them, not once a month but kind of—



Interviewer: When you would meet with them once a month was it for presentation of ideas or was it organizing, or just tell me a little bit about what you did.

Director of New Initiatives: Both, for instance one time we had, this was a science person, [named V-QUEST trainer], from Lynchburg County. You know, we did the one computer classroom thing, and different teachers tried to present what they were doing in the school, and help the other teachers give them materials and an idea of what they could be doing. (p. 21)

. . . a lot of them used one of their days, you know they'd use half a day a month to inventory their schools, you know, help order whatever. So, I think they did that as much as they provided inservice for their schools which is also a worth while service. . . I think that bringing the teachers together to work together was a great accomplishment, and I'm really sorry to that ah, it often takes that outside force to provide something like that. (p. 23)

While discussing with the former V-QUEST administrative contact the County's support of mathematics education reform, she was asked if the County funded release time for the lead teachers during the 1993-94 school year, and she stated:

Yes they did. They did finance that, and ah, yes, I was thinking more in terms of a specific professional development event, but they did buy time. That was one of the agreements that the County made and I think they probably, maybe, went a little bit further than some of the other districts might have gone, but the School Board actually did that. (p. 25)

The science lead teacher made the following remarks about the lead teacher meetings at the school board:

OK, so we didn't have money that year [1993-94] and the Principal and I ended up really chatting, and I think he really understood at the School Board meeting, when we were having those School Board office monthly meetings, I think he realized then that some of the site-based money was going to have to be appropriated for science. So the following year, which should be 94 [-95], that he gave us the money. . . (p. 12)

Later in the interview the science lead teacher talked about how the lead teachers were expected to be active participants in the reform initiative saying:

[Name of the Director of New Initiatives] held each one of us accountable for making a contribution to the County, and she, we had to give an inservice where we had to give some kind of information or something to our V-

QUEST group that met monthly, and she called me and asked what contribution I wanted to make Countywide? She had overheard that I would be interested in helping to solve the overlapping [curriculum] problem that has occurred since V-QUEST. In our County a lot of elementary teachers didn't do a lot of activities, and through that first year of V-QUEST they showed that [owl pellet] activity to elementary teachers as well as middle school teachers. So when our Pleasant County teachers came back in August everyone was doing owl pellets. Well if we did that, a student in our County could do owl pellets about six times and never do some of the other activities. So she gave me the green light. She wrote the letter to XXX in Lynchburg City and asked him to release [name of V-QUEST trainer] to come to our County for the day and [name of V-QUEST trainer] came down and brought her complete life's work in a box and gave it to us. (p. 16)

The science lead teacher summarized her experiences at the monthly lead teacher meetings in the following statement:

[The Director of New Initiatives] has been wonderful. [The Director of New Initiatives] definitely! She inherited the V-QUEST folks after [The Director of Secondary Education and Coordinator of the Gifted Programs] left . . . . Oh, she was wonderful. She had us met and her meetings were always organized, and she was very concise, and she held each one of us accountable, like I said before. . . . I think that was the beginning of year before last , when she first took over. . . . So she meet with us and said hello, I'm Mrs. [her name] and we're going through some restructuring and I'm your V-QUEST contact so here— you know, lets go to this convention. Who can go to this convention? Do you want to take the school bus van or do you want to take your own cars? She held each one of us accountable, and she had people come in to speak to us, and she was wonderful. She was always very supportive, like writing the letter to the person in the other County to release [the V-QUEST trainer] and Mrs.[her name] is wonderful, very supportive. (p. 33-34)

In answering a question about his involvement with local V-QUEST activities, the former Principal also talked about the monthly Lead Teacher meetings. He stated:

Lot of trying to get V-QUEST in front of the Board. A lot of meetings, still continuing to meet with the lead teachers throughout the County on a regular bases, once a month at the School Board office. Trying to keep that spirit

that was there at Clinch Valley alive. A lot of frustrations were starting to creep into it. . . . (p 8)

Artifact data to support that these meetings took place was limited, but some copies of Requests for Leave forms were found among the documents saved from the 1993-94 school year. The school's record keeping system consisted of putting all the documents from any given school year into a large box and labeling it with the school year. These boxes of documents contained every slip of paper from that school year about attendance, money transactions including the cafeteria's records, and copies of miscellaneous documents that went through the school's office. While searching through the 1993-94 documents, copies of requests for half-day leaves for V-QUEST were found for the mathematics and science lead teachers for the dates of Sept. 23, 1993, October 12, 1993, November 12 1993, January 27, 1994, and April 19, 1994. This does not necessarily mean that these were the only V-QUEST monthly meetings held that year, but these were the only months that documentation was found to verify that the lead teachers had requested substitutes to be out of the classroom for V-QUEST related activities. There were no other school of Division Level written records available for these meetings.

Part of the responsibilities of the V-QUEST Lead Teacher program were to sponsor one follow-up activity with the lead teachers for each month, and the lead teachers had a copy of this schedule. This Academic Year Calendar listed the months September through June and the lead teachers' and Principals' activities for each month. The schedule of events for the academic year of 1993-94 follows:

Academic Year Calendar

<u>Month</u>	<u>Lead Teachers</u>	<u>Principals</u>
September	Video and call-in	School Division Site Visits by V-QUEST Staff
October	One day regional meeting with other Lead Teachers (NE, SE, WEST)	School Division Site Visits by V-QUEST Staff
November	Two day VAST (science) conference in Williamsburg	
December	Video and Call-in	Audio-conference
January	Two day V-QUEST conference in Richmond	V-QUEST conference
February	Three day NCTM/VCTM (Math) conference in Richmond	NCTM Principal Sessions
March	Video and call-in	Audio-conference

April            One day regional meeting  
May             Video and call-in  
June            One week institute at Lynchburg    One day at Institute

(V-QUEST Lead Teacher, personal communication from V-QUEST August 1993)

These interview and artifact data provide evidence that the Pleasant County lead teachers were meeting as a group and that the purpose of those meetings was to share reform strategies and activities, and to provide a support group for reform. The lead teachers were expected to generate and share ideas, to be informed, and to work together to implement plans to accomplish instructional reform in the classrooms as well as help make and develop connections between the school and its community, parents and businesses. A speaker bureau was formed, and a list containing the names of people that would serve as publicity/information agents for the V-QUEST reform movement was provided to all the schools in the County; the Superintendent of Pleasant County Schools was at the top of the list. Again, the evidence indicates that the Pleasant County School System supported the goals of the V-QUEST reform initiative, and document the lead teachers' participation in the County's efforts to implement those reforms.

#### V-QUEST Lead Teacher Activities at the School Level

The story of Pleasant Middle School's lead teachers' reform efforts in their school will be told by the voices of the participants in the study and the artifact data as much as possible. Data presentation will begin with the former Principal's and lead teachers' comments about what their first actions were at Pleasant Middle School as lead teachers.

The former Principal provided the following information about the activities of his V-QUEST Lead Teachers:

One of the first things probably we did was we started talking about, OK what do we need as a school? What are the needs that are going to address the most kids? We realized we needed more hands-on— equipment materials. It was going to be a thing of having to. . .select and choose the teachers that we targeted knowing that there were going to be some strong resistance [sic]. It was a thing of . . . making a plan to inventory everything, and get a feel for what we did need. So a lot, I won't say a lot, but what moneys I could free up were targeted for math, science instruction. (p. 6)

The mathematics lead teacher described his initial activities with the following statement:

I did a needs assessment the first year after V-QUEST, and then we bought materials. I don't remember if I filled out the orders, or I told people that they had money, and they filled out the orders. I don't remember. (p. 4)

In the lead teacher interview he described the materials purchased in the following statement:

We bought materials. We were, I was able to convince the former administration that we needed money for materials, and he let us buy materials, and I tried to base it on the idea of kids' constructing their learning so I tried to do manipulatives and not books, not workbooks, not calculators. (p. 3)

The other eighth grade teacher had the math inventory of supplies and according to the mathematics lead teacher:

You will see most of the materials came in 1993-94 school year. That was because we had a Principal that really believed in manipulatives and the other Principal did not. (p. 4)

Among the 1993-94 school documents were purchase orders for mathematics supplies; some had the teachers' names and some had the teams' names and some just said math department, but following were the purchase orders that were found for that 1993-94 school year:

- 8/30/93 *Glencoe* textbooks \$5,467.60
- 12/10/93 The Math Learning Center \$252.00
- 12/10/93 Pattern blocks a class set, Pattern Blocks for the overhead and Rubber Bands \$252.00
- 1993 Think about it Math Word Problem Connection, Calculators and organizer, Dice 6 pairs \$96.25 (This was requested by the seventh grade teacher.)
- 1993 Jr. High Pattern Block Amazing Facts Series Middle Grades Math Project Kit 262.00 (This was requested by the seventh grade teacher)
- 1993 Calculator Math Beginner and Calculator Math Intermediate \$21. 90

These were requested by the sixth grade teacher

- 4/27/94 20 TI-108 calculators \$135.00
- 4/27/94 The math Learning Center \$40.00
- 1994 Teacher Created Materials *Thematic Units Challenge Learners* \$32.00
- 1994 class sets of Tangrams and Pentominoes, coin and bill set (cost was not provided) These were requested by a sixth grade Voyager team

Again, this is not an all inclusive list, but it is all the data that were available. It provides evidence that money was spent on mathematics manipulatives during the 1993-94

school year, and that this was a change of practice since there were no mathematics materials purchase orders found for the 1991-92 and 1992-93 school years.

The former V-QUEST administrative contact for Pleasant County talked about how the County's Eisenhower monies had been used to support the V-QUEST reform movement in 1993-94 before she left the position:

They dedicated a large portion of Eisenhower monies to ah, filling some inventory responses while I was there, and I don't really know what's gone on since, but I know at that particular time, I think it was, all but maybe ten percent of one year's Eisenhower money went toward having the people who had been trained as lead teachers submit an inventory of requests that, I think they had done an inventory and found some certain things that V-QUEST had recommended that be a part of a program that would encourage hands-on connection with science and math and so they did order some things. . . . (p. 19)

The mathematics lead teacher also started setting up a math resource room in the school for the mathematics teachers. When asked if the school had the NCTM *Standards* available for the teachers, the lead teacher made the following reply:

No, I made them available. Nobody uses them. . . .

Interviewer: Are they [NCTM *Standards*] in the library?

Mathematics Lead Teacher: No, they are in the math resource room that I set up. . . I bought them with my money, but I went to the people and said here they are. Here are the NCTM *Addenda*, that shows you how to teach the material. Use them. [The other eighth grade teacher] frowned and [a sixth grade teacher] said I don't need that stuff. (p. 11)

. . . Everything I get I make copies of and pass it on to the teachers. . . I have bought with my own money *AIMs* books and walked around and said look what I have. This is great. You might want to try it, and it was always, I don't need that stuff. . . So yes! I mean anything I get I pass on, on time. It either comes directly to me or [the Principal] passes it on. (p. 17)

Interviewer: Did you interact with other teachers in the building to improve mathematics instruction?

Mathematics Lead Teacher: Mr. [Sixth grade teacher] and Ms. [Sixth grade teacher] OK, yeah, yeah, sixth grade teachers are great. Seventh grade teachers hate me. Ms [eighth grade teacher] is resentful. Ms. [Seventh grade teacher] is real friendly to me, but I know she talks about me behind my

back. . . . Well, you know what they say? That I have [the Principal] in the palm of my hand. (p. 20)

Mathematics Lead Teacher: I tried. When I came back from V-QUEST; I was excited. This is reinforcement. I know these people are doing these things, but now I've got more activities and ideas that I can share with them. They were resentful.

Interviewer: Well, give me some examples of when you did get to share.

Mathematics Lead Teacher: Well, a bunch of times we just sit down and talk. Like with Mr. [Sixth grade teacher] we just sit down and talk about some math stuff, individually. I tried to do workshops, and I would send out a needs assessment, and I say OK— I would send out a note that we are going to try and have this workshop would you attend it? **NO**— so. (p. 21)

The former Principal described his faculty's response to the idea of V-QUEST stating:

[Pleasant] Middle School is a school that does not accept change, and does not want in some cases to change. Very comfortable with the status quo. Very comfortable with I've done it this way for years. It's worked before, and it will work again. So, there were deep pockets of resistance ah, there were some pockets of resentment that these two people were selected ah, that there wasn't a lot of faculty input on it. I made the decision , so I know that the two Lead teachers had some real battles, but they kept just chipping away at it, and you started seeing it creeping into the classroom, and I think it was the thing that, the good I saw out of the V-QUEST project, it wasn't really administrative pressure. It was more of a peer pressure, sometimes. It was hard to, to deny that good things were going on in their classrooms because you could see it. You could see it with the kids. You could see excitement. (p. 4)

While talking about goals that were set for mathematics reform, the former Principal stated that it wasn't math topics so much as it was math teachers that they targeted. His comment follows:

I don't know if we targeted any particular topic. It was more that thing that we targeted teachers. Ah, we targeted ones that we felt like were going to be receptive. I told the two Lead teachers that there was no use beating ourselves to death that we would target the [name of the other eighth grade mathematics teachers] that we would target the [name of the other eighth grade science teachers] that were willing to look at things differently, and I

think from that, and we targeted the Special Ed teachers because, I think they may be the one group that is most willing to make changes, and they're accustomed to it. So, we didn't target any one particular content thing,, but it was more the faculty that was going to be teaching it. (p. 18)

The next comments shared from the former Principal's interview show that he encouraged his lead teachers to act as leaders of reform. The interview exchange follows:

Math was never a subject that I enjoyed when I was in school, and to go in and watch the lead teacher in math and the techniques and the different things that were used. I suddenly found myself getting excited about math and realizing that it wasn't as foreign a language as I thought it was. There was a lot of good instruction. It was that thing of realizing that, I think as a profession too often we overlook the expertise that we have ah, we want to go outside and work in inservice when we've got the expertise right there in the County or in the building to provide that. . . . (p. 6)

Interviewer: Did your interests in the mathematics program and the mathematics lead teacher encourage him to make some changes and to try some new things in his classroom?

Former Principal: I hope it did. I hope it's that thing that again by encouraging teachers and in particular these two [V-QUEST Lead Teachers] to take risks that I wasn't going to chop their feet out from under them. I wasn't going to chop their head off is something didn't work. We would say, look at it ,and say, OK was there something we could have done to make this work or was it doomed from the word go. Ah, I think as a Principal you've got to provide that safety net. You've got to provide the atmosphere that encourages risk taking. We can't continue as a profession to do the same old junk that we've been doing for years. (p. 6)

When the mathematics lead teacher was asked if the Principal's involvement in V-QUEST had influenced the type of instructional practice that was encouraged in the classroom, he made the statement that follows:

Well see the first day that [former Principal's name] came into my classroom I could tell he would want you to do whatever you needed to do to teach math, but our old Principal was not that way and [new Principal's name] is not that much. . . . (p. 8)

There was a newspaper article clipping in the 1993-94 school scrapbook that described the mathematics lead teacher's recycling project. The title of the article from the local newspaper was [lead teacher's name] Recycles, and the article noted that he had accepted a challenge from VA PEN to recycle for six weeks then weigh the amount and post



it on the electronic bulletin board, and it stated that his students connected math to real life. The former Principal talked about the mathematics lead teacher's exciting lessons. The observation data provided evidence that the project had continued into the 1995-96 school year, and in the interview data the mathematics lead teacher talked about this recycling project and getting it from VA PEN. The three data sets, artifacts, interviews, and observations, served to support that the mathematics lead teacher did use projects for mathematics instruction during the 1993-94 school year.

The science lead teacher described the lead teacher's activities after participating in V-QUEST's two-week Lead Teacher Institute:

First thing we did was to get organized. After we finished that first V-QUEST session, we came back and organized all of our activities, and notebooks, and different things, and tried to correlate everything into experiments as far as SOLs and what was taught, and then I sent a memo to all the teachers explaining where I had been, and what I had been asked to do, and I asked for their input on what they wanted to see come from the V-QUEST program as far as supplies and money and services and that type of thing, and the general thrust— the general thrust from my faculty as far as the science teachers, and a lot of them had been teaching science for along time and have been teaching it together, and they really were not interested in any inservice. They felt like they had a pretty good command of science, but they were very interested in any help that I could give acquiring some money to buy some equipment, and that is mainly what I did, and I Xeroxed different ideas that I had and put them in the mailboxes, and I sent memos around consistently because this is what they wanted. Because they didn't want to meet after school. So I always put the teachers' names on a notepad and I sent lots of things around and lots of boxes around, and I would fix a box and start in sixth grade and fix another box of supplies and catalogs and start it with the seventh grade and another one for the eighth grade teachers, and then all the teachers were then asked to pass them around to all the other teachers. We could start with a different grade level each time, so each grade level had first crack at something, and that way the teachers could look at it at their leisure or kind of flip though and see what they really needed, and occasionally they would put a note in my box and say can I have a box of such and such? I need that now. That is basically what we have done, and they have felt free to leave notes in my mailbox if they needed something,

and I would get the equipment. Our sixth grade teacher in particular I would go back and get it for them and give it to them. (p. 2)

Interviewer: Did you and [the mathematics lead teacher] work together more after you participated in the Lead Teacher program?

Science Lead Teacher: Much more so we, we did. We were on the same team so we sat down and planned exactly what we were going to do together. Sometimes the students would do a science activity in my room and then would do the math part in his room. They would do the word problems or the graphs in his classroom. (p. 3)

When the science lead teacher was asked to give some examples of interdisciplinary units that they had used that year, she provided a detailed description of the toothpick-bridge unit that they worked on together. In this unit Social Studies did the history of bridges, and in Language Arts the students read and wrote stories and poems about bridges; the Language Arts teacher was also in charge of the helping the students write resumes with the use of a template on the WICAT computers. Each student had to write his or her own resume to apply for jobs related to the bridge building project, and student teams were formed by drawing one name from each of the following jobs: carpenters, accountants, engineers or architects, and treasurers. After the teams were formed they had to create their bridge building company.

Once the teams were formed, half of the students stayed with the mathematics teacher and half went with the science teacher. There was a lumber company set up that was in charge of selling the building materials, toothpicks, glue, and wax paper, and the treasurer of each bridge building company had the responsibility of completing an invoice for the company which the company president had to sign. Based on the price list provided in their packet of materials the students had to write checks for their materials, and their math had to be accurate.

Guest speakers were brought in to talk with the students about their careers: an engineer, the husband of the science lead teacher, the owner of Lowes in [Duncan] Town, an architect, a member of Pleasant town's beautification committee. The lead science teacher explained:

We had all five careers, and then we had five people from the community who would come and talk to them [students]. . . (p. 9)

The teams were challenged to design and build toothpick bridges that would hold the most weight, and the lead science teacher explained the details of the projects in the following statement:

They had a building code and the town Engineer from [Pleasant] came to our class the second day, and he had a copy of the building code, and he would come in with his hard hat and clipboard and would come in and measure the length of the toothpick bridge and the width and the width of the river to make sure each aspect met its specifications. (p. 10)

The science lead teacher explained that during the building of the bridges they had some theft of materials so the Principal was in listed as the sheriff and he checked purchase receipts against the materials on the job site and arrested any thieves that were discovered. The science lead teacher described the conclusion of the project as follows:

. . .the end of the second day was the day to test the bridges and see which one was the strongest bridge that could hold the most weight. . .we had a tin can with a bunch of weight in it. . .we gave awards and [mathematics lead teacher] checked all of the check books with the accountant; he was the auditor, and he gave an award as the accountant, and I gave awards as the project director. It was really neat. The kids liked it because it was hands-on, and it had a lot to do with careers, and they felt like they were learning a lot. (p. 11)

The lead mathematics teacher's brief reference to the 1993-94 interdisciplinary bridge project follows:

The science lead teacher] and I do toothpick bridges together and we bring in an architect and a carpenter and people like that to talk to the kids. (p. 10)

In the 1993-94 school scrap book there was an article from the local newspaper about the toothpick bridges; it was titled, "Learning Bridge." The article started out talking about design and strength, and how the academic team had worked to make learning an exciting project at [Pleasant] Middle School. Although the mathematics lead teacher's account of the unit lacked detail, it did provide supportive evidence that he and the science lead teacher worked together on this interdisciplinary unit. The additional artifact data enabled the researcher to triangulate the evidence, thus verifying that this interdisciplinary unit was in place during the 1993-94 school year.

The former Principal was asked if he did anything to encourage the lead teachers to implement mathematics reform, and his response follows:

Probably, since I've been in administration, each school that I've been in there's been a reason for me being there, and I think number one to build faculty to start believing in themselves again. I reckon in a way I'm more of a cheerleader coach-type administrator. I'm not a big authority administrator. It's ah, it's one that you try to show the good things that

change, or you try to target those individuals that you know are willing to take some chances. You got to provide them a safety net so, yeah it wasn't a , I reckon it wasn't a direct pressure, but it was more of a subtle indirect encouraging role. Give it a shot see if it works, see what you like, incorporate the good parts of it. I'm not saying that this is the cure all for all of it. So not a dictate— thou shalt use this method. (p. 4)

While talking about what the lead teachers did in 1993-94 the former Principal stated:

They conducted a couple of inservice for math and science people in the building. They would periodically place things in mail boxes, here's an idea that I tried in my class. It worked pretty well, and you may want to give it some thought. Again, the inventory of equipment, probably the first time that the school really knew what they had in the areas of math and science. So the two lead teachers really took an active leadership role and they became a very integral part. One of the things we were doing at the time was, as part of our site days, the eight o'clock hours and everything, we just identified certain days that were going to be departmental meetings, and these two teachers were the ones that really demonstrated how to use a lot of this, and I started seeing it creeping into other classrooms. . . . [W]e started purchasing materials that were needed. We started, I reckon, targeting money that was needed. There weren't a lot of any real math materials. Within a year every math teacher had a classroom set of calculators. Prior to this I think there was maybe a set for the entire school. Every classroom started having more manipulatives that were being used so there was [sic] definitely more materials available to the teachers. (p. 9)

. . . As a faculty we did several inservice on VA PEN. Net, at that point wasn't really a big thing but VA PEN every teacher had an account. We spent several faculty inservice really learning how to use it because for me I needed that information. I hadn't been in on it that much, and I needed some of the expertise from the ones in the building. I think that the use of technology definitely became a teaching partner. It wasn't something to be feared.

Interviewer: Who did the inservice for VA PEN?

The former Principal: [The mathematics lead teacher ] and [a special education teacher] were the two.

An article from the local newspaper found in the 1993-94 school scrap book highlighted the mathematics lead teacher's work with the New River Valley Resource Authority, to complete a project on VA PEN and to write an article for VA-PEN. He

conducted workshops on the use of VA-PEN for both the 1993-94 and 1994-95 school years. The mathematics lead teacher, the former Principal and the Director of New Initiatives all mentioned these workshops in their interviews. The former Principal talked about the mathematics lead teacher doing workshops for Pleasant Middle School; the mathematics lead teacher and the Director of New Initiatives talked about the workshops that he conducted for the elementary schools, and the mathematics lead teacher also talked about doing the VA PEN workshops for Roanoke County.

The former Principal attended both of V-QUEST's Drive in Workshops that were held in October and April as well as the three day NCTM/VCTM conference that was held in January in Richmond with his lead teachers. According to the copies of the requests for leave the conference in Richmond was January 27, 28, and 29, and the County paid a total of \$364.46 of the expenses for these three people to attend this conference. The October V-QUEST Drive in Workshop was on the 12th, but the location of the meeting was not provided. The April V-QUEST Drive-in Workshop was in Roanoke on April 17, 1994. The following comments were made about these events:

Interviewer: Now the V-QUEST program itself had a drive-in workshop in the fall and in the spring and there was also a V-QUEST session at the NCTM conference that year [1993-94] and my records indicate that you attended all three of those events.

Former Principal: Yelp. The conference was the blizzard if I remember. The ice storm. Afton Mountain was a real joy, ah, yeah because I thought if it was important for me to ask teachers to attend those things, then I thought it was important for me to be present and to be aware of what was going on and just again just trying to stay abreast of what was going on in math and science. (p. 8)

Former Principal: I tried to reimburse the teachers as much as possible through site money. I tried to make sure that I had money for the teachers who attend the conferences, and I tried to make sure as a school we joined any of the mathematics or science organizations that brought reduced rates at conferences that bought us information on— I tried, again, to pick up what I could to help either through site money or it was a thing of feeling very strongly about a conference, and I didn't have it in site then I would take it out of the local activity funds to pay for some of it. (p. 12)

. . . I really tried to get teams and individuals during that large block of time for team planning to use the option for PD [Professional

Development] points to go in and do observations with their colleagues. . . you had a lot of expertise in that building that was never realized. (p. 19)

. . . I tried to share any information that came across my desk, or came through either of the two lead teachers, making copies, providing them to teachers. Again, the departmental meetings to share information. I tried to if in any of my professional readings come across something to make copies either for team leaders or for the two lead teachers. So I would say as a school we tried to do everything we could. (p. 13)

The list of articles about restructuring the middle school and reforming mathematics instruction that were filed and shared by one of the participants, which were presented in the 1992-93 year data, confirmed that the former Principal did make copies of professional articles of interest and that he shared them with his faculty. There was a \$472.00 purchase order dated 7/31/93 for the *Master Teacher* Publication, and documentation that an Institutional Membership for the NCTM *Mathematics Teaching in the Middle School* was paid on March 9, 1994, by check number 010919 for \$50.00 at the request of the mathematics lead teacher. These purchases had to be approved by the former Principal which indicates that he made an effort to provide up to date research-based information to support his staff's reform efforts.

Additional evidence indicated the former Principal also supported his teachers' participation in mathematics related professional development. The artifact and interview data documented that resources were allocated for two mathematics teachers to attend a professional development workshop in Richmond during this school year. While discussing professional development opportunities the seventh grade mathematics teacher indicated that she and the eighth grade mathematics teacher had attended a workshop in Richmond (p. 13), and the eighth grade teacher referred to this workshop while discussing changes in her methods of mathematics instruction. The eighth grade teacher's comment about this conference follows:

. . . I had one workshop that I went to on motivating and the man who did that gave lots of up to date things, he gave lots of suggestions on alternative means of assessment. (p. 11)

The artifact data contained documentation that substantiated these recollections. There was documentation that the registration fees for one seventh grade mathematics teacher and one eighth grade mathematics teachers were paid by two separate \$145.00 checks, one numbered 010898 dated February 16, 1994, and the other numbered 010906 dated February 23, 1994, and the documentation indicated that the teachers attended the Bureau of Educational Research Conference titled Strengthening Student Achievement and

Motivation in Your Math Classes at Richmond, Virginia on April 27, 1994. There was also documentation that a \$36.00 registration fee was paid for the Mathematics lead teacher to attend the Regional Conference on February 24-26, 1994 in Richmond, Virginia. These data provide evidence that indicates the former Principal supported the mathematics teachers' professional development efforts.

These data indicate that Pleasant Middle School's former Principal was knowledgeable of needed reforms in mathematics education, that he was an active participant in the reform initiative, and that he took a leadership role in the reform of mathematics education. The data also provided evidence that he supported his lead teachers in their efforts to reform mathematics instruction in the classroom by providing funds, time and encouragement. He treated the lead teachers as professionals and encouraged them to share their knowledge with other members of the faculty through observations, inservice opportunities and dialogue. The Principal's interview data, the lead teacher's interview data and the artifact data indicate that the Principal provided funding to purchase needed instructional materials, and that he encouraged and provided support for the teachers to attend professional conferences.

The fact that Pleasant County had made a five-year commitment to the V-QUEST Systemic Reform Initiative indicated that the Division Level administration supported the reform efforts for mathematics education. In addition to this commitment, the artifact and interview data provide evidence that the County supported the V-QUEST reform movement by providing funds for the following: (1) release time once a month for the lead teachers to meet or work on V-QUEST related projects, (2) teacher and administrator to attendance at V-QUEST or NCTM sponsored conferences, (3) purchase of new mathematics instructional materials. The data also confirmed that the County organized and conducted monthly meetings for the V-QUEST Lead Teachers, and that the administration set goals that the lead teachers were expected to meet. In addition to these activities the Superintendent of Schools volunteered to be a member of the V-QUEST speakers' bureau which functioned as a public relations tool for the V-QUEST reform movement. These data convey that Pleasant County's administration supported the V-QUEST reform initiative and provided support for the lead teachers to fulfill their role as change agents in their respective schools.

The data verify that Pleasant Middle School's lead teachers were active as reform agents in their school. The mathematics lead teacher utilized technology with a mathematics recycling project that was used in the classroom, and he implemented at least one interdisciplinary instructional unit during the 1993-94 school year. The Principal and the lead teachers indicated that a needs survey was conducted in the lead teachers' respective

subject areas, and that funding was secured for the purchase of instructional materials needed for the implementation of hands-on methods of instruction in the classroom. The mathematics lead teacher conducted inservice workshops on the use of VA PEN as an instructional tool and he organized and set up a resource mathematics supply room for the mathematics teachers at Pleasant Middle School. The science lead teacher arranged for one of the V-QUEST science trainers to conduct an inservice for the County's science teachers, and she helped develop a scope and sequence of the hands-on science activities that were being implemented in the County. Both the lead teachers and their Principal attended all the V-QUEST sponsored conferences and workshops, and attempted to share the knowledge gained about reforming methods of instruction.

The former Principal was an active participant in reform efforts, and that he tried to support and encourage his teachers in their efforts to be agents of change, but both the lead mathematics teachers' comments and the former Principal's comments indicated that their efforts were met with resistance, and they had trouble getting the faculty to join in their spirit of reform. Although the lead teachers and their Principal expressed enthusiasm about the V-QUEST movement, the lead teachers indicated that the mathematics and science teachers were not interested in participating in after school inservice opportunities, and it was indicated that the lead teachers found the results from the end of year survey that was conducted at Pleasant Middle School about the V-QUEST Lead teachers activities disheartening and frustrating. In addition to the efforts of the V-QUEST Lead teachers to reform methods of instruction at Pleasant Middle School the *Addison-Wesley* instructional materials had been replaced by the newly adopted *Glencoe's Mathematics Applications and Connections (Glencoe)* series, and in the next section results of the analysis of the textbook and its related instructional materials is presented.

#### Documenting Change in Mathematics Instruction 1993-94: Artifact Data

Since the purpose of this section is to document changes in mathematics instructional materials, results from the analysis of *Glencoe's* seventh grade textbook and its related resource materials will be compared to *Addison-Wesley's* analysis results. The title of *Glencoe's* seventh grade textbook, *Mathematics: Application and Connections*, puts it right up front that the focus of mathematics instruction is not just on teaching computation, and one doesn't need to read a whole paragraph into the informational section of the 7th grade *Glencoe's* teacher's manual to notice striking differences between the two sets of instructional materials. The informational material in a section titled "Teacher's Handbook" begins by talking about the unique developmental needs of the middle school student, a topic that was not mentioned in the *Addison-Wesley* materials, and goal statements



which highlight major differences between the two sets of instructional materials. Those three goal statements follow:

**Engage students in Mathematics.** Students must be convinced that mathematics belongs to them and is not solely the property of the teacher or the textbook. Our Program accomplishes this by providing historical and cultural perspectives to mathematics, using multiple representations for concepts, highlighting occupations that require mathematics, allowing students to make decisions, and avoiding trivial, unrealistic contexts for presenting mathematics. It provides challenging tasks supported by interesting, relevant information that enables students to be active participants in mathematics.

**Help students expand and apply their mathematical skills.** Students must be taught to integrate the compartmentalized pieces of mathematics they learned in elementary school. For mathematics to be meaningful to them, they must learn to organize information, interpret data, and communicate quantitatively. They must learn how to reason, make conjectures, and solve problems. Our program helps students apply their mathematics and see it and technology as useful tools in their lives.

**Prepare students for further study in mathematics.** Our society demands a quantitative literacy stretching far beyond basic arithmetic skills. To succeed now and in the future, all students must learn to generalize (algebra), think spatially (geometry) and reason probabilistically (probability, statistics). **Mathematics: Application and Connections** is designed to prepare all student for the study of higher mathematics, by making sure they possess understanding as well as proficiency.

You will see that **Mathematics: Applications and Connections** meets these three goals and captures the essence of the NCTM Standards. The program provides the tools teachers need to help middle school students see, understand, and appreciate the connection between mathematics and real life. In every lesson, students at all levels repeatedly receive this message: “Math is for everyone. . . You can do it. . . You’ll use it every day.” (p. T3)

*Addison-Wesley* did not have a set of goals as such, but this statement from the first page of the seventh grade teacher’s materials parallels *Glencoe*’s goal statements:

**Solid Skills Development** with measurable results

Through the years, *Addison-Wesley* has continued to refine its presentation of basic skills based on input from thousand of teachers. *Addison-Wesley*

*Mathematics* provides a clear, consistent lesson format for teaching the skills that effectively build your students' proficiency and understanding. (p. T6)

There is obviously a difference in what understanding mathematics means in these two textbook presentations. Moving the focus away from teaching basic arithmetic skills was a new concept for the textbook as well as for many of the mathematics teachers at Pleasant Middle School.

A comparison of textbooks' recommended instructional plans. An analysis of *Glencoe's* recommendations for effective lesson plans and a comparison to the previous textbook's recommendations will be presented next. The authors described the instructional design of *Glencoe's* textbook materials in the following statement:

A carefully designed **THREE-STEP** teaching approach gives you the tools you need to **FOCUS, TEACH,** and **PRACTICE/APPLY.** (p. 13)

Since the *Glencoe* textbook is a student centered mathematics book, it does not provide a scripted lesson for the teacher to use as the *Addison-Wesley* textbook did, but instead offers a multitude of different strategies that the teacher may pick from to best reach the needs of his or her students. Among the resource materials included with this textbook was a resource book titled "Lesson Plans Mathematics Applications and Connections", and its contents were summarized by the following statement that was written on its cover: "Contents Include a One-Page Lesson Plan Master for Every Lesson in *Mathematics Application and Connections, Course 2*". The first page of this resource book will be used to provide an example of lesson plan options.

There was not a lesson included in the *Glencoe* textbook that paralleled the lesson example selected for *Addison-Wesley*, which was adding whole numbers, but both sample lessons were taken from the respective first chapters of the textbooks. *Glencoe's* first chapter in its 6th, 7th and 8th grade textbooks was titled "Tools for Problem Solving". A lesson plan format like the one that is presented for the *Glencoe's* first lesson, 1-1 A plan for Problem Solving, is provided for every lesson in the book. This lesson format organizes the text and resource materials about this lesson in a one-page layout so that the teacher may easily see what is available and then make instructional decisions based on the needs of his or her students. Once these instructional decisions are made it appears that planning could be as simple as putting check marks beside the materials that are going to be used to teach the lesson. The bottom portion of the Lesson Plan identifies the components of the lesson associated with each of the three steps in the lesson plan much like the chart that correlated the *Addison-Wesley* lesson's components with Madeline Hunter's seven step lesson plan. A copy of this one-page lesson-plan format for *Glencoe's* lesson 1-1 follows:

1-1 Lesson Plan

Teacher's Name \_\_\_\_\_ For Week Beginning \_\_\_\_\_

Grade \_\_\_\_\_ Class \_\_\_\_\_ M T W T F

NCTM Standards  
1-7, 13

Objective: Solve problems using the four-step plan.

State/Local Objective: \_\_\_\_\_

**PLANNING FOR THE LESSON**

Blackline Masters

Teacher Resources/Materials

\_\_\_\_\_ Study Guide 1-1

\_\_\_\_\_ Transparency 1-1

\_\_\_\_\_ Practice Master 1-1

\_\_\_\_\_ Group Activity Card 1-1

\_\_\_\_\_ Enrichment Master 1-1

\_\_\_\_\_

**Student Resources/Materials**

\_\_\_\_\_

(for each student/group)

**USING THE TEACHER'S WRAPAROUND EDITION**

**1 FOCUS**

\_\_\_\_\_ 5-Minute check, p. 4

\_\_\_\_\_ Motivating the Lesson, p. 4

**2 Teach**

\_\_\_\_\_ Using Calculators, p. 4

\_\_\_\_\_ More Examples, p. 5

\_\_\_\_\_ Checking for Understanding, p. 6

\_\_\_\_\_ Reteaching Activity, p. 5

\_\_\_\_\_ Close, p. 6

**3 Practice/Apply**

\_\_\_\_\_ Alternate Assessment: Writing, p. 7

\_\_\_\_\_ Extending the Lesson, p.7

Assignment Guide

\_\_\_\_\_ Maximum: 6-13

\_\_\_\_\_ Minimum: 6-13

\_\_\_\_\_ Alternate Assignment

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(Glencoe's teacher's manual, p. 1)

Glencoe's teacher's manual is called a wraparound edition because the "Lesson Notes" for each lesson are written in a margin around a copy of the student's textbook page, and the lesson notes for this problem solving lesson provide more detail about the three step lesson approach. **Focus** was step one of the lesson plan, and the suggested activities for this portion of the lesson were the 5-Minute Check, and a situation problem which was provided in Motivating the Lesson suggestion. The 5-minute Check was on a

transparency which also contained a visual aid for the four problem solving steps that were going to be presented in this lesson. The warm-up consisted of the following five problems:

Replace each \_\_\_?\_\_\_ with  $<$ ,  $>$ , or  $=$  to make each sentence true.

1. 4 hours \_\_\_?\_\_\_ 200 minutes
2. 150 minutes \_\_\_?\_\_\_ 3 hours
3. 300 seconds \_\_\_?\_\_\_ 5 minutes
4. 2.5 day \_\_\_?\_\_\_ 54 hours
5. 4 months \_\_\_?\_\_\_ 130 days (p. 4)

These problems required students to think and reason. Mathematics instruction was immediately connecting math to the real-world problem solving, and these problems provide the opportunity for students to discuss the concepts of greater than, less than and is equal to, and to communicate using the language of mathematics. Instead of starting off the year with a review of reading and writing whole numbers and the procedures for addition of whole numbers as the *Addison-Wesley* textbook did, the first lesson in *Glencoe's* textbook had students reading mathematics sentences and making multiple step comparisons of measures of time, a math skill students use every day. Since there were multiple methods of solving the problems, there were also opportunities to make connections between the different units of measurement relationships and how those relationships could be used in a variety of ways to solve problems. Every lesson in the textbook had a 5-minute check which consisted of two to five problems that required more than just applying a memorized arithmetic procedure to solve the problems.

Motivating the Lesson was also suggested as an activity for the teacher to use in the focus portion of the lesson plan. Following is the teacher information provided in Motivating the Lesson:

**Situation Problem** Have students solve the following problem. Kim ran for 0.7 hour, Will ran for 40 minutes, and Jerome ran for 1,925 seconds.

How can you determine who ran for the longest time? (p. 4)

This problem builds on the 5-minute check problem solving activity, and like those problems it is a problem that can be solved in more than one way. Note the phrasing of the question— How can you determine . . . , as opposed to— who ran for the longest time? The question is posed in such away that students are expected to explain how they solved the problem. The answer or solution to the problem is not the sole focus of this learning activity, and there is no “key word” to identify the arithmetic operation needed to solve the problem. This problem encourages students to reason and think, not just practice computation procedures. Also, like the 5-minute check this problem provides an opportunity for students to discuss their ideas. There was no scripted lesson that told the teachers what

to ask and what to tell the students as was provided in the *Addison-Wesley* textbook. A variety of teaching strategies were introduced in the “Teacher’s Handbook” section, and they will be shared at the conclusion of the presentation of the three steps of the lesson plan.

Step 2 of the lesson plan was **Teach**, and there were five options for the teacher to choose from for the Teaching portion of the lesson. All four of the options were presented in the wraparound section of the teacher’s manual, and **Using Calculators**, the first suggested teaching activity, follows:

**Using Calculators** Have students work with a partner to write a key sequence for solving the lesson’s opening problem. Include the steps needed to check whether an answer is reasonable. Have the pairs of students compare their results. (p. 4)

The opening problem for the lesson was:

In the news, you have often heard of people who are millionaires or billionaires. You know that they are very rich, but just how rich are they? One way to understand the size of a million is to find how many days it would take you to count to one million. You can use a four step plan to solve this and other problems. The four steps are described below.

1. **Explore** The plan begins with understanding the problem. You need to know what information you have and need and what is asked.
2. **Plan** After understanding the problem, you should develop a plan to solve it. There are many ideas or strategies you can use. You will learn many of these in this book. It is usually helpful to make an estimate.
3. **Solve** Then you carry out your plan. If the plan does not work try another—and another.
4. **Examine** Finally, you should look at your answer to see whether it answers the question you were asked. You may also check your answer by solving the problem in another way by using a different strategy. Compare your answer to the estimate. If the answer doesn’t make sense, make a new plan and try again. (p. 4)

There are some similarities between *Addison-Wesley*’s 5-point check list for solving problems and *Glencoe*’s four step plan. The first two steps in the 5-point check list, question and data, were combined into the explore step in *Glencoe*’s plan otherwise the plans are about the same except for the examine and check step. Here, it is suggested that a problem can be checked by working it a different way, and the check step in the *Addison-Wesley* textbook was, “See if your answer is reasonable. Estimate or check your computation” (p. 16). Thinking about alternative solutions was not encouraged in *Addison-*

*Wesley's* 5-point check list, whereas in *Glencoe's* four step plan using alternative strategies was suggested in three out of the four steps.

Other major differences between this teaching activity and *Addison-Wesley's* instructional set is that there was no scripted lesson provided for the teacher to tell the students how they should use these four steps to solve this problem, students were encouraged to work together to solve the problem, to use a calculator and not to depend on the teacher for the correct solution. The teaching suggestion made was to have pairs of students work the problem using a calculator and then compare their results. There is a model solution provided in the *Glencoe* book for students to compare their answers to, but it was not suggested as a scripted lesson for the students to copy and practice.

The second teaching option provided for Step 2 of the lesson was **More Examples**. This gave the teacher two additional problems that could be used to involve the students in using the four-step plan and mathematical reasoning to solve problems. The significant difference between the additional word problems and the ones provided in the *Addison-Wesley* text book is they did not all involve using the same arithmetic procedure to find the answer. All of the problems were about some unit of measure but the questions varied from finding an average speed, to how many days it would take to make a trip, or how many miles could you travel in a day.

The third option for teaching was **Checking for Understanding**. This consisted of five problem contained in the student's text, and following are the teacher suggestions that were provided for this instructional activity:

Exercises 1-3 are designed to help you assess students' understanding through reading, writing, speaking, and modeling. You should work through these exercises with your students and then monitor their work on Guided Practice Exercises 4-5. (p. 6)

The first three problems in this section were labeled Communicating Mathematics, and they are presented next:

1. **Tell** why it is important to plan before solving a problem?
2. **Tell** two reasons for including the *Examine* step.
3. **Write** in your own words:
  - a. what to do if your first plan does not work.
  - b. how you know it did not work. (p. 6)

Students are expected to reflect on the mathematics lesson and summarize their thoughts either verbally or in writing. Reflection was not a part of *Addison-Wesley's* instructional plan. In those lessons teachers were responsible for explaining all the information to the students. Guided practice in the old textbook focused on students

practicing procedures that the teacher had explained to them, and the teacher monitoring their understanding by walking around the room and checking their work. *Glencoe*'s lesson definitely did not focus on teaching memorization of basic arithmetic skills or on having the teacher explain everything to the students. The students were expected to construct and explain their understanding.

The fourth teaching option was the **Reteaching Activity** that follows:

**Using Cooperative Groups** encourage Students to work in cooperative groups to solve problems. As a group, students can discuss what to do in each step of the 4-step plan. One member records decisions and another does the calculations. It is the shared responsibility of the group to discuss decisions so that each member understands every choice made. (p. 5)

This is a major contrast to the reteaching materials provided with the *Addison-Wesley* textbook which was a set of blackline masters that presented an example of how to work the problem and then provided a set of 15 to 20 practice problems on that procedure. In *Addison-Wesley* it was the teacher's responsibility to provide individualized instruction for the students that did not master the skill being taught, and in the *Glencoe* series the teacher was expected to organize another interactive learning group for the students to communicate and discuss the mathematics objective(s) that was (were) being presented in the lesson.

The fifth and last teaching option for step 2 of the lesson was **Close**. In this activity the teacher was to **guide** the students to summarize how they could use the 4-step plan to solve a problem. Then the students were to formulate a problem based on information from their daily lives and use the 4-step plan to solve each other's problems. (p. 6) Guiding the students as opposed to telling the students is again a major difference between this portion of the lesson and *Addison-Wesley*'s instructional set.

Every one of these teaching options provided for student participation during the instructional part of the lesson. Students are expected to communicate with each other and explain their thinking and reasoning. Problem solving is the focus of the activities and the use of calculators is encouraged. Teachers were not teaching arithmetic procedures, and they were not coached as to what they needed to tell the students. Students were not memorizing procedures by practicing them over and over; instead they were applying arithmetic skills to solve real life problems. Students were expected to be active participants in all these learning activities, and the teacher's role was to guide the students in the use of the 4-step plan. There was definitely a change in the instructional strategies encouraged by the *Glencoe* textbook compared to those encouraged by the *Addison-Wesley* textbook.

Step 3 in the *Glencoe* Lesson Plan was Practice/Apply, and there were two different activities for the teacher to select from in this section: (1) Alternative Assessment, and (2) Extending the Lesson. The suggestions for **Alternative Assessment** follow:

**Writing** Have students work with a partner. One student formulates a multi-step problem without numbers. The other student writes how he or she would solve the problem using the 4-step plan. Then students switch roles.  
(p. 7)

Two things stand out about this activity: (1) it focuses on assessing conceptual understanding, and (2) it is an interactive assessment. This type of assessment was not an option in the *Addison-Wesley* materials.

The other activity provided for the Practice/Apply portion of the lesson was titled Extending the Lesson, and it was a suggestion that built on the last independent practice problem in the lesson which was about radios. Although the textbook did not say that this could be a research topic for students to use to write their own set of problems, it was definitely an option. The **Extending the Lesson** information follows:

**Mathematics and Media** Remind students that many people were responsible for developing technical improvements in radio transmission during the early part of this century. These include Lee de Forest, who invented the audion, which allowed radio waves to be amplified, and Edwin H. Armstrong, whose research made long range radio reception practicable.  
(p. 7)

*Glencoe* made connections between mathematics and the real world throughout the textbook and in every portion of the lesson. *Addison-Wesley* did use real world information in its word problems, but all the enrichment materials provided for the lessons were blackline masters that consisted of problems a little more difficult than the ones provided in the lesson. Research ideas or projects were not presented as ideas for extending or enriching lessons in the *Addison-Wesley* materials.

There are some similarities between the two textbooks' instructional plans. The Focus part of *Glencoe's* lesson was equivalent to the anticipatory set in *Addison-Wesley's* seven step plan, and *Glencoe's* Step 2, Teach, contained five different instructional activities that were equivalent to three of *Addison-Wesley's* instructional sets, modeling, checking for understanding and guided practice. In *Glencoe's* materials Independent Practice was homework while in *Addison-Wesley's* material it was practice exercises that were started in class and finished for homework if necessary.

The differences between the two textbooks were numerous. In the *Glencoe* instructional materials the teacher was to act as a guide in the students' learning of



mathematics, and learning mathematics meant constructing an understanding of concepts and mathematical procedures. Drill-and-rote practice was available for each lesson, but it was only one of several instructional strategies available to the teacher, and it was certainly not the method of instruction encouraged by the instructional materials. Students were expected to do most of the talking and explaining, and teachers were expected to observe, listen, interact, assess and guide as opposed to tell, demonstrate, assess and explain.

As mentioned previously, no scripted lessons accompanied each step of *Glencoe's* instructional lesson, but suggestions in the teacher's information section of the textbook shared many different instructional strategies that teachers could use to deliver the lessons. *Glencoe* described it as offering myriad opportunities for students to become active participants in learning mathematics (p. 6). The teaching suggestions that were provided in the "Teacher's Handbook" portion of the seventh grade teacher's manual follow:

**COOPERATIVE LEARNING ACTIVITIES** invites your students to work together in making observations, recording data, discussing, questioning, making conjectures, and developing conclusions.

**MINI-LABS** is cooperative learning activities that appear within lessons. They give students the opportunity to discover mathematical concepts.

**MATHEMATICS LABS** is cooperative learning activities. Some are previews of the lessons they precede. Others are extensions of the lesson they follow.

**COMMUNICATING MATHEMATICS** exercises are included in **Checking for Understanding**. They give students the opportunity to clarify their thinking about mathematical concepts. Students are asked to respond verbally, in writing or through the use of pictures, symbols, graphs or models.

**GUIDED PRACTICE** is an in-class closure activity that allows students the opportunity to check their understanding of lesson concepts before they begin **INDEPENDENT PRACTICE**—homework.

**JOURNAL ENTRY** asks your students to record their thoughts about the mathematics they're learning or solutions to problems.

**AN EXTENDED PROJECTS HANDBOOK** provides opportunities for your students to work together on intriguing long-term projects.

**CALCULATOR, MENTAL MATH, PROBLEM-SOLVING AND ESTIMATION HINTS** offer tips for problems.

**LOOK BACK** guides students to pages where they may review previously-learned concepts.

**TEAM TEACHING** offers suggestions on how to integrate mathematics with other disciplines.

**MULTICULTURAL EDUCATION** highlights how other people and cultures have influenced mathematics or presently use it.

**TEACHING TIPS** offer suggestions about special techniques you might use at various junctures of your lesson plan. (p. 6-13)

The difference in the focus of the suggested teaching strategies for the two textbooks is apparent in the language and in who is doing the talking. In *Glencoe's* instructional materials students are encouraged to communicate, clarify, work together, check their understanding, record their thoughts, explain their thinking, record data, discuss, question, make conjectures, develop conclusions, and discover mathematical concepts. In other words students were expected to be active participants in the lesson, and they were expected to **construct** their understanding of the concepts being covered. Students were not expected to be passive listeners or note takers. Instead of the instructional strategies focusing on how the teacher will tell the students the information that they need to learn as in the *Addison-Wesley* mathematics textbook, the students were expected to take charge of their own learning. Notice in the guided practice statement that it did not say that the **teacher** will check for understanding before independent practice— it says that guided practice provides **students** with the opportunity to check their understanding of lesson concepts before they begin independent practice—homework (p. 7).

In the teacher information section about innovative teaching strategies the following statement is made about *Glencoe's* Teacher's Wraparound Edition:

The teacher's Wraparound Edition provides you with unique teaching strategies. This makes it possible for you to reach your teaching goals and to create the environment most conducive to learning. (p. 12)

The *Addison-Wesley* teachers' manual used the wraparound design long before it was called wraparound, and it had a statement in its teacher's information that paralleled the above statement. *Addison-Wesley's* statement follows:

For most teachers, time is at a great premium. The organization of the *Addison-Wesley Mathematics Teacher's Edition* makes it quick and easy to locate everything your teaching demands for lesson support. Complete help is offered for planning, teaching, assessment and follow-up lessons. (p. T10)

The difference between the two statements highlights a significant difference between the two sets of instructional materials. The focus of *Addison-Wesley's* instructional materials was on teachers' needs while the focus of the *Glencoe's* textbook was on students' learning needs.

Another difference between the two textbooks was the layout of the lesson. The *Glencoe* textbook was advertised as an “All-new Middle School mathematics Program,” and in the information shared about what made this textbook all new, the following statement about the layout of its lessons was provided:

Most mathematics textbooks used at this level present each lesson in a two-page format. In the *Mathematics Application and Connections*, the length of each lesson is determined by the content presented. Skills and concepts are tied to applications that are part of the students’ real world or to connections with other mathematics topics and with technology. Each chapter places a strong emphasis on problem-solving skills. (p. 2)

This statement (1) supports the conclusions previously made from the analysis of *Addison-Wesley*’s lesson format, and (2) shows another difference between the two sets of instructional materials.

A comparison of textbooks’ curriculum contents. An analysis of the scope and sequence chart provided in the *Glencoe* teacher’s manual indicated that like *Addison-Wesley* a spiraling curriculum design was used to develop curriculum content. A comparison of the results of this analysis for both sets of textbooks is provided in Table 17. One obvious difference between the curriculum content of the two textbooks was that *Addison-Wesley* did not have any objectives under the developed category. In the *Addison-Wesley* textbook the objectives were identified as new or review, and since most of the objectives were about arithmetic procedures, it naturally followed that developing concepts was not a high priority. Another difference was the total number of objectives presented in the sixth and seventh grades. *Addison-Wesley*’s curriculum contained almost 100 more objectives in both the 6th and 7th grades than *Glencoe*. Factors that may have attributed to the reduction in the number of concepts covered in these two-grade levels were that *Glencoe*’s objectives were based on the NCTM *Standards* and focused on developing concepts and procedures instead of just isolated procedures, and it contained more instructional lessons designed for development of conceptual knowledge than instructional lessons designed to teach procedural knowledge. In addition there was more new material introduced in both of these grade levels in *Glencoe*’s textbook, and lessons designed to develop an understanding of new content usually required more instructional time than lessons designed to maintain or reinforce arithmetic procedures and computation skills, which was the goal of 72% of *Addison-Wesley*’s objectives.

Table 17

A Comparison of Glencoe and Addison-Wesley Curriculum Content

Textbook	Grade	Objectives				Total Objectives
		New	Developed	Review	Reinforced/ Integrated	
<i>Addison-Wesley</i>	6th	28%		72%		244
<i>Glencoe</i>	6th	41%	57%		2%	141
<i>Addison-Wesley</i>	7th	19%		81%		249
<i>Glencoe</i>	7th	39%	52%		9%	161
<i>Addison-Wesley</i>	8th	11%		89%		253
<i>Glencoe</i>	8th	21%	54%		25%	234

Since the only curriculum classification that was parallel between the two textbooks was the new objectives, no data comparisons could be made for the other categories, but the labels in the classifications systems of the objectives by the two different textbooks conveyed a significant difference. In *Glencoe's*, if the objective was not new or being developed, it was being reinforced and integrated. Making connections within the curriculum was part of the curriculum content focus, whereas in *Addison-Wesley's* materials if the objective was not a new objective, it was review or skill reinforcement; there was no mention of making connections within the curriculum content.

*Glencoe's* curriculum content was correlated with all thirteen of NCTM *Standards* in two different ways. First, there was an overview of the entire book presented in the "Teacher's Handbook" section where the thirteen Standards were listed in the margin of the text with a list of the chapters and page numbers that addressed the objectives; every Standard was correlated with at least three chapters in the book, and the majority of them were correlated with twelve or more chapters. The second correlation of the NCTM *Standards* to the curriculum content was provided at the beginning of each chapter in a section titled "Previewing the Chapter." Here all the objectives of the chapter were listed in a chart along with the NCTM Standard(s) that the objectives addressed. There was a blank column to the right of the NCTM Standards column titled State/Local objectives so that the instructional material could easily be correlated with the State or Local objectives.

Previewing the Chapter also provided Interdisciplinary Bulletin Board ideas, Team Activity ideas, a list of *Glencoe's* supplemental resource materials for teaching the chapter, a list of Recommended Outside Resources which provided information about related books and periodicals; there was a list of films, videotapes and videodisks; software suggestions

for both IBM and Apple computers were presented, a list of manipulatives needed to teach the chapter, and a chart that correlated each lesson with Applications and Connections. Every lesson in the chapter contained applications to the real world and connections within the curriculum content. In Chapter 1 connections were made between Algebra, Geometry and Number Sense in all ten lessons.

*Addison-Wesley's* "Planning a Chapter" was the section of the textbook that paralleled *Glencoe's* "Previewing a Chapter." It contained an overview of the chapter which provided a summary of the chapter's objectives, a Mathematical Background section and a Vocabulary section. The Mathematical Background and the Vocabulary sections contained information that the person teaching the lesson needed to know. In other words it taught the lesson to the teacher. Other features of the "Planning a Chapter" portion were Error Analysis, Problem Solving, Special Education, Subject Integration, and Activities That Count. The error analysis section showed various arithmetic errors that students might make, explained their diagnosis and suggested remediation. Here is an example of the remediation suggested for an addition problem which was missed due to a regrouping error:

Begin with examples that do not have zeros, such as  $522 + 7889$ . Discuss the steps in the addition algorithm including how regrouping is carried out from ones to tens, and tens to hundreds. Return to an example such as  $205 + 978$  and focus on the step-by-step addition. (p. 18)

This is an obvious contrast to the teaching suggestions in *Glencoe's* Chapter Preview, and highlights the difference in the instructional focus of the two textbooks. *Addison-Wesley* was designed to help teachers show and tell procedural information, while *Glencoe* was designed to help teachers involve students in learning activities to guide their development of conceptual and procedural understanding.

*Addison-Wesley's* Subject Integration section listed pages that problems were on that connected mathematics to other subjects, but no additional ideas were provided. Two different sections of *Glencoe's* Chapter Preview materials were devoted to providing teachers with additional ideas for integrating mathematics with other subjects. The Interdisciplinary Bulletin Board section presented ideas of how to use the display to connect Geography and Mathematics, and Team Activities provided two outside Field Trip ideas and two In-class speaker ideas for making real world connections. *Addison-Wesley* relied on the textbook to provide all the interdisciplinary connections, while *Glencoe* used the textbook as one option for integrating mathematics with the other disciplines.

*Addison-Wesley's* chapter planning information did contain a section titled Activities That Count. In this section there were four different ideas for competitive games that reinforced basic arithmetic skills. Some were whole group activities and some were

small group activities, but most all of them were based on competition and the review of arithmetic skills. In *Glencoe*'s material eleven different group activity ideas were provided in the resource materials titled Group Activity Cards, and all of these activities were cooperative learning activities that involved students in communicating, reasoning, and developing conceptual as well as procedural knowledge. These comparisons provide evidence to support the conclusion that *Addison-Wesley* was a teacher-centered textbook designed for teaching basic arithmetic procedures and computation skills while *Glencoe* was designed to take a student-centered approach and as a resource to help teachers facilitate students' development of relational understanding.

A simple comparison of the titles of each books' chapters provides further evidence to support that the curriculum content and instructional focus of the *Glencoe* text book had changed from the old *Addison-Wesley* instructional materials, and that the focus had changed to meet recommendations made by NCTM. *Addison-Wesley*'s seventh grade textbook had 16 chapters while *Glencoe*'s had 14, so as much as possible a one-to-one comparison between the chapter titles will be presented in Table 18. Again, the language used in *Glencoe*'s material highlights the difference between the two textbooks. Words like tools, applications, investigations, indicate that the content of this book was not limited to procedural information, and that students were expected to be involved in the learning process. As pointed out in the previous analysis of *Addison-Wesley*'s textbook, eleven out of sixteen of its chapters were focused on a review of arithmetic procedures, and the majority of the titles indicated that procedural knowledge was the focus of instruction. A look at the titles also indicates a change in the curriculum. *Glencoe*'s first Chapter, Tools for Problem Solving, made a strong statement about what was considered important in teaching and learning mathematics. *Glencoe*'s textbook moved the study of Statistics and Data Analysis to Chapter 3 as opposed to *Addison-Wesley*'s presentation of this information in chapter 14. The organization of *Addison-Wesley*'s curriculum objectives served to highlight the importance placed on learning arithmetic procedures and computation skills.

*Glencoe* devoted one chapter to Geometry and two other chapters to Geometry and Measurement, while the *Addison-Wesley* textbook devoted two chapters to Geometry and two separate chapters to Measurement. Connections within the curriculum were evident even in the chapter titles of *Glencoe*'s materials, while *Addison-Wesley*'s materials compartmentalized and isolated each mathematics topic. A look at the new material content material identified by the following chapter titles: Patterns and Number Sense, An Introduction to Algebra, Discrete Math, and Functions and Graphs, also serve to highlight the differences between the two sets of instructional materials. None of the new content

included in *Glencoe*'s materials focused on teaching arithmetic procedures or computation skills.

Table 18

*Addison-Wesley* and *Glencoe* Chapter Title Comparisons

Chapter	<i>Addison-Wesley</i>	<i>Glencoe</i>
1	Addition and Subtraction of whole Numbers	Tools for Problem Solving
2	Addition and subtraction of Decimals	Applications with Decimals
3	Multiplication and Division of Whole Numbers	Statistics and Data Analysis
4	Multiplication of Decimals	Patterns and Number Sense
5	Division of Decimals	Applications with Fractions
6	Geometry	An Introduction to Algebra
7	Number Theory and Equations	Integers
8	Addition and Subtraction of Fractions	Investigations in Geometry
9	Multiplication and Division of Fractions	Area
10	Measurement: Metric Units	Surface Area and Volume
11	Ratio and Proportion	Ratio, Proportion, and Percent
12	Percent	Application with Percents
13	Circles and Cylinders	Discrete Math and Probability
14	Probability, Statistics, and Graphs	Function and Graphs
15	Integers	
16	Measurement: Customary Units	

The last comparison is made to provide evidence that the curriculum content in *Glencoe*'s textbook had changed from that offered in *Addison-Wesley*'s materials is a comparison of the lessons in Chapter 1 of both books with a focus on problem solving. As reported in the analysis of *Addison-Wesley*'s instructional material each chapter was broken down into five or six separate objective lessons, which were organized to facilitate instruction of isolated arithmetic procedures. Like *Addison-Wesley*, *Glencoe*'s chapters were broken down into lessons with ten to fourteen lessons per chapter, and the titles of chapter one's lessons follow:

- 1-1 A plan for Problem Solving
- 1-2 Estimation Strategy: Front-End Estimation
- 1-3 Estimation Strategy: Compatible Numbers

- 1-4 Mental Math Strategy: Compensation
- 1-5 Problem-Solving Strategy: Choose the Method of Computation
- 1-6 Problem-Solving Strategy: Classify Information
- 1-7 Order of Operations
- 1-8A Mathematics Lab: Algebra: Variables and Expressions
- 1-8 Algebra Connection: Variables and Expressions
- 1-9 Algebra Connection: Powers and Exponents
- 1-9B Mathematics Lab: Spreadsheets
- 1-10 Algebra Connection: Solving Equations Mentally (p. 2A)

After the second lesson in chapter one there was a set of mixed review word problems included in every independent practice assignment. All of the lessons were connected in this way, and every skill that was introduced was connected to tools for problem solving. As the analysis of the curriculum content of the first chapter showed, each lesson was designed to involve students in problem solving, developing concepts, and learning arithmetic procedures. None of the objectives were presented as isolated arithmetic procedures, as in the *Addison-Wesley* textbook. There were problem solving and application sets of word problems provided in every lesson which, unlike the *Addison-Wesley* textbook, ensured the curriculum addressed conceptual as well as procedural knowledge.

The final piece of evidence provided to support that the curriculum content in *Glencoe's* instructional materials had changed from the curriculum content in *Addison-Wesley's* materials is taken from *Glencoe's* resource materials. Among the resource materials provided with the *Glencoe* textbook was a set of books identified as *Glencoe Mathematics Professional Series*. One of these books was about alternative assessments and while explaining the need for alternative assessments the changing curriculum in mathematics was discussed. The following statement in those materials supports the conclusions reached in the comparison *Addison-Wesley's* and *Glencoe's* curriculum contents:

The first standard, *Mathematics As Problem Solving*, makes problem solving the central focus of the mathematical curriculum. A problem-solving orientation to the curriculum gives primary emphasis not only to teaching students how to solve problems, but also to teaching all mathematics content, that is concepts and skills, through a problem-solving approach. This is a radical break from past practice in which concepts and skills usually were taught in isolation. (p. 2)



*Glencoe*'s instructional materials used a problem-solving approach to teaching conceptual and procedural content while *Addison-Wesley*'s instructional materials used a direct instruction model and focused on teaching procedural content in isolated segments.

A comparison of textbooks' problem solving contents. Since the first lesson of Chapter 1, A Plan for Problem Solving, in the *Glencoe* textbook happened to be about problem solving, the analysis of *Glencoe*'s instructional strategies and problem solving content overlap in places. Data needed for this portion of the analysis that was quoted previously will be referred to rather than duplicated in this section. *Glencoe*'s four step plan for solving problems is a portion of the problem solving data that overlapped. A comparison between this four-step plan and *Addison-Wesley*'s 5-point checklist noted that *Glencoe*'s plan had collapsed the first two steps in the 5-point checklist into one step so that the plans were similar, except that *Glencoe*'s plan encouraged students to look for alternative methods to solve problems while *Addison-Wesley*'s 5-point checklist encouraged students to check their computation.

The first part of analyzing the problem solving content for the *Addison-Wesley* textbook focused on the use of word problems in mathematics instruction. A summary of the significant conclusions from that analysis will be useful for documenting changes in the use of word problems for mathematics instruction in *Glencoe*'s textbook. Analysis of *Addison-Wesley*'s use of word problems revealed that word problems were used to reinforce students' computation skills or for students to practice a particular problem solving strategy rather than to challenge or encourage mathematical reasoning. If the lesson was about strategies for solving word problems, then the problems were presented in clusters of the same type problems so that the teacher could explain or tell the students exactly how to solve the problems, and then students were expected to follow the teacher's example(s) and practice the given strategy by solving word problems that were similar to the example problem(s). Two word problems were included in every independent practice assignment of lessons that were not devoted to problem solving, and the operations in these problems always matched the operation focused on in the lesson. Instruction related to problem solving encouraged neither alternative solutions, or problem solving strategies, and students were not encouraged to discussion, clarify, or justify their thinking. The major focus of problem solving was on getting the correct arithmetic solution rather than on mathematical reasoning or logic.

Problem Solving was the basis for mathematics instruction in the *Glencoe* mathematics series, and information about developing problem solving presented in the

Teacher's Handbook section of the teacher's manual provided details that support this conclusion. This information begins with a quote from one of the authors:

Problem solving is an integral component of this program. It requires students to think critically, examine new concepts, and then extend or generalize what they already know. (p. T9)

A quote from the NCTM Standards that was included in the Teacher's Handbook section of the materials to justify the need for problem solving in mathematics instruction follows:

. . . 'Problem solving is the process by which students experience the power and usefulness of mathematics in the world around them. It is also a method of inquiry and application. . . to provide a consistent context for learning and applying mathematics. Problem situations can establish a 'need to know' and foster the motivation for the development of concepts.' In response to the Standards the authors of **Mathematics: Applications and Connections** made problem solving and overriding theme of their program. . . (p. T8)

As previously mentioned, the fact that the first chapter of the sixth, seventh and eighth grade *Glencoe* textbooks was "Tools for Problem Solving" indicated the importance placed on problem solving for learning mathematics. Other features of the textbook that indicated the significant role that problem solving played in mathematics instruction were provided by an analysis of chapter one's lessons, which were listed in the analysis of *Glencoe's* curriculum content. A quick overview of the chapter's lessons revealed that word problems were included in every lesson. The three lessons that were devoted to problem solving strategies contained a mix of operations and types of problems. The word problems were not organized and presented by categories such as by computation operations, problem solving strategies, or as one-step problems, two-step problems, too little information, too much information, use a pattern and so on.

Seven out of twelve of the lessons contained a set of word problems labeled mixed review. The five lessons that did not contain mixed review were the first lesson, two word problem strategy lessons, the technology lesson on using a spread sheet, and the lab activity for algebraic expressions. Eight of twelve lessons contained a set of word problems labeled as Problem Solving and Applications, and the lessons that did not contain these problems were the same ones that did not include the mixed-review with the exception of the first lesson. Details concerning the number of problems included in each set and the number of problems within the Problem Solving and Application set that were critical thinking problems or journal writing problems are presented in Table 19.

Table 19  
Word Problems in *Glencoe's* Chapter 1

Lesson	Number of Problems			
	Mixed Review	Problem Solving and Applications	Journal	Critical Thinking
1-1	0	8	0	1
1-2	4	6	1	2
1-3	5	5	1	1
1-4	5	2	0	1
1-7	5	4	0	1
1-8	4	3	0	1
1-9	6	8	1	2
1-10	6	3	0	1

Table 19 shows there was a substantial number of word problems included in eight of twelve Chapter 1 lessons, and all four of the other lessons that were not on this chart contained word problems but were not labeled as Mixed Review or Problem Solving Applications. When these numbers are compared to the two problems in each lesson in *Addison-Wesley's* textbook there is strong evidence to support that the emphasis placed on solving word problems in *Glencoe's* instructional materials was much greater than that in the *Addison-Wesley* textbook.

Another difference between the two textbooks were the types of word problems provided in the instructional materials. As described in the summary of the results of the analysis of *Addison-Wesley's* word problems they were used for computation or the practice of specific problem solving strategies. There were no lessons in the *Addison-Wesley* textbook that provided a mixed set of word problems for the students to attempt to apply the problem solving strategies they had practiced. All of the word problems included in *Addison-Wesley's* lessons were on level one or two of Bloom's Taxonomy (knowledge and comprehension). There were 45 extra-challenge Think Math problems provided in *Addison-Wesley's* textbook, and the majority of those problems were nonroutine problems, but they were included as enrichment activities and not recommended for use with all students.

*Addison-Wesley's* Think Math problems were usually level three or four of Bloom's Taxonomy (Application and Analysis), but the quantity and use of these nonroutine problems was limited. The number of Think Math problems per chapter ranged

from one to five with most chapters having two or three. In *Glencoe's* textbook there was at least one critical thinking problem included as a part of every lesson. Table 19 shows that there were ten critical thinking problems in chapter one. All of the chapters in the textbook followed the same format as chapter one so there would be at least 140 of these type problems contained just in *Glencoe's* daily lesson materials. There were at least three more of these nonroutine type word problems included for every lesson in the teacher's wraparound section of the text in the sections titled Extending the Lessons, Options, and Bell Ringer. Based on just a comparison of the number of nonroutine word problems available, students had a much better chance experiencing problem solving that involved higher levels of thinking and reasoning with the *Glencoe* textbook.

Results of the analysis of *Glencoe's* instructional plan and curriculum content data supported the conclusion that students were expected to communicate their mathematical understanding by explaining their thinking, summarizing their problem solving strategies, justifying their answers, and exploring alternative-problem-solving strategies and solutions. Students were also expected to be able to communicate their mathematical understanding in writing, and the Journal Problems included in *Glencoe's* lessons were designed for that purpose. In addition to the three Journal Problems included in chapter one the Close section contained in the teacher's wraparound text provided an alternative problem for each lesson that encouraged students to reflect and communicate their understanding either orally or written. Again this was in contrast to *Addison-Wesley's* instructional materials which focused on documenting mastery of procedural knowledge through the use of paper-and-pencil computations.

Since the example lesson used to illustrate the instructional strategies recommended by *Glencoe's* textbook was also a problem solving lesson, a similar problem solving example lesson will not be repeated in this section. That lesson started off by having the students work in pairs and use calculators to solve a challenging real life problem about how big is a million, and the lesson highlighted some major differences in the use of problem solving and mathematics instruction between the two textbooks. First, in *Glencoe's* lesson the teacher did not tell the students how to solve the problem; second, the teacher was not responsible for telling the students if their solutions were correct; third, the students were expected to develop a checking procedure for their answer and determine if it was reasonable, and, fourth, they were encouraged to discuss and compare their solutions with other students. In *Addison-Wesley's* problem solving lesson there was a scripted lesson included for the teacher's use which provided students with all the information needed for solving the problem. The students were expected to internalize the problem solving procedure by working independently to follow the teacher's example(s) and practice the

problem solving steps on paper. Unlike *Glencoe's* problem solving lesson, *Addison-Wesley's* lesson did not provide for students to be active participants in problem-solving.

In *Glencoe's* Teacher Handbook section the authors described how the textbook was designed to make problem solving the overriding theme of their program by listing and explaining all the ways that problem solving was used in the textbook. This information provided additional support for the conclusions presented in this section. Following are the authors' explanations concerning the use of problem solving in mathematics instruction:

[The first chapter of all courses is titled] "Tools for Problem Solving."

**Problem-Solving Strategy** lessons present opportunities to solve nonroutine problem.

Frequent **Problem Solving Hints** suggest using problem-solving strategies to investigate and understand mathematical content and apply strategies to new problem situations.

**Applications** open nearly every lesson provide students with fascinating information that connects mathematics to the real world and give students a reason to learn mathematics.

**Problem Solving** examples give students the opportunity to study completely worked-out application problems in real-life fields, such as marketing and the environment.

**Connection** examples integrate one area of mathematics, such as geometry, with another such as algebra.

**Critical Thinking** exercises give students practice in developing and applying higher-order thinking skills. These exercises are usually directly related to the mathematical content of the lesson.

**Make Up a Problem** exercises ask students to formulate problems from situations within and outside mathematics.

**Problem solving and Applications** exercises in each lesson directly link mathematics to real-world fields like engineering, and to art, history, science, and other subjects.

Five **Decision Making** lessons in each of Courses 1-3 provide students with opportunities to connect mathematics to their real-life experience as consumers and citizens.

An **Extended Projects Handbook** provides opportunities for your students to work together on intriguing long-term projects. (p. T8-9)

Comparing this explanation of how problem solving was the basis for mathematics instruction in the *Glencoe* textbook to *Addison-Wesley's* use of problem solving highlights

the differences between the two sets of instructional materials. *Addison-Wesley's* parallel information concerning problem solving and mathematics instruction follows:

**Problem Solving** *for decision-maker of the future*

The foundation for the problem-solving strand is the 5-Point checklist—a practical guide that is logical, easier-to understand, and useful for solving all types of problems.

**Problem solving: Using the 5-Point Checklist** Problem-solving skill lessons show students how to approach problems and how to solve them. Problem-solving skills lesson highlight one step of the Checklist while application lessons utilize all five. Problem-solving skills are reinforced on Problem-Solving Practice Pages.

**Problem-Solving Strategies** Problem-solving strategy lessons help students develop critical thinking skills and work out problems not directly solvable with basic operations. Strategies are introduced on lesson pages and reinforced in Strategy Practice problems. To assure that lessons go smoothly, detailed teaching help is provided in the Teacher's Edition.

**Applied Problem Solving** Computation, problem-solving strategies, and reasoning are all brought together and applied to real life in unique problem-solving lessons of this type. Situations which involve students in a complete decision making procedure are presented. Students are given a chance to arrive at an answer, then make a decision based on what the answer means to them. (p. T8-9)

An analysis of the instructional material related to the 5-Point Checklist and Problem-Solving Strategies was presented in the baseline data, but the instructional material related to Applied Problem Solving was not investigated at that time. So for comparison purposes, an analysis of this instructional material will be presented next.

There were eight of these lessons contained in the sixteen chapters of *Addison-Wesley's* seventh grade book, and one of them was presented in the overview section of the teacher's manual as an example of the Applied Problem Solving lessons available in the textbook, so it will serve as the analysis example also. The problem included in this lesson was similar to the critical thinking problems in *Glencoe's* textbook. It was about 150 deer who eat acorns from an oak forest to survive, and the students were to use a table of data about the number of acorns in a square meter to determine if an oak forest four kilometers square would support 150 deer. Additional facts provided were that 450 kilograms of acorns would feed one deer, an acorn weighs 5 grams, and assume the oak trees were fairly evenly distributed throughout the forest. If the students had been left at this point to solve

the problem, it would have been an excellent application problem solving challenge, but immediately following the presentation of the problem and its information was a section titled Some Questions to Answer.

This section of the lesson contained five questions which lead the students through the steps needed to solve the problem, and the third question literally **told** the students how to solve the first portion of the problem. Question number three was actually not even a question, it was problem solving directions that follow: “Use sample plot D [from the table] to estimate the number of acorns in the forest. Number of acorns = number in sample x area of forest in square meters” (p. T9 & 362). An investigation of the other seven Applied Problem Solving lessons provided the same results, a good critical thinking problem accompanied with examples and/or the steps needed to solve it. As in the analysis of the rest of *Addison-Wesley*’s problem solving material the students were told how to solve the problem so that the problem solving challenges exercises were reduced to exercises in following directions and doing computation. This highlights one of the major differences between the *Addison-Wesley* and *Glencoe* instructional materials. *Addison-Wesley*’s instructional materials **tell and show** the students how to solve problem, and *Glencoe*’s instructional materials **involved** students in problems solving and used problem solving as a tool for mathematics instruction.

A comparison of the problem-solving information from each of the textbook’s introductory materials indicated that *Glencoe*’s materials featured more problem solving opportunities than *Addison-Wesley*’s materials, and this was supported by the data presented in Table 19. The information also highlighted the different instructional focus of the two textbooks: *Glencoe* was a student-centered textbook that sought to provide numerous and varied experiences for the students to construct mathematical understanding through problem solving, while *Addison-Wesley* was a teacher centered textbook that organized information concisely for easy delivery to the students, and its major focus was on teaching procedural knowledge and computational skills.

A comparison of textbooks’ calculator contents. There were two different types of technology incorporated into *Glencoe*’s mathematics instructional materials: calculators and computers, and the textbook-analysis results are presented independently beginning with calculator data. *Glencoe*’s recommendations for the use of calculators, and an analysis of the related instructional materials are presented along with a comparison of the parallel analysis results of *Addison-Wesley*’s materials. After this comparison documents any changes in how calculators were used for mathematics instruction a similar analysis of the use of computer technology and mathematics instruction is presented.

*Glencoe's* stance on the use of calculators in mathematics instruction was summarized in "Teacher's Handbook":

According to figures from the U.S. government, by the year 2000 seven out of 10 jobs will be related to computers, electronics, and high technology. Clearly, technology is changing the workplace and the home at an increasingly rapid pace. Without technical mathematical skills, today's students will have little or no chance of finding good jobs.

To help prepare them to function in a high tech environment, **Mathematics: Application and Connections** provides practice with computers, calculators, and spreadsheets. These tools are designed to enhance—not replace—students' practice with pencil-and-paper exercises, estimation, mental math, and other important tried-and-true techniques. (p. T11)

Both *Addison-Wesley* and *Glencoe* see the calculator as a tool to enhance students' performance in mathematics rather than a substitute for learning arithmetic skills and basic facts. The difference between the two sets of instructional materials and the use of calculators in mathematics instruction lies in the number of activities offered and the focus of those activities.

Calculators were used in five different ways for mathematics instruction in the *Glencoe* mathematics series. (1) Calculator Activities were used in the Focus portion of the lesson as motivational challenges. (2) They were used in the teaching portion of lesson as in Chapter one's lesson 1-1 (How big is a million?) that was previously presented. (3) The Problem Solving and Application portion of the independent practice often contained calculator challenges as a part of the lesson. (4) Calculator Activities to supplement instruction were provided for every chapter in *Glencoe's* Technology resource materials. (5) Many of the Cooperative Learning Activities provided as instructional options for the lessons used calculators.

In the *Addison-Wesley* series calculators were not incorporated into the Instructional Set of the lesson and were only used twice in the entire book in the Independent Practice portion of the lesson. *Addison-Wesley* limited the use of calculators to enrichment or supplementary activities to the lesson. These data show that *Glencoe* not only used calculators to supplement its lessons but incorporated the use of calculators into the teaching and independent practice portions of their lessons. *Glencoe* used calculators as an instructional tool, and *Addison-Wesley* focused on teaching students how to use the tool.

There were three different types of calculator activities contained in *Glencoe's* instructional materials: (1) instructional activities for learning how to use the calculator's



functions, (2) motivational activities to encourage students' involvement in lessons, and (3) calculator activities were used to facilitate or reinforce the learning of a particular concept. The calculator that was suggested for use with the *Glencoe* instructional materials was a TI-80, a scientific calculator. As a matter of fact the scientific calculator was pictured on the front cover of the seventh grade textbook which indicated its importance as a mathematical tool. The calculators used with the *Addison-Wesley's* materials were basic four-function calculators, and their use was not incorporated into the daily mathematics instructional lesson plans. *Addison-Wesley's* calculator activities were designed to teach students how to use the calculator and to reinforce computational skills. *Glencoe's* Calculator Activities were designed to help students learn how to use the calculators and to motivate, facilitate or reinforce particular concepts.

An analysis of *Glencoe's* instructional materials revealed that 61 out of 162 lessons incorporated the use of calculators into the Focus, Teaching or Practice /Apply portions of lessons. So without counting the cooperative learning activities and supplemental Calculator Activities that were instructional options, 38% of *Glencoe's* lessons used calculators for mathematics instruction. There was at least one Cooperative Learning Activity provided for each lesson, and at least one of those in every chapter involved the use of calculators. Combining the fourteen Calculator Activities with at least fourteen Cooperative Learning Activities that involved calculators brings the total number of calculator activities provided in the textbook's materials to 89. Using the same comparison that was made with the *Addison-Wesley* textbook of the number of calculator activities to 180 possible days of instruction brings the percentage of lessons that could have involved the use of a calculator to 49%. Almost half of *Glencoe's* daily mathematics instructional lessons incorporated the use of calculators compared to 21% of *Addison-Wesley's* lessons.

Not only did *Glencoe's* instructional materials offer more opportunities to use calculators for mathematics instruction, but the types of calculator activities that were offered in *Glencoe's* materials also differed from those in *Addison-Wesley's* materials. Both textbooks provided calculator activities that were designed to instruct students on how to use calculators, and in the analysis of *Addison-Wesley's* calculator instructional materials an example from each type of activity was presented to support the conclusion that all of *Addison-Wesley's* calculator activities were designed to either teach the student how to use the calculator and/or to reinforce computational skills. Examples of the various types of calculator activities offered in the *Glencoe* series are presented to illustrate the lessons objectives and for comparison purposes, to document change in the types of calculator activities that were available for mathematics instruction.

Following is an example of a calculator problem used in *Glencoe's* Focus portion of the lesson as a motivational challenge. The objective of the lesson was to round decimal quotients to a specified place, and the text of the lesson indicated that this was a calculator lesson. The **Focus** problems and the teacher suggestions that were listed in the wraparound text follow:

### **1 Focus**

#### **Motivating the Lesson**

Some calculators round and some calculators truncate results. *Truncate* means to cut off at a certain place-value position, dropping the digits that follow. Does your calculator round or truncate results?

**Situational Problem** Ask students how they would determine which store has better prices for used paperback books—Wilson's, which sells 5 paperbacks for \$6.49, or Stern's which sells 3 for \$3.87 (p. 75)

The opening question involved students in an investigation about the function of their calculator and in problem solving. As in all of *Glencoe's* lessons there was no scripted lesson for the teacher to follow. The development of the lesson depended on the teacher interacting with the students to facilitate their learning rather than telling the students step by step what to do to solve the problem.

The situational problem involved the students in using the calculator to solve a real-life problems. The sequence of buttons to press on the calculator was not provided for the students, and the teacher was not instructed to tell them how to solve the problem. Through whole group discussion and peer interaction the students were expected to use their calculator and "tools for problem solving" to plan and implement a strategy to solve the problem. Solutions and problem solving strategies were to be shared and discussed, and students were expected to determine what solutions were reasonable and which problem solving strategy worked best and why.

An example of how the calculator was used in the teaching portion of the lesson was provided in the analysis of *Glencoe's* instructional recommendations, but another brief example will be presented for analysis of the objective of the calculator activity used in the teaching portion of the lesson. The objective for this lesson was to choose the best problem solving method estimation, mental math, paper and pencil, or calculator, and the lesson opened with the following problem:

Ms. Meadows gave her class this problem. Choose five digits. Use all five digits to make a two-digit number and a three-digit number that when multiplied have the greatest product possible. (p. 17)

In the wraparound portion of the textbook under **2 Teach** it was suggested that the teacher begin by discussing with the students strategies that could be used to solve the problem, and then having the students determine whether an exact answer is needed or an estimate. After the **students determine** that an exact answer is needed then discuss the best method for solving this problem. Only after the **students decide** that using a calculator to multiply all the possible pairs of numbers would be the most efficient method of solving the problem do they actually work on solving the problem. Problem solving and reasoning are the goals of this calculator lesson. Students have to make a decision about when and why they would use a calculator to solve a problem, and then they have to use their problem solving tools and the calculator to solve the problem. Again this example indicated how *Glencoe* incorporated the calculator into the instructional portion of the lesson using a problem solving approach rather than a set of directions for the students to copy and follow.

Almost every lesson contained a calculator challenge in the Problem Solving and Applications section of the independent practice, but the students were not always told to use a calculator only to pick the best method and strategy. Several examples of calculator problems included in the independent practice portion of the textbook's lessons are provided to illustrate the wide variety of problems that were used. Examples of *Glencoe's* calculator problems follow:

Find the least four digit number that is divisible by 2, 5, and 9. (p. 7)

Make up a problem in which the factors each have two decimal places, but the product has only three. (p. 63)

Write a division problem where the quotient rounded to the nearest tenth and the quotient truncated to the nearest tenth are the same. Write a problem where they are different. (p. 77)

Use your calculator to determine whether 397 is divisible by 7. (p. 130)

If the dividend in a division problem is rounded up and the divisor is rounded down, what is the effect on the quotient? (p. 181)

If you cut a cardboard tube, you will find that it is a parallelogram. How much cardboard is used in a tube if its length is  $4\frac{1}{2}$  inches and its circumference is 5 inches? (p. 245)

All of these problems require logic and reasoning to solve and illustrate how the calculator could be used as a tool in solving math problems, but the students needed the conceptual and procedural knowledge before they could utilize the power of the calculator. Some of the problems addressed different functions of the calculator, but all of them involved the students in applying their mathematical knowledge to solve problems. None of the problems

provided step by step directions for the students to follow to practice using the function keys of the calculator, as did the majority of *Addison-Wesley's* calculator activities.

Calculator Activity supplements for each chapter were provided in *Glencoe's* Technology Master resource book, and each one of those activities was designed to teach the students how to use the calculator and to reinforce concepts taught in the chapter. For example the calculator activity that went with chapter one instructed the students on how to use the power key,  $y^x$ , to evaluate expressions with exponents. This activity included simple expressions like  $5^4$ , open sentences like  $n^3$ , and a challenge problem:

What is the highest power of 2 that the calculator will display before it gives and error message? (p. 1)

There were activities on finding the mean of a given set of data, rounding quotients to the nearest hundredth to answer questions, using the pi function to find the circumference of circles, changing fractions to decimals and determining if they were repeating or terminating decimals, solving equations, using the parentheses key, finding square roots, and using the % key. This is not an all inclusive list of activities that were presented in this resource book, but it does provide enough information to give the general idea of what these calculator activities were like. Every activity had a variety of problems in terms of level of difficulty like the examples presented for chapter one's calculator activity, and all of the activities provided instruction on how to use a function of the calculator, plus they reinforced a concept or skill that was taught in the chapter. *Addison-Wesley's* calculator activities that were provided in its resource materials were similar to these except the calculator functions were limited to the four basic operations, and eight out of the 14 activities that remained intact reinforced computational skills. Six of the activities did involve problem solving, and logic and reasoning, but all of *Glencoe's* supplementary activities involved the students in problem solving with at least one challenge problem.

*Glencoe's* Cooperative Learning Activities also involved students in using calculators to solve problems. Since each lesson contained a cooperative learning small group activity designed to fit that lesson's objective(s), the activities varied, therefore the example presented here was not necessarily representative of all the small group calculator activities. Stocking Up was a cooperative learning activity designed to involve students in division of decimals. A spinner was labeled with 6 different amounts of money from \$0.50 to \$2.00, and groups of three players were given \$15.00 worth of stock for the group to share. Group members took turns spinning the spinner and determining the value of their groups' stock and their individual share after each spin. All group members had the option of individually cashing in their shares before the next spin, and if a member cashed in his

/her shares then the remaining players had to recalculate the groups' worth before continuing play. The goal was to have the most valuable share after twenty spins (p. 77).

This activity involved the students in a simulation of a real life use of mathematics, and it provided opportunities for problem solving decision-making, logic and reasoning. Calculators were used as they would be in real life, and the activity provided students with a reason for learning to compute using decimals. The independent practice section of this lesson provided practice on the procedure of dividing decimals, and this calculator activity provided an application for that skill and served as a motivational tool. Students were expected to discuss their decisions of cashing in or spinning and the element of luck or chance connected this probability lesson. *Addison-Wesley's* calculator activities contained one partner game compared to at least fourteen activities in the *Glencoe* series that involved small groups of students in calculator activities.

The analysis of *Glencoe's* use of calculators in mathematics instruction indicated that calculators were incorporated into all parts of the lesson, and they were used as an instructional tool. These activities also support that experiences with problem solving tasks was an integral part of the instructional lesson, and calculators were just one tool that could be utilized in the problem solving process. *Glencoe's* textbook provided more opportunities to use calculators in mathematics instruction than *Addison-Wesley*, and *Glencoe's* instructional materials provided a broader experience in using calculators. The majority of *Addison-Wesley's* calculator activities were designed to teach students how to use the calculator or to reinforce computational skills. *Addison-Wesley's* calculator activities were limited to a four function calculator while *Glencoe's* were developed for the TI-80 scientific calculator which had statistic and algebraic functions in addition to the basic four functions.

Again the most significant differences between the two textbooks was in their instructional focus and curriculum content. *Glencoe* used calculators to enhance the students experiences with mathematics and to involve the students actively in problem solving so that the students could develop and construct conceptual knowledge as well as procedural knowledge. *Addison-Wesley* used calculators to supplement instruction after students had mastered the procedural information in the lesson, and the calculators activities mainly focused on showing the students how to use the calculator rather than on application. Students practiced calculator skills that were taught just like they practiced computational skills that were taught; the only difference was that the computation was not done on paper. The method of instruction used in *Addison-Wesley's* textbook removed all the problem solving challenges from the calculator activity, and all the students had left to do was copy and practice what the teacher or textbook instructed them to do.

A comparison of textbooks' computer materials. As the baseline data indicated Pleasant County had invested in a computer lab for each school that was designed to provide computer assisted instruction in mathematics, and in the 1993-94 school year this lab was still being used for this purpose. There were no computers in the mathematics classrooms, and there were no computers available in the building that could accommodate the software recommended by *Glencoe's* instructional materials. *Glencoe's* instructional materials contained two different types of computer related activities. Eight word problems that made computer connections were incorporated in the independent practice problems, and there were three cooperative learning activities that involved students in learning about computer programs like spreadsheets.

The problems in the textbooks were designed to familiarize students with the BASIC computer language, the function of simple BASIC computer programs, and the use of LOGO software to write simple programs. These problems were dispersed throughout the book beginning with chapter one, and there was one in every chapter except chapters three, six, nine, eleven, and fourteen. Chapters one, three and fourteen contained cooperative learning activities that involved using computer software. Although the problems and activities were not plentiful, there were no such activities or problems in *Addison-Wesley's* daily instructional materials. *Addison-Wesley* did have four computer activities in the back of the teacher's manual that were designed to familiarize students with programming in both BASIC and LOGO, but these materials were suggested as enrichment activities and were not included in the student's textbook.

Both textbooks had a section of supplemental materials devoted to computers, but the materials were very different. *Addison-Wesley's* computer resource materials consisted of fifteen worksheets that could be used as follow-up to the four computer programming lessons. They consisted of worksheets, fill-in-the-blank questions, that provided students practice with the language symbols used in BASIC and LOGO programs. *Glencoe's* resource materials contained a book, *Teacher Guide for Software Resource Mathematics Application and Connections* which provided a guide for teachers in how to use software to teach mathematics and a lesson-by-lesson correlation of suggested software described as a two-page layout for each chapter that included a list of the software titles for that chapter along with the type of hardware required. In addition, each lesson in the chapter contained suggested software and computer activities.

In the introduction of the *Glencoe* materials, the purpose of computers in mathematics instruction was described in the following statement:

Manipulatives are also an important component of middle school mathematics. Students of all ages benefit from "hands-on" learning with

concrete objects, before moving on to more abstract representations. A computer is an electronic manipulative that can help students move from concrete manipulation to more abstract representation. (p. 1)

This statement indicated a definite shift in the use of computer technology for mathematics instruction from *Addison-Wesley's* instructional materials and from the school's current practices. In *Addison -Wesley's* materials computers were not incorporated into teaching mathematics but were used to enrich mathematics instruction by teaching the students to write four simple programs using BASIC or LOGO languages. In *Glencoe's* textbook twice as many of these lessons were included in the student's independent practice portion of the lessons, and the teacher's resource materials were devoted to helping teachers understand how computers could be used to facilitate mathematics instruction and to educate teachers as to what materials were available for this purpose.

A comparison of textbooks' assessment practices and recommendations. Analysis results of *Glencoe's* assessment materials are presented in this section and as in the previous sections a comparison to *Addison-Wesley's* assessment analysis results will be used to document changes. Presentation of *Glencoe's* assessment materials opens with the introductory statement included in the assessment portion of the Teacher's Handbook which immediately highlights a major difference between *Addison-Wesley's* and *Glencoe's* assessment materials. The introductory statement that summarizes the purpose of *Glencoe's* assessment materials for the teacher follows:

In **Mathematics: Application and Connections**, assessment goes far beyond requiring students to exhibit simple recall of facts and algorithms. In addition, they are expected to organize information, apply previously-learned information to new situations, explain why something is true, and make conjectures based on gathered evidence. (p. T14)

The analysis of *Addison-Wesley's* assessment materials revealed that 87% of test items focused on arithmetic procedures which indicated that the tests were designed to assess student recall of facts and proficiency with algorithms. In addition the only type of assessments recommended or included in *Addison-Wesley's* instructional materials were paper-and-pencil tests. There were alternate tests available in the resource materials that provided different formats of paper-and-pencil tests such as multiple choice, fill in the blank, or free response, but there were no alternative assessments suggested or provided. As stated in the baseline data section, the purpose of the assessment materials provided in *Addison-Wesley's* instructional materials was to evaluate students' procedural knowledge and computation skills .

*Glencoe's* instructional materials, like *Addison-Wesley's*, included assessments at the end of each chapter which consisting of a chapter review and a chapter test, but the *Glencoe* series also included a Mid-Chapter Review that could be used to assess students' progress on learning the first half of the chapters' objectives. In addition to these summative assessments *Glencoe* recommended the use of daily formative assessments which were provided in the wraparound section of the teacher's text under step 3 of the instructional plan, Practice/Apply. These daily assessments were titled Alternative Assessment and they were described in the Assessment section of the Teacher's Handbook in the statement that follows:

**Daily Assessment** The Teacher's Wraparound Edition contains an alternative assessment option for most lessons. Students' understanding can be evaluated through writing, modeling, or speaking activities. These provide methods for providing immediate feedback as well as motivation for students who are usually most eager to show what they know. (p. T14)

This same section of the textbook described other recommended forms of assessment that were contained in *Glencoe's* instructional materials, and the introduction to these assessment recommendations stated that these program features and components were designed to help students assess themselves and to guide teachers in assessment. *Glencoe's* description of the components and features follows:

**OPEN-ENDED PROBLEMS** Most real-word problems do not have a correct solution. Instead, there are usually many appropriate options. To help prepare students to become smart citizens, wise consumers, and good decision-makers, the text presents a variety of open-ended problems that require students to work cooperatively, think critically, and propose multiple feasible solutions to problems. The decision-making features help teachers to assess students' reasoning skills and evaluate their abilities to work effectively in groups.

**PORTFOLIOS AND JOURNALS** Besides direct observation another way to assess students' understanding is to periodically review portfolios of their work. Another effective assessment method is to regularly read students' daily journals in which they are required to record and reflect upon what they have learned. (p. T14)

All of these options for assessment were changes from the traditional paper-and-pencil tests that were provided in the *Addison-Wesley* materials, and another significant difference was *Glencoe's* recommendation that students assess themselves. In *Addison-Wesley's* instructional materials teachers were responsible for telling the students what they



needed to learn and for assessing their progress. Teachers were not encouraged to involve students in any self evaluation, and there were no recommendations included in the old instructional materials that pertained to student self assessment.

In *Glencoe's* resource materials there was a set of materials identified as *Glencoe Mathematics Professional Series*, and one of those books was titled *Alternate Assessment in the Mathematics Classroom*. The first section in the book addressed the need for alternate assessment, and the following statement briefly described that need:

Today, the school mathematics curriculum is changing again, and, as it changes, there is a growing need for alternate methods of assessment. The purpose of this booklet is to discuss how the curriculum is changing and what assessment methods are needed to monitor and measure the performance of students against the new curriculum standards. (p. 1)

This statement supports the conclusion that the curriculum content in the *Glencoe* instructional materials had changed from that in *Addison-Wesley's* instructional material, and that assessments provided in the *Addison-Wesley* materials were appropriate for its curriculum content as stated in the baseline data. It also supports that the types of assessment offered and recommended in *Glencoe's* series were different from those in *Addison-Wesley's* materials.

This Alternative Assessment information stated that traditional paper-and-pencil tests were the primary means used to evaluate student performance in mathematics, and that this practice was a natural result of a curriculum that was skill oriented. With the change of the curriculum from focusing on teaching computational skills to teaching higher-level thinking skills and problem-solving there was a need to change the method of assessment. Traditional paper-and-pencil tests were limited in what they could test and, therefore, were inadequate for measuring a student's performance to think mathematically, understand ideas, and solve non-routine problems. *Glencoe's* suggestions for alternative assessments were briefly described in the introductory material presented above, and details and recommendations to teachers for how these assessment strategies should be used were provided in the *Alternate Assessment in the Mathematics Classroom* book.

In addition to all the alternative assessment suggestions and materials, there was also a set of Evaluation Masters included in *Glencoe's* resource materials. This set of supplemental materials contained alternate formats for paper-and-pencil tests, and there were two Multiple-Choice Tests, two Free-Response Tests, two Quizzes, one Cumulative Review (Free response) and one Cumulative Test (Multiple choice) for every chapter in the textbook. Using the same analysis process that was applied to the *Addison-Wesley's* assessments a comparison of the percentage of the test items that was devoted to problem

solving will be used to document any change in the test materials. An analysis of the test included in the textbook at the end of each chapter provided the following data: The range of total test items was 18 with the least number of test items being 15 and the most being 33. The mean number of test items was 21, and the mode for the number of test items was 20. The number of word problems per test ranged from five to twelve and the percentage of problem-solving tests items ranged from 21% to 60%. The mean number of problem-solving test items was 26%, and the mode was 35%. A comparison of the two textbook's test item analysis is presented in Table 20.

Table 20 reveals that on average *Glencoe's* tests had fewer test items, but a higher percentage of those test items were problem solving items. Since assessment was designed to match the instructional materials, these data support that problem-solving had a stronger emphasis in *Glencoe's* instructional materials than it did in *Addison-Wesley's*. Also the word problems included on *Addison-Wesley's* test matched the chapter's computation objectives, and since *Glencoe's* textbook did not focus on computational objectives, the word problem test items were related to the concepts in the chapter and were not categorized by operations or problem solving strategies. Thus, *Glencoe's* assessments involved the students in interpreting data, planning a strategy, implementing the strategy and examining their solutions. As in the analysis of *Addison-Wesley's* assessment materials four random samples of assessment word problems are presented as support for this conclusion.

Table 20

A Comparison of *Glencoe's* and *Addison-Wesley's* Test Item Analysis

Number of Test Items	<i>Glencoe</i>	<i>Addison-Wesley</i>
Range	18	25
Mean	21	29
Mode	20	26
Percentage of Problem-Solving Test Items		
Range	39%	18%
Mean	26%	7%
Mode	35%	6% and 7%

The first example provided is from chapter seven, *Integers*, and the last word problem on the test follows:

31. **Allowance** Ming is supposed to receive an allowance of \$25 each month. However, for each day he forgets to take out the garbage, his

allowance decreases by \$2. Ming forgets to take the garbage out three times during October. Find the amount of his allowance for October. (p. 293)

[The second example is from chapter 11, Ratio, Proportion, and Percent]

20. **Economics** Analysts predict that the minimum wage in the year 2000 will be 130% of the 1991 wage, which is \$4.25. What is the predicted minimum wage for the year 2000? Round to the nearest cent. (p. 451)

[The third example is from chapter 5, Applications with Fractions]

20. Kate found a  $\frac{1}{3}$  off sale. About how much did she pay for a \$39.95 golf jacket and a set of \$18.65 sweats? (p. 217)

[The fourth example is from chapter 3, Statistics and Data Analysis]

15. The prices of 50 pairs of shoes at a local shoe store are recorded in the table [that follows].

a. Find the mode, median, and mean.

b. Which average would the manager prefer to quote to a cost-conscious customer?

Price	Pairs
\$10	6
\$20	17
\$30	15
\$40	9
\$50	3

(p. 123)

All of these problems required the students to reason and apply their mathematical knowledge to find solutions. The problems did not provide key words to indicate what operation was needed to solve the problem, and most of the problems were multiple step problems that could be solved in more than one way. Whereas, all the problems selected randomly from *Addison-Wesley's* materials were low-level one-step routine-type word problems. Although these were application problems, they posed little challenge and focused on assessing or reinforcing computation skills. Thus, even the paper-and-pencil assessments provided in *Glencoe's* instructional materials had changed from those used in *Addison-Wesley's* materials in design and focus.

The following highlight the changes in assessment that were documented in this analysis:

(1) *Glencoe* recommended and encouraged teachers to involve students in self assessment. *Addison-Wesley* did not.

(2) *Glencoe* recommended and encouraged teachers to use alternative forms of assessment, i.e., observation, interviews, projects, demonstrations, presentations, portfolios, journals, and authentic assessment. *Addison-Wesley* did not.

(3) *Glencoe* recommended and provided suggestions for alternative daily assessments as a part of mathematics instruction. *Addison-Wesley* did not.

(4) *Glencoe*'s supplemental materials provided more assessment materials for teachers to choose from than *Addison-Wesley*.

(5) *Glencoe*'s paper-pencil tests focused more on problem-solving than *Addison-Wesley*'s, thus they contained fewer problems.

(6) *Glencoe*'s assessment materials recommended the use of calculators. *Addison-Wesley*'s did not.

#### Conclusions documenting change in mathematics instruction 1993-94: artifacts.

This analysis provided evidence that the newly adopted instructional materials for the 1993-94 school year incorporated changes in curriculum content, instructional practice, use of technology, and assessment practices, and these changes were all based on the recommendations of NCTM *Standards*. The focus of instruction moved from computation to problem solving. Mathematics content was no longer segmented with a focus on teaching isolated arithmetic skills; instead, mathematical concepts were connected to one another, and the content was connected to the real world. *Glencoe*'s instructional materials encouraged teachers to move away from teaching by telling and strongly suggested that students be provided opportunities to be active participants in learning mathematics. Learning mathematics no longer meant just memorizing arithmetic procedures; students were expected to construct relational understanding by actively participating in problem solving situations. Peer discussions and interactions, and whole group discussions were essential elements of mathematics instruction.

Paper-and-pencil practice, although still a part of mathematics instruction, was not the sole method of teaching or learning mathematics. Hands-on activities which involved students in reasoning, decision making, investigating, explaining and justifying their solutions, and problem solving strategies were a regular component of mathematics instruction. The goal of mathematics instruction was for students to develop conceptual and procedural knowledge rather than just demonstrate mastery of procedural knowledge. Therefore, teachers were encouraged to use alternative types of assessments in their daily instruction. It was suggested that teachers observe their students, listen to their explanations, have them write summaries, make comparisons, demonstrate their understanding through projects, and provide opportunities for peer interaction through small group classroom

activities. Calculators, computers, and videos were all suggested as essential tools for learning mathematics, and their use was incorporated throughout the textbook.

In addition to the newly adopted textbook, other artifact and interview data verified that funds were spent to purchase mathematics instructional aids. Manipulatives such as base ten blocks, fraction kits, and geometry materials were purchased as well as classroom sets of calculators. In the next section interview data related to these new instructional materials is presented to further document changes in methods of mathematics instruction for the 1993-94 school year.

#### Documenting Change in Mathematics Instruction 1993-94: Interview Data

The next set of data provides reflections from the participants as to how the implementation of *Glencoe's* instructional materials, the availability of manipulatives and calculators and the activities of the V-QUEST Lead Teachers effected mathematics instruction that year. The presentation begins with the former Principal describing the changes that he saw take place in mathematics instruction during the 1993-94 school year and sharing some of his efforts to encourage these changes:

Interviewer: One of the goals of V-QUEST was to improve mathematics education; as Principal did you notice any improvement in this area?

Former Principal: Definitely in that ah, because we started purchasing materials that were needed. We started I reckon targeting money that was needed. There weren't a lot of any real math materials. Within a year every math teacher had a classroom set of calculators. Prior to this, I think, there was maybe a set for the entire school. Every classroom started having more manipulatives that were being used so there was definitely more material available to the teachers. . . . There was less teacher talk and more hands-on. It really got better. Ah, I would have to say as I looked at it, it probably was happening in both grade levels; eighth grade really came around faster than anybody else. Where it was a lot of cooperative learning. It was a lot of just students actively involved in learning. Seventh grade there was at least a pocket there where it was still a traditional lecture. They turned their eyes away from Mr. [former Principal's name] while you're in there doing an observation. The other eighth grade teacher really bloomed as a teacher. Attended the writer workshop. It was amazing to watch the growth in this person. Here was a person that had been a very traditional math teacher, and suddenly because, I think, of that and some other things, she was willing to take the summer with [teacher of the South West Virginia Writing Project],

and the next year started incorporating writing in the math classroom, and those kids really benefited from that. Sixth grade ah, split thing.

Interviewer: Was that [name of the eighth grade teacher]?

Former Principal: Yes, yes [name of the eighth grade teacher]. It was just amazing to watch the growth occur. Again, she had been a very traditional, for lack of a better way of putting it, high school teacher and she suddenly became, again for the lack of a better way of putting it, a good elementary teacher. (p. 10)

The female eighth-grade teacher's comment adds supporting evidence that her instruction changed. Her comment follows:

I probably never did projects up until maybe two years ago, and I still don't do as many as I would like to; they have done one this year, but of course that is partly because I wasn't here, and last year I think my students did two during the year, and I had plans for at least one more this year, but I really like to do those because a lot of the students have art interest, or science interests that, you know, if I show them, a way that they can tie the two things together sometimes it makes them a little bit more interested. (p. 11)

When the former Principal was asked if he had noticed any changes in the area of assessment, he made the following comment:

Former Principal: It was really interesting because suddenly students were being assessed in away that it was real life. Instead of isolated book skills and theory you would see groups outside doing things measuring, estimating, ah, I mean it was amazing to watch how suddenly classrooms expanded beyond the four walls, and it was a lot of estimation. I tell you if this floor tile is twelve inches how many floor tiles will cover this distance? Newspapers coming in and assessing students in again the real life application of it. Not textbook, not some bought assessment. It became to me more real life skills that would be an application where the kids were going to use it. (p. 10)

In the next interview exchange the former Principal describes specific changes that he noticed in 1993-94:

Yeah it started getting real interesting. Suddenly it was more current practices. It was material being ordered that very definitely lent themselves to cooperative learning situations. Suddenly teachers were wanting tables in their rooms instead of desks. Ah, there had been a good deal of growth for

them for a couple of years and the corner had been turned. I think teachers were really at a point that they were ready to take it to the next level.

Interviewer: You mentioned cooperative learning. Did you see cooperative learning taking off more in the mathematics classrooms as an instructional technique?

Former Principal: It was really interesting to watch because the first year I was there about the best description I could give, and I was in the classroom observing, was traditional high school teaching, and that's not a put down to high school teacher. It was very much lecture. You could almost set your calendar to what day of the week it was as to what was going on in the classroom. If you were in there on a Friday it was going to be test. If it was a Thursday it was going to be a pre-test. If it was Monday it was introduction. I mean that part was very traditional approach to education by the time I left— there's a difference between chaotic noise in the classroom and learning noise, and teachers were really starting to have learning noise going on in their rooms. I watched one of the pockets of resistance the last year, students actively making models of things in the science classroom. The mess that it involved, and it was really neat to watch the change both in the teacher but more in the students, I think, in getting wired up and just really excited about learning, and it wasn't that way before. (p. 17)

Interviewer: Did the amount of funding for mathematics education change during this time?

Former Principal: Other than what I could free up, no. It didn't improve at all. (p. 12)

Interviewer: Did attendance to conferences change?

Former Principal: Probably from the first two years. . .there was increased participation. Suddenly other teachers were asking, What about this conference? How about this one? It was where I felt like the faculty was really looking for ways to expand their background and their expertise. There was one group of teachers that made a presentation at the Middle School Conference one year but I don't remember what year it was.

Interviewer: Did the amount of materials in the professional library increase after V-QUEST?

Former Principal: Probably not. (p. 13)

During the 1993-94 school year the County administration had encouraged the development of business partnerships for all the schools by pairing each school with a local

business that had indicated its willingness to participate in a school/business partnership program. In the next comment the former Principal shared how Pleasant Middle School's business partnership developed:

We developed a very strong partnership with Appalachian [Appalachian Electric Power Company] in particular. They really became true partners. Some of the other business partnerships were more fringe players. There wasn't the active involvement we got from Appalachian. . . .I talked with Appalachian you know, we didn't want them to spend money, you know, we wanted a true partnership. We wanted their involvement. . . .I would like to think that I encouraged the businesses that we had identified for us to be partners. We tried to use them at awards assemblies. We tried to invite them in for lunches, just anything to get them in the building. (p. 14)

The former Principal also took an active leadership role in encouraging parent involvement with Pleasant Middle School, and in the following statement he talked about how he tried to get parents into the school and how involvement with the V-QUEST program had facilitated these efforts:

. . . I've always been one that wanted parents in the building. I think it was probably one of the hardest things for the parents at [Pleasant] Middle School to get accustomed to. Ah, I wanted them there. I wanted them actively involved. It never got to the point that I wanted it, but it was better than it had been. Ah, parents were willing to help out financially. They were willing to support some changes, and I think it was maybe the two things coming together: my approach to it, plus V-QUEST, plus the lead teachers all of that, that parents suddenly stated realizing we were serious that we did want their input. We valued what they had to offer. We had Principal's coffees once a month where the parents could come in and meet with the Principal and the faculty, and there were days that we would have one or two parents. And there were days that would have a dozen plus. We picked up a lot just from those coffees. Ah, had a parent advisory group, and they would meet on a monthly bases, and again, we didn't talk just little piddely things, we really got into some things that were impacting on the school. I know that as a group they purchased some equipment there in the library for us. They really became an active part. So, I think it grew during those three years. (p. 15)

Artifact evidence that supported the former Principal's claim that he had always wanted parents in the building was provided in the school's scrap books which contained



clippings of Pleasant Middle School related newspaper articles, and copies of school/home communications for each school year. In the 1991-92 scrapbook there was a clipping of an article about the Parent Advisory Group and parents and community leaders are invited to join the group's monthly meetings by contacting Pleasant Middle School's guidance counselor.

The Principal describes the interactions with local universities and colleges in the interview exchange that follows:

Interviewer: You mentioned utilizing the local universities and colleges, did you have any programs that were on going at [Pleasant] Middle School that supported any of your educational programs?

Former Principal: At that point no. . . .Probably not. Probably the open communication would be in the last two years [ 1994-95 and 1995-96]. . .

(p. 15)

Interviewer: Was there more discussion about mathematics reform? Was it a topic that came to light?

Former Principal: Yeah, I think it was. I think it was a thing, that suddenly questions were being asked and I know that [the mathematics lead teacher] was suddenly being asked more and more by faculty— What about this? I want to see how you're doing ah, whatever, and it's just that, I think, the topic and conversation suddenly started coming around more toward it.

Interviewer: Do you think you had any math teachers that were models for mathematics reform?

Former Principal: [Named both eighth grade mathematics teachers] again the special Ed department. I would have to say, again, were the ones that just seemed to leap out at you. [Special Education Teacher], really once she made the switch from Ed program to the LD program it was amazing to watch her approach to things, and I know she spent a lot of time with [both lead teachers] ah, just picking their brains. (p. 18)

The end of the year survey results that were shared by the science lead teacher indicated that Pleasant Middle School's faculty did not see the outcomes of the first year's reform efforts quite as positively as their Principal. Following is the Lead Science Teacher's comment concerning the end of the year survey results:

Now our teachers, with the survey after the first year of V-QUEST. We did a survey, and everything, and they [the faculty] really didn't feel like a lot had been done for them, even though we did exactly what they wanted, asked us to do, which was to put notes in their mailboxes and pass things around

and give them money, but they really did feel like not very much had been, I think maybe this next year they feel like more has been done. We have tried to include all the teachers that teach science, even our special Ed teachers, and I have given them the SOLs for next year, and they have used the science SOLs to order their equipment, and I have taken the equipment to the LD teachers and the ED teachers, and I even took science books down to our EMH classes for everybody to kind of teach science. (p. 4-5)

The former Principal made the following comment as he talked about working with his V-QUEST Lead Teachers during the 1993-94 school year:

. . . Trying to keep that spirit that was there at Clinch Valley alive. A lot of frustration were starting to creep into it. That feeling that maybe from the top down it wasn't viewed as something important . . . (p. 8)

Interviewer: Were you encouraged, did the County do anything to encourage your involvement in V-QUEST reform initiatives?

Former Principal: **NO**.

Interviewer: Do you think the lead teachers were encouraged to work for change? Do you think it was supported?

Former Principal: I would hope that they were. It was being supported ah, for my part I tried to do everything I could again, from the County's part I would have to say **no**. It wasn't supported from the top. (p. 12)

Using the former Principal's words, frustration was beginning to creep into the V-QUEST reform movement. Although the teachers were funded for release time, no other County funds were available for materials, for conducting staff development, or for bringing in outside presenters. As the interview data from the lead teachers and the former Principal indicated, their efforts to reform were met with resistance, and the biggest negative reaction from the faculty was to staying after school for inservice. Most of the mathematics faculty had been teaching math for over twenty years, and the majority of those teachers had been at Pleasant Middle school for their entire careers. They indicated that they did not need or want to stay after school for someone to **tell** them how to teach. This not needing anyone to tell them how to teach may not have been so much resentment of the lead teachers as it was resistance to change, but none the less their attitude was perceived as resentment by the lead teachers.

#### Conclusions Documenting and Tracking Change During 1993-94

The artifact and interview data presented collectively document that the State, County and school were actively involved in the V-QUEST reform initiative to improve instruction

in mathematics, science and technology. The State designed and implemented the reform program that was funded by the National Science Foundation. The County made a five-year long commitment to the program and encouraged and supported the school's involvement in the program. At the school level the Principal and selected math and science teachers participated in the lead teacher training program and acted as agents of change to promote reform initiatives during the 1993-94 school year.

At the State Level administrators worked to improve mathematics instructional materials, assessment materials and practices and curriculum. At the County level lead teachers were expected by the County administration to be active leaders of reform, and released time was provided for the County's lead teachers to work together to plan and implement reform initiatives and to provide a strong support group for the reform agents. Community awareness was essential to the success of educational reform in mathematics, and the County's Superintendent was an advocate of and a spokesperson for V-QUEST. The County administrators organized and implemented a school/business partnership program, and the County's administrative contact became the coordinator for the Administrative Component of the V-QUEST reform initiative.

At the school level the Principal encouraged and supported the lead teachers by freeing up funds to purchase instructional materials, and acting as a coach and advisor to the lead teachers. The lead teachers conducted needs assessments for their respective disciplines, and they secured funding for instructional materials necessary for conducting hands-on type instruction. The mathematics lead teacher conducted workshops on the use of VA PEN as an instructional tool, created and organized a mathematics resource room which included the following materials purchased with his own money: the three *NCTM Standards (Curriculum and Evaluation, Assessment, and Professional Standards)* and *AIMs* materials which provided instructional techniques for integrating mathematics and science education through hands-on small group activities. The mathematics lead teacher acted as a consultant to the fellow mathematics teachers in the building, and modeled the integrated hands-on student inquiry approach to mathematics instruction for any teacher interested in observing this method of instruction.

The interview and artifact data also indicated that during the 1993-94 school year classroom sets of calculators, manipulatives, and new textbooks were purchased for mathematics teachers. As documented the *Glencoe* mathematics textbook was designed to match the recommendations made in the *NCTM Standards* for improving mathematics education, therefore these instructional materials encouraged a change of pedagogy and curriculum content. Five components for changing mathematics instruction were in place at this time: (1) The new textbooks provided instructional materials that were based on the

NCTM *Standards* and encouraged and provided support for teachers to change the content of their instruction, their instructional strategies, and methods of assessment. (2) Manipulatives and calculators purchased for the mathematics teachers at each grade level. (3) Two V-QUEST Lead teachers were in place to support and lead the reform of mathematics instruction. (4) The administration supported the lead teachers' reform efforts by funding professional development and providing released time for lead teachers to plan and work together. (5) The Principal took a leadership role and supported the efforts of his lead teachers.

A half-day inservice on how to use *Glencoe's* instructional materials for effective mathematics instruction was provided by the *Glencoe* textbook company, and a few weeks before school started all but two of the mathematics teachers indicated that they participated in this training, but they did not receive their new instructional materials until after school started in August 1994. There were no other inservices provided for the mathematics teachers concerning the use of cooperative learning or the newly purchased mathematics manipulatives. There were no workshops or inservice provided on how to plan and implement interdisciplinary instructional units, how to use the alternative type assessments provided with the *Glencoe* series, or how to design questions or activities to promote higher level thinking. The teaching teams had been mandated by the County administration to create at least one interdisciplinary instructional unit per semester, but only the eighth grade lead teachers provided evidence that such an instructional unit existed during the 1993-94 school year.

The new instructional materials recommended that computer technology be used in two ways to facilitate mathematics instruction: (1) using basic or logo computer languages to write computer programs, and (2) using instructional software to develop, reinforce and apply mathematical concepts. The Josten computer system that was in place during the 1993-94 school year did not provide facilities that could meet either of these objectives. The WICAT computer system did not have the capability of running any of *Glencoe's* suggested software or student written programs. All the student lab terminals could do was provide access to the system's individualized instructional materials. Therefore, the use of computers in the 1993-94 school year for mathematics instruction did not change but continued on as remedial type, individualized computer assisted instruction in a lab setting.

Mathematics classes were still only 45-minutes long which was a time frame that was not conducive to the inquiry-based hands-on activity oriented instruction recommended by the NCTM *Standards* or the new *Glencoe* instructional materials. The County had designed a Common Core Mathematics Curriculum based in the NCTM Standards, but the state's 1988 Standards for Learning were still in place, and methods of assessment

designed to match those standards had not changed. Although the new instructional materials encouraged the use of calculators for mathematics instruction and the investment of educational funds for the purchase of new mathematics instructional materials provided every mathematics teacher access to a classroom set of calculators and manipulatives, State and County assessments still focused on documenting mastery of computation skills and procedural information.

Given the limitations of the 45-minute class period, the available computer technology, the lack of training or inservice desired by or provided for the mathematics teachers, and the fact that neither the Division or State Levels' assessment materials or practices, or curriculum guides had changed, it is unlikely that a great deal of change occurred in the actual methods of instruction used for mathematics education during this transition year. However, every mathematics teacher was aware of the recommended changes; they had access to instructional materials that matched NCTM recommendations for reform, and they had access to calculators, manipulatives and the resources which were provided by the mathematics lead teacher. The mathematics teachers had the encouragement and leadership provided by an enthusiastic Principal and two V-QUEST trained lead teachers and knowledge that the State and County were actively engaged in a systemic reform movement.

From June 26 to July 1, 1994, Pleasant Middle School's two lead teachers attended the one-week follow up Lead Teacher V-QUEST Institute at Sweet Briar College. For middle school mathematics the content of this institute was focused on Alternate Forms of Assessment, Problem Solving, Leadership and Change, and Software. A document titled "V-QUEST Lead Teacher Possible Roles and Responsibilities" was included in the lead teachers' materials, and this document contained the five functions that the lead teachers and their Principal had developed goals and specific tasks for the previous summer. At least four hours of time was provided in the institute's schedule for the lead teachers and their Principal to update and develop plans to meet the goals identified as relevant to the needs of Pleasant Middle School. The Pleasant Middle School lead teachers regretted the loss of their enthusiastic, and supportive Principal, but they were optimistic as they waited expectantly to meet their new Principal for the administrative portion of their one week institute, but no administrative representative or communication from Pleasant Middle School arrived at Sweet Briar. Pleasant Middle School's two lead teachers were abandoned during the summer of 1994, and their disappointment showed in the lack of progress made on updating and planning reform initiatives for the coming 1994-95 school year.

### Documenting and Tracking Change in 1994-95

Documentation of change data for the 1994-95 school year will begin with a continuation of what was happening at the State Level concerning the revisions of the 1988 Mathematics Standards of Learning and pertinent to tracking the State's involvement with the V-QUEST Systemic Reform initiative. After the information about changes at the State level is presented, documentation of two significant changes at the Division and School Levels will be presented: (1) a new Division Level reform movement, Restructuring the Middle Schools, and (2) a new Principal at Pleasant Middle School. All of these changes had the potential to affect the progress of V-QUEST reform initiatives and to impact the changes being tracked through the interim years; therefore, after the data pertaining to these changes are presented, new initiatives by the lead teachers and documentation related to changes that are being tracked will be presented. As in the previous sections the participants voices will be used to convey the story as much as possible for the 1994-95 school year.

#### Documenting and Tracking Change at the State Level in 1994-95

Interview and artifact data will be used to document State Level changes that were taking place in mathematics curriculum. A brief summary of the events that had taken place in the revision process of the state's mathematics curriculum in the previous year will be presented, and then interview data from two State Level administrators, the leader of the revision process and a participant in the writing of the revisions will be presented to document the changes that were taking place at the State Level concerning mathematics curriculum. This information will be followed by interview data and artifact data to document that the State was still actively involved in the V-QUEST reform initiative during the 1994-95 school year.

#### State Level: Change in Mathematics Curriculum

As the Principal Mathematics Specialist had indicated in the presentation of the 1993-94 data, the proposal for the Common Core of Learning Curriculum was withdrawn in 1993, and educators from all across the State were involved in the process of rewriting Virginia's 1988 SOLs. During the summer of 1994 a draft of revisions for the SOLs was completed, and the interview data from the State Department's Principal Specialist K-8 presented next provides a description of what was happening in the SOL revision process at the beginning of the 1994 school year. This interview evidence is triangulated with the interview data from three other sources (1) the State Department's Secondary Principal Mathematics Specialist, (2) the Leader of the SOL revision process who was the

Coordinator for Mathematics for Fairfax County, and (3) the AEL Training Team Leader who served on the middle school Mathematics SOL revision team.

The Principal Specialist K-8's summary of the activities that took place in the revision process for the State's SOLs during 1994-95 year begins with activities in the fall of that year, and her account of the events follows:

They [SOL revision committee] had a meeting in October, I do know, and I attended that, and they were asking for feedback on that document, and people did give their feedback. Then ten regional meetings were held across the State, maybe eight or ten and ah, the ah teachers, administrators and so forth were asked for feedback at those regional meetings. They were held in the winter, like January and February of 1995 and then finally the Math SOLs were approved in the spring of 1995 by the Board of Education. So, that's sort of the process. The Math Standards did not meet with too much concern. (p. 3-4)

Next the State Department's Secondary Principal Specialist for Mathematics describes the events that took place in the 1994-95 school year regarding the revision process for the Mathematics SOLs in greater detail. Her summary of the events follows:

We came out with a draft in October following, what we called, a technical review process where we sent the document to higher education faculty for a technical review. We also sent the document to all the professional organizations in mathematics for feedback. It was only after we got feedback from the mathematicians and the professional organizations that really the first draft was presented to the public in October and indeed went to the Champion School Commission for review, and they essentially endorsed the document in October with a few editorial changes.

Ah, we went to the Board of Education in November, and we received ah, praise for the document on the first review, but ah, let's see was it November? I believe, yeah, and then by January after going through several stages, more or less, that involved the English and the History not the Math so much, but by January the document was made public by the Board for public hearings and public feedback, and we had ten, actually eleven, no we had ten public hearings in February and, I believe, the first part of March. It was in-between the months of January, February, and March that we had ten public hearings to get feed back, and then we took that feed back, and made revisions to the Standards and went back to the Board of Education, and then ultimately, the Board approved the Standards in June of 1995.

Now there were, many, several Board meetings in-between say November and June 95 where we discussed the Standards— and we gave up-dates, but there were little, there was little change to the Mathematics Standards between November and June. There were some editorial changes made, but simply the content that was presented in November was the content that was approved in June. The document does represent a consensus of the mathematics educators in the State as well as the special interest groups. (p. 2-3)

The description of what happened with the revision of the Mathematics SOL process during the 1994-95 school year was provided by the leader of that process, the Mathematics Coordinator for Fairfax County, included details concerning the technical review mentioned by the Secondary Principal Mathematics Specialist, as well as a summary of the events that preceded the State Board of Education's approval of the document in June of 1995. His statement concerning these events follows:

Ah, that fall [1994] we took that first draft and ran it by the State Department of Education, the Champion Schools Commission and the State Board of Education. The State Board reacted to that and gave us some additional recommendations—things they wanted us to go back and work on some more. So over that next school year we never got the whole big group back together, but we invited ah, the team leaders of the different groups back together, and we reacted to the recommendations from those groups, and essentially produced the second draft. That second draft was then distributed fairly widely, and there were public hearings, and there were hearings at, I think one public hearing at each of the ten State districts.

Interviewer: Or regions?

Coordinator for Mathematics Fairfax County: Regions, right, and there were other groups. We sent them to Virginia Counsel of Teachers of Mathematics, and VEA and the Virginia Supervisors Group, and the Math Coalition, and we got this second round of, of feedback ah, and then periodically went back to the Board, and we were discussing the items, and the feedback we got, and the Board wanted to know how everything was reacted to, and we pulled the team leaders together for the third time, and did what was essentially the final draft, and then went back to the Board that was in spring, late spring, and the Board took their final look at it, and actually gave final approval at a meeting in June of the second year. (p. 3-4)



The AEL Training Team Leader who was involved in writing the new SOLs provided a brief description concerning the timeline of the review process for the revised Mathematics SOL document stating, “. . .the public hearings were during the fall and early spring 94-95 ah, the State Department approved them June of 95” (p. 8). Her concluding remarks about this process follow:

Ah, I was very pleased with the mathematics SOLs. I felt very good about it. . . . I think [it] was a really, really good piece of work when we finished, and that seems to be ah, what I’m hearing from across the State. Ah, that most people feel like that of all of the revised Standards of Learning, that the Mathematics Standards of Learning probably were the, ah—I’m not sure exactly how to ah,— they were the, probably the, the most constructive and well written. Ah, there were very few changes that were made ah, either through the State Department, through the Board of Education ah, almost everything that was in the SOLs originally by the writing team remained in the SOLs. . . . (p. 4)

The corroboration of the four different sets of interview data substantiate that the State was actively involved in revising the mathematics curriculum during the 1994-95 school year, and the publication of the *Standards of Learning for Virginia Public Schools* by the Board of Education Commonwealth of Virginia in June of 1995 provides conclusive evidence as to the results of this process. This evidence also establishes that during the 1994-95 school year the 1988 *Standards of Learning Objectives for Virginia Public Schools* were still in place, and that the methods of assessment had not changed.

#### State Level: Change in V-QUEST Reform Initiative

The fact that one-week and two-week V-QUEST Lead Teacher institutes were held during the summer of 1994 indicated that the State was still involved with the NSF funded systemic reform movement; the one week institutes were follow-up experiences for the 1994 lead teachers and the two-week institutes were for newly selected lead teachers. Assessment was one of the major topics for the one summer institute, and the K-8 Principal Mathematics Specialist indicated that she had prepared and conducted some assessment workshops for the V-QUEST institutes that were held at Hollins College (p. 26), and she elaborated on the assessment goals and materials that she had helped create for the V-QUEST Lead Teacher training institute:

. . . the primary V-QUEST focus was that when we’re [assessing] we need to collect evidence of student learning through many different forms. . . we were saying you need to use all of these methods to collect evidence of

student learning, but we focused on that one [authentic assessment] to say this is a new one that perhaps you haven't tried, or you aren't using. . . (p. 22)

The Secondary Principal Mathematics Specialist interview data also indicated that the State Department remained involved with the V-QUEST Systemic Reform initiative. Her comments also support the assessment work described by K-8 Principal Mathematics Specialist. Her statement concerning this information follows:

Well through, you know through V-QUEST ah, the assessment component did develop some sample alternative assessments, and they have been distributed to the lead teachers. . . (p. 10)

Conclusive evidence to support that the K-8 Principal Mathematics Specialist did work on developing these assessment materials for the V-QUEST Lead Teacher Program was provided by artifact data supplied by the mathematics lead teacher. He had a copy of these materials which were provided in a three-inch V-QUEST notebook. The notebook contained materials for a three hour staff development workshop which were created by the K-8 Principal Mathematics Specialist and a Core Team Member Region Representative of the Virginia Department of Education was titled Enhancing Assessment Methods as a Means to Improving instruction: Developing a Scoring Rubric for a Performance Task.

The Associate Specialist for the State Department also provided data that indicated that the State was still involved in the V-QUEST systemic reform initiative. She described her position at the State Department as instructional media and training and more specifically the division that handled textbook adoption. She and a fellow employee of the State Department of Education had spent three years developing a criterion reference evaluation instrument for evaluation of instructional materials, which was not adopted by the State of Virginia, but was adopted by 1995 in the states of South Carolina, West Virginia, Florida, Ohio, and Kentucky (p. 9-10). Although this evaluation instrument was not adopted at the State Level its distribution to the lead teacher participants was sanctioned by the State for the 1994 and 1995 Lead Teacher Summer Institutes. The Associate Specialist briefly described her involvement with V-QUEST in the comments that follow:

I did present at the Lead Teacher Institutes so, I don't think there's too much anybody could do to squelch distribution so far. I mean this was certainly with the understanding at the Department of Education that materials would be distributed upon request, and certainly that last summer of the Lead Teacher Institute they were with full knowledge of the administration. Its just that they were not used for the adoption process at State Level. (p. 10-11)

### State Level: Conclusions

Although the State was actively involved in the V-QUEST systemic reform initiative and revising the state's Standards of Learning, the fact remains that during the 1994-95 school year all that had changed for the teachers at Pleasant Middle school were the instructional materials (new textbooks and access to calculators and manipulatives), the availability of the services of the lead teachers, and their Principal. The mathematics lead teacher was aware that the revision process for the 1988 Mathematics Standards of Learning was taking place because as a lead teacher he had worked on editing and revising the draft of the middle school SOLs, and he talked about the process in his lead teacher interview, saying:

My understanding is. . . I know they meet for a week or a weekend at some camp and worked on these things. Again, it seemed to me, that the focus was from the Northern Virginia Schools, there was this coalition of schools that started this. It seemed like it was the bigger Northern Virginia schools that did it, and then they passed it out to the smaller schools.

Interviewer: The Drafts?

Mathematics Lead Teacher: Yeah the Drafts, and said do you agree with this? And we worked on that together at V-QUEST. I worked on the draft for the middle school SOLs. I remember them bringing in those big stacks, and we were asked to edit, and make comments on the drafts. I think some things were moved, like objectives moved up or down to different grade levels. Now, I don't know that anything was rewritten based on our suggestions— I still think when we got those drafts “the draft” was the document and that whatever we said wasn't used. (p. 4-5)

The lead teachers' comments indicate that he was aware that the 1988 SOLs were revised during the 1994-95 and that he was given an opportunity to edit the draft of the revised middle school SOLs before the document was sent out for the public hearings. His comments also indicate that he felt decisions were made by the larger Northern Virginia Schools and handed down, and that the smaller schools **really** had no say in the content of the SOLs. Although the State had made an effort to include all the school divisions in the revision process, and the leader of the revision process had extended **two** invitations to all school systems to participate in the process, and the process provided multiple opportunities for **all** the stake holders to have input into the new mathematics Standards of Learning, there was a note of resentment in the lead teacher's words as he said, “. . . it was the bigger Northern Virginia schools that did it, and then they passed it out to the smaller schools” (p. 4). His comments indicate that he did not feel empowered, and he did not believe that the

lead teachers nor the Pleasant County teachers were truly a part of the curriculum revision process.

There were several other comments made by the mathematics lead teacher to support this conclusion. When asked if there had been any professional development opportunities offered or teacher inservice planned to help teachers become familiar with and implement the new SOLs he said, “State mandates and changes for implementing SOLs, they said—these are it, **do it**” (p. 10). While talking about the State Departments’ expectations for the new SOLs he said:

I think they’re trying to make all the— all the school systems in the State should be teaching the same thing, so once a kid from [Pleasant] County goes to Northern Virginia he will have mastered the same topics. . . . There is no way [Pleasant] County can compete with Northern Virginia School Systems. We don’t have the students. We don’t have the population. We don’t have the **money**. . . . If you don’t meet the Standards then you [school system] get no money. . . . Teachers will be held accountable. I guess, they’ll be in danger of losing their jobs, if their students don’t meet those Standards. School systems are suppose to be held accountable with exit tests. (p. 6-7)

The mathematics lead teacher was a knowledgeable professional who had been given more than one opportunity to participate in the revision process of the state’s Mathematics Curriculum. The Secondary Principal Mathematics Specialist pointed out that the all school divisions were offered an opportunity to participate in the revision of the 1988 SOLs because one of the problems with the Common Core of Learning was that it was seen as an in house State Department project, and that was not the perception they wanted to convey with the new SOLs. Systemic reform by definition is bottom up reform with top down support, and the sentiments expressed by the mathematics lead teacher convey that he perceived that reform was being handed down and that teachers were being pressured to comply with the State mandates.

#### Documenting and Tracking Change at the Division Level in 1994-95

This section opens with a brief description of V-QUEST related activities at the Division Level and is followed by details concerning the Division’s Middle School Restructuring Project initiated at the beginning of the school year. An explanation of how and why the Restructuring the Middle School Project was initiated by Pleasant County’s Administration is followed by a summary of the activities of the Restructuring Committee, and, last, a description of the changes that resulted from this project are presented. Interview

and artifact data are interspersed to document and track change throughout the 1994-95 school year.

#### Division Level: Change in the V-QUEST Reform Initiative

The Director of New Initiatives stated that the V-QUEST Lead Teachers were funded for two days a month release time during the 1994-95 school year, but that the job of coordinating the V-QUEST Lead Teacher activities was passed to the Gifted Resource Teacher K to 5. The following comments taken from the Director of New Initiative's interviews explained the change of leadership:

. . . I don't have any responsibility to work with those teachers, and that's too bad. Ah, **truly** that V-QUEST stuff should have been placed with a curriculum person, but it wasn't. It was not, and so I feel like I'm was out of the loop as far as V-QUEST in our County. . . (p. 23). . . . We tried to have something once a month that first year, and the second year [1994-95] [name of the Gifted Resource Teacher for K to 5 ] took it over, and she also meet with them, not once a month, but kind of (p. 21).

The Lead mathematics teacher stated that the Gifted Resource Teacher K to 5 went into the elementary schools and worked with the TAG students and with the elementary teachers, and he commented, ". . . she is part TAG and part V-QUEST Lead Teacher Coordinator or whatever. . . . She does her job, **jobs**" (p. 9)!

The Gifted Resource Teacher for K to 5 had previously been an elementary school teacher in Pleasant County, and in the summer of 1993 she was trained as an elementary V-QUEST Lead mathematics teacher; in November 1993-94 she assumed the position of Gifted Resource Teacher for K to 5 for the County. At the beginning of the 1994-95 school year she was given the additional responsibility of coordinating the V-QUEST Lead Teacher activities. The following comments provided a brief summary of the leadership she provided for the lead teachers.

[Name of two other Pleasant County elementary teachers] and I did many inservice where we, some of them we made deals with, if we purchased, if we used V-QUEST money to purchase a class set, because we had about thirty some teachers, we could do that [purchase] one for each teacher, and then for instance the Lego man, would come in and do the training for nothing. So we did that in a number of different ways, introduced to them Domino Math and the AIMS books, and some of the things we had seen there [at V-QUEST], but also some, not just some cutest things, we introduced methods of teaching that were a little bit different. . . . [Coordinator of New

Initiatives] has been wonderful to fund anything that we felt like we needed to go and see. I know moneys were given to [Pleasant] County Elementary Schools, and I was in on the ordering, giving some advice, on ordering some things and [Elementary School] was real good, every time they had an inservice they included [Another Elementary School's] faculty in on that. (p. 9-10)

Neither of the middle school V-QUEST Lead Teachers, nor the new Principal made any reference to Countywide V-QUEST Lead Teacher meetings during 1994-95 school year, and there was no artifact documentation of release time for the middle school lead teachers for V-QUEST related activities. When the mathematics lead teacher was asked if there had been any follow-up sessions for the V-QUEST Lead Teachers during the 1994-95 school year he said, "No" (p. 22). The only comment made by the science lead teacher concerning County level activities related to the curriculum work they had started the previous year to eliminate the overlapping of activities. In reference to the progress of that project the science lead teacher stated:

. . . last year I had pneumonia and was in the hospital and didn't get to do everything I wanted to do, but I've tried to consistently put things in the mail boxes or pass around memos and do whatever, and the feeling that we had was to wait until the [new] SOLs came [and] to take our overlapping notebook and incorporate it at that time. (p. 30)

There were no other references to County level meetings or activities involving the middle school lead teachers during the 1994-95 school year in the science lead teacher's interview data.

The Gifted Resource Teacher K to 5 who was responsible for the County level coordination of the V-QUEST Lead Teacher activities described her educational background in mathematics as strong stating:

In college all of my electives I took in math, so I have, ah, they consider it, a math endorsement. I've recently been looking into going into getting a masters in with a math related field. In fact it's just this summer I'm looking to start classes to do that, but basically math has always been my favorite subject, and that's what I've concentrated on when I've done team teaching. I do the math, and somebody else does the language arts; I do the social studies, and somebody else does the science, and that's what I, ah in fourth grade and fifth grade, that's what we're doing. (p. 1)

The Coordinator for the County's V-QUEST Lead Teacher's activities had a strong background in mathematics, but her concentration, experience and expertise were in

elementary mathematics education. The proposal for Restructuring the Middle Schools stated that the restructuring project was consistent with the County's continuing efforts to improve schools, and one of the on going reform initiatives listed was the critical years/critical skills program which focused on reducing the pupil teacher ratio in grades K-2 to improve basic reading and arithmetic skills. There were twenty trained lead teachers in the County, and of those, four were from two middle schools and the other 16 were from eight elementary schools. Since (1) the reform of elementary mathematics education was an identified goal for the County and (2) the coordinator for the County's V-QUEST Lead Teacher activities was an elementary curriculum person with a strong background in mathematics, and (3) an overwhelming majority of the V-QUEST Lead Teachers were elementary teachers, the V-QUEST Lead Teacher activities organized at the County level focused on the elementary schools.

The Superintendent talked about Division Level support for the V-QUEST Lead Teacher reform efforts in the interview exchange that follows:

Interviewer: The lead teachers took on extra responsibilities when they took on the role as a V-QUEST Lead Teacher, has the County or the system done anything to encourage these teachers to remain active or to stay involved and keep up with these extra responsibilities?

Superintendent: Certainly, I think, I met with them as a group on at least one occasion last year and commended them on their participation and encouraged them to continue to be that lead teacher and take advantage of opportunities regardless of V-QUEST or the status of V-QUEST, that we had a good beginning, and we'd like to see it continue. I guess, if anything we'd like to see more teachers get involved, and the leadership of that person to pull more people into their knowledge base and do more sharing. We had more sharing going on by some than others, and I encouraged all to get more involved. (p. 31)

Again neither of the lead teachers or their Principal mentioned any County level V-QUEST meetings during the 1994-95 school year, so if the Superintendent did indeed hold a meeting to congratulate the teachers on their work and encourage them to continue, it was not a memorable event. The evidence documents that the County's focus for the V-QUEST Lead Teachers was on developing and coordinating needed staff development for the elementary teachers, which left the middle school V-QUEST Lead Teachers without administrative support or leadership at the Division Level. However, the County administration was focusing intently on reform at the middle school level and the mathematics V-QUEST Lead Teacher was involved in the Division Level Restructuring the

Middle School Initiative. The next set of data provides details of this reform effort and the lead teachers involvement.

#### Division Level: Planning for Restructuring Middle Schools

The next section begins with information that explains why Restructuring the Middle Schools Project was initiated and how it was organized; this will be followed by data that document the lead teachers' involvement with the project and track its progress throughout the school year. The last portion of this section will document changes that resulted from the Middle School Reform Initiative. Three major sources of interview data are used to document the activities of the Division Level Middle School Restructuring Project: (1) the leader of the project, the Coordinator of Elementary and Middle School Instructional Programs, and two members of the Restructuring Committee, (2) Pleasant Middle School's Principal, and (3) the mathematics lead teacher. Interview data from Division and School Level participants are also used to provide evidence that the Restructuring Project was initiated during the 1994-95 school year. Artifact data provided by the Leader of the Restructuring Project, the Coordinator of Elementary and Middle School Instructional Programs, were used to document the activities of the Restructuring Committee, and those artifact data consisted of the following items: (1) the Restructuring the Middle School proposal created by the Coordinator of Elementary and Middle School Instructional Programs, (2) minutes of the committee's meetings [as available], (3) copies of handouts provided to the committee members, and (4) a copy of the committee's presentation prepared for the Superintendent and Division Level Administration.

Pleasant Middle School's mathematics teachers were in the fourth year of working in the constraints of a seven-period schedule, and although this schedule provided for daily team- and individual-planning times, it limited instructional periods to 45 minutes. The 45-minute class period was not compatible with the hands-on activity, student-inquiry-based methods of instruction advocated by the mathematics reform materials. This schedule still included the non-graded extended-learning class which was not necessarily focused on SOL related curriculum content, the 15-minute advisory (CARE) time and 10 minutes for Channel-One programming. The merits of the seven-period schedule were coming into question, and its disadvantages were beginning to outweigh its advantages.

In addition to the instructional limitations of the seven-period day, it was an expensive program, and by the year 1994-95 enrollment in the middle schools had dropped from about 1000 students to 600 students at each school. This decrease in student population equaled a reduction in capital resources received from the State for education. The administration wanted reform in mathematics education that resulted in improved



student performance on the ITBS Standardized Mathematics Tests, and reduction in spending or reallocation of resources was essential. A proposal for Restructuring the Middle Schools created and provided by the Coordinator of Elementary and Middle School Instructional Programs indicated that the results of a Quality Assessment Plan survey, an assessment questionnaire completed by teachers, documented the need for curriculum restructuring. So, in October 1994, the Superintendent scheduled a joint meeting of the two middle schools and announced the need for the two faculties to work together to Restructure the Middle Schools.

The Coordinator of Elementary and Middle School Instructional Programs who served as the leader of the Restructuring Project described the beginning of the process as follows:

. . . [the Superintendent] called me in and talked about it , and from there, um he decided that, that the starting point would be a meeting. A joint meeting with the two faculties, and that the way it would be presented to them was, um, you know, this is your opportunity to envision and plan for middle school education in [Pleasant] County for the next century because it is a process that takes time. I guess the emphasis was that the physical facility would not be designed until the two schools felt comfortable with a, not identical but shared program, and that the program was dynamic and, um, sound enough that the program needs then would drive the needs of, of the physical plan so that instead of building a Building and then adapting your program to whatever building you built that it would be the reverse and that was kind of where I came in. So I , I did all the logistical kinds of things to get the first meeting set up and then after the first meeting I kind of took care of the facilitating the process. (p. 2)

In the following statement Pleasant Middle School's Principal described how the Superintendent introduced the Restructuring the Middle School Project to the County's two middle schools. His description follows:

...[the Superintendent] scheduled a meeting with the joint faculties back in October, and ah, you know, kind of presented his for vision for, you know, building a new facility down the road, and then more importantly, I guess, getting a program in place— the best possible program for kids so that when we do have the opportunity to build something, you build around the program verses building a building and fitting the program in the building. . . . some brochures were distributed to get people interested in serving on joint committees and things like that. Committees were formed and [The

Coordinator of Elementary and Middle School Instructional Programs] kind of headed that up, and she called the first meeting, and then we just started talking. (p. 5-6)

The mathematics lead teacher's description of the beginning of the Restructuring the Middle Project supports the accounts provided by both the school's Principal and the Coordinator of Elementary and Middle School Instructional Programs. He stated that he learned about the Restructuring Program sometime in the fall at a meeting that [the Superintendent] called for the middle school teachers. He explained how he got involved:

At the meeting in October we had a form to fill out to sign-up for a Restructuring Committee, or a Beyond the Boundaries Committee, and the form that we filled out stated that we would meet probably once a week, but it didn't say six month, three months, or how long it would be, but she did say, [the Coordinator of Elementary and Middle School Instructional Programs] did say, that it would be intense. . . the whole purpose of the committee— was to meet with the other middle school so we could combine our ideas: what works for us and works for them, and put them together so we could have a new middle school. . . . I thought we were working on the **new** middle school, and **actually** we were working on restructuring both of the **old** middle schools, and I guess working toward a common ground on a five year cycle. (p. 2)

The Superintendent of Pleasant County referred briefly to the Middle School Restructuring efforts while talking about financial support for reform. Although his statement does not provide details concerning the Middle School Restructuring effort it does support that under his leadership it was a reform initiative that was taking place in the County. He said:

Reform wasn't set aside in the budget as just a line item: it's intertwined throughout the budget with respect to our overall plan because the budget really is your instructional plan, but with money in terms of dollars, and our instructional plan built around you know a five or six year effort as an incremental approach with respect to. . . you've got the Middle School Restructuring Project going on, use of time which involves staffing. So. what you will find, for an example, throughout the budget are examples of restructuring embedded in textbooks, in personnel, in curriculum development, and staff development and various line items but in some cases you may see in a narrative explanation a reference to the restructuring but in may cases it's simply part of the on going plan for improvement. (p. 21)

The Associate Superintendent made a brief reference to the Middle School Restructuring Project that started in the fall of 1994. Her statement also supports that Restructuring the Middle School was a Division Level reform project. Here are her comments:

That is ah, last year we did the complete study of Middle School Restructuring, and we are continuing that, and some teachers are a little bit hesitant to become involved in that, I don't know whether it's the peer pressure so, we need to constantly encourage teachers to be apart of that. (p. 10)

Division Level: Restructuring Activities. According to the Lead Mathematics Teacher the first committee meeting was held on November 7, 1994. (He commented that he remembered this date because of a death in his family on that same day). His account of the first restructuring committee meeting and the progress made in the first several meetings follows:

. . . we discussed our mission statement. We discussed how to correlate that with the County statement, and I guess that after three weeks of discussing this we decided on a mission statement that we already had from [Pleasant Middle School]. . . added a couple of things to it about technology. (p. 3)

The Coordinator for Elementary and Middle School Instructional Programs said, “. . . November was when we really started meeting as a group, the committee” (p. 2). Her summary of the first few meetings follows:

. . . I thought it was important that they come up with a shared mission statement, and so we spent probably the first two or three meetings just talking about missions that, you know, about what we believed about early adolescent kids, and about how they're educated, and I, I passed out some articles. Just shared some articles, just general things and. . . they actually worked in groups. They put a bunch of stuff on charts, we'd put the charts up, they'd start crossing out things that were the same. . . and gradually we came up with a, a mission statement. . . . (p. 11)

Following is a list of articles provided at the beginning of the Restructuring process to the Committee members that were included in the artifact data:

- Carroll, P. S. (1995) John Dewey for today's Whole Language Middle School. Middle School Journal, 62-68.
- George, P. S. (1993) Tracking and ability grouping in the middle school: Ten tentative truths. Middle School Journal, 17-24.

- Hawkins, M. L . (1994) Untitled Manuscript. National Middle School Association

- (1992) Ten Sins of Grading. Teaching for Excellence, 12 (2).

Pleasant Middle School's Principal described the first meeting as a get acquainted session and as an opportunity to talk about what a middle school should be. His description of the progress made in the first two or three meetings follows:

We spent quite a few meetings just trying to figure out, you know, what, what a middle school ought to be. We're kind of in a, you know, get acquainted mode, talking about a mission statement. We built a mission statement, and then we had another meeting called downtown with the Principals, [the coordinator of the restructuring project], and the director of technology. . . . that kind of refocused the whole thing because we had, I think, that kind of increased the speed to which we were supposed to come up with something. (p. 8)

Minutes of the Middle School Restructuring Committee's November 21st meeting are included in the artifact data, and they provide documentation that supported the verbal accounts of the progress of the Middle School Restructuring Committee Meetings held in the month of November, 1994. The minutes contained a list of the twenty-four members of the committee, the vision/philosophy statement written by the group, a brief description of a 1990 AEL publication on restructuring middle schools that was shared with the group by one of the committee members, a mission statement created by the other Middle School and information concerning the next meeting that was to be held on December 5, 1994. A copy of the portion of the AEL publication, *Middle Schools in the Making: A Lesson in Restructuring*, that was copied for distribution to the committee members is attached to the minutes of this meeting. The next meeting was scheduled for December 5, 1995, and the committee members were directed to discuss the draft of the mission/vision/philosophy statement with their colleagues, to bring ideas about subgroups, schools to visit, publications to order, and professional development opportunities.

Minutes from the December indicated that the committee had reached a consensus on a Middle School vision statement, and it read as follows:

[Pleasant] County Middle School is dedicated to providing a student-centered environment in which all students will develop: a commitment to life-long learning; respect for themselves and others; social, emotional, and physical health; and , the academic and communication skills necessary to become a responsible citizen. (Communication to Middle School Restructuring Committee—12/4)

The minutes also included the topics that were discussed during this meeting, and they included the following items:

- Is our practice consistent with what we believe
- How best to inform and involve all the faculty in the process
- The need to be informed about the costs of bringing existing schools up to code in terms of wiring, safety and handicap accessibility
- The focus should be on identifying “best practices”; additions were made to the list of possible visitation sites to see these practices in action
- The need to be informed and discuss the theory underlying the practice
- The importance of using resources wisely—scheduling
- Ideas for voluntary study groups to be organized after the first of the year.
- Topics for subcommittees

The last three discussion topics were scheduled for future action. It was decided that a scheduling team from each building would work with [a JMU consultant] on January 18, 1995, who would introduce the possibilities available through parallel scheduling to the combined middle school faculties on February 21, with a day scheduled for follow up work with the scheduling teams from each building on February 22, 1995. Suggestions were made as to materials that might be used for the study groups, and a copy for the foreword and table of contents or descriptions of the publications were attached to the minutes of the meetings; these are also included in the artifact data. Those publications included the following:

1. Inspiring Active Learning: A Handbook for Teachers an ASCD publication
2. Curriculum Architecture: Creating a Place of Our Own an NMSA publication
3. NMSA publication about integrated instruction

The list of topics suggested for subcommittees included: assessment, organizational structures, parental involvement, teaching strategies, community involvement/support, building and sustaining instructional teams, and advisory as an integral part of the middle school program. The next meeting was scheduled for December 12, 1994; it was requested that members decide which subcommittee they were interested in and make suggestions for additional subcommittees.

The next documentation concerning the Restructuring the Middle Schools was dated January 30, 1995, and it was a letter from the Coordinator of the Middle School Restructuring Committee to the Principals and teachers of both Middle Schools. The letter stated that a draft of the restructuring plan prepared for the Superintendent was attached for review and that she had incorporated as many of the ideas discussed as possible in that plan. She asked for comments and suggestions on the draft, and she indicated that the middle

schools needed to work on the organizational structure of the program and prepare a written draft of that section for her within a week. The last paragraph of the letter stated that she had also attached a copy of chapter four, *A Middle School Curriculum*, from James Beane's (1993) *A Middle School Curriculum: From Rhetoric to Reality*, which she described as a "wonderful resource" that was consistent with our mission, beliefs, and the quality school model; she hoped everyone involved would have an opportunity to read and discuss it.

An abstract summarizing the contents and purposes of the restructuring plan was presented at the beginning of the proposal; that abstract follows:

This proposal outlines a plan for curriculum integration in the context of middle school restructuring based on recent research on teaching and learning, [Pleasant] County's Plan for Systemic Change and *Quality Assessment Plan*, and the *Quality Schools* model. Need for curriculum restructuring is documented by results of the *Quality Assessment Plan* survey conducted in October, 1994, statistical data, and an assessment questionnaire completed by teachers. The Plan establishes short- and long-term objectives, the methods and procedures necessary to achieve the objectives, and a time line for implementation. Budget estimates are also included. Consistent with the objectives, evaluation of the program will be based on results of the *Quality Assessment Plan* survey to be administered in October, 1994, documented observations, statistical data, and assessment of students' competencies in technology. (Draft of Restructuring Plan January, 1994)

Two specific components of this restructuring proposal were relevant to tracking and documenting systemic change in mathematics instruction at Pleasant Middle School; those areas were: (1) the current research on teaching learning, and (2) results of the Middle School Strength and Needs Assessment Questionnaire that was complete by the middle school teachers. The current research cited on teaching and learning was used to support the emphasis on an integrated curricular program for the middle school, and the results of the teachers' questionnaire indicated the teachers' professional development needs.

The proposal stated that the plan for restructuring the middle schools in Pleasant County was consistent with the following research on teaching and learning.

1. The growing number of disengaged learners who perceive little relevance in school has intensified the need of curriculum reform. Curriculum reform must be central to restructuring efforts (Beane, 1993; Jacobs, 1989).
2. Research suggests the human brain searches for patterns and interconnections to construct meaning. Optimal learning occurs in

environments that stress connections and relationships rather than establishing artificial boundaries between the disciplines (Burns, 1984).

3. When instruction shifts from a prescriptive, discipline-based focus to emphasis on “real-life” issues, problems, and skills, students become more motivated to learn and more actively involved in constructing meaning. Real curriculum integration occurs when students address personally meaningful questions (Beane, 1991, 1993).

4. Integration of curriculum enhances connection making, fosters in-depth understanding, and promotes mastery of the fundamental competencies and higher-order thinking skills that prepare students for the 21st century (Drake, 1993). (Draft of Restructuring Plan January, 1994)

As the abstract indicated, the plan for restructuring Pleasant County’s middle schools was consistent with Pleasant County’s plan for Systemic Change, which focused on reform in mathematics, science and technology, and the research on teaching and learning supported the need for reforming the curriculum. Although curriculum reform had been a focus in Pleasant County during the 1992-93 school year, it was just now in progress at the State Level, and subsequently would be happening again at the Division Level for all academic areas, including mathematics, in the coming school year. These research data also supported the need for reform of methods of instruction in the classroom, and a change from teacher-centered classrooms that focus on teaching mastery of isolated skills and facts to a student-centered classrooms that focus on making connections, constructing understanding, and developing higher-order thinking skills through the use of problem solving and real-life applications.

The results of the Middle School Strengths and Needs Assessment Questionnaire completed by the teachers in November of 1994 suggested that the teachers were interested in and needed professional development to:

1. implement integrated thematic units, differentiated instruction, alternative assessments, and writing across the curriculum, and
2. adapt curriculum and instruction to meet students’ learning styles with an awareness of multiple intelligences.

This information substantiates that professional development had not been provided in the past to enable or support teachers in making these changes in their instructional methods and that there was a need for professional development in these areas. When Pleasant County’s middle schools moved to the team concept, the teams had been directed to implement at least one interdisciplinary teaching unit each semester, but only the eighth grade mathematics and science lead teachers provided evidence of the use of

interdisciplinary teaching units. These data support the conclusion that although mathematics instructional materials that matched the goals of systemic reform were in place, little change in the methods of mathematics instruction had occurred in the building due to the lack of curriculum and assessment reform and professional development.

The next documented event in the Middle School Restructuring initiative was a meeting on February 1, 1995, with [JMU consultant] and teams of representatives from both middle schools which included the Principal, a guidance counselor, and a teacher from each Pleasant County Middle School. The group discussed scheduling options that would provide curricular opportunities appropriate for early adolescents, reduce teacher-pupil ratio, and maintain the integrity of instructional teams. On February 21, 1995, [JMU consultant] conducted a two hour after school inservice on alternate schedules. This inservice was held at Duncan Middle School for the faculties of both middle schools, and the purpose of the inservice was to familiarize the teachers with different models of block scheduling and educate them on the benefits of block scheduling. Examples of several block schedule options and a copy of *Restructuring Middle Level Schedules to Promote Equal Access*, which was written by Robert Canady and Michael Rettig, were included in the materials presented at this inservice

Block Scheduling was promoted as a means of ensuring quality programs and creating equity of access to improved programs for all students. The Restructuring Committee agreed that to create a climate for student-centered learning it was necessary to provide longer blocks of instructional time, reduce the number of class changes and retain common planning time for academic teams; therefore, schedule redesign was presented as necessary to expedite the quality of instruction. Using the ideas and information shared by [JMU consultant] the scheduling subcommittee developed a block schedule for Pleasant County's middle schools that was considered to be more effective for the delivery of instruction than the seven-period schedule that was in place. One of the middle school Principals pointed out that with this new block schedule the amount of instructional time for seventh and eighth grade mathematics doubled; therefore, we could not go on doing business as usual. He stated that the seventh and eighth grade teachers must be committed to changing methods of instruction, that there must be a willingness to change and paid time for training. The block scheduling proposed for the middle schools was intended to :

- Target language arts and mathematics
- Encourage and integrated curriculum
- Support varied instructional strategies
- Provide a time structure adaptable to activities of interest to, and planned in cooperation with, students



- Accommodate varied learning styles in an environment of more selective teaching modalities
- Retain the Lead Teacher concept as an available option
- Meet the orientation needs of students coming to middle school and preparing them for the transition to the high school. (Principal presentation to committee)

The proposed block schedule provided for four 90-minute blocks, one of which was to be used for team and individual teacher planning. With this schedule the extended learning class was eliminated and, therefore, the need for additional personnel, but there were some draw backs to the proposed block schedule. Since there were only four instructional blocks in the day and there were four academic subjects and exploratory classes to be scheduled, two subjects had to become semester classes instead of year-long classes. The County had focused on improving student performance in mathematics and language arts; therefore, science and social studies were selected to become semester classes. Another draw back to this form of block scheduling was increased class sizes; due to teaching three blocks of mathematics a day instead of four, eight to ten students would be added to each class.

At the February 28th Restructuring Committee meeting the Coordinator told the committee that the Superintendent wanted to hear from the committee next Tuesday. The Coordinator explained that the Committee had to plan a presentation that would provide a conceptual overview with specific details concerning the work done on scheduling with [JMU Consultant]. She emphasized the importance of presenting the details of and the need for the four-block schedule clearly to the Superintendent. She suggested that they support it with [JMU Consultant's] information and a notebook of articles that focused on the major elements: interdisciplinary units and making connections. The presentation was to be made by the Principals, assistant Principals, and guidance counselors from each middle school and one teacher from each grade level. The committee decided to start the presentation with the committees' Mission and Beliefs Statements, and two sixth grade teachers to created a Power Point presentation for this purpose. This was to be followed by a presentation of the proposed four block schedule and its supporting data, and it was decided to conclude the presentation with an overview of the Committee's plans for subcommittees, and the staff development needs.

On March 7, 1995, the proposal for restructuring the middle schools was presented to the School Board, and after school on March 14, 1995, the presentation was made a second time for the faculty members of both middle schools and any other faculty members in the County who were interested in learning about the plans for restructuring the middle

schools. The agenda for this presentation was rearranged, but the content of the presentation remained as the Committee had planned. The presentation opened with Visualizing the Possibilities, which included the Committee's Mission and Beliefs statements. This was followed by a section about restructuring instructional practices, and supporting professional development; scheduling priorities and the proposed four-block schedule were presented last by the lead mathematics teacher and the Principals of the two middle schools. At the end of the meeting the Coordinator of the Restructuring initiative extended an invitation to the middle school teachers to join a subcommittee and get involved.

While talking about the presentations made by the Committee the Coordinator of the Restructuring Committee stated, “. . .the people who presented were nervous about it. They wanted to do a good job. They wanted, you know, they wanted it to be positive” (p. 9). As the Principal of Pleasant Middle School talked about his faculty's response to restructuring, he referred to the committee's presentation saying:

Well I think there's still a whole lot of them, even after we made our big presentation, and we were real pleased with how that went and everything, but there's still a whole lot of them uncertain, I think, of just how drastic the change would be. (p. 9)

The next Restructuring Committee meeting was held on March 22, 1995, at Duncan Middle School, and after the successes of the two group presentations were discussed the Coordinator of the Restructuring Committee explained that their next tasks were to finalize their work on developing the subcommittees and prepare to make their presentation to the Board of Supervisors. This presentation was significant because once the County Administration agreed with and supported the restructuring plan the Superintendent had to secure funding for the initiative through the Board of Supervisors; according to the two year budget included in the restructuring proposal at least \$40,000 was needed for staff development and technology hardware and networking equipment.

#### Division Level: Middle School Restructuring Changes

By the end of March the Restructuring Committee was ready to separate into subcommittees, and at a whole-County presentation the Coordinator of the Restructuring Committee distributed a list of the Restructuring Sub-committees and encouraged teachers to sign-up for one. She said, “. . .I mean it was an open invitation for people to get involved” (p. 6). Seven Restructuring Sub-Committees were developed with the expectation that members would be drawn equally from both middle schools, and that the Sub-committees would be co-chaired by representatives from each middle school. The list of the seven recommended sub-committees and accompanying brief descriptions of the

committees' tasks which follow was taken from the sign-up sheet distributed at the whole-County presentation.

- Use of Time: Explore and evaluate the effectiveness of innovative scheduling options
- Technology: Determine what technology is currently available in both middle schools; how to best utilize available technology; prioritize technology needs, cost associated with implementation, and recommended time line; and work with district's Technology committee to communicate and coordinate technology effort
- Parental Involvement and Communication: Improve parental involvement and establish PTAs or comparable parent organizations at each school; improve communication between homes and schools; organize opportunities for parents to receive programmatic information, participate in the decision-making process, and evaluate the effectiveness of the schools' curricular and instructional programs; and develop volunteer programs in both schools
- Evaluation: Work with experts to develop and implement assessment instruments and analyze data to evaluate various elements of the curricular and instructional program
- Staff Development: Identify, coordinate, and evaluate professional development opportunities consistent with the program objectives for middle school personnel
- Articulation: Identify how the middle school program fits into the framework of the County's K-12 program and plan for articulation across levels
- Community/Public Relations: Identify ways to get public input, facilitate communication with the community, and address public questions and concerns.

While talking about the progress of the Restructuring Committee the Coordinator stated that she had typed up the list of members for the subcommittees (p. 6), and that the Restructuring Sub-committees were scheduled to meet after school on Mondays for the rest of the school year. There were no written records of those meetings available for documentation, but the Coordinator of the Restructuring Committee talked about the activities of the Restructuring Sub-committees in her interview stating that some were more active in the 1994-95 school year than others. She stated that the Staff Development and Technology Restructuring Sub-committees completed tasks essential to the restructuring efforts during the last part of the 1994-95 school year. She explained that the Staff

Development Sub-committee had worked to prioritize the kinds of staff development needed, and they had made decisions concerning the recommendations that were made for the best types of staff development and the best times to offer them to teachers. The Coordinator stated that the Technology Sub-committee inventoried the technology in the middle schools and completed a technology needs assessment which they prioritized for the recommendations made to the district's Technology Committee as to what technology was essential and what technology they would like to have in available in the middle schools (p. 17).

The Pleasant County Coordinator of Elementary and Middle School Instructional Programs described her job responsibilities as they related to the middle school for the 1994-95 school year in the statement that follows:

. . . in terms of the middle school my primary responsibility was to begin to unify the program so there would be more consistency between the two middle schools. So, much of my time last year [1994-95] was spent ah, facilitating conversations between the two middle schools that then resulted in changes in scheduling. (p. 1-2)

The four-block schedule was approved for implementation for the 1995-96 school year, and stipends for summer work on curricular units were approved by the School Board and funded by the Board of Supervisors (Coordinator of Restructuring Process, p. 18).

#### Documenting and Tracking School Level Change in 1994-95

One of the biggest changes at the school level was the appointment of a new Principal at Pleasant Middle School. During the previous year the V-QUEST Lead Teachers were encouraged and supported in their reform efforts by a knowledgeable Principal who provided enthusiastic leadership. He participated in the V-QUEST training program and voiced his support to the County administration as well as to his teachers. He actively pursued and worked to develop a business partnership and to increase community and parental involvement in the school. He secured funding for new instructional materials, and he encouraged his lead teachers to share their knowledge concerning methods of instruction and instructional strategies with the rest of the faculty. Nearly all of these efforts ceased when he left.

The lead teacher activities begin with documentation of inservice and workshops that he prepared and conducted during the 1994-95 school year, and, although none of these workshops were conducted in his school, the Pleasant Middle School mathematics teachers were invited to attend any and all of the workshops. For this reason the information is presented under at the school level. Also, since the purpose of this section is to document

and track change in the V-QUEST Lead Teachers' activities at the school level, data concerning the new Principal at Pleasant Middle School will be included in the school level activities of the V-QUEST Lead Teachers. The Principal's support and leadership were essential to the success of the reform efforts initiated by the lead teachers, therefore his knowledge of the recommended mathematics instructional reforms and commitment to the V-QUEST systemic reform initiative were significant pieces of information for tracking the progress of the V-QUEST Lead Teachers' activities at Pleasant Middle School.

#### School Level: Lead Teacher Activities

The mathematics lead teacher stated that he continued to provide VA-PEN inservice training during the 1994-95 school year. He recalled that he conducted four or five workshops for elementary schools in the County and for teachers in an adjoining County. He could not provide the exact dates of these workshops, and since the workshops were conducted on his own time after school and he was not compensated in any way for his time, there were no artifact data available to document this information. The participants in these workshops were not participants of the study; therefore, there were no interview data available for support, either. The mathematics lead teacher stated that the workshops were designed to teach teachers how to use VA-PEN and how to use its resources to supplement mathematics instruction, and that during the workshops he helped teachers set up accounts, provided hands-on training concerning access to VA-PEN, and introduced them to mathematics educator discussion and idea sharing groups and mathematics resources such as the Math Pavilion, and the Puzzle Corner.

There was a good reason why the mathematics lead teacher did not conduct this workshop at his school: limited access to VA-Pen. There was one computer located in the school library that was equipped with a modem, and there were only two phone lines for the entire school; therefore, the equipment needed for conducting a hands-on VA-PEN workshop for the faculty was not available at Pleasant Middle School. The Principal of Pleasant Middle School during the 1994-95 school indicated that VA-PEN was not used very much at Pleasant Middle School due to access problems. He stated, ". . .we need more phone lines, and computers" (p. 3). The librarian described the situation while talking about use of the Internet and telecommunications. She stated, "It's [telecommunications] difficult right now, to go in through, we have to go through VA-PEN, and it's difficult because we never can, the access is not there right now" (p. 2). With at least eight teachers sharing a common planning time, two full-time administrators, two guidance counselors, two full-time office personal, students scheduled into the library during each class period of the day, and access to VA-PEN dependent on a free telephone line and limited to one computer,

access to VA-PEN for the faculty of Pleasant Middle School during the school day was almost nonexistent.

In addition to the VA-PEN workshops, the mathematics lead teacher indicated that he had also prepared two or three problem-solving workshops that he conducted for Pleasant County's elementary schools in March of 1995, and again, since the workshops were conducted after school hours, there were no artifact records of release time available to document the dates of these presentations, but the Coordinator of Elementary and Middle School Instructional programs did mention in her interview that the mathematics lead teacher made presentations to the elementary schools on problem solving during the Share Fairs that she had organized for Pleasant County's elementary schools during the 1994-95 school year (p. 3).

The mathematics lead teacher stated that he had also worked on writing a grant proposal with one of the V-QUEST Mathematics Trainers from Virginia Tech to fund a two-day summer workshop for the County's mathematics teachers, and the Coordinator for New Initiatives stated:

Last summer [1995] a number of the teachers in the County attended some inservice workshops that [Virginia Tech V-QUEST Trainer] put on, and I was in charge of that, but see I don't think anyone from [Pleasant] Middle School did that. (p. 15)

Interviewer: Ah, I think [seventh grade mathematics teacher] did.

Coordinator of New Initiatives: Well, [seventh grade mathematics teacher] did. You're right. (p. 15)

While discussing her lesson plans, the seventh grade mathematics teacher talked about where her ideas for her instructional activities originated; she referred to the class that [Virginia Tech V-QUEST Trainer] taught for the County saying, "I will make one more comment. Being in [Virginia Tech V-QUEST Trainer's] class at Tech last summer, I certainly gained a lot of ideas" (p. 4). Although the mathematics lead teacher prepared and conducted workshops and inservice during the 1994-95 school year to share knowledge and instructional strategies and techniques that had been promoted by the V-QUEST reform initiative, there was no evidence that any of these activities were connected with the efforts of the County's V-QUEST Lead Teacher program. As a matter of fact, while the Coordinator for the lead teacher Activities for the 1994-95 school year, the Gifted Resource Teacher K to 5 talked about the activities of the V-QUEST Lead teachers for the 1994-95 school year she stated:

. . . You know, I know [name of the Mathematics V-QUEST Lead Teacher] does a lot of things in his classroom, but I don't know about inservice and things like that. (p. 9)

It is possible that the mathematics lead teacher was selected by the County administrators to participate in developing and/or conducting staff development opportunities for the County because he was trained as mathematics lead teacher, but none of these workshops or inservice were arranged or organized by the person responsible for coordinating the V-QUEST Lead Teacher activities. The mathematics lead teacher's response to a question about additional responsibilities supports this conclusion, and that interview exchange follows:

Interviewer: Do you have more responsibilities as a lead teacher?

Mathematics Lead Teacher: Yeah [unenthusiastically].

Interviewer: You want to tell me a little bit about them?

Mathematics Lead Teacher: Well I'm not so sure about the lead teacher, but it seems like that anything that comes along that is new, and they want somebody to try it. They stick it to me. Like this Internet thing, and what else has happened?

[pause] The grant writing proposal.

Interviewer: The grant writing that you were involved in, were you selected by the office of that or did—

Mathematics Lead Teacher: —[The Coordinator for Elementary and Middle Instructional Programs] did it.

Interviewer: You were hand picked?

Mathematics Lead Teacher: Yeah. (p. 2)

Although the mathematics lead teacher did not conduct any inservice or workshops for his own school, he did continue sharing information and ideas by circulating written memos of new materials that he had placed in the mathematics resource room such as the NCTM (1995) *Assessment Standards*. He also stated that during the 1994-95 school year he interacted with two of the sixth grade mathematics teachers; the interview data that described this interaction follows:

Interviewer: Have you been observed teaching?

Mathematics Lead Teacher: Observations by—

Interviewer: —by anybody?

Mathematics Lead Teacher: No. **Oh**, some of the sixth grade teachers have.

Interviewer: Oh really, they come into your room and—

Mathematics Lead Teacher: —last year towards the end of the year. I think that's why [names of two sixth grade mathematics teachers] started coming

by my room. . . they are free fourth block, so they come in here to see what I do. Sometimes they just walk in and walk around for a few minutes and leave and other times stay half the block or most of the block depending on what we are doing. (p. 22)

The sixth grade teachers indicated that they interacted with the mathematics lead teacher and that he shared instructional materials, ideas and knowledge with them regularly, but they did not provide any data that could be used for triangulation purposes to document that they observed the mathematics lead teacher modeling methods of instruction. The available evidence supported that the mathematics lead teacher spent more time sharing ideas and working with the two sixth grade mathematics teachers than he did with the seventh or eighth grade mathematics teachers.

The purchase of new mathematics instructional materials needed for hands-on activity based instruction that was started during the 1993-94 school year by the needs assessment conducted by the V-QUEST Lead Teachers and their Principal was continued during the 1994-95 school year. Interview and artifact data document these purchases and its support by the new Pleasant Middle School Principal. The mathematics lead teacher stated:

We had \$4,000 to spend, and I probably spent \$2,000. Title One [money]— so we bought all the Title One kids a kit that has a protractor compass and a straight edge, and I don't know what else. We got twenty of those so the kids can check them out. (p. 16)

Although there was no uniformity or organization to the record-keeping system for the purchases made, the following artifact data supported that about \$4,000 worth of mathematical instructional materials were purchased during the 1994-95 school year. Several types of artifact data (i.e., invoices, copies of County purchase orders, canceled checks or copies of documentation that a check was drawn from a particular account to pay for a given invoice) were used to document who was responsible for ordering the materials, what materials were purchased, and the cost of those materials. Some artifacts provided more details than others, but all the details available are presented in Appendix X. These artifact data verify that \$3,793.15 were spent during the 1994-95 school year on mathematics instructional materials, and the records indicated that the mathematics lead teacher was responsible for spending over \$2,000 of that money.

The science lead teacher also indicated that the new Principal provided financial support for the purchase of materials needed to conduct hands-on instructional lessons in the classroom. Her statement follows:



Then our new Principal came, and I introduced myself, and I said I am the science V-QUEST teacher here, and I am the one who will be bugging you about the money for the science department. That is how I introduced myself. And he helped with money last year and this year, but I don't think if I hadn't mentioned V-QUEST, I don't think, we would have just naturally acquired any money. (p. 10)

Interview data from both lead teachers and their Principal indicate that the Principal made site-based funds available for the teachers to purchase materials needed for hands-on instruction. The data also indicate that the teachers selected the materials and completed the purchase orders for the Principal's approval. The Principal did not suggest what supplies should be purchased nor was there any indication that he denied a purchase.

When the new Principal was asked about purchasing mathematics instructional materials, he stated:

Well I think textbooks definitely would have to go through central office, school board approval, through the adoption process, but other things if the teacher felt like something would be beneficial, they probably give a requisition to get something.

Interviewer: Say the sixth grade teachers decided they needed a set of base ten blocks—

Principal: OH, we would get them. (p. 13)

Later in the interview the Principal stated:

Well, since I came, last year we spent roughly one-third of our site based money on that [mathematics instructional materials]. . . . [Last] year we gave math \$4,000 out of Title-One money. Title-One teachers purchased that, and it would be for math manipulatives and stuff. We got quite a bit of it. Now, software we don't have very much. (p. 15)

While discussing the procedures followed for making purchases of instructional materials, the mathematics lead teacher stated:

If I need something I order it. I mean it goes through the office and [the Principal] sees what I buy, and he just signs the purchase order. Major material would have to be approved by [Associate Superintendent] I guess. (p. 14)

According to the Superintendent, the Principal had control over how the school's site-based funds were allocated, and the portion of the Superintendent's interview that explained this follows:

Interviewer: If the teacher, if the math teacher needs something to make instruction in the classroom more effective is there some procedure they follow to get funds for this resource?

Superintendent: Well, again we have a site-based funding situation where they can make their case to the Principal, and he can allocate funds for different projects within the school. (p. 30)

The interview data support that the purchase of the mathematics instructional materials requisitioned by the teachers required the Principal's approval, which therefore indicates that the Principal approved of and supported the change of instructional methods to student-centered hands-on activities. The list of purchased materials also provided evidence that the availability of hands-on related mathematics materials increased for all three grade levels during the 1994-95 school year, but the staff development portion of this section indicated that the middle school mathematics teachers had not participated in any staff development or workshops pertaining to the use of these materials or to changing their methods of instruction by the end of the 1994-95 school year.

#### School Level: Change in Support for Lead Teacher Reform

Data in the Division Level V-QUEST section for this year provided evidence that the middle school lead teachers no longer had the support of the County's cohort of lead teachers, or administrative support or leadership in their reform efforts. During the one-week V-QUEST summer institute no administrator attended the administrators' sessions with the middle school lead teachers, and therefore the middle school lead teachers had not worked on their reform goals for the 1994-95 school year. When the new Principal was asked if he had participated in any mathematics education/reform leadership workshops or conferences he said, "No, I did go to a couple of V-QUEST meetings" (p. 13). He stated, "Actually I went to a V-QUEST meeting at the Principals association three years ago and talked to them. It was a very broad based explanation of V-QUEST and listed the systemic change it was after. Specifically for math, I haven't" (p. 14).

When the new Principal was asked to describe his leadership role for mathematics reform, he stated:

Well I am, my job description is instructional leader of this school. So, I am charged to know what the math curriculum is, and how it should be delivered, and to be involved in the math program totally. (p. 3)

Later in the interview he talked about staff development and mathematics education saying:

I would like to see just a lot of opportunities available and would like them to be invitational, where they [teachers] could choose to participate or not. I think when it is dictated or mandated you don't ever get past people not wanting to learn it. I think you can really turn people on to it because it is fun. It is a better way to do it. It is more interesting to teach these new methodologies. If people understood that, then they wouldn't feel forced to, to change. We would be better off. (p. 9)

While describing the qualities he would look for when hiring a mathematics teacher, the Principal stated:

. . . we would specifically look for someone who had advanced knowledge in math and was willing to do hands-on instruction, probably thinking along the lines of NCTM Standards and those kinds of instructions. (p. 20)

When the Principal was asked his opinion of the use of alternative assessments in mathematics, he stated, "I don't know if I am strong enough in the mathematics curriculum, to understand, to really give a valid answer" (p. 17).

These data document that the new Principal was not involved with the V-QUEST Systemic Reform initiative beyond the information stage, and that he was aware that he was responsible for instructional leadership. His responses indicated that he was aware of the NCTM recommendations for changes in mathematics instruction, and his approval of spending site-based funds to purchase mathematics instructional materials that supported hands-on learning indicated that he supported these instructional changes in mathematics, and his response concerning staff development indicated that he supported noncoercive learning strategies, which were promoted by Glasser's *Quality School*. However, his response to the alternate assessment question indicated that mathematics was not his curriculum strength, and the brief summary that he provided of his experience in public education revealed that his area of expertise was physical education. The information he provided follows:

This is my second year as a Principal. Before that I was an assistant Principal in a high school for five years. An assistant Principal in an elementary school for three years, and before that I was an elementary physical education specialist. (p. 1)

When the mathematics lead teacher was asked if the administration had supported him in the changes that he had tried to make in his mathematics instruction, he stated:

Yes and no. Well they want all that, but as far as getting what we need—no, unt-uh. Oh they talk a good game about, oh this is a good idea why don't

you do it, and then you tell them that you need this or that or the other to make it successful, and they tell you to do the best you can. . . (p. 8)

This statement seems to contradict the lead teacher's response to the questions about procedures followed when making purchases of instructional materials, but in that response he was talking about the steps followed when making purchases, and here he was referring to materials needed to complete interdisciplinary projects or hands-on activities in the classroom that were consumable supplies not mathematics manipulatives, instruments or calculators. These are projects or activities that were provided by the mathematics lead teacher as examples of activities that were hindered due to lack of money for purchasing materials: a kite building project, materials for AIMs activities such as balloons for the hover craft activity, and money to purchase plants for the project to beautify the school grounds.

The Principal stated that he spent about one-fourth of his time on instructional observation, and he explained the requirements for Principals and classroom observations saying:

Well, I am required to be in each classroom three times a year for new teachers, once or twice for others. It is very difficult to get into classrooms. Let me just say that I am not in there as much as I should be. Especially to be the instructional leader. (p. 23)

The comments made by the mathematics lead teacher, while discussing administrative support, indicated that the Principal had not visited his classroom: . . . [the Principal] will not come to my room. I invite him up to come see activities. He will not set foot in my room. . . . When we built our measurement activities and things like that, I'd say, 'Come on up and watch them build their houses it's real interesting'. Well anyway he never came. (p. 8)

However, the science lead teacher indicated that the Principal had been in her classroom, and her statement to that effect follows:

He has always been very nice and very helpful any time, you know, that I have had any concerns or questions. I don't think I've had a formal observation particularly, but he's been in and out of my room a lot, and sometimes I'm teaching and he's behind me, and I don't know he's there. He's come in to watch maybe one particular student or he's come in to get a student out, and he's stayed a little bit longer to kinda see what everyone is doing, and his favorite expression that he uses a lot is 'Are they always like this'? That's a question that I get a lot, are they always like this? (p. 34)

This statement indicated that the Principal did not conduct a formal observation, but that he did come into the science teacher's classroom and express an interest in what was happening by making a noncommittal comment. The science lead teacher's comment indicated that she liked this attention from the Principal, and the mathematics lead teacher's comment indicated that he wanted to interact with the Principal about his classroom activities but never got the opportunity.

The new Principal was nice, and he was supportive of his teachers, but he expressed no enthusiasm for the V-QUEST reform initiatives, nor did he encourage his lead teachers to actively pursue any reform initiatives. There was no evidence that he attended any of the V-QUEST workshops or that he worked with the Division-Level administration to encourage the continuation of the lead teachers' support group. Although he did allocate site-based funds for the purchase of instructional materials, he did not provide any leadership in reform initiatives with the lead teachers. The reform agenda that was developed by the lead teachers and their Principal at the end of the two-week V-QUEST institute and put into effect during 1993-94 was not referred to at all during the 1994-95 school year. There was no survey conducted at the end of the year by the lead teachers to get feedback from the teachers, and there were no reform initiatives planned for the future with the V-QUEST Lead Teachers. It was evident that the Principal's time and energy were invested in the Restructuring the Middle School Project; that reform initiative had taken top priority at the school level during the 1994-95 school year.

#### School Level: Staff Development Changes

The artifact data documented that the Principal spent \$2578.10 on staff development opportunities or materials. The list of those expenditures for the 1994-95 school year follows:

- Effective Schools from KDS Educational Press September 25, 1994 check number 011196 for \$16.00
- Outcomes Based Education Network October 14 to 17, 1994 Staff Development \$470
- November 10, 1994 Earth Wise Magazine check number 0112295 for \$40.00
- Education Week December 9, 1994 check number 18135 for \$69.94
- Master Teacher Invoice Number 381030 January 12, 1995 for \$129.96
- Professional Development check number 011529 February 28, 1995 for the Quality School Training Program \$50.00
- Mike Rettig (Inservice) March 6, 1995 total \$500.00

- Virginia Middle School Association (VMSA)membership \$112.50 June 19, 1995
- A sixth grade teacher and the eighth grade math teacher June 27 to 30, 1995 Paideia Center Summer Institute check number 011707 for \$1190.00

The NCTM membership was not renewed for the 1994-95 school year, but instead the school joined the Virginia Middle School Association. There was no reference made to the Outcomes Based Education staff development by any of the participants, and the artifact data only supplied the cost. Both middle schools shared the cost of [JMU Consultant's] inservice which was an introduction to block scheduling, and the details of that inservice were presented in the section about the activities of the Middle School Restructuring Committee. The Paideia Center Summer Institute was attended by two mathematics teachers, and they discuss its benefits in the next section on 1995-96 school year. The subscription to the Master Teacher was continued, and the new subscription purchases for the 1994-95 school year were Education Week and Earth Wise. These data document that the amount of money spent on professional development and instructional supplies was about the same and that the Principal did support the teachers who volunteered to participate in professional development opportunities. It also documents that more money was spent in both areas during the 1994-95 school year than in the previous year.

#### School Level: Other Changes

The last section for the 1994-95 school year is devoted to tracking change in the following areas: technology, interdisciplinary instructional units, teaming, business partnerships, and parent and community involvement with the school.

As for technology, the artifact data presented in the purchase of mathematics instructional materials indicated that one more class set of calculators was purchased this year, and technology purchases other than the mathematics related materials were as follows:

- Librarian
  - Video Player \$418.80 November 3, 1994
    - Software Information Access Company June 9, 1994 Invoice number One Tom Junior, Two Infotrac Software for Macintosh 1013240 check number 011133 for \$567.44

Other than the purchases made by the lead teacher for an Apple computer, there were no indications that any other technology purchases were made during the 1994-95 school year.

Use of the WICAT computer lab for computer-assisted-mathematics instruction did not change during the 1994-95 school year, but in the classroom there were calculators

available and new instructional materials that incorporated the use of calculators for mathematics instruction. The teachers were still teaching mathematics in 45-minute long class periods, the State and County curriculum was still the 1988 SOLs, and the assessment practices had not changed. Thus, the use of calculators was not encouraged by the curriculum content, assessments or the schedule. There were no specific interview data that provided evidence that the teachers use of calculators had changed for mathematics instruction during the 1994-95 school year, but it is likely that with the availability of the calculators, and the new instructional materials that calculators were used more in the 1994-95 classrooms than they were when they were not available.

As for interdisciplinary instructional units the eighth grade mathematics teacher and lead teacher indicated that they did use at least two of them during the 1994-95 school year, the bridge project, and the paper recycling project. While discussing the impact of block scheduling, the seventh grade mathematics teacher indicated that her team had worked on interdisciplinary units together, saying “. . . We have in the past worked on units together. . . (p. 12).” There were no other data available to substantiate that progress had been made by the instructional teams to reach the goal of developing at least two interdisciplinary instructional units, one for each semester. Since the middle school had moved to academic teams of teachers in 1988-89, development of interdisciplinary teaching units was identified as a goal for the middle schools, but there were no evidence to indicate that progress was monitored by the administration or that there was any evaluation of the teams’ progress toward reaching this goal.

Business partnerships were initiated at the Division Level and developed by the former Pleasant Middle School Principal in the 1993-94 school year. The former Principal had successfully created a tutorial program in mathematics and science with the engineers of the Appalachian Power Company (APCO), and the former Principal stated: “Partnership with Appalachian developed into a tutorial program” (p. 14). The new Principal made the following comment about this program saying, “Appalachian, actually what I meant to say is Appalachian Power. I guess it is American Electric Power. We had a very good tutor program, where last year their engineers came over to work with our kids. . .” (p. 10). The mathematics lead teacher said: “Well, we have business partnerships—There was the one with APCO. It was very active, . . . They provided tutors here for us that would come in and work with the kids during the day or after school or before school. . . I’m not sure who else our business partners are” (p. 9). This tutorial program continued through the 1994-95 school year.

The former Principal indicated that he had worked hard to get the parents into the school building with lunches with the Principal and by developing and encouraging an

active Parent Teacher Organization (PTO). The new Principal's comment about activities to get the parents and community involved with the school follows: "I think we have school philosophies and policies about trying to have parents involved in school" (P. 11). On the first page of 1994-95 school scrapbook there was a copy of the Welcome Back to School letter that was sent home the first week of school. The letter invited parents to volunteer and to join the Parents Advisory Group monthly meetings. There were no other artifact data to document that these monthly meetings were held, and the Principal did not mention the meetings when asked about encouraging parent involvement in the school. He did not mention the PTO, and there were no artifact data that documented parent or community involvement in the school. There seemed to be less enthusiasm by the Principal for arranging events to get the parents into the schools, and based on the lack of evidence there seemed to be less activity in this area during the 1994-95 school year.

#### Conclusion Documenting and Tracking Change in 1994-95

At the State Level the two-year process for rewriting the 1988 SOLs was completed and adopted, and in June of 1995 the new *Standards of Learning for Virginia Public Schools* were published and sent to all school divisions and teachers. The V-QUEST Lead Teacher Program was in its third year and the middle school lead teachers had completed their training which focused on authentic assessment and the development of leadership skills. At the Division Level the V-QUEST Lead Teacher support group was no longer intact, and since the reform efforts that involved the V-QUEST Lead Teachers focused on the elementary schools the middle school lead teachers were left without administrative leadership at the Division Level.

The new Principal at Pleasant Middle School was not involved with the V-QUEST reform initiative and curriculum knowledge of mathematics was not his strength; therefore, he did not continue the strong leadership role that was displayed by the former Principal. The middle school lead teachers were not encouraged to continue any reform initiatives that they had started the year before, and there were no efforts made at either the division or school level to plan future reform initiatives for mathematics. The school and division had made restructuring the middle schools the top priority for the middle schools and although the mathematics lead teacher was involved in this process, there was no evidence that his involvement was connected to his role of V-QUEST Lead Teacher.

The mathematics lead teacher did participate in selecting and purchasing new mathematics instructional materials that would facilitate hands-on student-centered activity based learning. The mathematics lead teacher continued to develop and provide inservice opportunities for the elementary schools and for schools in an adjoining County, but the



middle school mathematics teachers did not participate in any of his VA-PEN, or Problem Solving workshops. The mathematics lead teacher and one seventh grade mathematics teacher did participate in the 1995 summer workshop that resulted from a grant proposal that the mathematics teacher helped write, but there was no other evidence that any of the mathematics teachers participated in any staff development related to using the manipulatives and new instructional materials that were purchased over the last two years. The Restructuring of the Middle Schools resulted in the development of seven sub-committees that were expected to remain active in the following school year, and in a schedule change from a seven-period day to a four-block day. The mathematics lead teacher remained active in the restructuring process as a member of the technology sub-committee, but there was no evidence of any changes that resulted from this committee's work by the end of the 1994-95 school year. A needs assessment questionnaire completed by the teachers indicated that they were interested in professional development to implement integrated thematic units, differentiated instruction, alternative assessments, writing across the curriculum, and adapting curriculum and instruction to meet students' learning style. There was no evidence that any of these staff development opportunities were provided. When the Principal was asked if there anything done to help the mathematics teachers adjust to the block scheduling, he said, "Gave them advanced notice. No, we just *told* [italics added] them all during the summer that they were going to have an 84-minute block" (p. 15).

#### Documenting and Tracking Change in 1995-96

Presentation of data for documenting and tracking change in the 1995-96 school year begins with the State-Level data; it is followed by data for the Division Level, and then data for the school level is presented. Interview and artifact data is used to track and document details of significant changes that occurred during the 1995-96 school year at all three levels in curriculum, staff development, and assessment. Additionally, changes in the textbook adoption policy at the State Level will be documented, and changes in scheduling at the school level will be documented.

#### Documenting and Tracking Change at the State Level in 1995-96

Documentation of changes at the State Level begins with curriculum change data. Then, interview and artifact data are presented to document that the new 1995 SOLs were adopted, published, and distributed to the school systems for implementation. Interview data are also be presented to document the changes expected at the State Level related to the implementation of the SOLs. This information is followed by data concerning changes in

technical assistance and staff development arranged or provided by the State Department to facilitate school divisions in implementation of the SOLs. These data include tracking the progress of the V-QUEST Lead Teacher Initiative and documenting changes in that program. The last data section concerns State-Level policy changes concerning textbook adoption procedures.

#### State Level: Change in Mathematics Curriculum 1995-96

As the State Level data in the 1994-95 school year indicated, the state's new SOLs were completed, adopted by the State Board of Education and published during June 1995. This information is verified in the Standards of Learning for Virginia Public Schools document on the first page where the following information is written: "Adopted in June 1995 by the State Board of Education" (title page). After that statement a list of the names of the Board's President, vice-president and seven members is provided. The AEL Training Team Leader indicated in the following comment that the new SOLs were distributed to Virginia's teachers during the 1995-96 school year, she stated, "They were distributed to the school divisions to distribute to all of the teachers during the '95- '96 school year to be looking at [them]" (p. 7).

Data from the Principal Specialist K-8 indicated that the revised SOLs were to be implemented as of June 1995:

. . . in June of 1995, the Board came out with a statement that said, you know, you need to implement these Standards immediately, and ah so, you know, schools divisions, some school divisions got started right away writing curriculum, and others, you know, have been hanging back. Ah, for the most part math has been written first, math and then reading. . . . so, last year we spent a lot of time with Eisenhower moneys funding curriculum writing for math in school divisions that have very low scores. So, we used Eisenhower demonstrations moneys to fund those school divisions, and so that they could get a head start because they're so far behind. (p. 12)

The Principal Mathematics Specialist K-8 also talked about how the middle school curriculum had changed at the middle school level saying:

. . . well they have significantly changed what the mathematics curriculum would look like at the middle school. There is a significant amount of new content and earlier content in the math standards as well as a new focus so, those are three areas. (p. 7)

Talking specifically about content change the Principal Mathematics Specialist K-8 said :

In terms a new content you'll see. . . . First of all, we're dealing with earlier content, and that's content that was taught, but usual at the upper grades. So, in terms of earlier content as we now analyzed it in 6th grade, 79% of the content in sixth grade is earlier content. So, it was taught at an earlier grade level, and now its taught in sixth grade. So, that means in my opinion 79%, four out of every five days, the teacher who taught sixth grade in the past is teaching something new and different. In seventh grade we have 54% earlier content. So, that means one out of every two days they're teaching something new. Things they didn't teach before. Eighth grade we have 63% earlier content. So, in essence three out of every five days those teachers are teaching something new, and that has a lot of impact for professional development. There are a lot of teachers out there that have a lot of new concepts to learn, new material to learn. If they have been teaching at that level, and don't teach the whole middle school program.

Secondly, for new content, there's also new content you know, we have a lot more probability and statistics ideas, and patterns functions and algebraic ideas. So, at the sixth grade level there's 13% new content. At the seventh grade there's 27% new content, and at the eighth grade there's 32% new content. So, things like stem-and-leaf plots, box-and-whiskers plots, those are all new graphing methods that many teachers never used in the past so, that has a lot of impact for the future also. Also, in the geometry area there's a lot of new things, much more transformational geometry. So, that's the second area.

So there's earlier content, new content, and the third thing of course is the new emphasis, and at the middle school of course that means much more of an emphasis on problem solving. So ah, in essence kids have to learn the skills, but then they have to be put in situations where they can apply the skills, ah making those connections, and often those connections should be presented in the form of a problem where we're asking kids to draw upon their knowledge and skills and try and, you know, solve the problem and often, hopefully, in a real world context. They have to use their reasoning skills ah, whether it be inductive [or] deductive reasoning. They should be developing those skills so they can justify their work, and ah, also, they need to communicate their answer. No longer are we just looking for a number answer, we're looking for some kind of analysis, some way where they can discuss it or communicate it whether it be written oral or whatever.

I think it has a lot of impact in the middle schools because middle schools have been moving towards more of a team approach. At least that was the focus in the past, and also, there's more collaborative work where kids work in groups or cooperative groups of that nature, and so the change in math really would be supportive of that kind of change in the middle school. I mean I think they are aligned. There's an alignment of some of the issues that were middle school issues, you know working with smaller groups, putting kids in teams so that they only see a hundred kids a day or they're working with the same four teachers. It allows much more communication and maybe cross over between the subjects, making connections.

Maybe the math and science teacher could work together where the science teacher could generate, help the kids generate some data, and then the math teacher might help them analyze the data and graph it and then write a few statements about what the graph says. So, you know, it allows for that whole new change in our focus of what is important in mathematics. So, those are the three issues. . . . I think, the middle school movement, some of the issues there, and the new math SOLs would be in support of the middle school movement and vice-versa. (p. 7-9)

While discussing what the expectations were at the State Level for the state's new SOLs the Secondary Principal Specialist for Mathematics stated:

They [the SOLs] are a framework for developing the local curriculum. [Progress on] The standards will be assessed. So, some would say by default they are mandated, but legally they are not mandated, by legally I mean they're not in the code of regulations, but schools are expected to meet or exceed the SOLs because they [students] will be assessed. There will be a new assessment system put in place this year to start testing students' progress towards meeting the Standards at grades three, five, eight, and eleven. (p. 5)

When the Secondary Principal Specialist for Mathematics was asked, "Do you think that the implementations of these Standards of Learning will encourage a change in the way that mathematics is taught?" She replied:

Ah, yes I do, because if nothing else, the role of technology, because the standards call, explicitly call for the use of technology, and with the possibility of students being allowed to use technology on the assessment, it would definitely effect instruction, and the same thing is true with

manipulatives. Concrete objects are called for in the Standards ah, so I suspect that the teachers would want to teach at least to the intent of the Standards, and therefore they would use manipulatives to develop the concepts and skills. (p. 5)

Although there is only a small amount of overlap in the State level administrators' interview data concerning the SOLs, these data indicated that changes in mathematical content, in the focus of instruction and in the use of technology were incorporated into the 1995 SOLs for mathematics. The data also indicated that the school divisions were expected to write new curriculum guides based on the SOLs, and that the implementation of the new curriculum was expected to occur immediately. The Principal Specialist K-8 stated that the new standards encouraged a change in the way mathematics was taught, and the description that she provided of that change conveyed that teachers were expected to teach for relational understanding which meant developing conceptual understanding as well as procedural understanding. This was a significant change from the State's 1988 SOLs which focused mainly on procedural understanding. These changes in curriculum mandated changes in assessments, and the next section provides data concerning the plan for reforming the States Literacy Passport Test, and norm reference testing practice.

#### State Level: Change in Assessment

Explaining how the new assessment would be developed the Secondary Principal Specialist for Mathematics said, "This process will begin with a field test this spring, and we will test the test next spring, the spring of '98. There will be a statewide administration where we project there will be cut-off scores set for passing" (p. 5). Later in the interview the Secondary Principal Specialist for Mathematics discussed the proposed changes in State Level assessment practices as related to the new SOLs, and that interview exchange follows:

Well they [assessments] will be compatible because they will be based on the SOLs. There's [sic] two parts to the State assessment system. The first part is the norm referenced test, and the second part is the SOL test. Now the SOL test will be developed, will be built to assess the Standards so, that's criterion reference. Now, the norm referenced test will be a test that comes as close to correlating to the SOLs as possible. No norm reference test will match any one state's standards because it wouldn't be a norm reference test if it was, but what we want to try to do is to get a test that comes as close to focusing on the important content that we have defined for Virginia, and yes there is attention being placed at looking at correlation's of norm reference test items to the Standards of Learning. . . . The Board of Education has

specified that the 11th grade test will be a graduation requirement. It has not specified any other grade level. (p. 8-9)

Interviewer: Do you think that the assessments that are put in place, do you think they will affect the curriculums that the counties develop?

Principal Specialist for Mathematics: Oh most definitely, most definitely, as they **always** do. That is why it is important to have a State system where you've got a criterion reference test that tests what has been defined as being important. So, if the State test tests the Standards of Learning you would expect that the school divisions would want to teach the Standards of Learning, and so, in that case teaching to the test is OK, because they're teaching to the content that everyone has decided that is important. Now the norm referenced test is the one that's a little grayer. We would still expect teachers to teach the Standards of Learning, but you can also assume that there will other content tested on that test, but we're hoping that as result of teaching the SOLs, that students would be able to answer questions on other content. I think the SOLs are broad enough to cover just about any content topic that might be assessed on a norm referenced test just not at the specific level or in the same depth.

Interviewer: Changing the focus, still staying with assessment, but moving to the Classroom Level, do you think that the State is encouraging teachers, math teachers, to use authentic forms of assessment and different types of assessment other than just computation and paper-pencil?

Principal Specialist for Mathematics: Well in, yes, because in fact the Board the of Education passed an assessment resolution in April ah, clarifying the role of the State assessment, with classroom assessment, and one of the bullets in that resolution clearly says that it encourages and acknowledges the value of, of alternative assessments at the Classroom Level such as performance based assessments. What the board wants the public to understand is that you design assessment depending on your purpose. At the State Level we have to have assessments that are highly reliable and valid so, therefore, we cannot use portfolio, we cannot used a lot of performance based, although we're hoping to have some, but you have to minimize those kinds of items because of the accountability associated with it, but on the other hand, it says to teachers it's OK, and you should be using a variety of assessments to measure your students' progress, and to make some decisions about instruction.

Interviewer: Do you think this is being encouraged by the State in any way?  
Secondary Principal Specialist for Mathematics: Well through, you know through V-QUEST ah, the assessment component did develop some sample alternative assessments, and they have been distributed to the lead teachers, and they are available to anyone who is interested, and we perhaps will use some other form of disseminating those assessments once we find a funding source and develop a plan for doing some training on those assessments. We really at this point don't want to do a wide distribution of those assessments without some training on how best to use those assessments. What the State is trying to do is not give so much ah direction and not advocate a lot of things that are best left at a local level. Now if asked about a best practice we will certainly provide that information, but I don't think you will find the State up waving a flag, so to speak, on various practices such as performance-based assessment, but certainly if asked, and people want the information then we'll provide it to them. (p. 9-10)

The Principal Mathematics Specialist K-8 indicated that the implementation of the instructional changes inherent to the new curriculum (change of focus, and methods of instruction, and changes in the use of technology) depended on changes in methods of assessment. Her statement concerning changes in assessment follows:

Of course, the thing that's going to change, or have the most impact, of course is the assessment. The assessment is going to change what happens, and if the assessment doesn't live up to what the Standards say, then we've lost the battle. So, it's really the assessment will be the most, will have the most impact. We can **tell** teachers they should do hands-on science or hands-on math, they should use manipulatives, we can **talk**'til we are blue in the face, but until the kids are actually **accountable** for that kind of approach to learning, and that kind of approach to assessment, until the assessment is aligned with those kinds of instructional approaches I'm not sure we're going to win the battle. So, it all depends on what comes down the road in the next two years.

Well in fact, well right now a team is meeting to look at, there are going to norm referenced tests, and there are going to be SOL tests, OK? Which is like criterion referenced test. The norm reference test ah, the hum, in terms of the assessment an RFP went out for the assessment, to design an assessment to correlate with the SOLs for math, science, English and history, and of course I'm sure you read that the planned assessments are at grade

three, which will cover grades K-3. The assessments are at grade five for four through five SOLs, and for eight, for **grade** eight for grades six, seven and eight SOLs, and grade eleven for algebra and geometry, which pretty much blew everybody away, and that was the Board's decision. We didn't recommend **that**.

We were going to be delighted with Algebra, anyway the Board believes that we certainly have fallen behind in our Standards, that twenty years ago, or thirty years ago, when I went to school everyone had to take Algebra, Geometry and Algebra II, and they feel like we have allowed them to get by with a whole lot less, and we can't allow that so, that's their thinking. Hum, so in terms of accountability we do know that when these, this coming Spring of '97, kids will be tested on the norm reference test. That piece, and right this week there's a group of people in that are looking at comparing the tests submitted by the different companies against our SOLs to see how well the norm reference test measures up against both the content and the processes that we are looking to assess, which of course is the problem solving, the communications, and so forth, the connections. So, ah, that's the first step, and so, we will be testing, ah doing norm referenced tests in the spring of '97. In the spring of '98 we will doing SOL tests, and ah, that will be called, in the spring of '97 they're also going to be doing their first pilot of the SOL test. They'll be testing kids, we'll be looking at the reliability of the items and the validity of the items, and not all kids will be tested on the SOLs. So, '98 though we will get baseline data on all students so we will be reporting out at a student level scores for grades three, five, eight and eleven. Ah, they'll be students level scores and school level scores. There will not be teacher level scores.

So there will be no reporting out on how the teachers' students did. Because there's ah, I mean although the teachers have to be accountable, the students have to be accountable too. The problem is every teacher gets different sets of students, and that really creates a problem, and if we don't pretest I don't think we really should post test and say hey, teacher X your not doing well blah, blah, blah, because you, you know we can't give everyone the same, an equal, group of kids. So ah, I'm sure you've heard about the testing.

We don't know exactly when the high school test will be required for gradation. They're talking about the year 2001. Other people are talking



about the present, this past year's third graders who will be fourth graders this year in the 1996-97 school year. They would be the first ones accountable for Algebra and Geometry for graduations. The reason that group is being thought of is because um, we don't expect those Literacy Passport Tests to go away until two years from now. We expect two more testings of the LPT so, that would be the present, this years sixth graders and this years fifth graders, and that would be required for graduation, and this years fourth graders would be the first who would have the Algebra and Geometry required for graduation. So that's one thinking, and then others are thinking differently so, who knows? [Laughs a little] But ah, at least there's, right now, the barrier to graduation is the LPT, and we're thinking this year's fourth graders the barrier will be that eleventh grade test when they get there. (p. 10-12)

When the Principal Specialist K-8 was asked specifically about assessments being compatible without the new SOLs, she made this statement:

Right, well ah, so first of all, they're doing the norm referenced right now to look at the ah, alignment, and then we'll be doing the SOL assessments. We will be forming teacher committees to review the assessments, and then of course if you're on that committee you're not allowed to say what you saw in terms of assessments.

We will, [Doris Redfield] tells us that, when we get into that process, we will all be actively involved. We right now have two people in each core area, and the people that are doing the norm reference are the people that dealt with the SOLs, who worked on the SOLs, but for instance when we go into the SOL assessment development or review then I'll be dealing with K-8, and Secondary Principal Mathematics Specialist will be dealing with nine through twelve so that's what [Doris] tells me, and she says we'll be over worked next year. (p. 17)

While talking about changes for assessment practices in the classroom the K-8 Principal Mathematics Specialist shared the following information:

Well actually it was, what the picture was suppose to be, which was a grid. It gave an overview of test, tasks and observations. And the primary V-QUEST focus was that when we're assessing we need to collect evidence of student learning through many different forms including multiple choice tests, and that kind of stuff. Tasks like performance tasks, and through observational assessment, and so our focus was you need to collect it in all these ways, but

V-QUEST focused on performance assessment because it was in the area that teachers knew the least about. Which is what we felt.

So, that's what we were trying to do although we were saying you need to use all of these methods to collect evidence of student learning, but we focused on that one to say this is a new one that perhaps you haven't tried, or you aren't using, and as we look at these Standards, which are much more complex, they bring in together the problem solving and the, you know, the everything—the communication, the connections. You need to be assessing kids in the same manner.

Now, the State assessment is not going to have performance based tasks, but the ah, but the Board did come out with a statement that they recognized that classroom teachers should be using them in their classroom for assessment, but because of the cost we will not be doing that at the State. So what does that say to you? If you don't test what you value, you might not get it. But **they did** come out with a statement of their feeling about assessment, and they did have that statement in there that they believed that the classroom teacher should be using performance-based assessment as part of their assessment. So our picture, so unfortunately we're not going to have performance-based assessment, but I would hope that we would have, you know, a part of the test would use calculators there would be problem solving. I would hope that maybe they would have some paper manipulatives to give kids in some of the testing. So I hope the testing does align with the way we expect instruction to go, and, of course, different companies use those kinds of things, but we'll have to see what they do, but pretty much we don't expect any open ended kinds of questions, but we do expect higher levels of thinking on these assessment items. (p. 21)

Although the leader of the revision process of the SOLs, the Coordinator for Mathematics for Fairfax County, did not add to the details concerning the changes in assessment his comments did indicate that changes in expectations for assessment results were expected. His related comments follow:

I think they [State administrators] are expecting all school divisions to do everything in their power to get all youngsters to meet these Standards, and by meeting these Standards I mean being able to pass the criterion reference test that will be given at grades three, five, eight and eleven, and I think it is the expectation of the State that consequences will occur if in fact youngsters do not meet these standards. . . . there's been a great deal of discussion

about who is actually accountable, and there was a statement released in writing, a joint statement from the Superintendent and the State Board, that said that school divisions have the responsibility of holding teachers responsible for the achievement of the youngsters. So yes, I think this has, is all wrapped up in accountability. Accountability is what's driving this whole thing. (p. 4)

The AEL Training Team Leader also talked about the reform of assessment during her interview, saying:

. . . I wasn't involved in the writing of the assessment ah, and— hopefully the program, the assessment, will be piloted the '96-'97 school year. This is the time line now when this is going to, the, actual testing that's going to be ah,— they will begin the actually testing. (p. 7)

These data support that the State Department employees saw a need to reform the assessments that were in place because they did not match the focus or the content of the state's new SOLs. The data also indicate that for the recommended changes in mathematics curriculum and instruction to be successfully implemented at the local level that matching changes in assessment were essential. The Secondary Principal Mathematics Specialist stated that the teachers would teach to the test, and if the changes described in method of instruction were expected to happen the methods of assessment had to change. The projected date for changing the assessment was at least two more years in the making. The data also conveyed that alternative methods of assessments were encouraged for use in the classroom, but the materials prepared by the State Department were not widely circulated due to the lack of funds to provide inservice on how to use them. The lead teachers were provided copies of these assessment materials during their one-week summer institute, and they did receive inservice training.

#### State Level: Change in Technical Assistance/Staff Development 1995-96

Interview data from the Principal Specialist K-8, the Secondary Principal Specialist for Mathematics, and from the AEL Training Team Leader, and the Coordinator for Mathematics for Fairfax County are used to document and track changes in the technical assistance and staff development offered by the State Department. First data related to technical assistance designed to help school divisions implement the new SOLs are provided, second staff development data are presented which includes data about changes in the methods of offering staff development, and then data are presented which track the progress of the lead teacher training initiative. As in the previous sections the voices of the participants are used to present the information as much as possible.

The Secondary Principal Specialist explained how she arranged and provided technical assistance for Virginia's school divisions to facilitate the implementation of the 1995 SOLs. The details she provided concerning technical assistance and staff development provided by the State Department during the 1995-96 school year are presented in the following interview exchange:

Yes, that has been a large part of my job for the last year and a half. That has been my primary responsibility for the last year and a half to make sure that ah, teachers are aware of professional development opportunities, and indeed providing it myself. I have done hundreds of talks on Standards of Learning since the process started. In fact I just got back in the office from doing one, in one of the local areas. So, it is a **major** part of my job.

Interviewer: So, you coordinate those and sometimes do those yourself?

Secondary Principal Specialist for Mathematics: Yes.

Interviewer: Could you just give me an example, sort of an itinerary of what you would do, like do you just go out and have just an hour talk about the SOLs—

Principal Specialist for Mathematics: —It varies from a quick thirty minute update to a three-hour workshop. It depends on what the request is.

Technical assistance tailored to the need of the audience. It runs the gamut from just awareness of SOLs to actually giving and working with teachers on ah, taking the SOLs and translating them into curriculum and choosing appropriate activities. So, it runs the gamut.

Interviewer: Do you make any recommendations to counties as to what materials they should use or any organizations they can go to for support or things like that?

Principal Specialist for Mathematics: I do help broker some assistance. I do try to send callers to people who can provide the technical assistance or who have some resources that would be helpful to them.

Interviewer: And one of those is probably the AEL [Appalachian Education Laboratories]—

Principal Specialist for Mathematics: —That is one of them.

Interviewer: Is there another example you could give me?

Principal Specialist for Mathematics: Ah, another example is ah the Math Science Center, or the Science Museum of Virginia. There are various places I send them depending on what the request is.

Interviewer: Is there a set of guidelines in place pertaining to technical assistance for teachers. I mean say [Pleasant] County wanted some technical assistance, is there a process for applying?

Principal Specialist for Mathematics: No, there's no set procedure for requesting technical assistance. We work with school divisions on a one-on-one bases. We do a lot of technical assistance over the phone.

Interviewer: And of course the satellite programs could be considered technical assistance also.

Principal Specialist for Mathematics: Oh absolutely, absolutely, those are the more far reaching types of technical assistance.

Interviewer: Do you think that the way that this assistance has been provided has changed over the last five years?

Principal Specialist for Mathematics: Ah, Well it had to have changed because of limited staff. Now we're doing more by satellite using technology. We are brokering assistance versus doing the assistance, you know, as individual staff members. We still do some of that, but the demand is so great that we can't meet the demand. So what we can't do we try to broker.

Interviewer: And are you ah, using more of a regional model now as opposed to—

Principal Specialist for Mathematics: —Yeah the regional model is one that we have bought into and has been around for sometime, but we really haven't utilized much except for the last two years. So we're trying to do most things regional now, and that's where the AEL Eisenhower team will certainly be helpful to help provide assistance within the Superintendent's Regions of the State. We're hoping that everything that we do from now on can be regionalized so that we meet the needs of people within a particular region, and we won't have to use so much of a shot gun approach for technical assistance.

Interviewer: Would you elaborate a little bit on the Eisenhower team?

Principal Specialist for Mathematics: The Eisenhower team was an off shoot of the Eisenhower Math Science Consortium at AEL. Its ah, its a project of that consortium. We started about a year ago, and the purpose was to provide workshops on Standards Based training and in Virginia particular the Standards of Learning.

We now have ah, eight regional teams, one in each Superintendent's Region. There's a team leader of each team, and the team leaders work with the ah, State, two State specialist and a team leader, an overall team leader for the State, to develop a workshop package, ah, for delivering in the region. We just completed the first year, and that was the awareness phase, and we're now moving into phase two, which is, which will be workshops designed to help teachers take the State Standards and translate that into curriculum and instruction. So, it's really helping teachers to align curriculum, instruction, and assessment. So, there will be workshops available upon request after September [1996].

Interviewer: Who do you request those from?

Principal Specialist for Mathematics: You will request those from, we're making a change and this is a recent change. After October you can request them from the team leader in each region. Right now you request them from AEL. You make the request to AEL, and AEL contacts the team leader who will then select a team member. So, we're trying to cut out so much of the middle process there.

Interviewer: Now does that have to be done as a region or can specific counties—

Principal Specialist for Mathematics:—**NO**, no, individual schools or counties can request a workshop. There needs to be a minimum of thirty people for a three hour workshop. We can do some variation of it. We can do a three hour or a six hour workshop. What we're hoping to do is set up some regional workshops in the beginning of the year maybe to get the ah, to do some publicity about what is available, and after that go back to individual requests. All of this is in the planning stage right now. I just got back from a meeting in Nashville where we were discussing these plans. . . . This past year using some of our Eisenhower money we identified a regional coordinator in all eight regions, and those coordinators are now working with planning teams to develop a strategic plan for each region which includes the institutionalization and continuation program for K-8. Ah, so we're anticipating the plans to come in the end of September the people in the region will tell us how they want to continue the program what resources will be needed, and then we'll look to find what other resources are available to help move them along. Now, obviously without as much money as we were getting from NSF we won't be able to move as quickly,

or with as large a number as we did under V-QUEST, but the idea is to make sure that the idea, the concept doesn't die, and so that's what we're looking to do this year, and so we'll be looking for various funding sources, and we'll be involving people at different levels ah, in this effort. I think the key element here is that the regions are deciding what they want. What will be best for the teachers in their region based on, you know, following a set of guidelines, and certainly taking into consideration what has already been done with the lead teacher program no one wants to disregard that, but without the same level of funding and without having it directed essentially we need to look at alternative ways of training lead teachers.

I think all of us, you know, would agree that there are teachers out there who have different levels of expertise who don't need to go through the same training as a first year teacher. So, those are the kinds of things that we're looking at, but we are shifting. We want to shift the responsibility for the lead teacher program from a central institution or agency to the regions themselves. . . .The important thing is to keep the concept alive, and keep it ah, ah, if we, if the school administrators feel that it's important, then they will find a way to have their teachers trained. So we need to keep the concept alive, and then do what ever we can to bring the resources to bare for the training. (p10-14)

When the AEL Training Team Leader was asked about professional development or inservice opportunities designed to help teachers become familiar with and implement the new SOLs she provided the details that follow:

Well this program with the Appalachia Educational Lab is a training program that, right now we're looking, we started with just one of the strands, Patterns Functions and Algebra, as a beginning to help implement. Giving activities how to implement these, familiarizing people with the Standards of Learning and that particular strand. We are in the process right now of expanding, and taking in some of the other Strands. We've had ah, some request from probability, one of the second areas of concern is ah, the probably statistics and graphing, and so we're in the process right now of expanding the training program, and this is each of the Superintendent's Regions there is a training team, and there's a training leader, and ah this is one of things going on.

There is a group doing distance learning, out of [name's the County] that's developing a Distance Learning course that is hopefully going to be

marketed ah, in the fall. The Virginia Mathematics Coalition is looking at developing a Distance Learning Course, so there are lots of groups out there that are working on things, that are developing things, to try and help. Probably the most, the one that probably, right now, is getting the most attention is the Patterns Function and Algebra, because this appears to be where the weakness is; that a lot of elementary and middle school teachers don't have a lot of strengths in that particular area.

Interviewer: Do you think the individual school systems are being encouraged by the State to plan and use professional development to help implement the new SOLs?

AEL Training Team Leader: Ah, yes I do, I think they're being encouraged to do so, and again through the Training Teams, the Training Leaders are contacting people in each of the school divisions. We have lots of materials and brochures and information that's being distributed throughout the whole ah, State. They're encouraging each of the School Divisions to encourage their teachers to participate in the staff development that is being offered. (p. 11)

The Secondary Principal Specialist for Mathematics shared what the State Department was doing in terms of staff development for mathematics teachers in the statement that follows:

There's ah, I believe most school divisions are doing something on their own, or have done something on their own this year, and certainly with school opening up, but the State has provided several opportunities for teachers to get involved in staff development opportunities. We've also tried to ah, get to some of the disparate areas through satellite instruction, and we'll be doing more of that in the future. We've had satellite courses on the graphing calculator. I've had two one-week institutes on graphing calculators using graphing calculators to teach algebra, and I've had an institute for mathematics and science high school teachers on teaching using graphing calculators and CBLs.

We've had a data analysis institute for elementary and science institutes, and we have had what we call share fairs in every region of the State where both teachers and administrators could come to learn more about the Standards of Learning, and beginning this fall we will have a satellite Algebra Techniques Course for middle school and Algebra-one teachers, a course called Math Connects. It will be a satellite course out of Prince



William funded by the Department of Education. So, we are trying ah, to reach the teachers in different ways, but trying to use mediums that can get more teachers involved so they don't have to relocate for a period of time to get intensive professional development. We're doing a number of things ah, but I've just named some of the major things that we've been doing.

Interviewer: Has the State encouraged localities to conduct their own professional developments in any way?

Secondary Principal Specialist for Mathematics: Well certainly, the schools have, the School Divisions have their Eisenhower mathematics and science professional development money, and they are required to use that money for staff development or materials to support staff development that they might not be getting it funded from some other source. (p. 6)

When the Principal Specialist K-8 described the technical assistance offered by the State Department, she pointed out that there were only two people in the department to provide technical assistance for the entire State that supports the Secondary Principal Specialist remarks about the need to "broker" technical assistance for regions of the State. Her comments about the technical assistance offered at the State Level to help teachers implement the SOLs follows:

On curriculum development, we've spent a lot of time and Eisenhower moneys from the State on curriculum development this year we did, ah this summer they did a lot more with science, but math really we did the most with math last year, ah, the State in terms of SOL implementation. We only have the Eisenhower moneys to use for professional development because there are no other moneys for that in the State, except we only have two people in math, and we do technical assistance, but ah, often we do it related to Eisenhower moneys. Ah, so we're doing things like that, and ah technology for instance we've offered some satellite graphing calculator courses at the high school. So we've done that through Virginia Satellite Education network which is called V-SEND.

First we did ah, we pulled down something from Kentucky Educational TV, and we shared that program. It was like six two hour sessions and then this year we developed, [Dan Yeats] who works at the Math and Science Center, he did a program with [Gloria Clark]. Now [Dan Yeats] works in Henrico County and [Gloria Clark] works at the Math and Science Center. They put together a ah, using the graphing calculators and the CBLs, they put together, I think, it's about a six hour presentation, and

we just recently sent all those videos out to every school division.

Ah, in terms, we did curriculum share fairs so, we had regional share fairs four regional share fairs this spring where you know we invited the school divisions to hear what the impact on the, how they might implement the SOLs, and so to get them thinking about what they might be doing with their own Eisenhower moneys or any other professional development moneys they might have. Of course as a result of V-QUEST, V-QUEST will be over on Aug. 31st of this year I understand from the V-QUEST secretary yesterday, and ah, there have been, the lead teachers the third cohort of lead teachers finished up their summer this year, they came back for the second one week institute.

We had three one-week institutes, and they were focused on technology which is what they asked for. We had one at Virginia Tech, one at Christopher Newport, and the other at George Mason, but they were primarily focused on technology with of course an application in the math and science area. Ah, [Secondary Principal Mathematics Specialist] just finished up two one-week courses actually the same week at JMU where teachers were invited to work with calculators and CBL equipment. I just finished up two one-week courses making sense of data for grades three and grade five teachers in the eastern part of the sate for the low achieving schools here, and ah, that was making sense of data for, in both math and science. Those worked out really well. . . .

We're, we've been supporting ah, we also have something called Appalachian Educational Laboratories. [Name's the AEL Training Team Leader for Pleasant County's Region] is one of the coordinators, Regional Coordinator for that. She has like ten people trained who can go out and give an overview of the NCTM *Standards* and the Virginia SOLs, and anybody can write and get them to go out ,and they get paid two hundred dollars to do that from a grant that the Appalachian Education Laboratory has for this region which includes the State of Virginia. So, they had the first lesson last year they have the second lesson this year. So, it's like a three to six hour presentation, and really it's great professional development that any school can ask for and get it for free. So, we've been doing that. To support that [Secondary Principal Mathematics Specialist] and Jim Firebaugh have been leading that piece up. Of course there's been the V-QUEST Tech Prep and inservice institutes. (p. 12-14)

. . . we're trying to hit it from a lot of, we're trying to hit professional development from lots of different, through lots of different avenues and from any little moneys we have. We also gave a big grant, well a grant to the Virginia Math and Science Coalition, last year they got a twenty thousand dollar grant to write a course called Algebra for the New Middle School Teacher. They piloted it this summer. They wrote it last year. They piloted it this summer in the Spotsylvania and the Charlottesville area, and this fall I know there's going to be about four of those courses offered. Ah, we're going to offer it in region three which is up like in the Essex area, and region one which is like in the Petersburg area with Eisenhower funds that's to be paid with ah, for, teachers tuition is being paid for, that way they get three graduate credit hours.

. . . the Math and Science Coalition applied to this Higher Ed Eisenhower funds, and they're offering it in about four or five other locations. I think there's one in southwest Virginia, somebody out there applied for it so, they will be getting that course. You know, that's in terms of middle school that's a big one for them. It's for the middle school teacher and it's much more calculator oriented; data analysis oriented. In fact I'm writing that application to today. I have to write it out and get it out to those teachers so they can sign up for free tuition.

Interviewer: Is there anything else you would like to add about the Standards of Learning and what the State is doing to implement them, or anything?

Principal Mathematics Specialist: No, I think that gives you a picture of what we're trying to do with professional development, and you know its broad and ah, of course we're not doing enough we're just very, **two people** and **very little money**. Obviously, the big, the way that we obviously have to impact it is with the ah, here's the other thing, the most important thing I forgot. The Eisenhower program of course is about a three and a half million dollar program every year, and this past year, this is something I administer, we ah, set up a needs assessment, every school divisions in order to apply to get their Eisenhower entitlement had to fill out a needs assessment, and so we designed that needs assessment so it was aligned with implementing the Standards of Learning. . . . in essence they had to fill out about ten questions like what current, what instructional strategies they're going to be working on through their professional development program, and so forth and so on. So, they did a needs assessment which is a three year picture. So they did a

needs assessment, and a three year plan of what they're going to do in order to get their moneys for this year. So, in subsequent, the next two, years they'll be able to get that. They should be focusing on that agenda that they set up for themselves. So that's the biggest way we hope to impact the SOLs in math and Science. (p. 12-16)

The Principal Specialist K-8 did indicate that the State had developed a package of performance based assessments to share with the state's teachers, and she stated, "Well we sent out a set of about twenty assessments which were performance tasks, and we sent it to the Principals in May. Principals of schools where there were lead teachers so—" (p. 21-22).

The K-8 Principal Mathematics Specialist also talked about changes in the technical assistance offered by the State Department, and her remarks about those changes follow:

In terms of technical assistance from the Department I would just say that ah no longer are we allowed to just go out and work with one school division. We're not allowed, but you know sometimes we do it as long as we are working with a whole school division, but we are suppose to be working on a regional model. For instance I worked with six school divisions in region one and we wrote curriculum. These were six school divisions who had limited money for curriculum development. So, how I designed it is we did K-8 plus algebra curriculum so, we had ten grade levels, and we had one person from each school division sitting on each grade level, and so in essence we developed a regional curriculum, and then they went back to their school divisions made modifications brought it back, we revised it and came up with a regional curriculum, and then if they wanted to make any other changes for their school they could.

So I did that in region one with six school divisions, region with three school divisions: Essex, Northampton, North Cumberland, and Westmoreland. And then in Southwest Virginia I worked with ah, I think eleven school divisions. So. Southwest Virginia, [Pleasant] was not one of them, but [Pleasant] was part of the one that we did with language arts. I sort of lead that crusade because, I had Eisenhower funds, and I got approval to use that for them and ah, so consequently English went out and did it, and now Science is out there doing it this summer. They did science that way, and I think they had nineteen school divisions involved in the development of a regional science curriculum.

. . . the share fair, of course, reiterated that— **hey** you all got, you

need to **all** be writing curriculum. So we used the same model that I described in Hopewell. Ah the Region One we used that out in Region ah Six, no Region Seven which is out where you are. Carroll County was involved, and we did it in Abingdon, so we had teachers from all the counties participating, and then reviewing back at the school, and then, I didn't ah, so they've got a draft that they'll be working with this school year, and then we'll probably bring them together next spring and rewrite that. We have, the State does have a few people still left that are Regional Staff Development people, in the Regions where we have ah, maybe I'd say the lowest scores, and we do have a person, two people out there, Bobby Joe Peters and Mont Bush. One works in Region Six and one works in Region Seven. Mont is in Six and Bobby Joe is in Seven, and so, they coordinated all of that which was great! So, ah in terms of providing technical assistance I just had to go in and set the model up and then move it ahead, and then [Secondary Principal mathematics Specialist] came out the second time we met, and worked with secondary people, and so that worked out pretty well. So, we can work with regional people, in regional models or, you know, maybe in a big school division. (p. 23-24)

When the Coordinator for Mathematics for Fairfax County was asked if he thought the implementation of the new Standards of Learning would encourage change in mathematics instruction he said, "If the proper staff development is done, yes. If it's not, then it will in fact just get everybody teaching to a test" (p. 4). After making this statement he talked about the professional development that was offered from the State Department for the 1995-96 school year:

There's been some— there were a number of different teleconference kind of things that were done. Courses offered through teleconferencing statewide were aimed at helping teachers meet these standards. There were also a number of ah, training institutes that were available, ah, graphing technology institutes at the high school level for algebra and connecting math and science, and, I think, I would consider the training of the V-QUEST Lead Teachers as a very definite State-wide effort at helping people implement those changes. It's just there are so many teachers statewide it's going to take a very long time and a lot of money. V-QUEST only dealt with math and science and really only dealt with one person from math and one person from science at a school, and that wasn't even going to get to anywhere near all the schools in the State.

So it's ah, it is a big project. The State also has committed funds for the purchase of equipment to help the Standards be implemented at the high school level. Specifically graphing calculators. . . . not in terms of a grant there is actually in the baseline budget for the State for next year, twenty million dollars for technology, that will purchase among other things graphing calculators for algebra students.

When the Coordinator for Mathematics for Fairfax County was asked if the State was doing anything to encourage individual school systems to provide professional development to help implement the new Standards of Learning. He said, "I hear them saying that, but the only actual evidence that I've seen is in the rewriting of the criteria for obtaining Eisenhower funds, that is now tied specifically to preparing teachers to meet the SOLs, and that is insufficient funding, but so far that's the only example I've seen" (p. 5).

While providing examples of technical assistance that the State Department had provided in the past to Pleasant County the Secondary Principal Specialist for Mathematics related a brief history of Pleasant County's involvement with the V-QUEST Systemic Reform Initiative. She stated:

— Well, [Pleasant] was involved in V-QUEST in several ways. Obviously lead teacher, and they were also involved with the Preservice Inservice Component working with [R. University]. [Pleasant] was also involved back in the early '90s in doing some work with restructuring ah, elementary schools. While we did not give them a demonstration grant, they did ah receive some money, from the preservice inservice grant at [R. University], some money to help build up their Math Science Technology School-Within-a-School Program, and [Pleasant] receives their share of the State funds and federal funds just as everyone else. (p. 10)

These data indicate that the State Department of Education viewed the 1995 SOLs as blueprints for rewriting local curriculums, and that some leadership and technical assistance was provided for curriculum writing to the counties labeled as disparate counties and through Share Fairs for other counties. These data also indicate that staff development was viewed as essential for changing the way mathematics was taught, but there was limited hands-on staff development due to limited resources and staff. The creative solutions to this problem were providing technical assistance through distance learning, and brokering staff development through AEL. Most of the staff development described focused on using the graphing calculator to teach algebra which was training geared for the high school mathematics teachers. The AEL workshops which were applicable to the middle schools focused on introducing mathematics teachers to the content changes of the new SOLs. The

Share Fair organized for Region Seven by the State Department of Education which provided assistance in writing a local mathematics curriculum was attended by representatives from Pleasant County.

#### State Level: Change in V-QUEST Lead Teacher Initiative

The V-QUEST Lead Teacher Initiative was described as a valuable source of staff development for the state's teachers, but due to the State Department of Education's implementation of the Regional model for providing staff development, State Level support for the V-QUEST Systemic Reform Initiative was withdrawn. The V-QUEST Lead Teacher training program was phased out during the spring and summer of 1994. Funding for the Director of the V-QUEST Lead Teacher Initiative was phased out over the fall and spring of the 1994-95, and the last one-week institutes for the lead teachers that started their training in the summer of 1993 were conducted by the State Department of Education staff. All funding for the V-QUEST Systemic Reform Initiative ended two years prematurely in the spring of 1995. The following interview data from the State Level staff provides the details available concerning the V-QUEST Systemic Reform Initiative.

The Principal Specialist K-8 made the statement that follows about the end of the V-QUEST Lead Teacher program:

Of course as a result of V-QUEST, V-QUEST will be over on August 31st of this year I understand from the V-QUEST secretary yesterday, and ah, there have been, the lead teachers the third cohort of lead teachers finished up their summer this year, they came back for the second one-week institute.

We had three one-week institutes, and they were focused on technology which is what they asked for. We had one at Virginia Tech, one at Christopher Newport, and the other at George Mason, but they were primarily focused on technology with of course an application in the math and science area. (p. 11)

In the following statement the Secondary Principal mathematics Specialist indicates that the V-QUEST Lead Teacher Initiative is no longer being funded at the State Level, and she states that if the school divisions are interested in keeping the lead teacher concept alive they will have find an alternate way to train lead teachers. The Secondary Principal Mathematics Specialist's remarks concerning the end of the V-QUEST Reform Initiative follow:

Now, obviously without as much money as we were getting from NSF we won't be able to move as quickly, or with as large a number as we did under V-QUEST, but the idea is to make sure that the idea, the concept doesn't die,

and so that's what we're looking to do this year, and so we'll be looking for various funding sources, and we'll be involving people at different levels ah, in this effort. I think the key element here is that the regions are deciding what they want. What will be best for the teachers in their region based on, you know, following a set of guidelines, and certainly taking into consideration what has already been done with the lead teacher program no one wants to disregard that, but without the same level of funding, and without having it directed, essentially we need to look at alternative ways of training lead teachers. . . . We want to shift the responsibility for the lead teacher program from a central institution or agency to the regions themselves. . . The important thing is to keep the concept alive, and keep it ah, ah, if we, if the school administrators feel that it's important, then they will find a way to have their teachers trained. So we need to keep the concept alive, and then do what ever we can to bring the resources to bear for the training. (p. 13)

Obviously the significant change for the V-QUEST Systemic Reform Initiative, including the Lead Teacher Training program, was that support for the initiative was withdrawn at the national level. The V-QUEST Initiative did not match the Regional Model proposed for the state's staff development and technical assistance specialists and funding was reallocated. The political details pertaining to this decision were not shared, but the end results were clear: the V-QUEST Lead Teachers no longer had direction or support provided by the State Level administrators. School Divisions were free to continue the program if they could provide alternative methods of training lead teachers. Although the Secondary Principal Mathematics Specialist stated that they would do whatever they could to attempt "to bring the resources to bear for the training," it was clear in the statement that the State had no funds available for the individual school division's lead teacher programs. All available staff development funds were allocated for Regional training and devoted to implementing the New SOLs.

#### State Level: Change in Textbook Adoption Policy

The Associate Specialist for Instructional Media and Training talked about the role that the new SOLs played in textbook adoption, and she discussed the policy changes in textbook adoption that were associated with the adoption of the new SOLs. Her comments are presented in the interview exchange that follows:

Well heretofore the curriculum areas in the Department of Education have set up and developed their own criteria for selection of instructional materials



with a lot of local input. Ah, these criteria have been field tested, and then sent to publishers to let publishers know what Virginia wanted in the way of instructional materials. However, with the last science adoption and the [State Superintendent of Schools] administration the sole criterion for selection now is only the Standards of Learning; there are no other criteria for selection used in this administration. So, the only thing we publish now is the evaluation profile on each item submitted for adoption which states their percentage of correlation for that textbook or for that particular instructional material, we're now into the adoption of non printed [sic]. Just with our current social studies and secondary English adoption that's quite needed, but with the science adoption and the reading, the last reading adoption '94-'95 adoption which were postponed a year in order for the Standards of Learning to be fully developed and approved by the State Department, State Board of Education excuse me, the sole criteria was percentage of correlation to the revised Standards of Learning and no other. And for those of us in education that should send up a flag in that those are minimal standards, and we encouraged localities to select only those materials on the State-contract list ah, that were highly correlated to the Standards.

Now we do not publish a recommended list any more, only a State-contracted list so that any item submitted for review and evaluation is placed on six year State Contract, and we don't say whether it's recommended or not.

Interviewer: Hum, sounds like the State Department is taking less of a leadership role.

The Associate Specialist for Instructional Media and Training: Well that was the whole rationale that [The State Superintendent of Schools] did not feel that the Department of Education should be in the process of even adopting instructional materials. He would really like for the State to get away from that. He felt that it was too prescriptive, ah, he, a lot of people would like to remove it and delete it from the code of Virginia but that has not happened yet. I believe that [the State Superintendent of Schools] felt the Board of Education wanted to remain in some sort of administrative role as far as instructional materials were concerned so, he kind of got around it that way, in not publishing a recommended list. We're leaving more decisions up to the localities about what they do with the funding, and all we're doing is

encouraging them to adopt materials which have shown a high correlation.

What we do at the Departmental level, we validate and analyze the publisher's correlation that are [sic] furnished with each item submitted for adoption, and we pull together teams of educators throughout the State and bring them to a summer workshop to validate the publisher's correlation, which is only saying, looking at the publisher's correlation and saying yes on this page and this page there is a correlation.

Interviewer: Now does that team include classroom teachers?

The Associate Specialist for Instructional Media and Training: It's largely classroom teachers that are recommended by local Superintendents and we select from that pool of recommendations for the statewide team; some administrators, mostly teachers, and we also have a parent, university scholars, very often a journalist just a knowledgeable citizen. (p. 7)

The Principal Specialist K-8 made a few remarks concerning the changes in the states textbook adoption policies, and her comments follow:

Well of course if you talked with [Associate Specialist for Instructional Media and Training] you know that they had come up with a plan. Ah, just the big picture on textbooks, of course the State is trying to go away from a State adoption process, which some people are opposed to. They would like the State adoption process so we could sift between and among the books that really meet the SOLs versus those that don't. In, across the nations probably about half the school divisions, half the States are State adoption States. Others are open territory, means any company can come in and try to sell a school division book, and so, I know, they're trying to do away with that and of course probably elaborated on that, that's the big picture.

In terms of textbooks, you know what is a textbook and how is it defined? Is it a piece of technology or it is a, you know, hard bound book that, we have in the past, that last six years. Those questions have to be answered, and I'm sure that's going to be answered at the school Division Level, and third in terms of a textbook, of course we've been pushing the textbook as a resource for instruction, but in the majority of cases, I would say '99 percent of the cases in Virginia, your going to find the textbook as the sole, no not '99 percent, in the majority of classrooms the textbook is the sole instructional resource. (p. 13)

The Secondary Principal Mathematics Specialist made comments about textbook adoption policy changes at the State level are presented in the interview exchange that follows:

Interviewer: OK. Do you think the SOLs will influence the selection of instructional materials for math?

Secondary Principal Mathematics Specialist: Well most certainly, ah, we're not up for State adoption for another year, but if the mathematics adoption runs like the science, the history, and the English have run, the sole criterion for the selection, the sole criterion for the review of instructional materials will be the SOLs.

Interviewer: OK. So, that pretty well answers the question about the instrument that [Associate specialist for Instructional Media and Training and her partner] worked on—

Secondary Principal Mathematics Specialist: —yeah—

Interviewer: —It probably will not be used—

Secondary Principal Mathematics Specialist: —The instrument itself will not be used, but there are many school divisions who have chosen to use that instrument or a similar instrument to review materials at the local level. Ah, the criteria that, that ah, are included, you know, on that instrument are not a lot different than what we've used in the past. In fact, if you were to compare the old criteria for mathematics textbook adoption with that instructional materials criteria you would find a lot of similarities, and indeed if you were to look at the old science textbook adoption criteria [laughs as she says this] you would find many, many more similarities. So, it's not like that set of criteria was something new and different. The strength of that [sic] criteria was simply that it was a consensus of a consortium of states. So, you know, people still, still can use the criteria [sic], ah and they can feel confident that the criteria is supported by a consortium of states. (p. 7)

As the Associate Specialist for Instructional Media and Training stated before the sole criterion for textbook or instructional materials adoption became the material's correlation with the state's Standards of Learning; the State published a recommended list of textbooks for adoption and localities selected a textbook from among those recommended by the State. This policy was changed and now any item submitted for review and evaluation is placed on six year State Contract and it's correlation with the State's SOLs is validated by a State selected team of reviewers, but the State makes no recommendations. In the past instructional materials were limited to textbooks, but now

instructional materials includes nonprinted materials, but as the K-8 Principal Mathematics Specialist pointed out for the majority of the school divisions the textbook is the sole mathematics instructional material. Although the code of Virginia places the responsibility of supervision of textbook adoption at the State Level, the State Superintendent was making policy changes to move that responsibility to the state's school divisions.

#### State Level: Conclusion Documenting and Tracking Change in 1995-96

The new Standards of Learning were adopted and sent to the Pleasant County school division for implementation during the 1995-96 school year. With minimal support from the State the school division was expected to write a new County curriculum designed to implement the new SOLs **immediately**. The new Standards of Learning contained new mathematical content and supported a change in the focus of mathematics education, and implementation of the new SOLs necessitated a change in methods of instruction. Teachers were expected to incorporate technology into mathematics instruction, to use manipulates and hands-on learning activities to develop conceptual understanding, and a problem solving approach to help students connect procedural knowledge and conceptual understanding, but the 1995-96 school year opened with the old County curriculum guidelines, and teachers were expected to spend a great deal of time outside the classroom writing their new mathematics curriculum.

Although some technical assistance through teleconferences was provided for the use of graphing calculators in mathematics instruction, this training was designed to help the high school mathematics teachers rather than the middle school mathematics teachers. Most of the staff development provided that was applicable to the middle school teachers focused on becoming familiar with the content of the new Standards, and assistance for designing a new curriculum based on the Standards of Learning. The only staff development provided that related to implementing the Standards was provided by the V-QUEST Lead Teacher program which ceased to exist at the end of the 1994-1995 school year. The lead teachers now had no State support structure or funding to facilitate or encourage them in providing staff development for implementing the new SOLs at the local level.

The Principal Specialist K-8 was also the Eisenhower Mathematics Program Coordinator for Virginia, and she stated that part of her job was setting up their Eisenhower programs for all 135 school divisions in the State, and that she also dealt with the exemplary projects that were done at the State Department with Eisenhower funds (p. 1) As a part of this job she had designed a new application that school divisions were to complete in order to receive their Eisenhower staff development funds. She described this application as a needs assessment that consisted of about ten questions that were aligned with implementing

the Standards of Learning, and she stated that in completing the application the school division would essentially outline a three year plan concerning what instructional strategies they are going to be working on through their professional development program (p. 12). This too was a job that would have to be completed during the 1995-96 school year which meant that the teachers would begin the school year with no staff development specific to implementing the new Standards of Learning.

The focus of reform concerning mathematics at the State Level for the 1995-96 school year was on assessment. The two Principal mathematics specialist both plans for assessment reform and provided a two year timeline for expected results, therefore the assessments that remained in place for this school year were the same assessments that had been in place for the 1988 SOLs. Technology was to be used for mathematics instruction, and problem solving and conceptual understanding were to become a major part of the focus of mathematics instruction, but the assessments focused on assessing procedural knowledge and computational skills without the use of any technology, and as most of the administrators at the State Level mentioned at some point in their interviews—teachers teach to the test.

The changes in adoption of instructional materials were designed to transfer the major responsibility for instructional materials adoption to the Division Level; this amounted to another unfunded State mandated change to the division and its teachers. Although mathematics was not scheduled for textbook adoption until the next school year, plans would have to be made and policies created for a task that used to be managed at the State Level. The data provided concerning this change indicated that there was not a consensus among the State-Level staff that this was a best educational practice, and the localities had no voice in the decision. This is not a practice that supports systemic reform, which was supposed to be bottom up reform with top down support.

#### Documenting and Tracking Division Level Change in 1995-96

The changes at the State Level mandated changes at the Division Level, and the changes specified for mathematics were rewriting the County's curriculum guidelines and changing the focus and methods of instruction used in the classroom. Every school division in the State of Virginia was expected to write and adopt new curriculum guidelines that reflected the content of the state's newly adopted Standards of Learning. The focus of mathematics instruction was expected to change from the previous strong emphasis on procedural knowledge to an emphasis on problem solving and conceptual understanding connected to procedural knowledge. Another major change was that mathematics teachers were expected incorporate technology into their classroom instruction. The next section

begins with the presentation of data to document how Pleasant County's school division addressed these mandated changes; that section is followed by the presentation of data for tracking the progress of initiatives from the previous years. The initiatives being tracked now consist of teaming, mathematics instructional materials, technology, interdisciplinary instruction, block scheduling, restructuring the middle schools and the V-QUEST Lead Teacher initiative.

#### Division Level: Change in Mathematics Curriculum

The new SOLs had been distributed to the school divisions at the end of the previous school year, but there was no evidence that indicated any action had taken place during the summer of 1995 to distribute the new curriculum information to the teachers or to begin work on writing the County's new curriculum guidelines. The subcommittees for the Restructuring the Middle School initiative were in place, but none of those committees specifically addressed curriculum, and none of them were active during the summer of 1995. According to the Principal of Pleasant Middle School the committees for revising the County's curriculum guidelines were established during the 1995-96 school year, and his comments indicated at the time of the interview, May 20, 1996, that the mathematics committee was just beginning the first phase of the revision process and that was to evaluate the County's current curriculum.

While describing collaborative efforts that his school was involved in during the 1995-96 school year, the Principal referred to the curriculum committees saying, ". . . The County Curriculum Committee coming up, the SOL Committees, that is going to be collaborative with the other middle school. . ." (p. 10). Later in the interview, when asked if his faculty had participated in any activities to help them become familiar with the state's new mathematics SOLs, he made the statement that follows:

Well, we have a long term project next year to develop a whole new curriculum, not just in math, but in all the domains well, the main domains anyway, and the subcommittee is working right now in evaluating the current curriculum, and then, I guess, during the course of next year, we will have biweekly meetings to put together the new curriculum for mathematics. . . (p. 12)

The Coordinator for the K-6 Gifted and Talented Program was the Chairperson of the Math SOL Committee, and she provided details concerning the organization, progress and goals of the Mathematics Curriculum Committee:

I'm the chairperson for the Math SOL Committee. My responsibilities for that include: I have a core committee of eighteen other people from all the

elementary, middle and high schools, all except for [names one elementary school] for some reason they didn't give me somebody from [that school], and I've written to them a number of times, and our goal this summer [1996] was to find out what we are doing right now in math in [Pleasant] County, and to hopefully evaluate that a little bit, give some suggestions for improvement that hopefully don't cost a lot of money, because it's just not there, but then next year all during the year we'll be meeting with people in the County who are interested in math. Everybody in the County, is what I've been told, has to commit to one of the Core Curriculum so, I could have even a hundred people possibly on a committee. Its going to really be a challenge, and ah, so, we will be working on writing the objectives, the activities, the resources and the assessment for all the SOLs.

Interviewer: I assume this committee was formed as a response to the new SOLs—

Chairperson of Math SOL Committee: — Absolutely

Interviewer: —and ah, trying to match our curriculum to the State's Standards.

Chairperson of Math SOL Committee: Right, it was formed, it was actually formed out of that Math Task Force that was meeting on Wednesdays once a month at 7:00 AM. It came, well this math one, a lot of the people came from that one, and it's got to be done. Every County has been **told** that they **have** to write their curriculum so, this is the, what the best way they can come up with in [Pleasant] County to do it. (p. 3-4)

While discussing the activities and progress of the Mathematics SOL Committee, the Chairperson stated:

[The Associate Superintendent] gave each of the chairperson a notebook with pretty much a scope and sequence of what we're suppose to be doing. . . . We met [this summer]. We've already worked one full day, but we broke it up into two-part days, and what we did on those days were to create a survey which we gave to all the teachers, all the teachers that teach math. Hundred-ninety-two surveys went out, and hundred-two came back so, that was pretty good representation, and then the second time we met to go through the surveys. We typed up the results, and now it has to be made into the presentation, and it will go to [the Associate Superintendent].

Our ultimate goal is to write the mathematics curriculum, but now immediate goals, ones we're just starting, we're doing this piece by piece

slowly. We're starting with just the objectives first. Taking each SOL writing the objectives, and then we'll go on to write the other pieces as the year goes on. We're also meeting, well I went to that SOL Share Fair at Tech back in May. I thought that was excellent ah, excellent, but frustrating. Excellent because it gave us a lot of good ideas, but frustrating because we're wondering why we're all doing this in every County, and we're not collaborating a little bit more than we are.

. . . We've been told to be as, this is practical, this isn't a piece of work that's going sit on the shelf. We hope this is going to be a piece of work that is actually going to be implemented. Ah, there's a lot of, especially in [Pleasant] County and I'm sure everywhere else, there's a lot of need for improving our math abilities, our math activities, and so forth, and, I think, this is a good vehicle for it. (p. 4-5)

Well right now the rest of the summer. We agreed, and [the Associate Superintendent] did too, that we didn't have to meet five days together. What we're doing, we're writing objectives on our own at this point, because we did the things we needed to do as a group so, everybody now is working on certain objectives, and putting in some time that way, and then we'll probably meet again at the end of summer just to kind of bring things back together. (p. 12)

The male sixth grade mathematics teacher was a member of this committee and his comments about the progress of the SOL Mathematics Curriculum Committee follows:

Yeah, right now I am on a steering committee, a math restructuring committee [Math Task Force], that has been meeting, I guess we have been meeting six to eight months out of this year. Because of the changing SOLs in the State, we have to set up a curriculum based on that. As a matter of fact I got a letter yesterday from [Assistant Superintendent] asking me if I would participate on the steering committee on that matter. So we are going to work on that, restructuring the middle school curriculum as a whole. I have also worked on that committee the last couple of years.

The Math SOL Committee Chairperson briefly discussed the outcomes of the Mathematics Task Force meetings in the comment that follows. The information provided indicates that the Mathematics Task Force was active during the 1995-96 school year and details concerning one of the outcomes of that committee are also provided. The comments of the Chairperson of the Mathematics SOL Committee comment follows:



The Math Task Force met regularly. I'm not to sure the outcomes of the meetings were followed through totally, but they were followed through some, because one of the things that came out of that was the testing in sixth grade to determine if children should be accelerated a little bit more or not. So I feel like we've made some head way. (p. 4)

When the Associate Superintendent discussed the progress of the Mathematics Curriculum Committee, she provided data that supported the statements made by the Chairperson for the Mathematics Curriculum and the sixth grade mathematics teaching concerning the progress and outcome of the Mathematics Task Force's work:

. . . There has been a committee that's been working all year looking at just math, and you've been a part of a couple of those meetings, and in fact right here on my desk right now is a piece of that; where we're looking at a Placement Entrance Test to give to all sixth graders next year as they enter the sixth grade level, so we can have a read on what [the] youngsters' skills really are in the math area coming in[to] the middle school. The area of assessment is one of the places I see a massive need. Knowing where students are, not just, I'm not talking about the norm reference test here, but I'm talking about authentic assessment as a part of the regular classroom. So, we've spent some time this year looking at that, and beginning with some inroads, but we need more work, and we need teachers to be willing to speak out about curriculum in the area where they have skill— to help with that development. (p. 10)

The eighth grade mathematics V-QUEST Lead Teacher was a member of the Mathematics SOL Committee, and his comments about the committee although brief also support that the outcome of the Mathematics Task Force to develop sixth grade assessment materials was indeed acted upon during the 1995-96 school year. His comments follow:

. . . these committees that we are working on now, no changes have been made. They haven't **told** us what we are suppose to decide yet. . . right now I'm involved in three committees. I got assigned to do a math assessment for incoming sixth graders. . . Ah, we have to still finish up our recommendations for algebra and the SOLs. . .

Interviewer: Tell me a little about the middle school Math Committee.  
mathematics lead teacher: Well, they are in limbo waiting on the SOL Committees, our last meeting was that the SOL committees would be set up.  
(p. 6)

The Superintendent provided details concerning the Mathematics Task Force and the Mathematics SOL Committee as he talked about how the County encouraged mathematics teachers to work together as professionals to improve mathematics instruction. His comments also supported that the Mathematics Task Force met once a month before school all during the 1995-96 school year, and he indicated that the Task Force made recommendations to the SOL Mathematics Committee. His statements concerning the details of the Mathematics Task Force and the SOL Mathematics Committee follows:

This past year we formed a Mathematics Committee [Task Force], and I was part of it, and basically we invited people from across disciplines, elementary, middle and high school, to join us in a breakfast meeting once a month to examine our mathematics curriculum, our results, our strategies, and come up with ideas about what we needed to do, and that has helped a great deal. It's lead to us ah, ah, making some changes in the curriculum, recommendations that will go to the SOL Committee for this next year.

Addressing the assessment issues, and determining that we have a need for a screening instrument for kids coming into the middle school to determine their skill level in mathematics, and address that level rather than assuming that all students are starting from ground zero at the same place at the same time, and I think that has been a big help. It also has led to some of the changes we made [that] I mentioned earlier in the ninth grade. We feel a need to address those kids that are in the lower quartile in mathematics as well as language and get them up to standard rather than bringing the standard down to them. (p. 30)

The Superintendent also referred to the mathematics curriculum committee while responding to a question about the NCTM *Professional and Curriculum Standards*. His response indicated that the County did not necessarily support the NCTM *Standards*, and that the curriculum committees would not start actually construction of the County's curriculum guidelines until the 1996-97 school year.

We haven't but when we have committees, curriculum committees, such as the ones that are going to be working this year [1996-97] they will certainly examine the NCTM *Standards* and incorporate those that seem to match with our philosophy and the SOLs. Simply because we have the NCTM *Standards* doesn't necessarily mean we embrace them or agree to all of them, and I think, I take my lead from the collection of mathematics people in our County deciding whether those *Standards* should be embraced or not. (p. 16)

Later in the interview he provided a little more detail about the status of the curriculum committees. When asked if any opportunities for the mathematics teachers to become familiar with the State's new SOLs had been provided, his response included information about the goals of the mathematics curriculum committee for the 1996-97 school year. His statement follows:

That's a little premature. That will be going on this year [1996-97]. As part of the planning process not only will they be gathering data and information about what the content ought to be including on the SOL. The SOLs are part of what we're doing. We're revamping our curriculum using SOLs as sort of a center piece, but it's not going to be limited to the SOLs. They're minimal standards. So, as we develop the curriculum for each content area certainly what our aim is, is to use those Mondays to engage in dialog and inform people about what the new Standards are going to be and engage in training activities that are necessary to help people in support of it, that new curriculum. (p. 25-26)

These data indicate that in the 1995-96 school year a Mathematics Task Force, which consisted of teacher representatives from every grade level and County administrators including the Superintendent, was organized to assess the status of mathematics education at every grade level. According to the data provided the Task Force met once a month throughout the school year and after assessing the status of mathematics education, the Task Force made recommendations for curriculum, instruction, and assessment reforms that were needed to improve student performance in mathematics. The fact that the County Superintendent participated in these meetings suggested that reform in mathematics education was viewed as high priority need for Pleasant County, but the teachers that were members of the Task Force were not compensated in any way for the time or effort required to actively participate and fulfill the responsibilities of the committee.

#### Division Level: Tracking Change Initiatives

There was no evidence at the Division Level that any of the middle school restructuring subcommittees formed at the end of the 1994-95 school year remained active during the 1995-96 school year. The Coordinator of Elementary and Middle School Instructional Programs was also the Coordinator for the Middle School Restructuring Initiative, and with one week left to serve as an employee of Pleasant County, she summarized the results of the Middle School Restructuring Initiative in the statement that follows:

. . . in terms of the middle school my primary responsibility was to begin to unify the program so there would be more consistency between the two middle schools so, much of my time last year was spent ah, facilitating conversations between the two middle schools that then resulted in changes in scheduling. I don't think they resulted in, in very many substantive changes in curriculum or in instruction with the exception of a couple of classrooms. . . (p. 1)

The Superintendent's comments indicated that the focus of the Division administration was on reforming mathematics education at every grade level including the middle school, and that the committee that was active for the majority of the 1995-96 school year was the Mathematics Task Force committee. All the interview data presented supported that the purpose of the Mathematics Task Force was to assess the current condition of Pleasant County's Mathematics education program and to compile a list of recommendations that were to be presented to the Mathematics Curriculum Committee. The data also support that the Mathematics Curriculum Committee was not active until the end of the 1995-96 school year. During the discussion of the active reform initiatives for the 1995-96 school year the Superintendent made no comments concerning any of the Middle School Restructuring Subcommittees.

The only comment made by the Superintendent about the activities of the Middle School Restructuring Initiative during the 1995-96 school year was that the new block schedule had been implemented, and that he hoped it had a positive impact. His comment concerning block scheduling follows:

This past year was the first year that we implemented a form of block scheduling at both middle schools. . . I would hope it impacted positively, in that it gave them more time, more control over their time to work with students. I think it's a plus in any discipline to have more control over your time. Rather than the bell ringing every forty minutes whether your done or not . . .(p. 29)

The Coordinator for the Mathematics Curriculum Committee indicated that during the summer of 1996 she and Pleasant Middle School's V-QUEST mathematics teacher had created and conducted a mathematics survey for the teachers of Pleasant and that they had compiled the results for a presentation to the Associate Superintendent. The data also indicated that at the time of the Coordinator for the Mathematics Curriculum Committee's interview, July 8, 1996, the Mathematics Curriculum Committee had not started writing the objectives for the County's mathematics curriculum. Neither of these active members of the 1994-95 Restructuring the Middle School Committee and its subsequent subcommittees

made any reference to their respective subcommittees' activities during the 1995-96 school year.

Although Pleasant Middle School mathematics lead teacher was an active member of the Mathematics Task Force, the Mathematics Curriculum Committee, and given the responsibility of designing an assessment of mathematics skills for incoming sixth graders, there was no indication that the County continued to actively support the V-QUEST Lead Teacher's Reform Initiative. In the following interview exchange the Superintendent indicated that the V-QUEST Lead Teacher Reform Initiative was no longer supported at the division. That interview exchange follows:

Certainly, I think I met with them as a group on at least one occasion last year and commended them on their participation and encouraged them to continue to be that lead teacher and take advantage of opportunities regardless of V-QUEST or the status of V-QUEST. . .

Interviewer: Well I know three years ago the County provided released time for the lead teachers to meet once a month, a half day once a month so, I know that was financial support in that you provided the substitutes and the free time for the teachers to work together, and after that . . . I was wondering if any other projects or programs like that were under way or funded?

Superintendent of Pleasant County Schools: I'm not able to pull off the top of my head, but I think we have pulled them together from time to time since then and continued to. . . included them in committee work. We haven't turned over reform to the lead teachers. Again, this is an incremental process embedded in many ways in a lot of different things we do. It includes personnel selection and assignment, curriculum development, committee work, textbook selection, ah, computer utilization and training, but certainly lead teachers have been included, involved, their opinions have been listened to, but we haven't turned over the process of reform just to the lead teachers, or too, is the only reform being done that's that coming out of lead teachers? No, but it's embedded in a lot of things we do. (p. 31-32)

The Director of New Initiatives, who had served as the coordinator of Pleasant County's V-QUEST Lead Teachers during the 1993-94 school year, indicated that the V-QUEST Lead Teacher Initiative was no longer supported at the State or the Division Level. Her comments indicated that the V-QUEST Lead Teacher Reform Initiative no longer existed, and those comments follow:

Well you see I'm not, since V-QUEST is **dead** I don't have any responsibility to work with those teachers, and that's too bad. . . . as far as V-QUEST in our County, and I think, all over the State it's dead. Is it alive and well? Well those people that were named as lead teachers, I think, in a lot of the schools are still taking that lead teacher role, but it's supported at the school level. . . . I mean those teachers still exist, but I would say that organization does not. . . . There are teachers who are still active and [The Gifted and Talented Resource Teacher] is certainly one, and I think she has County goals because she has, she is one of the Gifted Teachers, and she certainly really played a leadership role . . . (p. 23)

When the Coordinator for Elementary and Middle School Instructional Programs was asked if she thought that the County encouraged the lead teachers to be active in mathematics reform, she indicated that the V-QUEST Lead Teacher Initiative was not supported at the Division Level during the 1995-96 school year. Her comments follow:

Ah, I think there's been lip service. . . . I know that there were a couple of times last year and a couple of times this year that I've made a comment that I wish that we could make some kind of report about V-QUEST and nothing happened. Ah, the Share Fair that I organized last year was really the only time that there was anything not only sanctioned but encouraged from the Central Office that allowed a way of, you know, an organized way of sharing. . . (p. 4) It is tragic that it [V-QUEST] had to just kind of— it's very hard when there is not an institutional support for it. . . (p. 15)

The Superintendent indicated that he thought the lead teachers had met as a group one or two times during the 1995-96 school year, and the Coordinator for Elementary and Middle School Instructional Programs' data support that there was one Division Level sponsored event for the lead teachers that year. The data verify that the V-QUEST Lead Teachers were still actively participating in Division Level reform initiatives, but not as an organized and supported group of lead teachers. There is little evidence to support that the lead teacher's involvement in the Division Level mathematics educational reform initiative was related to his lead teacher designation. The Superintendent did say that the lead teachers were included in the decision making committees, and that their voices were heard by the County Administrators. The lead teacher stated that since he had taken on the responsibility of lead teacher he had received a lot of extra duties. His exact words were:

Well I'm not so sure about the lead teacher, but it seems like that anything that comes along that is new and they want somebody to try it. They stick it to me. . . . (p. 2)

The data indicate that both the State and Division Levels had withdrawn all support for the V-QUEST Lead Teacher Reform Initiative. The data also verify that the mathematics V-QUEST Lead Teacher was actively involved in all phases of the mathematics curriculum reform efforts, and that he was given extra responsibilities such as creating a sixth grade diagnostic assessment instrument, creating a survey to evaluate the current mathematics educational program, participating in compiling and reporting the results of that survey, preparing presenting technology related workshops, and assisting in a writing grant proposal to secure funding for inservice training related to implementing the new SOLs. As the Director of New Initiatives stated although the V-QUEST organization no longer existed, the trained lead teachers did, and the knowledge and leadership skills of Pleasant Middle Schools lead teacher were put to use by the County in all aspects of mathematics education reform, but at the end of the 1995-96 school year the administration was still talking about reforming mathematics education, and the actual process of revising the County's curriculum was just getting started.

The data also indicate that although the County placed a major emphasis on reforming mathematics education, progress was disjointed and slow. The focus on restructuring the middle school the previous year had resulted in a schedule change that doubled the amount of instructional time for mathematics instruction, yet there was no Division Level evidence to indicate that any professional development was considered or provided for the mathematics teachers to assist them in changing their instructional strategies to match the new 90-minute blocks of instructional time. Instead the teachers were given the new State *Standards of Learning* and told to implement them immediately, but the County had not changed its curriculum guidelines or assessment practices. Even though the new SOLs promoted a change in the focus of mathematics instruction, and mandated the use of technology in mathematics instruction the Division Level administration had not changed its focus on the purpose of mathematics instruction.

When the Superintendent was asked if he had noticed any changes in the mathematics program at Pleasant Middle School, he stated, "I'm not aware of any unique material or programmatic changes. I am aware that the block schedule has been added. I am aware that the computation scores are the lowest in the County and we're very concerned about that" (p. 30-31). When he was asked if there was anything specific he would like to see happen in mathematics education or anything that he would like the mathematics teachers to work on, he stated:

Oh yes, we have that as one of our major goals for next year, is to address what appears to be gaps in our testing program in our curriculum.

Computation in particular is a weak area that has been identified across

grade levels in mathematics, and we've asked our teachers, we've got a mathematics committee working on the problem, to examine you know why that is and what we need to do to correct it. Certainly we're concerned that our math scores are not as high as we'd like to see them compared to other disciplines and especially in the area of computation we're real concerned. (p. 18)

The Associate Superintendent supported these concerns when she responded to a question about the use of calculators and mathematics instruction. Her comment indicates that the main impetus for reforming mathematics education was improving the students computation scores. Her comment follows:

. . . I still feel that youngsters have to learn the basics that they have to master some of the computation skills, and that we can't just give them a calculator and never teach them the basic skills. For example right now our math computation scores at the middle school level are not good. We have 142 eighth graders going to the ninth grade next year scoring below the 25th percentile in math computation. Now, you know, the only way that we're going to handle that is to make sure that children have mastered the basic skills. We can't just rely on their using a calculator to do basic skills, as important as I think calculators are, they have to still master the skills, and I think a balance between those two things is extremely important. (p. 6)

The Division Level administrators' goals for reform in mathematics education did not match the goals of the V-QUEST Lead Teachers Initiative or the objectives of the State's new SOLs. The mathematics teachers were in their second year of using new instructional materials. They had access to manipulatives and calculators for mathematics instruction, but they had no staff development, no consistent leadership or support for change, and two of the major components of instruction did not match the intent of the new instructional materials; neither the curriculum or assessment practices had changed by the end of the 1995-96 school year. The Superintendent expected improvement in mathematics education that would result in higher computation scores and did not necessarily support the reforms recommended by the NCTM *Standards*. Again, the middle school mathematics teachers were inundated with change, but not the systemic change supported by V-QUEST and the V-QUEST Lead Teacher Initiative.

#### Documenting and Tracking School Level Change in 1995-96

The adoption of the State's new SOLs and the implementation of block scheduling were two major changes that had potential to directly impact mathematics instruction at the



school level. Data related to block scheduling are presented first, beginning with a description of the changes that resulted from the implementation of the block schedule and how those changes impacted instructional teams and mathematics classes in the sixth, seventh and eighth grades. This is followed by a presentation of interview data from the mathematics teachers at all grade levels, the Principal and Division Level administrators to document the professional/staff development opportunities that were provided to prepare mathematics teachers for this change. Interview data from these same sources that describe the instructional changes as well as the advantages and disadvantages of the new block schedule are presented to document the schedule's impact on mathematics instruction. This section of documenting and tracking school level change concludes with interview data related to the teachers' role in the decision making process; this is used to document teacher empowerment in the reform process.

Second, data pertaining to the implementation of the State's new SOLs and the creation of the County's new curriculum guide are presented. Interview data from both the school and Division Level participants that pertain to the process in place for implementing the State's new SOLs are presented to document the progress made in this area during the 1995-96 school year. The State's new Standards of Learning were designed to change the mathematical content taught in the classroom, the methods of instruction used, and the desired learner outcomes from procedural understanding to relational understanding. The implementation of the State's new SOLs-mandated changes in the mathematics classrooms that matched the NCTM suggested reforms. Therefore, documentation of the progress made in implementing the State's new SOLs also serves to document progress in systemic reform.

The implementation of both block scheduling and the State's new SOLs had the potential to impact methods of instruction, instructional materials, and assessment in the mathematics classrooms; therefore, much of the data related to tracking the activities of the V-QUEST Lead Teachers and the ongoing academic reform initiatives (academic teaming, the use of cooperative learning, implementation of interdisciplinary instructional units, the types of instructional materials used for mathematics instruction, and methods of assessment) are included in data that document the impact of the implementation of block scheduling and the State's new SOLs on mathematics instruction. Any additional data pertaining to tracking any of the on going academic reform initiatives are presented in the third portion of this section.

### School Level: Change in Schedule

This section opens with a description of how block scheduling changed the instructional day for the different grade levels, and then details concerning the professional/staff development provided to help the teachers prepare for the move to block scheduling are presented. The teacher, Principal, and Superintendent interview statements concerning the impact of block scheduling on mathematics instruction document the changes in mathematics instruction as well as the advantages and disadvantages of the schedule change. The presentation of the block-scheduling interview data concludes with remarks concerning the future of block scheduling for the middle school.

The implementation of block scheduling eliminated the extended-learning class, doubled the amount of instructional time for mathematics and language arts, decreased the number of mathematics classes taught by each of the seventh and eighth grade mathematics teachers from four to three, and provided for social studies and science to become one-semester classes. Block scheduling for the seventh and eighth grade teachers meant more time to teach mathematics and language arts, but it also meant that some seventh and eighth grade social studies and science teachers would be teaching at least one class outside of their field of certification.

Since the mathematics teachers taught three 90-minute classes each day and the social studies and science teachers two classes of social studies or science, each social studies and science teachers' third class would be either mathematics or language arts. Therefore, the implementation of block scheduling actually increased the number of inexperienced, uncertified mathematics teachers which also increased the number of mathematics teachers who had to share the available instructional materials. Changing social studies and science to one-semester classes also made organizing and conducting interdisciplinary instructional units more difficult for the seventh and eighth grade teachers.

For the sixth grade the change to block scheduling was just as dramatic, but different. At the sixth grade level social studies and science classes remained year long classes, but in compliance with the middle school philosophy the sixth grade academic teams were reorganized to reduce the number of teachers and class changes for the younger students. The sixth grade teams were changed from four person to two person teams, and with the elimination of extended learning time the two person sixth grade academic teams had a two hour block of time in which to teach mathematics and social studies or language arts and science. As the sixth grade teachers talked about the advantages and disadvantages of these changes the most significant change for them was the move to heterogeneously grouped classes.

When Pleasant Middle School's Principal was asked if there had been any staff development or training provided to prepare the teachers for the move to block scheduling, he said, "Gave them advanced notice. No, we told them all summer, they were going to have a 84-minute [block]" (p. 17). Earlier in the interview he indicated that the County's focus for staff development that year was on the elementary schools which basically left no funding for staff development at the middle school level. His statement follows:

Well, I think there was a thrust this year at the elementary level to do a lot of staff development, a lot of inservice, especially in the language arts and literacy. There has been a lot of discussion about mathematics, a lot of committees and meetings with the administrators and central office people that we do need a pretty extensive staff development in math, but we haven't had the staffing to do that. Certainly, I think, that is recognized as a need, but I haven't seen a commitment to it, and I think it is basically because there is only so much money to spend. (p. 6)

When the mathematics lead teacher was asked if the administration provided any staff development that focused on the reform of mathematics education, he stated, "Not that I know of. . ." (p. 17). In an earlier interview the mathematics lead teacher stated:

We need staff development, and I hoped that staff development would be built into this [restructuring the middle school], and I mean real staff development, not some expert coming in saying, I don't know, in two hours this is how you do it. We need continuous staff development, and it needs to be hands-on. How to use hands-on in the classroom, how to teach problem solving, how to develop problems to use in problem solving, how to use cooperative learning effectively, but. . . they **talk** about doing all of this, but they don't do it! They bring in these **experts** on the *Quality Schools*. (p. 8)

The mathematics lead teacher stated that the teachers were provided access to information concerning national mathematics and science conferences, workshops and professional development opportunities, but ". . .they [teachers] would have to pay their own way, and that keeps people from going" (p. 17).

When the other eighth grade mathematics teacher was asked if there had been any specific mathematically oriented professional development opportunities offered, she made the following statement:

By the County? Um, not as much as I would like. We have asked for quite a bit of training with manipulatives and that kind of stuff, and we didn't really get that. I don't know if they couldn't find anybody or what. . . and we did ask for help with heterogeneous groups as far as how to reach the gifted in

the heterogeneous groups, and we did have a one day, not one day, well a two hour speaker on that. That was helpful, but we still need a lot more. . . . um, well, last summer quite a few of us did the *Quality Schools*. That was good, because that goes into the students' needs, you know, as far as meeting their needs for freedom and power, and you try to kind of incorporate that, you know, incorporate that with your lesson and that kind of thing. (p. 14)

When the seventh grade mathematics teacher was asked to talk about the staff development that had been offered by the County in preparation for moving to block scheduling, she stated, “. . .being in [named a Virginia Tech professor who served as a V-QUEST Lead Teacher Trainer] class at Tech certainly, I gained a lot of ideas” (p. 5). This was a class on using hands-on activities to teach mathematics that was offered for two days during the summer at Virginia Tech, and it was funded through the grant that was prepared by the Coordinator of Elementary and Middle School Instructional Programs and the mathematics lead teacher. The seventh grade mathematics teacher attended this class, and in the interview exchange that follows she talked about staff development opportunities that were provided by the County, and she explained that the class at Virginia Tech was not actually funded by Pleasant County saying:

Actually, I think that class [at Virginia Tech] may have been a grant, in fact it was, it was an Eisenhower grant, but we did get released time for half a day, I think, four times throughout the year, maybe, I believe it was four times. . . . I do think that we need more inservice type things.

Interviewer: Any particular topics that you think need to be addressed?

Seventh grade mathematics teacher: Well I think the use of manipulatives. I even think that if mathematics teachers, even at the two middle schools, we met one time together this year, and we did say that it was probably our more productive after school meeting, but I do think that if we shared ideas, and I know that with [named the other new seventh grade mathematics teacher],the other 7th grade math teacher, we share a lot of ideas. If I do something, and it works, I tell her, and if it doesn't work I tell her, and she does the same thing. I think if we could pool even our resources here it would be helpful. (p. 12-13)

According to the mathematics lead teacher, the seventh grade mathematics teacher, and the Coordinator of Elementary and Middle School Instructional Programs, there was a two-day inservice offered during the summer that had been funded with Eisenhower Grant money, but only two Pleasant Middle School teachers who indicated that they attended that

workshop were the eighth grade mathematics lead teacher and the seventh grade mathematics teacher. The seventh grade mathematics teacher indicated that the Principal supported staff development for the mathematics teachers stating that he had provided released time for half a day for the teachers to work together, and she said, “He [the Principal] is very willing for us to attend any conferences that are available. Actually we haven’t had a mathematics conference offered recently” (p. 14).

The new seventh grade mathematics teacher explained that the staff development day spent with the other middle school’s mathematics teacher resulted from suggestions to the Principal by Pleasant Middle School’s mathematics teachers. The statement that follows contains her comments about the mathematics teachers of the County’s two middle schools’ joint meeting and comments about the need for more time to work together and individually to improve mathematics instruction:

We’ve had one opportunity, and I requested, and a couple other teachers requested,— we ah, are mandated to meet every Tuesday from 3:30 to 5:00— a Monday memo came out yesterday saying— do you have any suggestions for topics? We had suggested, and for what ever reason, it has only been done once, and it was with the [other middle school] faculty. They suggested, we suggested, it worked beautifully, the math people worked together for one day. We said if we are going work from 3:30 to 5:00, what about doing it more frequently where we could feed off each other. We have a room, a resource room, down here that I haven’t had time to go in, and just give me time to rummage and find things, and we have all requested that and say yeah, if we could— (p. 22-23)

When asked if there had been any professional development opportunities offered, the sixth grade teacher stated:

. . . I am taking the TAG [Talented and Gifted] classes, and they have helped me a little bit. I haven’t done any math. Is it V-QUEST that does the math? . . . In math, **no**, I have not been offered anything except what you might be doing in the TAG classes. (p. 16)

The Talented and Gifted classes did not focus on one subject area, and although there may have been some mathematics information included in the classes, the focus was on meeting the needs of the Gifted and Talented student in the regular classroom. For the sixth grade teachers this was significant training because this was their first year teaching heterogeneously grouped classes. When asked if she attended the inservice offered on *Quality Schools*, the sixth grade teacher stated, “No. We read the first three chapters, and after that we weren’t required to read anything else, and I didn’t” (p. 18).

When the sixth grade mathematics teacher was asked if he had been provided any opportunities to participate in professional development related to teaching math, he stated, “I have had opportunity, but I have not gone to that many of them. Most of them have just been things that I have done on my own” (p. 24). He stated that he did not attend the inservice on *Quality Schools* because the class that he signed up for was filled (p. 24). His interview data indicated that his interaction with the V-QUEST Mathematics Lead Teacher was his main source of professional development, and he talked about the need to have time to interact with other mathematics teachers. The details are provided in the interview exchange with the male sixth grade mathematics teacher that follows:

I talk to [V-QUEST Lead Mathematics Teacher] all the time. If something comes up in that book that I am not sure of, or that I am not real comfortable with, and sometimes it happens in the middle of class. Something will come up, and I don't know what it is, or I am not sure what it is, and they ask me a question, and I can't answer it. I am not so above these kids to say, ‘I don't know’. I think that is one of the things that is important. These kids have to know that you are human, and that you make mistakes, and that you don't know all the answers, and sometimes you have to go somewhere else and find the answers, and they have heard me say several times, ‘hold on to this’ I will find out from someone else. I will talk to [V-QUEST Lead Mathematics Teacher] this afternoon, and I will have your answer tomorrow. I talk to[V-QUEST Lead Mathematics Teacher]. I talk to several others, you know, in finding out what this means, and what do I need to do there, or is this answer right. Sometimes we have found mistakes in the book. . . and when I run up on one of those, I want to check it with someone else to see if it is a mistake, or whether it is something I am doing. The kids understand that.

Interviewer: Do you get a chance to interact with other teachers in the County in this way?

Male sixth grade mathematics teacher: We haven't had a whole lot of success with that. We are doing more of it now than before. We are talking more with [the other middle school] teachers, right now we are in the process of talking to the elementary fifth grade teachers. We want to see what they are doing, and they want to see how their kids are performing up here. Whether what they have done is working. . . .(p. 25-26)

Every mathematics teacher commented on the need for staff development in mathematics, and most of them identified the area of need as methods of instruction, i.e.,

how to teach math using hands-on activities, manipulatives and problem solving. Most of them indicated that they were aware that a two-day professional development opportunity had been made available to them during the summer at Virginia Tech, but only two of the six mathematics teachers in the study attended. While talking about the implementation of block scheduling at the middle school, the Superintendent made the following statement:

. . . the kids need to move within the class and be active and involved in work that addresses their unique needs at that age. I certainly will do— and that's where staff development is badly needed. In some cases some teachers have taken real advantage of that, and then others, but it ought to be an active classroom environment during that long block of time. **Lecturing** will not work. It never worked before, and it works even less now if that's the only method that a teacher relies on. (p. 26)

This statement confirms that the Superintendent viewed staff development for mathematics teachers as an important need, and he saw a need for a change in mathematics instruction at the middle school.

The Principal indicated that, although there had been discussion among the County administrators about the need for staff development in mathematics instruction, limited resources required the prioritization of needs, and the elementary schools were targeted as the sites in greatest need of professional development in mathematics instruction. This statement is supported by the fact that during the 1994-95 school year Division Level activities related to the V-QUEST Lead Teachers focused solely on the needs of the elementary schools. Further, the staff development opportunities described by the Gifted and Talented Resource Teacher that were available to elementary teachers during the summer of 1995-96 also supported the County's focus for the 1995-96 school year remained on improving mathematics instruction in the elementary schools.

These data document that block scheduling was implemented at Pleasant Middle School with little or no professional/staff development for the mathematics teachers at Pleasant Middle. Although the mathematics teachers were not provided any support or training for the move the block scheduling, the Superintendent, Principal and all the teachers indicated that there was a great need for staff development. Specifically, the teachers and the administrators indicated that there was a need for staff development in how to use a variety of instructional strategies and materials such as cooperative learning, manipulatives, hands-on learning activities, problem solving approach, differentiation of instruction, and technology. The teachers also indicated that they needed time to work together professionally and they needed time to explore the available resources. Teachers at all three grade levels indicated that sharing ideas with the other mathematics teachers in the County

was a beneficial use of their time, but they also indicated that this happened only once during the year.

Block scheduling resulted in significant changes for all three grade levels. The seventh and eighth grade mathematics teachers changed from 45-minute class periods to 90-minute blocks of instructional time, and there were two additional mathematics teachers at each grade level; in all cases these were teachers who were inexperienced and uncertified to teach mathematics. There were no new instructional materials purchased this year, therefore the already limited supply of materials was to be shared among even more teachers. The seventh and eighth grades maintained four person academic teams, but now each team had two different mathematics teachers, two different language arts teachers, a social studies and a science teacher, and they no longer shared the same students throughout the year; thus, interdisciplinary-team teaching became more difficult. The sixth grade teachers changed from four-person teams to two-person teams, and this change was accompanied by a move from homogeneously to heterogeneously grouped classes. Another change at the sixth-grade level was flexible scheduling; instead of designated class periods for each subject the mathematics teacher had a two-hour block of time, in which to teach mathematics and social studies, and the teachers allotted time according to their needs. The participants' comments concerning how these changes impacted mathematics instruction are presented next.

As the Superintendent talked about the impact of block scheduling on mathematics instruction at the middle school, he made the following comments:

. . . This past year was the first year that we implemented a form of block scheduling at both middle schools, and it's been treated a little differently from one school to the other, but I would hope it impacted positively, in that it gave them [teachers] more time, more control over their time to work with students. I think it's a plus in any discipline to have more control over your time. Rather than the bell ringing every forty minutes whether you're done or not. The short blocks of time involve taking the role, getting your lesson introduced, setting up, if you had a lab, getting kids set up, breaking down, closing down the class, so you ended up in a forty minute block with very little instructional time, and kids were out in the hall again getting excited and talking to one another and running from one locker to another, and they come into the classroom breathless, and you begin the process again. Take role again, getting set up again, whatever the class is. So, to me in any discipline, whether its mathematics or otherwise, the larger block of time eliminates a lot of that just pure old mechanics of role taking and shutting



down and starting up and lost time and lost distractions, I mean not lost distraction, lost attention. (p. 26)

While talking about how the decision to implement block scheduling was made, the Principal stated that the reason for implementing block scheduling was to encourage the use of interdisciplinary units of instruction. The Principal's comments follow:

I think it was a compromise/combination. The way we got to the schedule at the middle school level, I don't know if anybody knows, the **real** focus was on restructuring and moving towards interdisciplinary units. There was a lot of talk about having to use certain things [methods of instruction] with the schedule, so I kind of proposed looking at the block schedule about the same time that downtown was talking about it. That was when [consultant from UVA] got involved, and the more we started talking to him about it, the more reasonable it sounded. Plus we had a pretty nasty schedule. . . .(p. 17)

In the following interview exchange, the Principal talks about the impact of block scheduling on the mathematics program at Pleasant Middle School and his expectations.

Interviewer: Do you think the block scheduling has had any impact on the mathematics program?

Principal: I think it has been positive at the middle school level, you get to spend more time. The teachers seem to think it is effective.

Interviewer: Has this matched your expectations of what block scheduling was going to do?

Principal: Well, the expectations were for the general school atmosphere, as well as, what happens in the classroom. I would say generally it has. There has been some talk that even though there is double time in math, the kids still can only process so much. So, whether you can expect double amount of skill attainment is questionable. The overall— I think it has been positive. (p. 16)

Interviewer: Do you think the block scheduling has lead to interdisciplinary type teaching?

Principal: I think the teams that were doing those kind of things before just continued, I don't think it changed the structure that much in some cases.

Interviewer: Do you think the math teachers will be supportive of continuing the block scheduling?

Principal: Yes. . . . I have already done a survey, most all of them, I haven't seen any math teachers that don't like it. (p. 17)

The teachers' data concerning the impact of block scheduling on mathematics instruction is presented next beginning with comments from the mathematics lead teacher. When asked how block scheduling had impacted his classroom instruction, he stated:

Well, it's given me more time to complete activities that would take an hour, and when we had 45-minute blocks, we did part of it this day, and then we'd come back the next day, regroup, re-explain, do all that, then finish the activity, and I thought we lost continuity. This year I can finish activities in one day, and if it's a two day I can break it up easier. . . . It gives me more time to do things with the kids, but I think there are probably more disadvantages for this age group than there are advantages. . . . I mean it's very hard on them [students]. Their attention span is not good. It's extremely hard on them; in social studies and science they have to cover a hundred eighty days worth of material in ninety days—they're having a hard time with it. (p. 16)

Not because I don't think it's good for science and social studies. I actually don't think that kids at this age and even at the ninth grade level or at the tenth grade level can handle blocking. They can't; there is too much material to learn and too little time, and they get confused easily at that age. Particularly at the eighth grade we're in a brain lull. Right? I mean we're at that plateau where we sit there for a while whether it be six months or a year and a half, depending on the kid. I just don't think it's good for them. I don't think they get the science concepts like they use to. (Second Interview p. 22)

As documented in the baseline and tracking data, making connections between mathematics and other academic subjects was customarily a part of the mathematics lead teacher's instructional plans, and several of the team's interdisciplinary instructional units were documented, e.g., the bridge unit, the design a room unit. With the implementation of block scheduling the use of the instructional units were dropped or activities were drastically modified. In the next interview exchange the eighth grade mathematics lead teacher talked about the problems that the semester science and social studies class schedule presented for conducting interdisciplinary teaching units:

Well [the 8th grade science lead teacher] and I always do activities that involve what she's doing in the classroom. Since she's on a semester basis now, this semester I'm doing physics activities with the kids to reinforce what they did **last** semester. [The 8th grade L.A. teacher] and I do things together. When we did the friction tractor she had them write descriptive paragraphs about what they did and what it looked like and things like

that—so there’s a connection there. When we weren’t semesterized, or whatever you want to call it, [the 8th grade social studies teacher] and I did a lot of things together too. Now we’ve done **nothing**, even though I’ve spent some time working with him on doing some displays for history day.

Interviewer: Has that changed since the blocking?

Mathematics Lead Teacher: Yeah, we, ah we just, we just don’t do it. Social Studies and I just don’t any more—together, like we use to. . . . (First Interview, p. 14)

Mathematics Lead Teacher: Ah, when we do stock market I have a broker come in and when we do our toothpick bridges, [eighth grade science lead teacher] and I use to do that together, but I’ll be doing it by myself this year. (First Interview, p. 9)

Mathematics Lead Teacher: . . . The last four years we have been teaming, kids started making connections. [The eighth grade science lead teacher] and I try to do as much as we can, but it’s real difficult. She has the kids for half a semester. There are activities that she would like me to do, and I’ll say, well it’s just not appropriate mathematically at this time because they don’t have these skills, and those skills [that] I would have to teach separately before I could do the activity. That’s not good. Next year, I will probably go in there and do it anyway because they need that reinforcement, and then the second semester if I didn’t do some science activities they wouldn’t get any science done at all. (Second Interview, p.23)

The science lead teacher’s comments indicate that she agreed with the mathematics lead teacher in that block scheduling made it more difficult to use interdisciplinary activities to teach. Her comments follow:

Well there are advantages to all ways that we do this. What that [semester schedules] did was involve another math teacher to be involved in it with [the mathematics lead teacher] and myself and we shared what we had done and she shared with us. (p 2)

Interviewer: Did you all [eighth grade mathematics lead teacher] work together on this campus beautification project?

Eight Grade Science Lead Teacher: No, I didn’t get to do this, this time. I didn’t get to do as much this year as I did last year. . . . We kept teaching together even though we didn’t share the same students, we kept on going. (p. 19-20)

While the other eighth grade mathematics teacher discussed how her mathematics instruction had changed, she made the following comment about how the longer class periods provided by block scheduling facilitated the use of a variety of instructional strategies:

I think it has changed in the fact that there is more time for individual instruction, more time for writing, communication, discussion. More manipulatives are being used, both because of the time and because of the fact that we have them and because of the fact that I realize there is a need for it more than we did before (p. 9). . . . I probably tend to use activities more, and part of that is the time element, and part of it is that we have manipulatives to use that we didn't formerly have, and we were given funds to purchase those a couple years ago. (p. 2)

Later in the same interview the eighth grade mathematics teacher talked about the advantages and disadvantages of block scheduling, saying:

Yes, the way it [the schedule] is set up here for us it is ideal for mathematics and language arts, since we have twice as much time as they have for those subjects. [Of] Course the science and social studies people don't agree with that, but it is ideal, really, to be able to have that period of time where you can have a hands-on activity, do concept development, all that, in the same time frame, or the same day. Before, if I decided to take a different approach, maybe they did an activity one day, and then they would have to finish it the next day. Some of the, you know, I had this big mess, stuff I had to save and put out the next day, and it works great the way we have it right now, for me. **I love it.** (p. 13)

The seventh grade mathematics teacher's data concerning the impact of block scheduling on her mathematics instruction follows:

Well, I am definitely using manipulatives more often. This has been true since we adopted the new textbook, and we have had this book, this is our third year. We adopted the book because of the new NCTM Standards, and so I have definitely changed my teaching style. . . . My assignments are shorter. I probably take as many grades as I used to, but the length of the assignment is much shorter, and in the block period time they are doing more group work instead of you take this worksheet home, and you do it. They may do their homework in a group. . . . Block scheduling has been wonderful for teaching math. . . . Well, you just have a lot of time to get the materials out. You can do an activity, talk about it and complete it in one day.

You don't have to start it one day and get things out, put them up, kind of complete things. (p. 9-12)

While discussing the merits of teaming, the seventh grade mathematics teacher pointed out one of the disadvantages of the block schedule in the interchange that follows:

I don't think we have strong team unity any longer. I think, I think the team concept is wonderful, and it is nice to be able to talk with a child's other teachers, and you know, maybe have a team meeting with a child. We are just, I shouldn't really say that because the language arts teacher and science teacher have worked together just this year developing a magazine. We have in the past worked on units together but this year it seems as if we haven't worked as a team quite as much, I think. . . . Well, because we have, you know, the science teacher teaches one semester, and the social studies teacher teaches one semester, and you know, by the time they get to know their students, and so forth. (p. 12)

The other seventh grade teacher who was teaching mathematics for the first time stated that she liked the new block scheduling in the comment that follows:

I have enjoyed block this year. . . . This year the biggest positive has been getting rid of extended learning, that was a waste of time. I know I'm getting— you can quote me on that. I can make **no** justification for extended learning. I can make **no** justification for advisory. You advise your kids as you teach them. You don't set aside twenty minutes, and tell them you are coming in and now I am going to impart great wisdom to you. We come closer, we're not there yet, but we've come closer to getting back to just teaching, which is what we need to be doing. Just a block here, a block here and a block here and God forbid— just teach the kids. (p. 21)

The female sixth grade mathematics teacher's reaction to block scheduling follows:

I don't like the blocked math. I don't like the blocked system **at all**. I like having specific times for classes, and that way when we have the block, we may spend two hours on social studies, and we may not get around to math one day. I think some of the classes suffer from it, and if a teacher doesn't like math, she may spend 20 minutes on math and one hour and a half on social studies. I just don't like it. I like the other system. I liked everything neat and orderly. (p. 14)

When she was asked to describe the impact of block scheduling on her mathematics instruction, the sixth grade teacher stated:

. . . I have more groups than I used to because we don't get to group children anymore. I think I am going slower than I used to, and the amount of material that I cover is not as much as it used to be. (p. 3)

Later in the interview, while discussing specific components of her methods of mathematics instruction, the sixth grade teacher was asked if her use of communication or questioning changed? She stated, "I don't really think so. I did it long enough, and I decided my way" (p. 10).

The male sixth grade teacher's comments about how his mathematics instruction had changed during the 1995-96 school year indicated that the move to heterogeneous grouping had impacted his mathematics instruction also:

I do more of the grouping than I did in the past, I use more of the cooperative learning, and more of the Paideia types of activities than I used to. I used to have them [students] in lines and in straight rows and give them class work and let them do the class work and take up the papers and check the papers and give the papers back, and I found out that that takes a lot of time and it is busy work, and busy work doesn't get you anywhere. . . . I know a lot of teachers that have to spend a lot of time after hours, after school, running material off, and they have to plan for each day, and it does take a lot of time. Grading papers just adds to that, and when you can do it within your groups, and you can see that they are progressing and they are learning, then you can do it with small groups without having to take those papers up and go through each and every problem to see if they are doing that. If you can see that they are making progress, then why take up all those papers, spending three and five hours at home at night grading those papers? It allows me more time for planning. (p. 15-16)

When asked to explain why he had made this change in his method of instruction, he made the following statement:

It is called heterogeneous grouping, when you have kids who are talented and gifted all the way down to LD [Learning Disabled] and ED [Emotionally Disturbed] in groups, you have to spread yourself around. Especially when you are by yourself, and you don't have an aide in the room with you to help you. You have to go from group to group and you can't let yourself stay in one place too long, because when you do, you will have one group on task and another over here getting off task and doing something else, and getting into things they shouldn't get into. So the only way you can do it, is in small groups and keep moving around to make sure everyone

keeps working and it works you to death, but it is the only way you can work with heterogeneous groups, unless you have someone in the room with you. . . . I feel like I have been more successful than I have been in the past. (p. 15-18)

What the female sixth mathematics teacher described as the disadvantages of block scheduling the male mathematics teacher described as its advantages. His comments about the advantages of block scheduling begin with a statement to teachers who might be considering the move to block scheduling. His advice follows:

Not to; expect the unexpected; not worry about your time, how much time you have got. You have got plenty of time to do what you want to do, and if it takes more time than half the block, so be it. You use it. If you have something that comes up that is really puzzling to the kids and really has their interest, and it will last the whole 84 minutes, use it, go for it. You could always come back the next day, with whatever other subjects you have, and you could teach that subject the next day. If you are required to spend a certain amount of time here, and a certain amount of time there, to me, blocking is not for; that is not what blocking is all about. Blocking is you got the time to use, and you use it where it fits in best, and if it's 75 minutes for one and 15 for another or whatever, then that is the way it should be, and use it that way. (p. 23-34)

When Pleasant Middle School's Principal was asked if the teachers would have a voice in the schedule for the next school year, the Principal said, "I have already done a survey, most all of them, I haven't seen any **math** teachers that don't like it." Since the block schedule changed the Science teachers from a full-year class to a semester class, there was a question about how the Science teachers responded to the survey, and the Principal's response follows:

Actually the Science teachers are in favor of it, too. My glitches are with Title-I because it is hard to pull kids out of a whole block or half of a block, and Special Ed, it is really causing problems for Special Ed. But my science teachers, they like the block too. . . .the comments have been that they feel like they haven't covered all the material, but what they covered they probably did a better job. (p. 18)

The Superintendent's comments about the impact of block scheduling on mathematics instruction were presented earlier in this section, but the following interview exchange is quite relevant here:

Well, I would be really interested after a year in talking with our teachers about that, and I intend to get some information this summer from them over, you know, the past year. This past year was the first year that we implemented a form of block scheduling at both middle schools, and it's been treated a little differently from one school to the other, but I would hope it impacted positively, in that it gave them more time, more control over their time, to work with students.

Interviewer: Do you think the teachers will be able to play any role in how block scheduling is utilized, in other words if teachers thought that they might use a slip-slide schedule more effectively than going to say math every day of the week, is that going to be an option or a consideration?

Superintendent: I think that's where the teams have to sit down and make those decisions, and they ought to be made based on what's best for the students, and I would need to understand how it is best— just so we are all aboard. I rely heavily on teachers and Principals to make those calls, but I don't want us to lose track of County-wide goals, and our efforts, and we have a lot of work to do in mathematics right now, and I just don't want to lose time. I don't want to be distracted with other things, and I think our focus is going to have to remain, and whatever they want to do I think, I need to see how it maintains its focus. (p. 29-30)

Obviously the most significant change for mathematics instruction during the 1995-96 school year for the seventh and eighth grade instructors was longer blocks of instructional time, and the common thread that ran through all the interview data from the teachers and the administrators about this change was that more time to teach mathematics was perceived to have a positive impact on mathematics instruction. The Superintendent stated, "I would **hope** [bold highlight added] it impacted positively, in that it gave them more time, more control over their time to work with students. I **think** [bold highlight added] it's a plus in any discipline to have more control over your time." The Principal's comment that was similar to the Superintendent's follows: "I **think** [bold highlight added] it has been positive at the middle school level; you get to spend more time. The teachers **seem** [bold highlight added] to think it is effective." All of the teachers except one stated that in essence that the move to block scheduling was beneficial to mathematics instruction because they had more time teach.

The significant point about these comments is that this reform initiative was made without any plans to document the effectiveness of the move to block scheduling. According to the Superintendent, Principal and Coordinator of Elementary and Middle School



Instructional Programs, the move to block scheduling was an attempt to force teachers to change their methods of instruction and to hopefully push forward the use of interdisciplinary instructional units in an effort to promote reform in mathematics and Language Arts instruction. The eighth grade lead science teacher's comment that follows describes this from the teacher's point of view. She stated:

Society in general is changing and the students are changing so we have to do things differently to keep their attention and to keep them moving along, and the blocking forces us to come up with a variety of activities throughout the block to meet the needs of all the styles of the learners that are in there and to reduce the discipline problems. (p 25)

Although some of the teachers mentioned the difficulties that the new block schedule presented in organizing and conducting interdisciplinary units, the administration made no reference to the inherent problems created by the semester class schedules. Comments by the Superintendent and the Principal both indicated that teacher recommendations would be considered before final decisions concerning the next school year's schedule were made. The Principal shared that he had conducted an informal survey of his teachers concerning the future of block scheduling, and his conclusion was that all the teachers supported the move to block scheduling. There was no indication that any other efforts were made to document or evaluate the results of block scheduling. The Principal summarized the impact of block scheduling on the used if interdisciplinary type instruction, saying, "I think the teams that were doing those kind of things before just continued. . ." (p. 17).

As the teachers talked about their involvement in the restructuring process, data were provided to support that the Principal talked with the teachers about block scheduling and to document how the teachers viewed their involvement in the restructuring process. In the next interview exchange the female sixth grade mathematics teacher explains that she did not like block scheduling and that the Principal was aware of her feelings.

Interviewer: Do you ah, think that you are going to be able to have some input on next year's schedule?

Female sixth grade mathematics teacher: I've already told [the Principal] my opinions, but I think there are probably more teachers that like the block system than don't. Although, four teachers up here don't like it. [Referring to the four sixth grade teachers that shared the classrooms on the second floor hallway.]

Interviewer: . . .I was just wondering if they're having teachers give any feedback or input, I mean has [the Principal] asked?

Female sixth grade mathematics teacher: No, he didn't ask, I was just down there and felt like that was what I wanted to say about that.

Interviewer: I would be curious if they are going to open it up to recommendations.

Female sixth grade mathematics teacher: I think that when we restructured the middle school that was the point in involving us because they wanted to or not, but I was never asked. I think it was just done. Because [Pleasant County] always just says **OH!** in California they are doing this, but of course by the time that we get around to doing it California has decided that it doesn't work, but we go ahead and do it anyway. So, I don't think that it will last very many years. Hopefully not, of course **I** don't know. (p. 20)

The male sixth grade mathematics teacher explained that he had served on the middle school restructuring committee, and that he was involved in the decision making process through his committee activities. He comment follows:

Yeah, right now I am on a steering committee, a math restructuring committee, that has been meeting. I guess we have been meeting six to eight months out of this year because of the changing SOLs in the State. We have to set up a curriculum based on that. As a matter of fact, I got a letter yesterday from [the Assistant Superintendent] asking me if I would participate on the steering committee on that matter. So we are going to work on that, restructuring the middle school curriculum as a whole. I have also worked on that committee the last couple of years. (p. 26)

Neither of the seventh grade mathematics teachers indicated that they had worked with the administration on making any instructional policy decisions, but both teachers felt like they were treated as professionals by the Principal. The new seventh grade mathematics teacher, however, indicated that this was not the case with the school Superintendent. In response to the question concerning being treated as a professional the new seventh grade teacher stated, "Anyone in the school, yes. Outside of the school I have a great amount of difficulty with the Superintendent of the schools" (p. 23). She did not elaborate on this statement, but it was clear that her working relationship with the Superintendent of schools was strained.

When the eighth grade mathematics lead teacher was asked if he felt empowered as a teacher to make decisions, he stated, "**No**, decisions are made and passed down. They want you to think that you're empowered to make decisions. . . . It's just like restructuring here at the middle school when we did blocking. We all had ideas of what we wanted, but it came down to what we were told to do" (p. 6).

When the female eighth grade mathematics teacher was asked if she had worked with the administration for improvement of instruction she stated, “Not a lot other than, you know, getting . . . materials and that kind of thing” (p. 14). Her comments indicated that she felt like that she was treated and trusted as a professional by the administrators most of the time, but that she did not participate in the restructuring of the middle schools decision making process (p. 15).

The eighth grade science lead teacher indicated that the Principal made a special effort to get everyone’s ideas before he made decisions. Her statement follows:

Our Principal goes around and asks everybody everything, and of course we can’t all have what we want, but they [administrators] certainly know how we feel about all these different things, and they do that all year long about any issue that comes up. He does, he is wonderful about that. He makes the final decision, and we respect whatever decision he makes, but he certainly allows us the opportunity to express ourselves. (p. 20-21)

While discussing the problem that the semester class schedule had created for using interdisciplinary teaching units, the science lead teacher agreed that it created problems and stated that she and the mathematics lead teacher had discussed solutions to this problem. The interview exchange begins with the science lead teacher explaining one of the solutions that she and the mathematics lead teacher discussed. Her comments follow:

. . .we have done a lot of talking about that, and we have even tossed around doing an A/B blocking for social studies and science.

Interviewer: Do you think you will be able to have some input into how the schedule works next year?

Eighth grade science lead teacher With our administrators, yes, they really have been really receptive to any ideas that anybody has had. (p. 21)

For bottom up reform with top down support to be successful the teachers need to be empowered and involved in the instructional decision making process. The data presented here indicate that only half of the teachers were involved in the restructuring process, and that only one of those teachers made a positive comment about that experience. The mathematics lead teacher indicated that, even though teachers were involved in these time consuming committees, all of the instructional decisions were still made and handed down to them from the various levels of the administration. The teachers who were not involved in the instructional decision making process indicated that they felt like they were treated as professionals, and they acted as professionals to implement whatever educational **mandate** was **required**. Only one of the sixth grade teachers expressed the opinion that

commonly surfaces among teachers with new educational initiatives— educators jump on every new bandwagon that comes around, and this, too, shall pass.

Another disadvantage that surfaced as a result of block scheduling that was not mentioned by any of the administrators was that there were at least four uncertified and inexperienced seventh and eight grade mathematics teachers teaching approximately 100 students mathematics during the 1995-96 school year. Only the eighth grade science lead teacher voiced a concern about teachers being assigned teaching duties outside their field of certification. Her comments follow:

—with the math, I think, there are teachers teaching math who are not certified, and that might make a difference because they don't have their heart in it. At least with Science that's what we are trained to teach, and particularly our science teachers are having to teach science and math, in seventh and eight grade that's all we teach. . . . (p. 23)

Considering that there was no professional development nor support built into the system for these newly recruited mathematics instructors, questions come to mind: What is best for students? and Equitable opportunities? Although only one participant acknowledged this flaw in the system, it was definitely one of the least desirable outcomes of block scheduling and a disadvantage for the reform of mathematics instruction.

#### School Level: Change in Curriculum

The other major change that took place during the 1995-96 school year was the adoption of new SOLs. School systems were directed to design and create new curriculum guides for the implementation of the new SOLs, and as a result of the Restructuring the Middle School initiative each subject area in the school system had a committee organized to develop these curriculum guidelines. Interview data from the two mathematics teachers, the eighth grade mathematics lead teacher, and the male sixth grade teacher document the activities and progress at the school level of the mathematics curriculum development committees. Both of these teachers were active members of the Restructuring the Middle School Committee during the 1994-95 school year, and they were designated as members of the Restructuring Mathematics Curriculum subcommittees that resulted from the initial restructuring work. The interview data from the eighth grade mathematics lead teacher and the sixth grade male mathematics teacher concerning the progress of these committees as of the spring during the 1996 school follows:

Eighth grade lead mathematics teacher: These committees that we are working on now, no changes have been made. **They** [administrators] haven't **told** us what we are suppose to decide yet.

Interviewer: Tell me about the middle school math committee:

Eighth grade lead mathematics teacher: Well they are in limbo waiting on the SOL committees. Our last meeting was that the SOL committees would be set up. (p. 6)

. . . Right now I am on a Steering Committee, a Math Restructuring Committee, that has been meeting. I guess we have been meeting six to eight months out of this year, because of the changing SOLs in the State. We have to set up a curriculum based on that. As a matter of fact I got a letter yesterday from [the Assistant Superintendent] asking me if I would participate on the steering committee on that matter. So, we're going to work on that restructuring the middle school curriculum as a whole. I have also worked on that committee the last couple of years. (p. 26)

There were other data available to document the lack of progress of these committees, but data pertaining to other meetings that were initiated and attended by the mathematics teachers indicate that everyone was aware that there was a need for creating new curriculum guidelines. During the eighth grade mathematics lead teacher's second interview, he talked about two joint meetings of the County's middle school mathematics faculties. The interview exchange containing these data follows:

. . . well you know we have had two meeting this year with all the math teachers. We have only had two meetings, one there and one here.

Interviewer: Do you think they were productive?

Eighth grade Mathematics Lead Teacher: In a way, yes. It may have helped some of the people, who are not math people, understand the NCTM Standards. Because that's what I did for the first time. I went over the standards, which some of them like them, and some of the people say, oh we're not doing computation, that's not right. Computation is not a skill to be taught in the eighth grade. It is a skill to be learned previously. We need to use all the time we have for critical thinking skills and higher organized mathematics but — (p. 21)

The seventh grade mathematics teacher discussed these meetings while talking about the need for mathematics teachers to share ideas, and she said, “. . . I even think that if mathematics teachers, even at the two middle schools, we met one time together this year, and we did say that it was probably our more productive after school meeting, but I do think that if we shared ideas and. . . I think if we could pool even our resources here it would be helpful. . . that particular meeting had to do with the new SOLs" (p. 13).

The new seventh grade mathematics teacher discussed the joint middle school meeting while talking about professional development, and the related portion of her statement follows:

. . . We've had one opportunity, and I requested, and a couple other teacher requested,— we ah, are mandated to meet every Tuesday from 3:30 to 5:00— a Monday memo came out yesterday saying do you have any suggestions for topics. We had suggested, and for what ever reason, it has only been done once, and it was with the [name of the other middle school's] faculty. They suggested, we suggested, it worked beautifully, the math people worked together for one day. . . (p. 22)

The male sixth grade mathematics teacher also made a brief comment regarding the interaction with the other middle school's mathematics teachers, and that interview exchange follows:

Interviewer: Do you get a chance to interact with other teachers in the County in this way?

Male sixth grade mathematics teacher: We haven't had a whole lot of success with that. We are doing more of it now than before. We are talking more with [other middle school's name] teachers. Right now we are in the process of talking to the elementary fifth grade teachers. We want to see what they are doing, and they want to see how their kids are performing up here, whether what they have done is working, and we are in a process right now of a test that can be used in the beginning of the sixth grade year. . . (p. 26)

The experienced seventh grade mathematics teacher recalled one joint meeting between the two middle schools while discussing the staff development needs, and her comment follows:

Well I think use of manipulatives. I even think that if mathematics teachers, even at the two middle schools, we met one time together this year, and we did say that it was probably our more productive after school meeting. But I do think that if we shared ideas, and I know that with [name of the other seventh grade mathematics teacher], the other 7th grade math teacher, we share a lot of ideas. If I do something and it works, I tell her, and if it doesn't work, I tell her, and she does the same thing. I think if we could pool even our resources here it would be helpful. (p. 12)

Although these data sources do not agree on the number of times that the mathematics teachers of the two middle schools met during the 1995-96 school year, the consensus was that the number of meetings were few, one or two. None of the participants

mentioned actually working on curriculum development during either of the meetings. The mathematics lead teacher indicated that he made a presentation on the *NCTM Standards*, and one other teacher mentioned that one of the meetings was about the State's new SOLs. Other than these opportunities to discuss the need for rewriting the County's curriculum, there was no other evidence that indicated any progress was made on curriculum development at the school level during the 1995-96 school year.

The only evidence that the Curriculum Restructuring Committee was active at all during the 1995-96 school year was that there was a new test being designed for the upcoming sixth grade students to assess their level of proficiency, and the eighth grade mathematics lead teacher was responsible for creating this new assessment instrument for the County. There was no other evidence available to document that the restructuring mathematics curriculum committees made any progress on curriculum development during the 1995-96 school year. Data presented in the Division Level section from the Superintendent and the Chairperson of the Math SOL Committee document that development of the County's new curriculum was planned for the summer of 1996 and the 1996-97 school year. In the statement that follows the Superintendent explains a change that was in the planning stages for the 1996-97 school year's schedule. This change was designed to provide time for the teachers to meet during the school day to work on curriculum development. The interview exchange concerning the details of this schedule change follow:

Early release Mondays that are planned for next year—Oh yes, It's not just a, ah, we didn't just build it in for people to do what ever they want [laughs out loud], which we would hope would be to develop themselves or organization ah, most every Monday session will have a plan of some kind. It will be devoted to either SOL committee work or situations within each school that need to be addressed. (p. 19)

The limited data on the subject of the County's mathematics curriculum development at the school level indicated that the teachers did not devote a lot of their time to curriculum writing during this school year. The data indicate that the administration planned for the teachers to be involved in this process and ultimately responsible for the process. Lack of progress during this year could be attributed to a combination of several factors: (1) when the subcommittees were formed, administrative leadership was withdrawn therefore there was no leadership provided, (2) opportunities for the teachers to work together were limited, (3) the teachers were already involved in a major reform initiative, block scheduling, which, if done correctly, involved teachers making major changes in methods of instruction, (4) the process for involving the maximum number of teachers in curriculum development

was not completed until the spring of 1996, (5) change in personnel, the chairperson of the Restructuring the Middle School Initiative left the County, and a new administrator had to take over the leadership position, and (6) there was curriculum development work to be done at every grade level for every subject area and the emphasis of curriculum reform was on the elementary schools during the 1995-96 school year.

Thus, although the teachers were expected to change the methods of instruction used in the classroom, technically neither the curriculum content or focus of the mathematics curriculum had changed, and the methods of assessment used at the Division and State Levels had not changed. Computation and procedural knowledge were still the major foci of these assessments, therefore teachers still had to place strong emphases on these skills. So, even with the move to block scheduling and the obvious encouragement to change the methods of instruction used in the classroom, the teachers were limited in the amount of change they could actually make in their mathematics instruction. Since there was also little or no staff development provided, no professional support system available, and the disadvantages created for the use of interdisciplinary instructional units by the move to semester long classes, it seems remarkable that teachers were able to make any changes in their methods of instruction. But, according to the artifacts, interview and observation data, mathematics instructional reform was evident to some extent in all classrooms. The implementation of teaming, block scheduling, and use of the *Glencoe* mathematics textbooks all help document that change reached the mathematics classrooms of Pleasant Middle School.

#### School Level: Change in the Use of Calculators for Mathematics Instruction

The increased use of technology for mathematics instruction was encouraged for instructional reform, and the use of technology for mathematics instruction was documented for the 1991-92 baseline school year and traced through the interim years of the study. This section is devoted to documenting the use of technology for mathematics instruction during the 1995-96 school year with a focus on documenting changes since the baseline school year.

Observation and interview data for documenting the use of, or changes in the use of, technology for mathematics instruction is presented in two parts: calculators and computers. As in the previous section the 1995-96 classroom observation data serve three purposes: (1) to document the use of calculators and computers during the 1995-96 school year, (2) to retrospectively support the conclusions made about the use of technology for mathematics instruction during the 1991-92 school year, and (3) to document changes in the use of technology for mathematics instruction since the baseline school year.



To document change, the presentation begins with a summary of findings from the data that document the use of calculators for mathematics instruction during the 1991-92 baseline school year. This is followed by brief data summaries that document the use of calculators or the suggested use of calculators for mathematics instruction through the interim years. Then artifact, observation and interview data related to the use of calculators for mathematics instruction during the 1995-96 school year are presented. Finally, conclusions are drawn of how the use or suggested use of calculators for instruction changed since the baseline school year.

In documenting mathematics instruction during the 1991-92 baseline school year, a detailed analysis of data pertaining to the use or suggested uses of calculators for mathematics instruction was presented. A brief summary of these findings is presented here for comparison purposes to document change. The State's 1988 SOLs did not introduce the use of calculators for mathematics instruction until eighth grade, and then there was a stipulation that mathematics instruction should place an emphasis on estimation, mental arithmetic, paper-and-pencil calculation; the 1988 SOLs stated that calculators and technology should be used where feasible to enhance learning (p. 20). The County Curriculum guide, however, provided for the use of calculators at the seventh grade level with this objective: students should be able to identify the keys of the calculator and be able to use them to work problems that involved using the order of operations, finding percents or converting fractions to decimals (Objective V). Students were **not** permitted to use calculators on any of the local or State assessments (i.e., Passport Literacy Test, and the nationally normed ITBS Test).

The *Addison-Wesley* textbook used for mathematics instruction during the 1991-92 school addressed the use of calculators for mathematics instruction in this statement. “. . . Calculator skills should be taught in addition to, rather than instead of, computational skills, for specific educational goals” (p. T26). A detailed analysis of the calculator-related instructional materials contained in the *Addison-Wesley* textbook revealed that there were only 38 calculator-related lessons; all of those lessons focused on teaching students how to use the calculators. Artifact data were used to document that classroom teachers had limited access to calculators; there was one class set available per grade level, and those had to be checked out through the library.

Additionally, an analysis of the interview data from the teachers, Principal and Division Level administrations resulted in the following conclusions:

- (1) the use of calculators was not encouraged for mathematics instruction,
- (2) the supply of calculators was limited, three classroom sets for at least ten mathematics teachers in the building,

- (3) calculators were rarely used for mathematics instruction in the 1991-92 mathematics classroom, and
- (4) when calculators were used, the objectives were to teach the students how to use calculators or to practice procedures that had already been taught such as using the order of operations to solve problems, or possibly for enrichment purposes for individual students.

Calculators were not an essential part of mathematics instruction during the 1991-92 school year.

During the 1991-92 school year the County organized a Common Core Curriculum Project committee that consisted of teachers and administrators for the purposes of (1) investigating what was taught in mathematics, and (2) restructuring the curriculum. In March of that same year the newly designed Common Core Curriculum was presented to the Division Level administrators along with recommendations for changes in methods of instruction and instructional materials. Teachers were encouraged to use interdisciplinary teaching units, collaborative teaching, cooperative learning, a problem solving approach, calculators, technology, and manipulatives for instruction and assessment. These changes resulted in mathematics instruction that focused on developing both conceptual and procedural knowledge.

The Common Core Curriculum was published in poster form and presented to the teachers at the beginning of the 1992-93 school year, but there was a change of administration at the State Level and support for the Common Core Curriculum Project was withdrawn. At the school level only two teachers made reference to the Common Core Curriculum, and interview and artifact data supported that there were no follow-up meetings, inservice or staff development opportunities provided for implementing the new curriculum. When the State decided to abandoned the Common Core Curriculum Project and replace it with efforts to revise the State's 1988 Standards of Learning, Pleasant County did likewise. Therefore, the County's new Core Curriculum that was designed around the NCTM *Standards* was never implemented.

Mathematics reform awareness increased, and the Core Curriculum guidelines and NCTM *Standards* influenced the textbook adoption process for that year, but mathematics instruction in the classroom changed very little during the 1992-93 school year. The teachers were still teaching on the 45-minute, seven-period schedule, using *Addison-Wesley's* instructional materials, following the 1988 State SOLs, and working to prepare students to demonstrate mastery of procedural knowledge on the State's Passport Literacy Test and the County's ITBS assessments. The use of calculators for mathematics instruction changed in no discernible ways during the 1992-93 school year.

Three major changes are documented during the 1993-94 school year which facilitated or encouraged change in the use of calculators for mathematics instruction: (1) the two V-QUEST Lead Teachers and the Principal of Pleasant Middle School had attended the two-week V-QUEST Lead Teacher Training Institute at Clinch Valley, which placed a heavy emphasis on using state-of-the-art technology to teach mathematics and science (seven out of fourteen outcomes were technology based), (2) mathematics instructional materials were purchased which included classroom sets of calculators for each mathematics teacher, and (3) *Glencoe* textbooks were selected and adopted, and they were designed specifically for middle school needs and were based on the NCTM *Standards*.

A detailed analysis of calculator-related lessons in the *Glencoe* textbook presented in the 1993-94 material demonstrated that calculators were used with almost every lesson in the textbook. At least 49% of the supplemental instructional activities involved using a calculator, and the use of calculators was viewed as essential to mathematics instruction. *Glencoe's* textbook provided more opportunities to use calculators in mathematics instruction than *Addison-Wesley's*, and *Glencoe's* instructional materials provided a broader experience in using calculators. In the *Glencoe* textbook calculators were used to enhance the students' experiences with mathematics and to involve the students actively in problem solving so that the students could develop and construct conceptual knowledge as well as procedural knowledge, and *Glencoe's* assessment materials recommended the use of calculators in evaluation settings.

From the artifact and interview data, the investigator concluded that other than the half-day inservice provided during the summer of 1993 by the *Glencoe* textbook company representatives, there were no inservice or staff development opportunities provided for the mathematics teachers to help them learn how to use calculators as an instructional tool or to help them implement the recommended changes for mathematics instruction. The teachers were still working under the limitations of 45-minute class periods, the lack of training or inservice, and neither the Division or State Levels' assessment materials or practices or curriculum guides had changed; very little change in the actual methods of instruction used for mathematics education during this transition year could be documented; however, it is highly likely that the use of calculators in the classroom increased. This conclusion is based on the following: (1) The mathematics teachers were aware that the State and County were actively engaged in a systemic reform initiative to improve mathematics instruction, (2) The mathematics teachers had encouragement, support and leadership provided by an enthusiastic Principal and two V-QUEST trained lead teachers to improve mathematics instruction, (3) The use of calculators for mathematics instruction was encouraged, (4) Calculators were available for use in the mathematics classrooms, and (5) Teachers used the

*Glencoe* textbook for mathematics instruction in which just about every lesson included at least one calculator problem or activity. All of these changes suggest that calculators were used more often for mathematics instruction. They may not have been used to the best advantage, but evidence exists that the use of calculators in mathematics classrooms increased during the 1993-94 school year.

There was a change in school leadership for the 1994-95 school year as Pleasant Middle School's Principal moved to one of the County's elementary schools and a new Principal was hired for the middle school. Pleasant Middle School's V-QUEST Lead Teachers lost an admired and respected supporter and advocate for reform of mathematics education as the County shifted its focus, money and attention to reforming mathematics education in its elementary schools. For the middle schools, the focus of reform shifted to Restructuring the Middle School, and a committee of teachers and administrators from both of the County's middle schools was organized and began to meet. By March the Restructuring Committee was divided into subcommittees, and a Technology Committee was created. The directive for this committee was as follows:

Technology: This committee would determine what technology is currently available in both middle schools; how to best utilize available technology; prioritize technology needs, cost associated with implementation, and recommended time line; [sic] and work with the district's Technology Committee to communicate and coordinate technology effort. (from the sign-up sheet distributed at the Restructuring the Middle School committee's County-wide presentation in March 1995)

Although there was evidence presented in the 1994-95 school year data that administrators and teachers were aware that changes needed to be made in the use of technology for instruction and in the 45-minute long class period schedule, there were no actions documented during the 1994-95 school year that facilitated teachers in making these changes. The 45-minute class period was still in place during the 1994-95 school year, and neither the State's nor the County's curriculum guidelines or assessment practices had changed. Two more class sets of calculators were purchased during the 1994-95 school year, but there was no specific evidence provided by the teachers that the use of calculators had changed since the previous school year.

The opening of the 1995-96 school year brought with it significant changes for the mathematics teachers at Pleasant Middle School:

- (1) The State adopted the revised 1995 Standards of Learning.
- (2) The State issued a mandate for counties to create new curriculum guides to implement the SOLs.

(3) Pleasant Middle School changed the seven-period daily schedule to a four-block schedule.

(4) Support for the V-QUEST Systemic Reform Initiative was terminated at the State level.

These changes had the potential to change the way technology was used for mathematics instruction; the 1995 SOLs called for an increased use of technology for mathematics instruction, and the 90-minute instructional blocks made it necessary for teachers to change their instructional methods. The States' mandate for new curriculum guidelines forced localities to assess what was being taught in mathematics classrooms, how it was being taught, and to make the changes necessary to implement the new SOLs.

Although the lack of support at the State Level for the V-QUEST Lead Teacher Initiative did not eliminate the lead teachers, it did result in removal of all administrative support for any reform efforts by Pleasant Middle School' V-QUEST Lead Teachers. Since the County's focus during the 1994-95 school year was on mathematics reform in its elementary schools and Pleasant Middle School's V-QUEST trained Principal had been moved to one of those elementary schools, the Pleasant Middle School V-QUEST Lead Teachers lost administrative support at the school and Division Level. With the removal of State support for the program during the 1995-96 school year, the County followed suit and eliminated all administrative support for its V-QUEST Lead Teachers. Although Pleasant Middle School' V-QUEST Lead teachers continued to offer assistance whenever asked, they were powerless to initiate or lead any reform efforts in the school including technology reform.

When the Secondary Principal Mathematics Specialist for the State talked about how the 1995 SOLs would change classroom instruction, she commented on the use of technology:

. . . the standards call, explicitly call, for the use of technology, and with the possibility of students being allowed to use technology on the assessment, it would definitely effect instruction. . . (p. 5)

The opening statement of the Mathematics Standards of Learning for grades six, seven and eight includes the following comment concerning mathematics instruction and technology. "While learning mathematics, students will be actively engaged, using concrete materials and appropriate technologies such as calculators and computers" (p. 18).

As documented earlier, the County's curriculum guidelines had not changed, there was only one two-day mathematics staff development session offered during the summer of 1995, and there were no in-service opportunities provided during the school year. Teachers were left to their own resources to implement the State's new SOLs and to learn how to

prepare effective mathematics lessons for the new 90-minute blocks. As documented earlier, four of the six study teachers indicated that they used more small-group activities for mathematics instruction during the 1995-96 school year, and at least fourteen of the textbook cooperative-learning activities required the use of calculators.

Every teacher in the study was observed using calculators in at least two out of the five mathematics lessons observed, but this statistic does not provide an accurate picture of the use of calculators for the year. There were thirty mathematics lessons observed, and students were observed using calculators at some point during ten of those lessons; however, the investigator judged that the use of calculators was not appropriate for all of the lessons observed. Seven of the observed lessons were designed to meet geometry objectives, such as measuring angles or mastering geometry related vocabulary, and three lessons were devoted to learning to read and make graphs. The use of calculators had little or no applicability to any of those ten lessons. Five of the remaining ten lessons were designated specifically as review lessons devoted to practicing computation and arithmetic procedures to prepare students for the upcoming ITBS test. Therefore, calculators were used for ten of fifteen lessons where the investigator judged the use of calculators as appropriate. In two of the observed lessons the use of calculators was limited to checking paper-pencil computation, but in all of the other lessons calculators were used as expected by the State's SOLs and as recommended by the NCTM *Standards*, as tools for problem solving.

The school supply list sent home to 7th and 8th grade students for the 1995-96 school year included the purchase of a scientific calculator, and both eighth grade teachers were observed reminding their students that they needed to bring their calculators to class. These data support the increased use of calculators for mathematics instruction since the base-line school year when there was only one class set of calculators available per grade level. The interview data from the teachers and administrators provide additional support that the use of calculators for mathematics instruction had changed since the baseline 1991-92 school year. Those comments or interview exchanges follow:

Interviewer: Do you think implementation of the mathematics [1995] SOLs will encourage change in the way mathematics is taught?

Eighth Grade Mathematics Lead Teacher: I hope so. The way mathematics is taught has got to be changed. It's not meeting the needs of a technological society today. We still have teachers who emphasize computation. Our Superintendent emphasizes computation. I don't know why he can't get it through his head. Everything you read and see says [when] kids gets into the eighth grade and can't add, subtract, multiply, divide— big deal give him a calculator. (p. 8)

The female eighth grade mathematics teacher made the following statement about the use of calculations for mathematics instruction:

. . .and there is also a difference in content, I don't stress computation so much as I used to. A lot of times, by the time they [students] get to the eighth grade they resent practicing division, multiplication, you know, if they haven't learned it up to that point, you know, I am just kind of— here is a calculator. I don't want the problem solving to be limited by their computation, you know, if they have the problem solving skills I want them to use a calculator. (p. 8)

The seventh grade mathematics teacher talked about her views on the use of calculators for mathematics instruction in the comment that follows:

The students are allowed to use calculators for most things. I personally do not think that they should have them all the time. I think they have become very dependent. They have been told that all students can use calculators, and they have become very frustrated when they are doing fractions because they can't do fractions on a calculator. So, if they can't do it on a calculator we don't need to do it. I certainly think there is a place for calculator in the classroom, for example the soft drinks and the cereal activity a use of the calculator would have been tremendous there, but when they are doing integers I don't think they need a calculator. I think, they need a number line, and so I, I think, kids need to learn basic mathematics. The students do not know their multiplication facts. I would say better than 50% of the students in my class do not have immediate recall of multiplication facts. Well, to me you can't do estimation or problem solving or shop at the Wal-Mart store without having immediate recall. There is a place for calculators. (p. 8-9)

The other seventh grade teacher expressed a strong belief that students need to learn their basic skills and that the students had learned to be too dependent on the calculator:

At the beginning of the year, all of the students were given a survey test based on what they came to me able to do. Basics skills are the weakest point. Simple addition, subtraction, multiplication, and division for all of them. I understand students are no longer being required to learn multiplication tables. I differ with that greatly, and I can not let it, let them leave me without having to learn some, and one of the reasons so much of what I have taught this year the basic math of adding, subtraction, multiplying and dividing is just a step in the process of solving the problem, but if you can't do that then they are lost with the other concepts. They

should, in my opinion, be able to recall simple facts without thinking. I know that it is a great exercise, but the thinking should be reserved for a higher level. (p. 6)

At some point I will insist that they all show me that they can do it [solve simple equations], but again, I can look at those kids and tell you which ones are capable of doing a lot in their head and which ones that think they're capable of doing it in their head and need to put it on paper and those that unfortunately have been taught over the years that a calculator is the answer to everything and can't use a calculator correctly. I think the saddest part are the younger, or not younger, the weaker students that think the calculator is the answer, because they are missing problems because they can't think logically enough to use the calculator. Someone should have been teaching them on paper how to do these things because they're not going to carry a calculator to the grocery store. . . . (p. 10)

The sixth grade teacher expressed her view of the role calculators should play in mathematics instruction while she discussed the expectations for their written work:

First of all I want it [written work] to be neat. I don't want just the answer. I want to make sure that they know how to do it [the computation]. They have this terrible habit of using calculators, and I want them to know their multiplication tables and so forth. In math, especially math, that is one area where you have to be neat and precise, and I just, I am trying to get that habit built into them. We have a header form at [Pleasant] Middle School that the papers are supposed to follow, and I check and make sure that they do. I check and make sure that they don't put two or three numbers on a space, you know, because it makes it easier for me to grade, and it makes them see that, it is important to see that they need to be neat and precise in math. (p. 6)

Interviewer: You mentioned calculators, how do you feel about calculators in the every day classroom?

Female sixth grade teacher: We don't use them everyday. I have lots of worksheets though 'cause they are fun to work with. I don't want, I know that later on it is OK to use them, but when we take the Passport Literacy Test they have to know these operations; they cannot use a calculator. So, when we use calculators it is for a specific purpose and learning how to use a calculator and doing some fun games with them. It's a particular thing it's not everyday.



Interviewer: So, when your focus is on teaching them operations you don't use the calculator. Do they ever use it to check their work?

Female sixth grade teacher: Yes, and especially the written problems or the big problems, they like to check their work, and I let them do that. (p. 6)

The male sixth grade teacher used calculators while teaching surface area, and expressed that it was important for students to learn to apply mathematics in real life. Although he did not mention the word calculators, the use of calculators for applications and real life experiences was implied, and he did use the calculators for problem solving during both of the follow-up observations. The comments that follow indicate that mathematics was more than just doing paper-and-pencil practice. His statements follow:

I want them to be able to bring their outside experiences in the classroom and take the classroom experiences outside the classroom. . . . It's everyday experience things that's [sic] outside the classroom. The purpose in learning something, and to me education is not just what goes on in the school building, education is something that— you can use it, or you can put it to use some where else, and application is a large part of a child's education. . . .(p. 5)

. . . It [*Glencoe* textbook] has got a lot of application to it, and it has so much in there that you can't do it all, and if you are looking for something that really is practical, that goes not in just mathematics, but goes outside the realm of a math class— that book does it. It has lots of practical uses. It has got a lot of labs in it, a lot of learning techniques and skills in it, there is [sic] a lot of things you can do with that book. (p. 24)

The Principal's comment was short and to the point, saying, "Yeah, you may not need to know your multiplication table by rote, but yeah, you need to be able to use that calculator" (p. 19).

The Director of New Initiatives made the following comments concerning the use of calculators and mathematics instruction:

I was a good math student. I carry a calculator around with me all the time, and I think we ought to be stressing things like estimation using calculators. (p. 9)

Interviewer: Do you think that the use of calculators in the mathematics classroom has changed over the last five years?

Director of New Initiatives: I think it has slightly because I did a survey of our teachers in April for Eisenhower funds, a needs assessment, and one of the questions was if they had access to calculators because I could buy some

if they didn't. Every single school said that more than seventy-five percent of their teachers had access to calculators, and in the middle school and high school there were graphing calculators, they said. I don't believe they're used, but they have access to them, but the fact that they're not being used isn't because they don't have the access, which is what I thought was the problem. . . .(p. 10)

The Coordinator of Elementary and Middle School Instructional Programs offered the following information concerning the use of calculators and mathematics instruction:

Interviewer: What do you think the appropriate role for calculators at the middle school level in mathematics should be? Do you think they should be accessible to every student?

Coordinator of Elementary and Middle School Instructional Programs: I think the balance at the middle school level becomes, continues to be important as it is at the elementary, and that is, I want there to be a balance between an understanding of the concept and the ability to use the calculator. To me the calculator does not replace all the activities and experiences you provide a child to help them understand a concept and conceptualize what it is that's going on. Then the calculator, once the concept is there, the calculator saves you huge amounts of time. I don't add long columns of numbers. I don't divide two digit divisors. I do an estimate in my head and check it with the calculator. That's what I want for my kids. I want my kids to understand the concept of long division, have wonderful estimating skills, then always have a calculator handy for the specifics. (p. 9)

The Associate Superintendent provided the following statements concerning the use of calculators for mathematics instruction:

Interviewer: I want to move to what you see as the appropriate role of calculators in the middle school classroom. [3 seconds pass and we both start to speak at the same time saying Ah] Go ahead.

Associate Superintendent: Again, I think its like computers that we're sticking our head in the sand if we do not provide options for students in learning to use the calculators, but I still feel that youngsters have to learn the basics that they have to master some of the computation skills, and that we can't just give them a calculator and never teach them the basic skills. For example, right now our math computation scores at the middle school level are not good. We have 142 eighth graders going to the ninth grade next year scoring below the 25th percentile in math computation. Now, you know, the

only way that we're going to handle that is to make sure that children have mastered the basic skills. We can't just rely on their using a calculator to do basic skills, as important as I think calculators are, they have to still master the skills and I think a balance between those two things is extremely important. (p. 6)

In the following interview statement the Superintendent of Pleasant County Schools provided the County's philosophy on the use of calculators for mathematics education as well as his own opinion. His statement follows:

We have no division barrier against using calculators in the classroom. What we do have is a philosophy that starts with a basic mastery and understanding through manual calculations, traditional calculations being taught first and then relying on the calculator as a tool, but I still believe in the basic mastery of, memorization of, the multiplication table for example. Being able to do short and long division and the basic math functions, addition, subtraction, and ah, manipulating decimals. I believe children need to be taught how to do that with pure old paper and pencil, and then once the mastery is proven and demonstrated to be able to use a calculator to speed up that process whenever necessary. I do believe in the early grades we need to rely more heavily on basic mastery in a traditional sense, and then as children get more comfortable, and we're comfortable that they've mastered the material, then I think calculators can be used as a tool. It's speed, as well as accuracy later, but I think you need to understand the basic concept first. . . . I think sets of calculators can be bought, but I don't know that one per child is necessary. I think they can be available in a classroom in sets of six, maybe one calculator per three children available in a table setting, as you're doing work you need to get up and check something, what have you. The rate of use I would be concerned about. Again, as we move into the higher grade levels, and they've demonstrated mastery the basic concepts they can begin to rely more heavily on that tool. I think if you have it there on each child's desk there's going to be a tendency to quote to play with it, manipulate it, use it in ways that you didn't intend, and I think it can be a distracter if you're not careful.

Interviewer: Is there any other comment that you would like to make about the use of calculators and mathematics education in general.

Superintendent: Well, just that I would have died had I have not had a calculator in statistics, and we need to all realize that it is a wonderful

instrument and it should be used openly and comfortably and easily accessed as we move through the curriculum, but I do still believe in the early grades being a time where we master the concepts and the traditional methods. (p. 12)

The interview, observation and artifact data all indicate that the number of calculators available had increased since the 1991-92 baseline school year, and that the use of calculators for mathematics instruction had increased and changed. Since the implementation of the *Glencoe* textbook, the calculator lessons and activities had changed from teaching students how to use the functions of the calculator to teaching students how to use the calculators for problem solving, to use calculators in learning activities to develop conceptual understanding. The teachers were not observed using any of these activities designed to develop conceptual understanding, but they were observed using the calculators for problem solving activities, and in a traditional method, for checking paper-pencil computation. None of the teachers or administrators believed that students should have access to calculators 100% of the time in mathematics classes, but five of the teachers encouraged the use of calculators for problem solving, and working with large numbers, and all of the teachers and administrators thought that calculators should be used after the students demonstrated mastery of computation and arithmetic procedures.

The sixth and seventh grade teachers expressed concerns that students were calculator dependent, and that the use of calculators in the previous grades had resulted in students not learning their basic facts or mastering paper-and-pencil computation skills. Both of the eighth grade teachers indicated that they did not focus on teaching computation as much as they had during the 1991-92 school year, and that they did not want the lack of computation skills to hinder their students in learning to use logic and reasoning to solve problems. Both the Associate Superintendent and Superintendent expressed serious concerns about the students' lack of mastery of basic facts, computation and arithmetic procedures, but the indication was that that was seen as a problem in the elementary mathematics classes, and evidence showed that, since the 1994-95 school year, the County had focused its mathematics reform efforts on its elementary schools. All of the administrators and teachers agreed that the use of calculators needed to increase but not at the expense of students learning basic facts, and as the Superintendent said, "concepts and traditional methods"(p. 12).

This same concern is expressed in the States' 1995-96 *Standards* in the introduction to the sixth, seventh, and eighth grade standards. Right after the statement that says students should be learning mathematics by being actively engaged using concrete

materials and appropriate technologies such as calculators and computers, this cautionary sentence appears:

However, facility in the use of technology shall not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency in basic computations. (p. 21)

The evidence shows that the teachers were making an effort to use calculators for mathematics instruction as directed in the 1995-96 Standards.

The new 90-minute blocks of instructional time permitted or even required teachers to use more instructional activities, thus there was more time available for teachers to use calculator activities to enhance instruction; each teacher had a classroom set of calculators, and the students were expected to have their own calculators. Analysis of the *Glencoe* textbook documented that there were more calculator activities available for the teachers to choose from, and the lead teachers had experiences and ideas that they were willing to share with any teacher interested; two of the five mathematics teachers did use the mathematics lead teacher as a resource. The observation data revealed that calculators were used for 66% of the observed lessons where the use of calculators was appropriate; the observation data also showed that the teachers focused on teaching and reviewing traditional paper-pencil computation procedures to prepare students for the ITBS test and the Passport Literacy Test.

Preparing for these end-of-year assessments was an important instructional goal for teachers. Even though the instructional materials had changed, the State's curriculum content had changed, and the teachers were using different methods for mathematics instruction in the classroom, the County's curriculum guidelines had **not** changed and the methods of assessments had **not** changed. Procedural knowledge was still the desired outcome of mathematics instruction. There were two comments by the Associate Superintendent and the Superintendent that emphasize the significance of this point. To accentuate the dilemma faced by the mathematics classroom teachers, this quote by the Associate Superintendent bears repeating. While talking about the use of calculators for mathematics instruction, she stated the following:

For example, right now our math computation scores at the middle school level are not good. We have 142 eighth graders going to the ninth grade next year scoring below the 25th percentile in math computation. Now, you know, the only way that we're going to handle that is to make sure that children have mastered the basic skills. We can't just rely on their using a calculator to do basic skills. . . (p. 6)

There were approximately 400 eighth graders going to the ninth grade so approximately 35% of the eighth graders tested below the 25th percentile in computation on the 1995-96 ITBS test. As the Superintendent talked about the changes in mathematics instruction at Pleasant Middle School that resulted from the move to block scheduling he bluntly said the following:

I'm not aware of any unique material or programmatic changes. I am aware that the block schedule has been added. I am aware that the computation scores are the lowest in the County, and we're very concerned about that. (p. 31)

This statement combined with the Superintendents' comments concerning the use of calculators for mathematics instruction make it clear teachers had to make some difficult choices concerning instructional reform. Assessments still focused on procedural knowledge, while the State's new Standards and the County's new instructional materials were designed to teach relational knowledge. The content and suggested methods of instruction had changed, but the desired outcomes had not changed. Although the use of calculators for mathematics instruction did change and increase, traditional methods of instruction were required as well, and the observation and interview data reflect this blend of instructional methods. The teachers' concerns about students not knowing their basic facts, and the continued focus on traditional paper-pencil computation were justified.

Calculators were seldom used for mathematics instruction during the 1991-92 school year, and if they were used it was to teach the students how to use the calculator. Based on the artifact, observation and interview data the number of calculators increased from 3 sets of calculators to at least 10 sets of calculators, and the use of calculators changed from practice on using the calculator to application of the calculator particularly for problem solving activities (e.g., finding the mean for the Hover Craft times, finding the average number of gallons of soft drinks consumed in a year by a group of four students, finding the surface area of prisms, and using a formula to find the minimum cost of five items purchased from a newspaper search). Since there were only 38 calculator lessons provided in the *Addison-Wesley* textbook and there were 180 days for instruction, calculators would have been used at most for 21% of the lessons during the 1991-92 school year. In the *Glencoe* textbook at least 49% of the lessons involved the use of calculators, and teachers were observed using calculators for 66% of the lessons where calculators were applicable; therefore, it is highly probable that teachers used calculators at least twice as much for mathematics instruction during the 1995-96 school year as they did during the 1991-92 baseline school year.

### School Level: Change in the Use of the Computer Lab for Mathematics Instruction

To complete the documentation of how the use of technology had or had not changed since the 1991-92 baseline school year, data pertaining to the use of computers for mathematics instruction are now presented. First, a brief summary of the findings concerning the use of computers for mathematics instruction during the baseline school year is presented; it is followed by data that help track changes in that use and concludes with the presentation of observation and interview data to document how computers were used during the 1995-96 school year for mathematics instruction. The 1995-96 observation and interview data are used for three purposes: (1) to document how computers were used in mathematics instruction during the 1995-96 school year, (2) to retrospectively support conclusions made about the use of computers for mathematics instruction during the 1991-92 baseline school year, and (3) to document changes in the use of computers for mathematics instruction since the baseline school year.

As reported earlier, a 31-terminal Josten Computer Lab with two servers was installed for use during the 1991-92 school year. That school year, mathematics educational reform was seen as a top priority, and although the Josten Computer Lab was designed to provide individualized computer assisted instruction for sixth, seventh and eighth graders in language arts, social studies and mathematics, mathematics instruction was targeted for the 1991-92 school year. A schedule was created to provide every student in the building three 20-minute sessions of computer assisted instruction per month.

The Josten Computer Lab was selected because it best matched the 1988 mathematics Standards of Learning and the County's goal of improving computation scores on the ITBS and Literacy Passport Test. This Computer Assisted Instruction was much like pages of a textbook; students were expected to work ten to twenty practice problems after viewing example problems. Students were allowed to proceed through lessons at their own pace with the goal of demonstrating mastery of one objective before moving to the next objective in the sequentially designed lessons.

The baseline data concerning computer technology included a review of *Addison-Wesley's* computer related instructional materials as well the WICAT computer lab data. A summary of the conclusions drawn from these data about the use of computers for mathematics instruction follows:

(1) Both sets of instructional materials emphasized mastery of arithmetic procedures and computation skills in isolation, and they focused on procedural knowledge and instrumental understanding.

(2) There was limited access to technology for mathematics instruction. (60 minutes a month per student.)

- (3) The use of technology for mathematics instruction was subordinate to mastery of arithmetic computation.
- (4) Drill and review practice were viewed as important to learning mathematics.
- (5) Whole group direct instruction by the teacher, individualized instruction and independent written practice were the main aspects of mathematics instruction in the 1991-92 classroom.

Interview data from the teachers, Principals and County level administrators documented that no new software was purchased for the WICAT computer lab since the 1991-92 school year. Science software was added between the 1991-92 school year and the 1995-95 school year, but it was agreed when the system was purchased that the schools would receive copies of the science software when it was completed. Since there were no changes made in the software or hardware of the WICAT computer lab during the course of this study, data provided in the participant observations and interviews concerning the computer lab provide retrospective support for the baseline data conclusions about the use of computers for mathematics instruction during the 1991-92 school year.

Every student received approximately 60 minutes of computer assisted instruction each month. During the 1991-92 school year mathematics classes were scheduled for three 20-minute lab visits each month, but with the move to block scheduling the length of the lab sessions increased to 30-minutes with mathematics classed scheduled into the lab twice a month. Three of the classroom observations (the eighth grade lead mathematics teacher, and both seventh grade teachers) conducted during 1995-96 included observations of those classes participating in 30-minutes of computer assisted mathematics instruction. These three observations provided evidence to document the type of mathematics instruction used in the computer lab during the 1995-96 school year, and to retrospectively support the baseline data conclusion concerning the WICAT computer lab and mathematics instruction.

In general appearance the computer lab looked as it did when it was set up during the 1991-92 school year. It consisted of 31 student terminals and two computers manned by a lab technician. The two computers operated by the lab technician were the servers, thus none of the 31 student terminals had hard drives. There were no modems connected to the computers; therefore, there was no access to VA PEN or the Internet.

When the eighth grade mathematics lead teacher took his class to the computer lab during the third observation of the first set of observations, the students were working on a review of fraction arithmetic to prepare for the upcoming ITBS test, which was given in the spring of the eighth grade year. His students spent thirty-five minutes in the lab working on basic arithmetic skills, while the instructor walked around the lab offering individual assistance to those students who indicated by holding up their hands that they needed help.



All of the students were working on fraction arithmetic problems, but some moved through the review more quickly than others; thus, the instruction was individualized in terms of pace, but not in terms of ability. All of the students participated in the arithmetic review even if they said it was easy. One student commented while in the lab “This is easy,” and the teacher responded with, “Good, I’m glad to hear that.” There were no word problems involving fractions present in this computer work, and all of the observed tasks were drill-and-rote type practice tasks. As the students continued to work, the eighth grade mathematics teacher reminded them that they were expected to complete thirty assignments before the end of the nine weeks. He then sat down at a computer terminal and pulled up a report that told how many assignments each student had completed. As he read through the list, he called out each student’s name along with the number of assignments that he or she had completed this nine weeks.

The veteran seventh grade teacher also took her class to the WICAT lab during the third observation of the first set of observations. The assignments were intended to match the classroom objectives for customary measures and areas of squares and rectangles. Like the eighth grade lead teacher’s assignments, these assignments consisted of drill-and-rote practice problems. There were four types of practice problems observed during this 30-minute observation. In the first exercise various squares and rectangles were drawn with dots placed at equal intervals which engaged the students in counting the number of segments to determine the length and width of the quadrilateral before finding its area (the area was **not** marked off as a grid; only the sides were marked in equal length segments). Another set of practice problems provided squares or rectangles with the lengths and widths labeled for students to determine the area. The next assignment instructed the students on how to find a missing dimension when the area and one dimension of the square or rectangle was given, and the lesson was followed by ten similar problems for practice. The fourth type of problem provided an opportunity for students to reason and apply the area concept. Irregularly shaped polygons that were composites of two or more squares or rectangles were provided for students to determine areas. All the reasoning and thinking involved in this problem solving situation was removed when the computer showed and instructed the students how to divide the irregular shapes into square and rectangular sections and then instructed them on how to find the area of each section and get the area of the original figure by adding the areas of the individual sections together. The program provided the formulas, explained how to use the formulas and then provided practice problems on finding area, and, like the other assignments observed, if the student scored 70% or better he or she moved to the next assignment.

One slight problem did occur during this lesson. The assignments loaded for this group to practice were under a broader heading of geometry, and when the students successfully completed the square and rectangle problems the next assignment that came up was finding the circumference of a circle, followed by adjacent angles and finding complements and supplements. Even though the computer offered detailed lessons before presenting practice problems, most all of the students were totally dependent on the teacher to explain anything new they encountered; thus, for about half of the thirty-five minutes in the lab about half of the students sat with their hands up in the air waiting for the teacher to tell them how to do the problems. The experience proved to be frustrating for the teacher who ended the session by saying, “We had some things on the computer today that we have not covered in class. So, I won’t take a grade, and we will cover it” (p. 8).

The other seventh grade teacher also took her class to the computer lab during the third class observed in the first set of observations, for their thirty-five minute computer assisted instruction. Like the veteran seventh grade teacher’s assignments, this teacher had the technician load assignments that matched the objectives that were being covered in class. In class the objective was to solve one step equations involving fractions and decimals, and in the computer lab the teacher had most of the students working on basic arithmetic with fractions. Each grade level had its own set of materials so the seventh and eighth graders observed doing fraction practice were doing different problems, but they were doing the same type problems set up in the same way. This supports that the computer assisted instructional materials matched the state’s SOLs and the County’s curriculum in two ways: (1) organization of the instructional materials was based on a spiraling curriculum, and (2) the purpose of the instructional materials was to provide students with individualized practice to master basic arithmetic skills with whole numbers, fractions, decimals and percents.

The following description taken from the observation field notes provides data to verify that basic arithmetic skills were the focus of this lesson and that mastery of basic arithmetic skills was the goal. The seventh grade teacher had a few students who needed to finish word processing his or her Ted and Ed inverse stories, and before leaving the classroom, she reminded the students that if they needed to finish their stories to take them with them to the lab. All of the students except the two finishing their Ted and Ed stories were logged in on the computer by 9:37 and were working on fractions.

As the students worked, the teacher walked around the room going from student to student giving assistance, answering questions and helping students get started. She discussed basic facts with one student, then moved across the room to talk with another student requesting assistance. The teacher offered some suggestions and encouraged

another student to work on her problems instead of helping everyone around her. The instructor continued to walk around the room giving individual assistance and reminding the students to let her see their scores before they moved on to the next assignment. She talked to a student who said that he had already done the assignment he was working on; she said that it was one of two things, either he didn't make above 70% or he didn't finish. He says he must not have finished, and then he set to work on the assignment. Next the teacher talked with one of the girls and told her that she needed to get out paper and pencil to work the problem she was on because she was not capable of doing all the arithmetic in her head.

While focusing on one student, the following observations were made. The boy sitting closest to the observer was working on subtraction of fractions, and he was working the problems in his head. He entered his answer to the subtraction problem which was correct but not simplified and the computer responded: No, the answer is  $19/36$ . The boy hit return and moved to the next problem. The computer lab technician came over to this student and offered some help, but the student informed the technician that he knew what he was doing. He was obviously embarrassed by the unwanted attention and started hitting the keys quickly to demonstrate that he knew what he was doing. When he reached the end of the assignment, he was told that he had to get ten problems correct before he could move on. He stared at the screen, hit a key on the key board and then started to do another set of fraction subtraction problems in his head. The second time through the practice problems he made 100%; then he moved to the next practice on subtracting fractions, which involved renaming fractions with common denominators. There was five minutes of class time left when he started this section, and he held up his hand for assistance, but the teacher was busy, and she did not get to him before class was over. The student still had his hand up when the teacher gave the directions to log out and push your chair under the table.

These data support that students worked until they demonstrated mastery of the basic arithmetic skill being practiced, and that mastery was demonstrated solely by entering the correct responses into the computer for at least 70% of the problems in the assignment. The teacher's comment about the need for working the problem on paper also illustrated the point that basic arithmetic skills were the focus of the computer assisted instruction. Students received immediate feedback from the computer as to whether their responses were correct, but the students were dependent on the teacher for all instruction. Students were not encouraged to be problem solvers or to communicate about mathematics, and, clearly, the purpose of computer assisted instruction was for students to receive individualized instruction and repetitive practice to master computation and arithmetic procedures.

To complete the documentation of the role computers played in mathematics instruction for the 1995-96 school year and any changes since the baseline year, it is

necessary to once again examine some of these interview data. An analysis of the interview data used in conjunction with the analysis of the computer related artifact and observation data help triangulate data in support of the conclusions drawn to this point concerning the role that computers played in mathematics instruction and the limited changes made in the use of the WICAT computer lab for mathematics instruction. Presentation of the interview data begins with the Division- and school-level administrators talking about the role of computers in mathematics instruction and ends with the mathematics lead teacher's description of the instructional resources available in WICAT's software.

The presentation of the interview data begins with the Superintendents' response to a question about the role of computers in mathematics instruction. His response follows:

Well that's a good question, because right now our staff is reviewing the current methods that we are using with the WICAT lab. Ah, we don't think it has been as effective as maybe we thought it would be in a lab situation. I do believe it's better geared toward remediation and ah, and we've relied too much on it to do everything for everybody. (p. 9)

The response from the Associate Superintendent to the same questions was in agreement with the Superintendent's response. She stated that the way the lab was being used needed to be changed and that the administration was beginning the process reviewing how the technology was used during the 1995-96 school year. Her comments follow:

We're having major discussions about that [how the WICAT lab is used] now. In fact, this past Monday we meet with all Principals to look at the use of the Josten WICAT lab, and to begin to make some decisions about how we need to change that. You can't do much if you only go in there once a week for twenty minutes. ( p. 4)

. . . the problem is in the equipment. The newer software, our older equipment will not handle, and that's true also of our WICAT lab. We can no longer upgrade the WICAT labs with new software because the equipment won't handle it. So if we buy new programs, we've got to make sure that we have the equipment to handle that. . . . It's a major problem, just a major problem. (p. 5)

While discussing the use of the WICAT computer lab for mathematics instruction, the Director of New Initiatives provided details about a committee that was working on changing the way that the computer lab was being used for mathematics instruction. Her comments follow:

We're about to have a meeting with all the Principals to look at new directions for the WICAT lab. That kind of software, we know, functions

best for remediation, and right now every child gets the same amount and exposure, and I think it could be used more effectively.

Interviewer: Is that pretty much the way it has been used from the start?

The Director of New Initiatives: Yes. That was kind of a contract, I think, with the voters, cause that's how it was sold. . . . Well, what I want to do is replace the computers. I mean they're outdated, see they really need, that technology even though it was purchased five years ago. Now hardware, the average life of hardware and software is six months so, you know that's twelve times as old as it should be. (p. 5)

When asked if she would recommend this computer system to another school district, she stated the following:

Well, I would tell them what do you want to use it for, and if they were trying to mirror our system I would say we wouldn't mirror our system now a days. That isn't a wise use, knowing what we know now. I think it was a good decision at the time, but times have changed, and we know different things. That kind of instructional software works best with the bottom quartile. We know that, that's what research has told us. So for a school system looking into it we would say that's how it's going to be focused. I mean that's how it should be focused on the bottom quartile. . . . (p. 6)

The former director of Secondary Education and Gifted Program, discussed the WICAT computer lab, saying:

Its archaic, that is obsolete. I'll just simply say that. Now, what is the problem is that you've got a lot of money invested in that, and so I go back to that philosophy that we originally put into that plan. We had sketched out in there at least the broad philosophical outlines, not the action plan, but the philosophical outlines that you would recycle equipment when it became out of date or you step down its use. It doesn't wear out it's just the memory is too sluggish, the networking is too sluggish, but you can use those for all kinds of things. Drill-and-practice programs are perhaps working at the lowest level of how we know people learn— period. It's a learning strategy more than we are brutalizing the memory ah, people remember best when they activate chemical memory not just electrical memory, and I think that ah, we have to have an emotional assist to help you really track something for long term memory. You can hardly ever get that reaction from drill and practice. People who are having problems developing a skill, whether it's in

mathematics or language arts, need an enriched environment not a pared down environment. (p. 13)

The Coordinator of Elementary and Middle School Instructional Programs comments concerning the use of the WICAT computer lab for mathematics instruction were in agreement with the other Division Level administrators. Her comment follows:

OK, I don't particularly like the way we're using it now. I don't think the WICAT concept is a productive effective concept. It's intended for remediation, and if we could find a way to remediate the lower quartile without attaching the stigma of pulling them out and taking them someplace else that would be well and good, but to have everybody sit there and go through this drill-and-kill, I don't believe it's productive. . . . (p. 7)

The former Principal's comments concerning the WICAT computer lab provided details concerning past and current uses of the computer lab for mathematics instruction. His statement follows:

First year we were trying to get the thing up, our lab had more problems than anybody's and it stayed down more than it was up. First year I was there I thought it was the biggest waste of money that the County ever administrated. It never was utilized the way I would have liked it. It was still being used for drill and kill. It was not being used to allow students to expand themselves and it was frustrating, I know, for the upper level kids. Again, they were locked into the drill-and-kill. . . . when I left it was still pretty much drill-and-kill and a resentment of the more capable student. (p. 11)

The Principal of Pleasant Middle School had little to say about the WICAT computer lab as he discussed how technology was use for mathematics instruction during the 1995-96 school year. His remarks follow:

. . . the Josten Lab is it, with exception to what [the lead teacher] gets off VA PEN at home, but the Josten lab is used for remediation. . . (p. 4)

The eighth grade mathematics lead teacher's comments about the computer lab provides details about the available software and how he used it to individualized instruction. The interview exchange follows:

Interviewer: How about the WICAT [Josten Computer Lab], has [sic] there been any new purchases of software for the WICAT?

Eighth grade lead mathematics teacher: Not to my knowledge.

Interviewer: Is that still basically drill, drill-and-rote practice?

Eighth grade lead mathematics teacher: Well no, there are other things in there that if you **search** you can find them. She [computer lab technician] trained me how to put my assignments on, so I was able to go in and look at the whole software capability, and I found things that were just great in there. Proof sequences that I assigned to certain students. Not all the students. There are some advanced algebra skills that I found in there that we didn't know about. She didn't even know, so there's a lot of things I found that I can use for enrichment. I teach lessons in WICAT. I mean we have drill in there, but there are times they are doing something in the classroom that corresponds to what we're going to do in WICAT, and I can actually go in there and teach a lesson and have them work on it right then . . . (p. 5)

All of the administrators agree that the best use for the 31 computers in the WICAT computer lab was for remedial instruction for the students in the lower quartile. The comments also indicate that the WICAT computer lab was used to provide individualized computer assisted instruction since its installation in 1991; every Pleasant Middle School mathematics student received approximately 60-minutes of computer assisted instruction a month. Other than a change in the WICAT schedule, the use of the computer lab for individualized computer assisted mathematics instruction remained consistent from the baseline school year through the 1995-96 school year. The data indicate that the hardware was outdated, and that the software not only had not been, but could not be, upgraded; therefore, the computer assisted instructional programs used during the 1991-92 school year were the same programs observed in use during the 1995-96 school year.

The eighth grade lead teacher did indicate that he had found some interesting assignments hidden among the eighth grade software options, and that he assigned those to selected students for enrichment. When he was observed in the computer lab, all of his students were working on drill-and-rote fraction arithmetic practice problems. All three observations and all the interview data support that computer assisted mathematics instruction was limited to individualized drill-and-rote practice on computation and arithmetic procedures which in turn supports the conclusions concerning the purpose of and the methods of mathematics instruction during the 1991-92 school year. The data also support the conclusion for the 1995-96 school year that although methods of instruction had changed to some extent, traditional methods of instruction were still used for mathematics instruction. There were data to support that after five years of use, the County administrators wanted to evaluate the use of the WICAT computer lab for mathematics instruction, and they all expressed a need for change in the way that technology was being

used for mathematics instruction, but during the 1995-96 school year only the schedule had changed.

### School Level: Change in Computer Instructional Materials

Although the technology materials provided with the *Glencoe* textbook were documented during the 1993-94 school year to be a change from those provided with the *Addison-Wesley* textbook materials, as well as a change that was supportive of reform, the teachers did not have access to the technology needed to run the software or to do the technology related activities and lessons provided with the *Glencoe* textbook. The Principal of Pleasant Middle School talked about the lack of Internet access at the middle school, and he and the lead teacher explained that the only change in use of technology outside the computer lab was that access to VA PEN had been limited to 12 hours a day, thus making it even more difficult to use the one resource that they had. The Principal's comments concerning the Internet follow:

Interviewer: Do you have access to the Internet?

Principal: I have it at home, yes I do.

Interviewer: How about here at school?

Principal: No, we don't have it yet. We are working on it.

Interviewer: So, the teachers don't have it here either?

Principal: No.

Interviewer: How about VA-PEN?

Principal: Yes, but it is not used very much this year because access is a problem.

Interviewer: Is that through the library? Is that where they have it? Is it one computer?

Principal: Right. (p. 3)

The 1992-93 data were used earlier to document that the lead teacher conducted workshops on how to use VA-PEN as a mathematics instruction resource, and the former Principal talked about that change in the interview comment that follows:

As a faculty we did several inservice on VA Pen. Net at that point wasn't really a big thing, but VA Pen every teacher had an account. We spent several faculty inservice really learning how to use it because for me I needed that information. I hadn't been on it that much, and I needed some of the expertise from the ones in the building. I think that the use of technology definitely became a teaching partner. It wasn't something to be feared. (p.

10)



The lead teacher explained how limited access to VA-PEN changed his ability to use its resources in the statement that follows:

. . . In the past I've used VA PEN as much as I possibly could to do class projects, and students used it for history day projects, and we did problems of the week, but this year with access as it is from 7:00 AM to 7:00 PM you can't get through. Just disaster. (p. 5)

The Associate Superintendent explained why the use of technology for instructional purposes was slow to change in the statement that follows:

Principals are always looking for ways to upgrade the equipment in their schools and to have access availability on the part of teachers and students and to get teachers to the knowledge level where they'll be real comfortable in using the technology with students. One of the problems we do have in [Pleasant] County is the infrastructure, the wiring; in these old schools it's a major, major problem. And ah, particularly in the middle schools and a couple of our elementary schools. The schools are sixty years old, fifty years old and there's a problem with the infrastructure.

When the Principal at Pleasant Middle School was asked if he encouraged the use of technology for mathematics instruction, his response also pointed to the problem of limited access. His response follows:

I would like to encourage it more than I do. I know the system is trying to encourage it and have made several offers to help people purchase computers and things like that. My problem with encouraging it is, it is hard to encourage it when you don't have access. If we had access people would be drawn to it versus encouraging it and having people trying to find their own access. (p. 4)

While the Superintendent talked about professional development opportunities, he explained the special offer that was provided to encourage teachers to purchase their own lap top computers in the comment that follows:

Yes several opportunities and ah, over an expanded period of time. Everything from our interest in trying to get people to buy their own computers, i.e., lap tops, so that they can carry these to inservice training sessions, and we've had a good number, and I believe right now that we've had forty to fifty teachers that have lap tops in our County that we enabled due to a financing arrangement through a local bank, and a lower price due to mass purchase from the IBM corporation. But the reason for that encouragement was so individuals would personalize their own development,

and that we would participate with them as a partner in offering the inservice and the training necessary to use that equipment, and we've done that. Once they purchased the lap tops we brought them in and literally went through lessons on how to use the equipment properly, and that's an on going effort, and every month through the year we're doing inservice on data entry for report cards, grades and things like that. We're training Principals, teachers, secretaries, bookkeepers, eventually we will be networked with information that ah, we will all be able to link to. Right now the key is to learning the data entry process and coming up with formats that we want to use, and the next step is, of course, linking us together so we can actually move that information where ever we want to. (p. 5)

None of the mathematics teachers in this study had purchased lap top computers or attended any of the related inservice. After attending the two-week V-QUEST Lead Teacher Institute, the mathematics lead teacher and a special education teacher worked with the support of their Principal to provide inservice training for the teachers at Pleasant Middle School on how to use VA PEN as a mathematics instructional resource, and every teacher in the building was assigned a VA PEN account. It is evident that during the 1991-92 school year the County had made major investments in technology, equipping every school in the County with a Josten Computer Lab, and they had applied to participate in Virginia's V-QUEST Systemic Reform Initiative for Science/Mathematics and Technology. The County was committed to bringing technology into the educational system, and both Division and School Level administrators encouraged the use of technology. Technology reform was evident during the first two years of the study, and while the use of the WICAT computer lab continued to provide, unchanged, individualized computer assisted mathematics instruction through the 1995-96 school year, technology reform of computers in the classrooms stalled.

After the teachers learned to use the services offered on VA PEN the problem became access. The wiring at Pleasant Middle School hindered progress, and by the 1995-96 school year there was still only one computer in the building that was connected to VA PEN, and there were only two phone lines in the building. During the first four years of the study the teachers had 24-hour a day access to VA PEN, and those teachers that had access at home could use the services outside of school. The lead teacher was the only mathematics teacher at Pleasant Middle School that had access to VA PEN at home, but he regularly shared ideas with his colleagues. During the 1995-96 school year access to VA PEN was cut in half at the State Level, and this made it even more difficult for teachers to get access to VA PEN.

The technology committee that resulted from the Restructuring the Middle School Initiative was in place, but by the end of the 1995-96 school year no changes had been suggested or made. Eight computers and a CD ROM Tower had been purchased for the library during the 1995-96 school year, but, since library visits were scheduled through Language Arts classes, it was difficult for the mathematics classroom teacher to utilize this technology for classroom instruction. The mathematics lead teacher's description of technology for the 1995-96 school year was summed up in these three statements. He said, ". . . so this year technology has been out . . . . You can't get through. . . . Just disaster" (p. 5). As the Principal said, he would encourage the use of computers more if the teachers had access to them. There was a sense of frustration conveyed by everyone who discussed the use of computers and teachers; it just wasn't happening.

#### School Level: Change in Technology Summary

While the use of calculators in the mathematics classroom had increased since the 1991-92 baseline school year, the use of computers for mathematics instruction in the classroom had actually decreased. Mathematics teachers showed little interest in purchasing their own lap top computers for the purpose of expanding their knowledge of computers capabilities, and the school building was not conducive to its introduction into the classrooms. The use of computer assisted instruction had remained consistent over the five-year period. During the 1991-92 school year a publicly funded large capital investment was made in a computer system that five years later was described as archaic and obsolete. The County faced a dilemma: a contract with the public to improve mathematics scores juxtaposed against a Josten Computer Lab system that was not adaptable to upgrades or changes, continued low computation scores, and a mandate in the form of the new 1995 SOLs to engage students in the appropriate use of technologies for mathematics instruction. At the conclusion of this study, the dilemma was unresolved.

To complete the presentation of the change data for the use of technology for mathematics instruction, each conclusion documented in the baseline data is compared to the current findings. The first conclusion: technology related instructional materials consisted of textbook and nontextbook materials (WICAT computer lab, and other computer technology). The presentation of the textbook technology-instructional materials data included an analysis of the computer technology lessons contained in the textbooks and in any resource materials. The number of lessons that included computer related activities, the type of activities included, and the objectives of those activities were compared. A brief summary of the changes documented in the textbook materials is presented next.

All of the computer related lessons in the 1991-92 *Addison-Wesley* textbook were designated as enrichment materials with the objective of developing basic computer literacy without the necessity of a computer terminal; reading and writing BASIC computer program language. During the 1991-92 school year the textbook lessons emphasized mastery of arithmetic procedures and computation skills in isolation, and consequently emphasized mathematics instruction that focused on procedural knowledge and instrumental understanding. As documented in the presentation of the 1993-94 instructional materials data, the new *Glencoe* textbook's technology materials, like the rest of the textbook materials, focused on teaching conceptual and procedural knowledge, relational understanding. Computer technology was incorporated into every chapter with software, and Internet resources were suggested for each objective. Instructional and assessment software was included with the textbook materials. Although the computer related textbook instructional materials showed significant change that matched the suggested reforms for technology in curriculum and instruction, in the 1995-96 school year the teachers still did not have access to the hardware necessary to utilize the computer software resources or the suggested Internet sources.

This leads to the second baseline conclusion: access to technology was limited for both teachers and students. It was during the 1991-92 school year that the WICAT computer lab was first used for individualized computer assisted teaching access, and by the 1995-96 school year three 20-minute sessions a month per student showed little impact in improving students' computation skills. During the 1991-92 school year there were no computers in teachers' classrooms, and there were only two computers in the building that offered 24-hour a day access to VA PEN; further, there were only two phone lines available for the entire school. During the 1995-96 school year access to VA PEN was cut in half, and every student still spent 60 minutes a month in computer assisted instruction. The use of computers in the mathematics classroom for instruction had not happened, and there was no access to the Internet anywhere in the building. By the 1995-96 school year access to computer technology was **extremely** limited at Pleasant Middle School.

The only aspect of technology that showed any change from the 1991-92 school year was the use of calculators for mathematics instruction. The artifact data documented that during the 1993-94 school year classroom sets of calculators were purchased for each mathematics teacher, a few graphing calculators were purchased for the algebra classes, and the new SOLs and *Glencoe* instructional materials addressed and encouraged the use of calculators in the classroom. Not only did access to calculators improve, the interview and observation data verified that calculators were used more often in the 1995-96 mathematics classroom. The comparative analysis of the calculator related instructional materials

demonstrated that the use of calculators for mathematics instruction changed from informative lessons designed to teach students how to use the calculator, to include lessons that involved applications and investigations and problem solving challenges.

The third conclusion: the use of technology for mathematics instruction during the 1991-92 school year was that the use of technology for mathematics instruction was subordinate to mastery of arithmetic computation. The newly adopted SOLs, for sixth, seventh and eighth grades stated, that facility in the use of technology should not be regarded as a substitute for among other things proficiency in basic computations (p. 21). Although the NCTM *Standards* and the *Glencoe* instructional materials strongly encouraged the use of technology for mathematics instruction, the State and Division level assessments still focused on the evaluation of computation and procedural skills, and the Division and School Level administrators focused on improving student scores on these tests. By the 1995-96 school year this philosophy created a conflict between the suggested classroom technology reforms and desired instructional outcomes: which method of instruction would best reach the desired outcome— using calculators in the classroom or not using them. All of the teachers commented on this conflict, and all reached a decision concerning the use of calculators for mathematics instruction.

Both eighth grade teachers stated that students who had not mastered basic computation skills were provided calculators to use in mathematics class, and every teacher was observed using calculators for mathematics instruction. However, every teacher expressed a concern about the number of students who did not know their multiplication tables and that had not mastered all the paper-pencil computation skills. Also the majority of the teachers expressed a concern about students being calculator dependent. Even the lead teacher who firmly believed that computation should not be taught in an eighth grade mathematics class expressed a concern about mastery of computation skills. Each teacher had to decide when it was appropriate to use calculators in the classroom for mathematics instruction. By the 1995-96 school year the new SOLs placed increased importance on problem solving; the implementation of block scheduling encouraged the use of small group learning activities, and the *Glencoe* instructional materials incorporated the use of calculators into every lesson. Therefore the data strongly support that the use of calculators for mathematics instruction was not always subordinate to mastery of computation skills during the 1995-96 school year.

As documented previously, the use of the WICAT computer lab for drill-and-rote practice had changed very little since the 1991-92 school year; therefore, most of the computer technology used during the 1995-96 school year was devoted to mastery of computation skills. However, not all the uses of technology for mathematics instruction

during the 1995-96 school year remained subordinate to mastery of arithmetic procedures. There were exceptions such as the use of computers to access VA PEN for teaching suggestions, project ideas and the problems of the week,

The fourth conclusion based on the analysis of the technology-related data in the baseline school year: drill-and-review practice was viewed as important to learning mathematics. There is evidence that this view was changing. Teachers were encouraged to change their methods of instruction from teacher-centered lectures and demonstrations to student-center interdisciplinary approaches using small group activities, discussion, cooperative learning, problem solving, and technology. Technology and mathematics curriculum committees were formed, and the Superintendent requested an evaluation of the WICAT computer lab's use for mathematics instruction. The extended class periods that resulted from the change to block scheduling required teachers to change their methods of instruction, and every teacher was observed using instructional tasks that were not limited to drill-and-review practice. Drill-and-review practice was not eliminated from classroom instruction, but it was no longer the only method of instruction. By the 1995-96 school year, emphasis on drill-and-review practice was decreasing while emphasis on teaching conceptual and procedural knowledge was increasing; still, there was always that nagging concern— computation scores on the ITBS and Passport Literacy assessments.

The fifth and last conclusion: the 1991-92 baseline school year analysis of the technology data supported that traditional whole group direct instruction by the teacher, followed by individualized instruction and independent written practice were inherent to classroom mathematics instruction. By the 1995-96 school year the technology data support that calculators were being used more for problem solving and hands-on learning activities; this resulted in student-to-student communication being encouraged and to calculators being used as problem solving tools. The data were used to document that in 1995-96 every teacher in the study used a mix of traditional instructional methods and suggested reform methods for mathematics instruction.

Two major themes were evident from the 1995-96 technology data: (1) the use of technology for mathematics instruction needed to change, and (2) access to technology needed to improve at Pleasant Middle School. The technology committee was asked to develop a new plan for the use of technology for instruction, and the mathematics committee was asked to design the County's new curriculum to implement the 1995 SOLs. Although the ground work had been laid for these changes during the 1995-96 school year, none of them were implemented that school year.

### School Level: Change in Instructional Methods and Related Assessments

Artifact and interview data related to curriculum, instructional materials, and methods of assessment were used to document methods of instruction used during the baseline school year. The case was presented earlier in the analysis of the instructional materials data that replacement of the *Addison-Wesley* mathematics instructional textbook with the *Glencoe* mathematics series in the 1991-92 school year was a positive move for reform of mathematics instruction. The instructional methods, objectives, and curriculum content of the *Glencoe* mathematics textbooks were in alignment with the NCTM recommendations for reform of mathematics instruction, and all the teachers in the study except the new seventh grade mathematics teacher had used the *Glencoe* math textbook to teach math for the past four years. Documenting reform of mathematics instruction in the classroom relies heavily on documenting that the textbooks and their related materials were actually used for mathematics instruction. This was achieved by triangulating data from all three data sources, artifacts, interviews and observations.

In this section, data are presented that indicate that all six mathematics teachers had access to and were knowledgeable of the *Glencoe* instructional materials and that the teachers used those materials to plan and conduct classroom instruction. This is followed by a presentation of interview data that uses the teachers' own words to describe their methods of instruction and changes made over the past five years. These interview data combined with analysis summaries of the classroom observation data serve to complete the documentation for the extent of reform in each classroom; they also provide data relevant to the documentation of changes in methods of instruction since the baseline school year. Therefore, as the identified instructional reforms in the mathematics classrooms are documented, in many cases instructional changes from the baseline school year can also be discerned.

This retrospective use of the 1995-96 observation and interview data to lend support to baseline conclusions concerning methods of instruction is supported by findings shared by Diane Ravitch (2000) in *Left Back A Century of Battles Over School Reform*. As reported by Diane Ravitch (2000), Jeanne Chall of the Harvard Graduate School of Education was commissioned by the Carnegie Corporation of New York in 1961, to conduct a research study of reading reform, and in sharing Chall's findings Ravitch (2000) wrote the following:

Comparing the effectiveness of reading methods turned out to be extraordinarily tricky because each approach contained elements of the of the other. Chall found that 'every school that introduces a new method still retains a good deal of the old one'. (p. 355)

After presenting the interview and observation data that document the extent of reform present in each classroom and how those instructional methods were different from those used during the baseline school year, a brief summary of the findings from the analysis of the baseline data is presented and the final set of interview data from teachers, school and Division Level administrators are used to complete the case for change of methods of instructions in the classroom since the baseline school year.

The artifact data establish that the *Glencoe* textbook series was adopted, purchased and recommended for use during the 1992-93 school year. Every student in Pleasant County School System was provided a copy of the mathematics textbook, and every teacher had a copy of the teacher's manual and its accompanying resource kit. The observation data revealed that all six teachers in both the pre- and post-observations used the *Glencoe* textbook for mathematics instruction, and all of the teachers talked specifically in their interviews about how they used the textbook to plan and deliver mathematics instruction. The first set of interview analysis provides evidence that the teachers were familiar with the Glencoe instructional materials, the second that the teachers used the textbook for mathematics instruction, and the third documents the methods of instruction/assessment used during the 1995-96 school year and how those differed from those used during the 1991-92 school year.

When the teachers responded to the question, whether they would recommend the *Glencoe* textbook to other mathematics teachers, they talked about the merits and disadvantages of the textbook and shared their opinions of the *Glencoe* textbook and its approach to mathematics education. Those responses provide evidence that the teachers were knowledgeable of the *Glencoe* instructional materials and of extent of instructional reform in their classrooms. The presentation begins with the eighth grade teachers; supporting data from other participants are included when applicable.

Both of the eighth grade teachers stated that they would recommend the *Glencoe* textbook for mathematics instruction. The eighth grade mathematics lead teacher stated, "I like the *Glencoe* book. . . . There's a possibility that [Pleasant Middle] could get a grant using this textbook to have some teacher training on how to implement the SOLs. [A teacher from the high school] is looking into it" (interview 2, p. 2). The other eighth grade teacher stated: "I am really pleased with it. I think the activities offered are very appropriate, and it gives teachers lots of ideas as far as activities and things to do" (p. 13).

The seventh grade mathematics teacher's reply to the question, would she recommend the *Glencoe* textbook, was a simple "Yes." When asked for reasons why she would recommend the textbook, she stated the following:



Well, because of the large number of activities, that certainly helps, particularly if you have a newer teacher that doesn't have the manipulatives in the room that I am fortunate enough to have. This, we have enough resources to draw from just from that text, if we have nothing else. (p. 12)

The other seventh grade teacher's response to the same question follows:

I wouldn't make a recommendation one way or the other because, quite frankly, you could give me, and perhaps this is self serving, but can give me most any book, and I can teach math out of it. I mean I don't **need** it. I like, I like having to follow from this to this to this, but the way I learned math, at my age ah, I am almost 51, so this math is not the way I learned math, so I think perhaps I'm teaching it better because I rely [a little laugh] on my methods as well as newer methods. (p. 22)

The female sixth grade teacher said that she would not recommend adopting the *Glencoe* textbook, stating that “. . . it is too difficult for the students. It is wonderful for above average students, but it is too difficult for the average student” (p. 15). Later in the interview she shared that she used the *Glencoe* textbook because the Principal had asked her to use it. When asked if she was supported, encouraged or given any directives about using the *Glencoe* textbook, she said, “Just to make sure you, I, use the *Glencoe* math book. Make sure you use it” (p. 17).

The male sixth grade mathematics teacher said:

Yeah. I like the book. It has got a lot of application to it, and it has so much in there that you can't do it all, and if you are looking for something that really is practical, that goes not in just mathematics, but goes outside the realm of a math class, that book does it. It has got a lot of practical uses. It has got a lot of labs in it, a lot of learning techniques and skills in it, there is [sic] a lot of things you can do with that book. (p. 24-25)

It is clear from these statements that all of the teachers were aware of the hands-on instructional activities included in the *Glencoe* Mathematics Series. Four of the six teachers stated that they would recommend the series to other educators because, among other reasons, of the variety and quantity of hands-on learning activities provided by the textbook. These data support that all of the teachers were familiar with the *Glencoe* instructional materials and that four out of six of them liked what the instructional materials had to offer.

Since detailed descriptions of the teachers using the *Glencoe* textbook to teach mathematics were provided earlier in the study (a snapshot view of mathematics education and analysis of the observation data), presentation of the observation data at this point is limited to a summary of the findings. Six teachers were observed five times each during

1995-96. During the first set of observations there were 89 different tasks identified and coded; 52 (58%) of those tasks were textbook based.

During the second set of observations, 51 tasks were identified and coded; 29 (57%) were textbook based; of the tasks observed that were not textbook based, all but three were designed to reinforce or introduce a lesson from the textbook. There were thirty instructional lessons observed during the 1995-96 school year, and the *Glencoe* mathematics textbook was used at some point during all but three lessons in which the retired *Addison-Wesley* textbook was used instead. The observation data provided a snapshot view of mathematics instruction during the 1995-96 school year, and an analysis of those data documented the number of tasks that were coded as level 3, supportive of reform, or level 4, strongly supportive of reform. There were 140 tasks observed; 50 were coded as level 3 or 4, and every teacher showed evidence of instruction that matched the NCTM recommended reform. The data document that the teachers used the *Glencoe* textbook for mathematics instruction during the 1995-96 school year and lend additional support to the conclusion that instructional reform was present to some extent in every mathematics classroom. The Interview data presented in the next section complete the triangulation which supports the instructional reform conclusions present in each of the 1995-96 mathematics classrooms.

Having established that all the mathematics teachers had knowledge of the *Glencoe* textbook and that they all were observed using the textbook for mathematics instruction during the 1995-96 school year, this section documents how methods of instruction changed over the five-year period and the extent of mathematics reform present in each teacher's classroom. Although there are two distinct goals in this section (i.e., triangulating data to document the extent of instructional reform in 1995-96 and documenting changes in mathematics instruction since the baseline school year), much of the data are applicable to both situations; therefore, a comparison format is used.

All of the teachers were asked about how their mathematics instruction had changed over the past five years; the responses serve to document how the mathematics instruction of 1995-96 was different from the instruction of 1991-92. When addressing changes in classroom instruction, the teachers included information concerning assessment. Excerpts from the eighth grade lead teacher's interview data about instructional change follows:

Interviewer: Have you changed the way that you teach math any in the past four or five years?

Eighth Grade Lead Teacher: Assessment, that's about it. (p. 1)

Interviewer: Has the new [*Glencoe*] textbook, or the relatively new textbook, changed the way that you do your lessons now or the way that you teach?

Eighth Grade Lead Teacher: [2 second wait] I use it more as a supplement than anything else. I don't teach chapter to chapter. I use to do that, and now I teach on a need to know basis. . . . I start the year out with the metric system, and then I do one project, and when they do that I can tell what they need to work on, and sort of prioritize it to what I need to do first semester. . . . I've always kept check sheets with skills for the kids. I've always done that. That hasn't changed. Uh Assessment has changed. How I assess students has changed. (p. 2)

Interviewer: Have you changed the way that you teach math with your new materials or professional development that you have encountered?

Eighth Grade Lead Teacher: No—I've always been a hands-on person. Now, I've got new ideas.

Interviewer: Has the way you used problem solving changed?

Eighth Grade Lead Teacher: No

Interviewer: Do you use a problem solving based approach to teaching?

Eighth Grade Lead Teacher: In everything I do I try to end up with something like the problem solving . . . and I do a lot of team problems, and if I have time left over I have problems that I put on the overhead. The kids can work in pairs or in peer-pairs or they can talk around, that is what we're doing, or they can do it individually, and then they work these problems out, but they have to write an explanation, and then I will read them and give it back to them and say— Do you all have any changes that you want to make on this? I probably do more of that than I used too.

Interviewer: More explanations?

Eighth Grade Lead Teacher: More nonroutine type problems than, instead of, just the old standard.

Interviewer: Did you always require them to give explanations of how they solved the problems, or did you just focus on answers?

Eighth Grade Lead Teacher: Not so much written. It's just that I would go around the room and say— Do you want to explain that? I do more writing now than I have ever done. That's for sure. Kids do more writing. . . . We do vocabulary. They keep a notebook of the vocabulary. I don't make them do a formal definition. I want them to be able to recognize them, not provide them, not define them— the classic definition. I tell them that you need to put them in your own words, or do a description of it, or even draw a picture. I just want to know that you to know what it is.

Interviewer: Do you use manipulatives to teach math?

Eighth Grade Lead Teacher: Three kinds.

Interviewer: Has this changed?

Eighth Grade Lead Teacher: Yes, because we have more materials. Before we didn't have materials. We had to make our own materials. That took a lot of time.

Interviewer: How about reflective activities in your lessons, Do you use reflective activities?

Eighth Grade Lead Teacher: Right, I do more than I used to.

Interviewer: Is it part of your assessment or evaluation?

Eighth Grade Lead Teacher: It is a part of their learning and part of the assessment content. I will read paragraphs and say— this is good. this is good, but I am not sure if I understand what you mean by this, and it doesn't **have** to be right; we do that several times.

Interviewer: You mentioned that you do a lot more writing, and I know that your students do a lot of explaining in the classroom, do you think that communication plays a big role in your mathematics lessons?

Eighth Grade Lead Teacher: Communicating, like I do, is one of the most important things you can do. How can an engineer work with a company and not be able to explain what he's done. Those are the kinds of examples I use with the kids. They go on to be an engineer and I say, sure, but you have all these other people asking you questions, and you have got to be able to communicate to them the mathematical ideas behind your reasoning so they can understand and carry out what you want them to carry out. Otherwise you have chaos or the bridge falls. Oh that's one of my best activities—

Interviewer: —the bridge?

Eighth Grade Lead Teacher: Yes, because they have to cooperate so much together or that bridge will collapse.

Interviewer: How would you describe the balance of time that you have between ah, focusing on understanding basic skills versus reasoning and logic.

Eighth Grade Lead Teacher: When I started the year off I wasn't going to do basic skills at all, that what ever we did was going to be directed so [that] we could stop and take care of fractions, and when we do this, it will take care of decimals, but in midstream I decided I had to change, and do, and did away with my thinking type stuff because the kids couldn't handle that

because their basic skills were so limited. So, I had to spend more time on basic skills. Boring worksheets, I don't know what else to do with basic skills. If we did an activity that required fractions they couldn't do the activity because they couldn't do the arithmetic. I don't know what to do. (p. 12-13)

Interviewer: Have you changed the type of tasks that you use in your classroom?

Eighth Grade Lead Teacher: The activities? Yes. Yes the increased time gives me time to do more complex activities. Which we try them and see. . . . How I do assessment has changed. Well I used standard paper-pencil test, but [now] I do learner interviews. I do activities where they demonstrate what they are doing. I do writing activities so that they can show me they understand in an explanation. I do projects, and I'm trying to do some rubrics with them, but I still haven't caught on to that. As a matter of fact, the last project that my Algebra class did with paper was a survey, and they had to write a paper with it, and I used a rubric to score them, which they were very confused about, but I do a lot more interviewing, and I have my little check sheet, and I'll ask a kid— here's a set of data how would you find the mean? And he would explain it to me and I'd check OK. How would you find the mode? So forth and so forth. It's more talking to the kids and more projects and activities, and that's a whole lot better than paper-and-pencil, but still the paper-and-pencil is applied. (p. 15)

In the Lead teacher's second interview he made statements about how his instruction had changed that support and in some cases enhance the information provided in the first interview:

Eighth Grade Lead Teacher: I have always used some hands-on, that has increased over the years as I got support from the Principal, but I had a Principal the first eight years that I was here that felt students should be sitting at their desk doing book work, and if they did anything else it was always that you're too loud, why are the kids playing and things like that so no, as Principals have changed it has made it easier for me to do what I thought should have always been done. (p. 3)

Interviewer: Talk to me a little bit about how you think your use of assessment has changed.

Eighth Grade Lead Teacher: Well basically, I was always a paper-pencil type of person, even if a kid did projects they had paper-and-pencil tests, and now

I lean towards other types of assessment. I even do rubrics now, although I still don't feel comfortable doing them. I assess students a lot of different ways instead of paper-and-pencil. I can do personal interviews. I can let them write me paragraphs. I can give them paper-pencil tests. I can give them oral tests which is different than an interview because I would have specific questions one, two, three, four, five. As the interview will depend on the students response, that is different. I mean, gosh, I don't know, I don't know what different assessments that I use. I use different assessments, but right now I'm not doing one. So I don't know why some days I just walk into the classroom and say it looks like a good day to do this type of assessment and it's just like spur of the moment. (p. 10-11)

Interviewer: Has your use of homework changed?

Eighth Grade Lead Teacher: No not really.

Interviewer: Do you —

Eighth Grade Lead Teacher: —but yeah it has, it really has. I used to use the textbook for everything and a few activities, but I do a whole lot more activities at home, and I try to get the parents involved. You see the kids go home and they have an activity to do, and then I ask the parents to sign the paper saying they discussed it, and they get a bonus that way. . . . I give more activity related things to do at home than I use to instead of drill-and-practice which is OK, but they need more than just drill-and-practice. So they measure things at home and make sketches with the parents helping them . If they are doing projects I encourage the parents to work with them and then write a little letter explaining what they did, and the kid gets extra credit. I try to get parents involved in what we are doing. (p. 14 -16)

Although not all of the instruction coded as supportive or strongly supportive of reform was representative of instructional change for the lead teacher, the data document that he had made some significant changes in his classroom instruction since the 1991-92 school year. A summary of the eighth grade lead teacher's observation data revealed that during the five classroom observations he used 21 instructional tasks and 12 of those tasks were supportive or strongly supportive of reform. The lead teacher identified assessment as the area of his classroom instruction most changed since the 1991-92 school year, but he also described changes in methods of instruction. He indicated his use of the hands-on methods of instruction had increased, and that he had made changes in the types of homework assignments and assessments used.

The lead teacher stated that he used more application type activities or projects for homework instead of just practice exercises, and he attributed the increased use of hands-on instructional activities to the following: (1) the availability of instructional manipulatives, (2) the reassurance from the V-QUEST training program that this was the best method of instruction, (3) a Principal that was supportive of this method of instruction, (4) longer class periods, and (5) less dependency on textbook directed instruction. The lead teacher emphasized that the biggest change he had made in his classroom instruction since attending the V-QUEST Lead Teacher Training program was in the methods of assessment that he used. He used a variety of assessments instead of just paper-and-pencil tests, and he placed an emphasis on students explaining solutions to problems rather than just providing answers. He was observed using the check-list of skills, talking to individual students and small groups about how they approached or solved the problems assigned, and having the students prepare written explanations of how they arrived at solutions. His methods of assessment now more closely matched his methods of instruction.

Seven of the 24 tasks observed for the other eighth grade mathematics teacher were coded as supportive or strongly supportive of reform and representative of instructional change since the 1991-92 school year. Although much of the interview that indicated that the eighth grade teacher's methods of instruction had changed since the 1991-92 school year was presented in the section which documented block scheduling, it is presented again here to emphasize that the instruction represented a change of instructional methods for this eighth grade teacher:

Interviewer: Has anything about your planning changed in the past few years?

Eighth Grade Mathematics Teacher: Yes, I think so.

Interviewer: Could you tell me about the changes that you made?

Eighth Grade Mathematics Teacher: Definitely with the increased time for class I try to use more different strategies than I felt that I had time to use previously. I also try to make more connections with applications and things like that, that they would have use for this information, and [I] also try to use more primary materials. I supplement the textbook more with almanacs, maps, newspapers, than I used to.

Interviewer: Is there anything else about your planning that would be significant?

Eighth Grade Mathematics Teacher: I probably tend to use activities more, and part of that is the time element, and part of it is that we have

manipulatives to use that we didn't formerly have, and we were given funds to purchase those a couple years ago.

Interviewer: Would you talk about what kinds of things you focused on or considered while you were making your lesson plan? Did you focus on what you were going to do or what the kids were going to do?

Eighth Grade Mathematics Teacher: Well, I probably, that is related to the last question, that is one thing that changed more I think. I try to be a little bit more focused with what the kids expect of their learning, more than my so called teaching. Whereas, I feel like formerly I was more textbook and objective driven, and especially with the increased time, I try to think more about what the student needs and how I can meet their needs in that amount of time than I do specifically meeting the objective. . . . (p. 2-3)

. . . I use writing frequently. The kids do keep a math journal or a math log. They didn't write in it during those days, but they normally during the course of the year they do from time to time. I feel that writing is an important way of sorting out what they are learning in their mind, in other words, sometimes it is all in there in kind of a jumble and if they can fit it into words to write it down or tell somebody else, it kind of helps to solidify what they have learned.

Interviewer: Have you always used this task, is this something that you have always used in your classes?

Eighth Grade Mathematics Teacher: No, this is something that I have started using in the last three or four years.

Interviewer: Can you credit some source for this idea or is this just a suggestion from a textbook?

Eighth Grade Mathematics Teacher: Well, I really don't know where I got the first idea. The first year I did it I went into it with no information, and I really don't know where I got the idea, but it was something I just kind of did on my own, and then the summer following that, I did the Writing Project, Southwest VA Writing Project, and [I] got some of the information that I needed as far as how to make it more meaningful. So that would be a resource I used a bit.

Interviewer: Now again is this a task, the hands-on type activity, is this a task that you have always used in your instruction or have you changed this practice?



Eighth Grade Mathematics Teacher:: Probably, I would have used it occasionally. You know, several years ago, ten years ago, but I have tried to use it more frequently with more different units, more different concepts. (p. 4-5)

Interviewer: Has your use of whole group or direct instruction changed over the last five years?

Eighth Grade Mathematics Teacher: Um-hmm.

Interviewer: Would you tell me a little about that?

Eighth Grade Mathematics Teacher: Well, for various reasons, with the 45-minute class period we always, generally all the teachers in the school we were encouraged to follow the model of direct instruction, guided practice, and I still use that, but within that I try to vary the methods to include some hands-on, to include some real applications as far as tying the lesson to something in the world.

Interviewer: . . . has your use of individualized instruction changed?

Eighth Grade Mathematics Teacher: Yes, it has increased. The new block schedule has, I think, given us good opportunities for working with kids individually. In small groups too, I don't think you saw as much small group activity as I usually do.

Interviewer: I saw some paired problem-solving, and I am going to ask you a little about that . . . there was a lot of student-to-student communication going on. . . and I was wondering if you encouraged the student-to-student as well the teacher-to-student communication in your lessons?

Eighth Grade Mathematics Teacher: Yes, in lots of cases for some of the students especially that [student-to-student] communication, they learn more from that than they learn from me. Lots of times another student puts it in, you know, better terms for them to understand. So, I encourage them even when they are working practice work to dialogue about what they are doing not just share answers or that kind of thing.

Interviewer: Has that changed for you? The use of student-to-student communication, has that changed?

Eighth Grade Mathematics Teacher: Oh, yes!

Interviewer: Well, tell me a little bit about that.

Eighth Grade Mathematics Teacher: Well that was formerly known as cheating, I think. You know, you expected the kids to do their own work, be quiet, [and] do their own work, and if you have a question ask the teacher.

And you know with different objectives, different content, with heterogeneous grouping, I'm not often able to answer each individual question. I do have more time this year, that's good, but it works better if they can ask another student some things rather than my having to answer the same question 20 times, if I can visit each group and answer it six times, or whatever, it helps me use my time more efficiently. (p. 5-6)

Interviewer: Is there anything else that you would like to add that would show a picture of how your typical classroom has changed from the way it was say five years ago?

Eighth Grade Mathematics Teacher: I think it has changed in the fact that there is more time for individual instruction, more time for writing, communication, discussion. More manipulatives are being used, both because of the time and because of the fact that we have them and because of the fact that I realize there is a need for it more than we did before, and there is also a difference in content, I don't stress computation so much as I used to a lot of times. By the time they get to the 8th grade they resent practicing division, multiplication, you know, if they haven't learned it up to that point, you know, I am just kind of here is a calculator. I don't want the problem solving to be limited by their computation, you know, if they have the problem-solving skills I want them to use a calculator. (p. 9)

Eighth Grade Mathematics Teacher: In terms of tests, they are probably not a whole lot different other than I might ask, application type of questions, and they will usually be bonus questions, because a lot of kids haven't developed those higher level thinking skills or they are in the process of developing them. Occasionally, I will organize a test differently, rather than having them just work problems or fill in the blank, or something like that, I might have them, well there is one that I can think of that I did recently in Algebra, of course, it wasn't, I have done it with fractions too, but I had them, this particular Algebra test was on factoring and rather than giving them all these expressions to factor, I had them classify them as the difference of two squares or polynomial square or the polynomial with a nominal factor and all the terms and then, you know, they had to classify as well be able to factor them. So, I throw a few things like that in once in awhile, but I can't say that there is a big difference as far as assessment.

Interviewer: How about in terms of projects or those types of evaluations; has that changed?

Eighth Grade Mathematics Teacher: Yeah, I use those more often, um, I probably never did projects up until maybe two years ago, and I still don't do as many as I would like to; they have done one this year, but of course that is partly because I wasn't here. And last year I think my students did two during the year, and I had plans for at least one more this year, but I really like to do those because a lot of the students have art interests, or science interests that, you know, if I show them a way that they can tie the two things together sometimes it makes them a little bit more interested. (p. 10-11)

Eighth Grade Mathematics Teacher: I think it [mathematics instruction] has changed for the better. . . . You know, from a teaching aspect I feel, you know, I feel that what I am trying to do is a little more worthwhile than just going through the textbook and learning to compute and teaching to compute, that kind of thing. I think it is going to get better. I am never satisfied with what I am doing. I am always, you know, trying to work on some area, you know, assessment, the project and things. That is something I really want to get going now. (p. 15)

The eighth grade teacher's interview data indicate that she had made changes in the content presented in mathematics class by focusing less on computations. She relied on the textbook less and focused more on problem solving. The use of calculators and manipulatives in her classroom instruction was new because the materials were purchased after the baseline school year. These interview data also verify that traditional methods of instruction that focused on computation were encouraged and prevalent during the 1991-92 baseline school year. As she talked about this, she stated that she still used those methods in her mathematics classes, and this is supported by the observation data which showed that 12 of the 24 instructional tasks observed were coded as marginally supportive of reform and 5 were coded as weakly supportive of reform. She indicated that her methods of instruction had changed because she saw the need to change, but she also indicated that there was support and encouragement to change.

The eighth grade mathematics teacher's instructional goals had shifted from teaching computation and covering the textbook to planning instruction that met the students' needs and focused more on problem solving. She stated that in addition to whole group direct instruction and guided practice that she now used a variety of instructional strategies (e.g., small group activities, pair sharing, and individualized instruction). She tried more connections with applications, and she tried to use more primary materials to supplement the textbook materials. The data support that hands-on instructional activities, calculators, student-to-student communication, writing-to-learn and individualized

instruction were regularly used during mathematics instruction. All of these instructional strategies were new to this eighth grade mathematics teacher's lessons except for individualized instruction and learning activities, but her use of individualized instruction and hands-on learning activities had increased since the purchase of materials and implementation of the new block schedule.

Although the eighth grade mathematics teacher still used paper-pencil tests for assessment, she indicated that she had changed, to some extent, the types of questions used on tests. Her response indicated that she included some higher-level-thinking type questions which were not typical of the computation-and-procedure -focused tests used during the baseline school year. She also tried using projects for assessment and intended to continue working on incorporating more projects into her mathematics classes. The teacher's reflections concerning the instructional changes that she had implemented in the classroom conveyed that she viewed them as positive.

Like the eighth grade lead teacher, this teacher intended to continue working to improve the methods of assessment and mathematics instruction used in the classroom. Following the leadership provided by the NCTM *Standards* and the V-QUEST Systemic reform initiative, classroom instructional reform efforts started with change in curriculum content, instructional materials and instructional strategies with assessment reform coming last. Both eighth grade mathematics teachers indicated they were now focused on changing the methods of assessment used in the classroom; both mathematics teachers were well into the process of changing their methods of instruction because both were now focused on the last goal, reforming methods of assessment.

The former Principal of Pleasant Middle School attended the two-day administrators V-QUEST training session in Clinch Valley; he indicated that he had noticed a change in the eighth grade mathematics teacher's instruction since the V-QUEST Lead Teacher Institute. His observations concerning changes in mathematics instruction are shared in the interview exchange that follows:

Interviewer: Did you notice any progress in pedagogy; was there less teacher talk and more hands-on?

Former Principal: It really got better. Ah, I would have to say as I looked at it, it probably was happening [in] both grade levels, eighth grade really came around faster than anybody else where it was a lot of cooperative learning. It was a lot of just students actively involved in learning. Seventh grade there was at least a pocket there where it was still a traditional lecture. They turned eyes away from [Principal's name] while you're in there doing an observation. The other one [8th grade mathematics teacher] really bloomed

as a teacher, attended the Writers Workshop, it was amazing to watch the growth in this person. Here was a person that had been a very traditional math teacher, and suddenly, because, I think, of that and some other things, she was willing to take the summer with [name of the Southwest Virginia Writing Workshop's professor], and the next year [she, the eighth grade mathematics teacher] started incorporating writing in the math classroom, and those kids really benefited from that. Sixth grade ah, a split thing [3]—  
Interviewer: —I have to ask was that [name of the eighth grade mathematics teacher]?

Former Principal: Yes, yes [name of the eighth grade mathematics teacher].  
It was just amazing to watch the growth occur, again she had been a very traditional, for the lack of a better way of putting it, high school teacher and she suddenly became, again for the lack of a better way of putting it, a good elementary teacher. (p. 9)

These data provide strong support that the instruction observed that was coded as supportive and strongly supportive of reform for this eighth grade teacher was indeed a change from the type of instruction that was used during the baseline school year.

Although the Principal described a pocket of resistance to reform and mathematics instruction as lecture in the seventh grade classroom, the veteran seventh grade mathematics teacher observed in this study had implemented many of the suggested mathematics reform strategies by the 1995-96 school year. Of the 28 tasks observed only two were coded as level 1, weakly supportive of reform, all the rest of the tasks were coded as level 3 or 4, supportive or strongly supportive of reform. This seventh grade teacher was a prime example of mixing old methods with new ones. Eighteen of the observed tasks were from the *Glencoe* textbook and used cooperative learning, pair-sharing and/or hands-on learning activities, and the teacher encouraged student-to-student communication and student explanations, but she held strongly to the principle that it was the teacher's responsibility to explain, tell and show the students how to find the solutions to the problem solving tasks presented. The seventh grade teacher had changed the material presented in class, and she had changed many of her instructional methods, but she was not comfortable with letting the students explore a variety of problem solving methods, and inevitably fell back on telling and showing for mathematics instruction. The interview data concerning change conveys that the seventh grade teacher was knowledgeable of the suggested reforms and that she was in the process of incorporating them into her mathematics lessons by blending the new strategies with her traditional instructional methods.

Interviewer: Has anything about your planning changed in the past five years?

Veteran seventh grade mathematics teacher: Yes, more so this year probably than other years because we have the blocked time. I don't feel as pressured. We have a longer period of time for math than we have had in previous years. I don't feel as pressured to cover just material in the book and move on. We have time to do more activities and things that will help them internalize, hands-on. . . . (p. 1)

. . . Well, I think, anything that students can visualize, see or cut, the more they can connect or relate to math. (p. 4)

. . . I do a hands on activity basically every day this year. (p. 5)

Interviewer: The problem solving approach that I noticed in your classroom, is that something that you have always used?

Veteran seventh grade mathematics teacher: That is something that I, probably is one of the more difficult things to use, and no, I am more new in that area. . . . Well, I certainly have read the new research, you know, I am trying to change my teaching style. (p. 5) . . . Well, I am definitely using manipulatives more often. This has been true since we adopted the new textbook, and we have had this book, this is our third year. We adopted the book because of the new *NCTM Standards*, and so I have definitely changed my teaching style. . . .(p. 6)

Interviewer: . . . Why did you select that task [amount of cereal consumed in a week]?

Veteran seventh grade mathematics teacher: It is something that they are all very familiar with, that they can relate to, it relates to real life. (p. 4)

Interviewer: So in each class you had some type of hands-on activity that the students were doing. Have you always used these types of activities in your instruction.

Veteran seventh grade mathematics teacher: No. . . . (p. 5)

Interviewer: Would you talk to me about why you used the reflective type opening to your lessons?

Veteran seventh grade mathematics teacher: Pretty much just to trigger their memories, to relate, to be able to take what they previously learned and applied and relate to the new idea or concept.

Interviewer: After you have introduced the new topic of area, you asked the students a question about when they would ever need to know the area. Was that a question that you had planned to ask?

Veteran seventh grade mathematics teacher: Well, questions they will ask you frequently, Why do we need to know this? It's to relate it to the real world. (p. 5-6) . . . I think, it is important for the students to be able to understand that they use math in lots of ways other than the paper-and-pencil method. (p. 11)

Interviewer: Has the type of homework you assigned changed?

Veteran seventh grade mathematics teacher: Yes.

Interviewer: I noticed that one of your homework assignments was about getting an estimate about the amount of cereal they consume in a week, and that was after you had them try to visualize the number of servings in a bag of cereal. This is definitely not a traditional type homework assignment. Do you have any other examples of the type of assignment that would be nontraditional?

Veteran seventh grade mathematics teacher: Hmm, maybe measuring something at home, or making a scale drawing, looking at containers in the cabinet.

Interviewer: Has the role that homework plays in your teaching changed?

Veteran seventh grade mathematics teacher: Yes.

Interviewer: Could you talk a little bit about that?

Veteran seventh grade mathematics teacher: My assignments are shorter. I probably take as many grades as I used to, but the length of the assignment is much shorter, and in the block period time they are doing more group work instead of you take this worksheet home and you do it. They may do their homework in a group.

Interviewer: Have you changed your method of assessment?

Veteran seventh grade mathematics teacher: I basically am still using a chapter test.

Interviewer: A paper-pencil format?

Veteran seventh grade mathematics teacher: Yes.

Interviewer: Are there any forms of assessment that you use occasionally, that are not paper-pencil?

Veteran seventh grade mathematics teacher: Well, I think I am doing assessment every day in the classroom. Everything that they do, it may not

be something that I carry a book around and write down, but I am certainly assessing their knowledge.

Interviewer: How about projects or reports or anything like that?

Veteran seventh grade mathematics teacher: I had done projects, but I have not found a project that I feel that is worth the time that is spent on it. I did try to do a group project in the fall, and I allowed class time and we went to the library a couple of times, and I just didn't feel that what I got was worth the amount of time that I put into it. I have nothing against projects, but I haven't found the right one.

Interviewer: So, would you say your use of assessment has changed over the last five years?

Veteran seventh grade mathematics teacher: Yes.

Interviewer: Can you describe a little bit about how you feel that it has changed?

Veteran seventh grade mathematics teacher: I do not put as much weight on test grades, if a child does well all nine weeks, and has a low test grade, I don't average as one specific percentage. (p. 9-10)

Interviewer: I didn't see any specific writing tasks while I was observing the class, but do you use any writing assignments for your students? In terms of writing to learn?

Veteran seventh grade mathematics teacher: Some, Some, but not what I would like to, I still have a book beside my night stand that I have planned on to do some journal writing, or and I have other resources but I haven't been able to do them. (p. 8)

These data document that this seventh grade teacher used the mathematics textbook for planning mathematics lessons, and, therefore, serves to document that the content and methods of instruction had both changed since the baseline school year when the *Addison-Wesley* textbook was used for mathematics instruction. The interview data indicate that she used hands-on activities, cooperative learning, student-to-student communication, and problem solving rather than guided practice and independent practice for the majority of the instruction. Her responses revealed that she thought it was important for students to make connections within the mathematics content and outside the mathematics classroom, but the observation data showed that the teacher took the responsibility for making these connections for the students. Although she used a problem solving task for much of the mathematics instruction observed, she always did the thinking for the students. She would ask guiding questions and let the students respond, but in every lesson she explained



exactly what the students needed to do to solve the problem, leaving the students the task of doing the mathematical computations. Calculators were used for some of these computations, but doing mathematics could be described as following the teacher's directions or examples to compute the answer to the problem. There were fewer practice problems; the nature of the problems had changed, and the teacher often asked higher level questions, such as how does the area of a figure relate to the perimeter of the figure, but the teacher always took responsibility for providing the correct information or solution. After providing the information she would ask students to explain how they arrived at their answers, but the students were seldom required to reason or think about the reasonableness of their responses.

Much of the suggested instructional reform was present in this seventh grade mathematics classroom, but the fundamental roles of the teacher and the students had not changed. The teacher planned lessons so that the students were active participants, but they were still dependent learners practicing the skills or procedures provided by the teacher. The interview data indicated that the role of assessment had changed as far as assigning grades to students, but that the methods of assessment used by this seventh grade teacher had not changed. She had tried using projects, but she had not found one that worked for her yet, and the teacher stated that she was focused on learning how to use writing for mathematics instruction and assessment. Both the interview and observation data support that this teacher was knowledgeable of the NCTM suggested reforms and that she was in the process of changing her teaching style. She stated that the implementation of block scheduling for the 1995-96 school year had provided the time needed to make these changes in her methods of instruction.

Since it was the other seventh grade mathematics teacher's first year teaching mathematics, documenting change in her mathematics instruction from the baseline year was not possible. However, portions of her interview data combined with facts from the observation data do support two conclusions presented in this section devoted to documentation of instructional reform as change from the baseline school year's methods of instruction. The two conclusions pertinent to this section are (1) traditionally used methods of instruction are mixed with the current reform methods, and (2) although the *Glencoe* instructional materials were designed to be compatible with the NCTM recommended instructional reform, using the materials for mathematics instruction did not necessarily equal reform of instructional methods.

While talking about how she created her lesson plans, she stated that she used the *Glencoe* textbook for mathematics instruction, saying, "Well, basically [name of veteran seventh grade mathematics teacher] and I have pretty well decided together that we will go

through the [*Glencoe*] text in order, through chapter eight. I think, at that point we have no choice but to start skipping around hoping to pick up concepts that they don't understand or have not had" (p. 3). She was observed using the *Glencoe* instructional materials, cooperative learning activities, small group activities, and hands-on learning activities from the textbook that connected mathematics to real life, but 21 of the 29 instructional tasks observed were coded as level 1 tasks, weakly supportive of reform. Simply using the textbook for instructional ideas and materials did not yield mathematics instructional reform.

Additional support for the conclusion that traditional methods are mixed with the current reform methods is provided by her response to a question about her opinion of the *Glencoe* textbook. Her response:

I wouldn't make a recommendation one way or the other because quiet frankly, you could give me, and perhaps this is self serving, but [you] can give me most any book and I can teach math out of it. I mean I don't need it. I like, I like having to follow from this to this to this, but the way I learned math at my age ah, I am almost 51, so this math is not the way I learned math, so I think perhaps I'm teaching it better because I rely on my methods as well as newer methods. (p. 22)

Taking the ideas and material provided by the *Glencoe* textbook and combining them with the instructional methods that she had learned and traditionally used resulted in the majority of her classroom instruction being weakly or marginally supportive of reform. Like the veteran seventh grade teacher, even though the students were active participants they remained dependent learners.

All twenty of the male sixth grade teacher's observed instructional tasks were coded as weakly or marginally supportive of reform. His interview data concerning how his methods of instruction had changed support that he was interested in changing his methods of instruction and that he was in the process of implementing the changes that he could incorporate into the traditional show and tell method of instruction. Here are some of his comments:

Interviewer: Has anything about your planning changed in the last five years? Referring specifically to math.

Male sixth grade teacher: Just basically the SOLs they've come out, and we've changed, but my own method itself has not changed a whole lot. I guess, I don't follow as strict or rigid lesson plan now as I used to. (p. 1)

Interviewer: Has this changed your teaching technique?

Male sixth grade teacher: I think I do, yeah, I think it has changed. I think before, especially with the block, we only had a 45-minute block and I found myself talking more than they had time to work, and I found that my evaluation work was not as good. They didn't retain as much. I was going over it, talking more, and I got to where I thought I was going to beat my head against the wall. I wasn't getting anywhere. I found that the more I let them do, the more they hold on to it. It is like anything else, the more you experience the more you retain it. It is like if I said the more you ride it the better you get at it, and you can tell someone how to ride a bicycle, but until they do it, it doesn't mean anything to them. (p. 11)

Yeah, I do more of the grouping than I did in the past. I use more of the cooperative learning and more of the Paideia types of activities than I used to. I used to have them [students] in lines and in straight rows and give them class work and let them do the class work and take up the papers and check the papers and give the papers back, and I found out that that takes a lot of time, and it takes a lot of my time as well as a lot of their time, and it is busy work, and busy work doesn't get you anywhere, and more kids get in trouble when you do it that way. They don't have time to get into trouble when you do it this way. I don't have time to get in trouble either if I do it this way, and I find that it lightens the load in after school hours on me. I know a lot of teachers that have to spend a lot of time after hours, after school, running material off, and they have to plan for each day, and it does take a lot of time. Grading papers just adds to that, and when you can do it within your groups, and you can see that they are progressing, and they are learning, then you can do it with small groups without having to take those papers up and go through each and every problem to see if they are doing that. If you can see that they are making progress then why take up all those papers, spending three and five hours at home at night grading those papers. It allows me more time for planning. (p. 15)

. . . I don't use as much from the book, like for homework assignments as I used to. I used to assign a page for them to do and to come back and check it the next day, and every now and then I still do, 'cause there is practice in the back, especially if I feel like the majority of the class is not getting what I want them to get, then I will give them a practice exercise to do, and we will go over it to reinforce what we have already done.

Interviewer: Have your methods of assessment changed? (p. 19)

Male sixth grade teacher: Yeah, I don't take as many grades as I did before. I don't grade every single paper like I used to. I pick and choose, and a lot of things that they do I know when it is time to evaluate. I don't want to evaluate when I am looking around the room and I find that 50% of the kids are not catching on to what we are doing or are not doing well, because if I do then I am going to have 50% failures. So why evaluate them? I don't want to evaluate till I am sure that they know what they are doing then if they make a few mistakes and mistakes they make is [sic] carelessness. It is not in the act of not knowing what to do or how to do it.

Interviewer: The use of projects, have you always done that or is that something new that you have brought into math?

Male sixth grade teacher: I use projects quite a bit now because it is [sic] fun things for them to do, it is [sic] hands-on things too. A lot of math, especially building things, it is a part of everyday life. When you build something you use math, or if you are going to do something like that, it is very good hands-on type of activity. (p. 18-19)

Interviewer: Do you interact with other teachers in the building to improve your mathematics instruction?

Male sixth grade teacher: Yeah, I talk to [eighth grade mathematics lead teacher] all the time. . . . (p. 25)

Interviewer: Have you participated in any professional development activities sponsored by the County?

Male sixth grade teacher: Yeah, I have gone through the PAIDEIA, and I have gone through the cooperative learning, and let's see what else was it that we went through— they have offered several, and I have gone to just about every one of them. (p.24)

These interview data support that this teacher was interested in reforming his mathematics instruction, that he took advantage of the professional development opportunities offered, and that he used the mathematics lead teacher as a resource. The data also indicate that he selected strategies from the suggested reform that he could use with his traditional method of show and tell. His statements indicated that he was not satisfied with the results of relying solely on lecturing for delivery of instruction, and that he found the use of small groups, pair-sharing and informal methods of assessment preferable to the way that he used to teach. Seventeen of the twenty observed tasks were from the *Glencoe* textbook, and this teacher endorsed the *Glencoe* textbook with the statement that follows:

It has got a lot of application to it, and it has so much in there that you can't do it all, and if you are looking for something that really is practical that goes not in just mathematics, but goes outside the realm of a math class that book does it. It has got a lot of practical uses. It has got a lot of labs in it, a lot of learning techniques and skills in it. There is a lot of things you can do with that book. (p. 24)

His statements indicated that he was making an effort to move away from teaching isolated facts and procedures, and that he used the textbook and the lead mathematics teacher as resources in finding new ways to make these connections. All of the observation and interview data concerning making connections indicated that he had focused on making connections between mathematics and the real world. There were no indications that he worked to make connections within the mathematics content. The data show that this sixth grade teacher was in the first stages of implementing reform into his classroom in that he selected portions of the suggested reforms that enhanced his mathematics instruction or eliminated time consuming paperwork.

His statements indicate that he believed lecture did not work, and that students learn by doing, so he was knowledgeable of the NCTM suggested instructional reform, but he had not completely translated that knowledge into action. Although students were encouraged to practice skills and procedures in small group where students were encouraged to help one another the mathematical content was still delivered by the teacher in the traditional show and tell method of instruction. Students were involved in problem solving tasks and projects, but the teacher still provided detailed instructions on how to solve the problems, and even though student-to-student communication was encouraged the teacher took responsibility for all reteaching through individualized instruction. Individualized instruction was a review of the information provided during whole group instruction, and evaluation of the students' understanding to determine who needed individualized instruction consisted of the teacher verifying that the students' written responses were correct. While the students did practice some of the mathematical skills or procedures in a more interesting manner than just pages of practice problems, mathematical thinking and reasoning were not encouraged; being observant, listening and practicing were the skills stressed for being a successful mathematics student.

For this teacher the types of instructional materials used in the classroom had changed, the types of assignments used for practice had changed, and now he was making connections between mathematics and the real world, but the delivery of content had not changed since the 1991-92 baseline school year. The parts of his instruction that did match the NCTM suggested reform were changes of practice for this teacher, but he was just

beginning to incorporate portions of the suggested instructional reform into his mathematics classes.

The female sixth grade teacher on the other hand was resistant to reform. The sixth grade teachers had changed to two person teams, and with the advent of block scheduling they had two, two-hour blocks of time provided for them to teach either Social Studies and Mathematics or Language Arts and Science. Another change for the sixth grade teacher was a move from homogeneously grouped to heterogeneously grouped classes. As she talked about how her methods of instruction had or had not changed, she also talked about her feelings about the changes that had been made at the school level. That interview data follows:

Interviewer: Has anything about your planning changed in the past five years?

Female sixth grade teacher: The past five years? Probably, in some things. I have more groups than I used to because we don't get to group children anymore. I think I am going slower than I used to, and the amount of material that I cover is not as much as it used to be.

Interviewer: Is there anything particular that you focus on when you are creating your lesson plan, such as the textbook as a guide, or the students needs, or is there something that you sort of rely on more than others?

Female sixth grade mathematics teachers: Well I begin with of course the lesson in the book, and as I go through there is usually something that comes up that one of the children will need me to help with, and I go ahead and include that in my lesson plan for the entire class. Basically that is what I do. . . .

Interviewer: Do you use any particular format for your lesson plans?

Female sixth grade teacher: No, matter of fact, I am sort of like some other teachers that have been doing it for so long that I don't actually write anything down. I just jot down the page number and what the lesson is about, and I don't make out a formal lesson plan.

Interviewer: Has your use of questioning and communication changed in the teaching of mathematics over the past few years?

Female sixth grade teacher: I don't really think so. I did it long enough, and I decided my way. (p. 2)

To get the sixth grade teacher to talk about “her way,” specific questions concerning the first three lessons observed were posed and the responses to those questions provide evidence of her preferred method of instruction. When the sixth grade teacher was

asked about why she used the retired *Addison-Wesley* textbook for the first three mathematics lessons observed, she made the following comment:

Because I just wanted to review, and the *Addison-Wesley* is much easier, and I just wanted to review a little bit before we went on to chapter 11, because we had worked a little bit on multiplying decimals when we were practicing the Passport Literacy, and we needed to go back and review, and that book is so much easier, it's just amazing. I didn't want to do any theory type things I just wanted to review, so I used that. We always use that book sometime during the year. (p. 5)

Interviewer: I am going to move to some of the things I noticed about the communication in the classroom, and I have just a few things, and one of them is your use of whole-group instruction. Why do you choose to use the whole-group demonstration type of instruction versus say everybody working in small groups, like this one group up front.

Female sixth grade teacher: Because it is easier for me. I just think that, when the whole group, the larger group I can manage focusing on one thing. It is easier for them to concentrate, and if you have little groups all over the classroom, although, I know that is the way things are supposed to be, I just don't see how people can concentrate when people are talking and working together. If, sometimes on occasion they can work together, after I have taught what I want to teach, and then they can help each other, sometimes.

Interviewer: Now, I also noticed that you focus quite a bit on the quality of their work—

Female sixth grade teacher: —In neatness.

Interviewer: Not just putting down an answer, I wanted you to talk a little bit about your expectation from them in terms of the quality of the work they turn into you.

Female sixth grade teacher: First of all I want it to be neat. I don't want just the answer. I want to make sure that they know how to do it. They have this terrible habit of using calculators, and I want them to know their multiplication tables and so forth. In math, especially math, that is one area where you have to be neat and precise, and I just, I am trying to get that habit built into them. We have a header form at [Pleasant] Middle School that the papers are supposed to follow, and I check and make sure that they do. I check and make sure that they don't put two or three numbers on a space, you know, because it makes it easier for me to grade, and it makes them see

that it is important to see that they need to be neat and precise in math. (p. 5-6)

Interviewer: You mentioned calculators, how do you feel about calculators in every day classroom?

Female sixth grade teacher: We don't use them everyday. I have lots of worksheets though cause they are fun to work with. I don't want, I know that later on it is OK to use them, but when we take the Passport Literacy test they have to know these operations, they cannot use a calculator. So, when we use calculators it is for a specific purpose and learning how to use a calculator and doing some fun games with them. It's a particular thing; it's not every day.

Interviewer: The only other specific task that I want to ask about is the small group that is working ahead up front. I would like you to just talk about how you manage that group and sort of what they are doing, and how you work with them.

Female sixth grade teacher: What they do is, since they are such a small group, is that they get together and read over the lesson and instructions, then if they have any questions I help them with that, and then they basically do their work independently, and I check it. They always do corrections. They are people that have been making A's all year.

Interviewer: Do they do the stuff that the class is doing?

Female sixth grade teacher: No

Interviewer: So they are moving on?

Female sixth grade teacher: Yes, and in the second period I have a larger group that is doing that.

Interviewer: How do you keep up with the paper work?

Female sixth grade teacher: It drives me crazy, it truly does. In second period I have a group working in a fifth grade math book and a group working ahead, and then the average group, and what is so funny. I'll be up here teaching the big group, the larger group, and one [student] from the other group will come up right in the middle of my sentence, asking me a question about their lesson, and I will give them this weird look like what are you doing, but it's a lot of paperwork and it is difficult to keep up with, but sometimes you just have to do it, because you can't hold some of these people back. They are getting so bored, and some poor children just cannot do the sixth grade math.



Interviewer: Has your use of homework changed over the past five years?

Female sixth grade teacher: Hmm-mm, I don't give nearly as much as I used to give (p. 10). . . .

Interviewer: . . .What about writing assignments, do you use any writing in mathematics?

Female sixth grade teacher: Not as much as I am supposed to now a days. We do, basically things that we write, we do it together in class in case there are questions. There are always questions in lessons that you have to write out answers, and we do those together. (p. 10)

These interview data show that the teacher is knowledgeable of suggested instructional reforms and that she is knowledgeable of the content of the *Glencoe* textbook, but neither the suggested reforms nor the *Glencoe* instructional materials matched her instructional needs or goals. Her goal was to prepare her students for the Passport Literacy test, and to meet the needs of each individual student. As documented in the baseline data the Passport Literacy test focused on assessing mastery of computation skills and procedural knowledge, and it was still the State's assessment tool for the 1995-96 school year. It was this teacher's opinion that the *Addison-Wesley* materials were the best instructional materials for meeting this goal, and it was documented in the baseline data that the two were indeed compatible.

The biggest difference between mathematics instruction in 1995-96 and 1991-92 school years for this sixth grade teacher was in meeting the needs of the individual students. Since the students were heterogeneously group, the teacher created ability groups within the classroom, which was a change from the homogeneously grouped classes she taught during the 1991-92 school year. She stated that she covered less material and found it more difficult to teach the classes grouped this way. The data indicate that, although she was familiar with at least some of the suggested instructional reforms, her instruction had changed very little over the course of her career. As she stated, “. . .I did it long enough, and I decided my way” (p. 2).

She stated that a typical mathematics lesson plan consisted of the page number from the textbook and a statement of the objective that was to be covered that day. Her description of a typical mathematics lesson matched the lessons presented during the observation period. A typical lesson started with an explanation and/or demonstration of how to solve the example problem(s) provided in the textbook, and this was followed by students working as a whole group or independently on the guided-practice problems provided in the textbook; then independent practice was assigned. The teacher monitored the students' progress for mastery of the objective being taught and planned her lessons to match the

students' needs; present the next objective or reteach the current objective. Review for maintenance of computational skills and arithmetic procedures was a regular part of mathematics instruction as well as individualized instruction which matched the students' abilities. All of which was typical of this "teach by telling" traditional method of mathematics instruction, but during the second set of observations the sixth grade teacher used the *Glencoe* instructional materials, and although the lessons followed the same format, the type of practice tasks assigned were different.

The guided practice for this lesson was a small-group lab activity where the students worked together to build a model of a rectangular prism and a square based pyramid, and after reviewing the mathematical vocabulary associated with this task (i.e. triangle, rectangle, solid figures, vertex, edge, face, and base) the students answered questions concerning these vocabulary terms and the polygons that they had built. During this activity the students talked with one another and discussed the answers to the questions while the teacher worked with the small group of students that worked ahead of the rest of the class. To conclude the lab activity the teacher used whole-group instruction and the overhead to write the answers to the lab questions so that the students could check their work and copy down the answers that they did not get. This hands-on task with student-to-student communication was a change from the instructional tasks used during the 1991-92 school year, but the delivery of the content material associated with the activity did not change; the teacher told and showed the students what they needed to learn. These data indicated that this teacher would at least occasionally select an activity provided in the new *Glencoe* instructional materials and incorporate it into her mathematics lessons, therefore her mathematics instruction was marginally supportive of mathematics reform; there was marginal change in her instruction since the baseline school year.

The last interview comments that this sixth grade teacher made about change indicated that she saw the changes that had happened in the last five years as neither positive or sufficient.

Interviewer: Has the picture of your typical math class changed any in the past five years?

Female sixth grade teacher: I think the students are, to my way of thinking, are less interested in learning, and they are truly less interested in doing quality work. Just whatever they happen to put on a piece of paper, they would be perfectly willing to hand it in if you would take it, but I am talking about in general. (p. 9)

. . . Well, I don't have as much optimism about education as I used to, I think the system is in a bad need of overhaul. We need to have stricter

standards, and more responsibility from the students, they are basically not held responsible as much as, I think, it should be. I think, we try to make things too easy for them (p. 18).

It is clear from the sixth grade teacher's statements that although she saw a need for educational reform, she was not in agreement with the suggested reforms for mathematics instruction. Her comments also indicated that she did not believe her students were making as much progress as they did when they were grouped by ability for mathematics instruction, and therefore she was not supportive of the change to the two person instructional team for sixth grade, nor was she in favor of the move to block scheduling. She was not supportive of the use of calculators for mathematics instruction in the elementary grades because she believed her students were becoming calculator dependent which she viewed as a hindrance to being successful mathematics students. As she pointed out, the students could not use calculators on the ITBS or Passport Literacy mathematics tests.

She did not like using the newly adopted *Glencoe* textbook for mathematics instruction. Her comments about the textbook indicated that she used it for instructional purposes only because she had been asked to do so, and classroom observation data revealed that she used the retired *Addison-Wesley* textbook for instruction three times while the *Glencoe* textbook was used twice. This sixth grade teacher held a strong belief that the best way to teach mathematics was to show and tell the students what they needed to know, assign individual repetitive practice and monitor their progress. She did not encourage student-to-student communication and found the changes forced upon her by block scheduling a hindrance to effective mathematics instruction.

The observation data for the sixth grade teachers indicate that neither of them were as far along in implementing the suggested mathematics reforms as the seventh or eighth grade teachers, and the Principal's comment about reform in the sixth grade being a "split thing" (p. 9) was an accurate description. The male sixth grade mathematics teacher was receptive to the reform ideas, and his observation data revealed that he had incorporated many of the suggestions into his daily instruction. He had started using cooperative learning activities in small groups; he used pair-sharing and student-to-student communication daily, and he had changed the types of assignments used in class. He now used projects, more demonstrations, more problem-solving tasks, and fewer practice problems for guided practice and homework, but he relied solely on show and tell for the delivery of content, and the book was the mathematics authority.

These school level interview data from the 1995-96 school year complete the triangulation of data for documenting both the methods of instruction and instructional materials used in the mathematics classroom during the 1995-96 school year, and for

documenting change since the baseline 1991-92 school year. The interview data show that every teacher had knowledge of and used the *Glencoe* textbook for classroom instruction. All of the seventh and eight grade teachers agreed that the change to 90-minute blocks of instruction time had resulted in the use of more small-group and hands-on learning activities in the classroom. The fact that the textbook provided such lessons, that the school had purchased the needed mathematical instructional manipulatives and that each 7th and 8th grade mathematics teacher was observed using small-group or hands-on learning activities for mathematics instruction supports that there was evidence of change in methods of instruction used in the 7th and 8th grade classrooms. Although every teacher talked about the need for students to master basic arithmetic facts and computational procedures, four out of five of the veteran teachers talked about the need for students to think, reason, become problem solvers and be able to communicate mathematically. All but one of the veteran teachers stated that the way they used the textbook for classroom instruction had changed. Instead of teaching the objectives lesson by lesson as prescribed by the textbook, the teachers now used the textbook as a resource of ideas for connecting mathematics instruction to the real world, or for designing learning activities to develop conceptual understanding as well as procedural knowledge.

The fact that the *Glencoe* textbook was used for instruction supports the conclusion that the types of instructional tasks and the mathematical content used during the 1995-96 school year had changed since the baseline-school year. Each of the teachers described how homework and classroom instructional tasks had changed, and a few of the teachers talked about changes in methods of assessment. Interdisciplinary units, projects, interviews, observation, written summaries, and individualized computer assisted instruction were just some of the changes mentioned, but the State and County Level assessments had not changed. There was also a point in each teachers' interview or observation that they talked about the need to teach and review basic computation skills to get ready for the "test".

#### School Level: Change in Assessment

Since school-level assessment data were not confined to the mathematics teachers' interviews and observations data shared for documenting changes in methods of instruction, other data that focused on assessment only is presented in this next section. There was evidence that indicated that reform of mathematics assessment in the classroom was recommended and encouraged by State-Level administrators. Presentation of this data begins with a comment from the science lead teacher about the State's Assessment Notebook. As the science lead teacher talked about how assessment had changed since being involved with V-QUEST, she provided information that verified that the State's

Assessment Notebook was at Pleasant Middle School, and her comments support the conclusion that the mathematics lead teacher had changed his methods of assessment since attending the V-QUEST Lead Teacher Training Institutes. Her comments about assessment follow:

. . . we have that assessment notebook, and I think the different samples and the different projects that we give, and the different things, we do them differently. We try to have a variety of assessments and not just the regular test and the notebook. . . . We [lead teachers] passed around our assessment notebooks and techniques, and that is something that the teacher has to want to do, and just have, to have the time to set down and look through everything, and then if they have any questions ask and if they want to see samples. We've had just the teachers ask about assessment, about the notebook, and I said would you like for me to show you samples or would you like to look at the V-QUEST notebook, and they choose to look at the notebook, and, I don't know, I never had any feedback as to any type of change. I know that [the mathematics lead teacher] has done a lot of different things with the rubrics and different types of things. (p. 30-31)

These interview data document that assessment reform was a focus of the V-QUEST Systemic Reform Initiative, and they also support that the methods of assessment used by the mathematics lead teacher during the 1995-96 school year had changed from the methods he used during the 1991-92 school year. In the detailed analysis of the artifact data used to document the methods of instruction that were used during the 1991-92 baseline year it was documented that all of the assessment materials provided with the *Addison-Wesley* instructional materials were paper-pencil type tests that focused on assessing mastery of computation skills and procedural knowledge. The lead teacher stated that he used to use the textbook to teach chapter to chapter and that he used standard paper-pencil tests; he also stated that now he doesn't do that any more saying, ". . . now I teach on a need to know basis" (p. 2).

Reform of assessment was a component of the V-QUEST Lead Teacher Training, and strongly encouraged by the NCTM *Assessment Standards* and *Curriculum Standards* but the interview, observation and artifact data documented that the methods of assessment used during the 1995-96 school year had changed very little for the majority of the teachers in this study since the 1991-92 school year. The eighth grade lead teacher was trying different methods of assessment in his classroom, but the majority of the other teachers used traditional paper-pencil chapter assessments provided with the *Glencoe* textbook. Each of these tests did include some higher-level thinking type questions, i.e., problem solving

and application type problems, that were not typically included on *Addison-Wesley* tests, but students were still not permitted to use calculators, therefore, mastery of computation and arithmetic procedures was still emphasized on 1995-96 assessments.

Three of the teachers did use one or two projects for assessment, and three of the teachers used written explanations or diagrams for assessment, but all of the teachers stated that the majority of the assessments they used were paper-pencil tests. All of the teachers used informal classroom observations for assessment, and for the most part teachers used these informal observations in making decisions concerning lessons plans. Only the mathematics lead teachers indicated that, as he observed students, he listened to them explain his or her solution and used a check-off sheet to document students' mastery of required objectives. None of the other mathematics teachers were as far along in assessment reform as the 8th grade lead teachers, and in general changes in methods of assessment since the baseline school year were minimal. The following data are offered as final support this conclusion.

As documented in the State and Division Level 1995-96 data presentation, the ITBS test was still the norm referenced test used by Pleasant County, and the Literacy Passport Test was still in place as the State's test for minimum competency; both of these mathematics tests measured mastery of computation and arithmetic procedures. Plans to replace the Literacy Passport Test with a method of assessment that better matched the new SOLs were discussed, but no changes in methods of assessment were made during the 1995-96 school year at the State or Division Level. During the one-week V-QUEST Lead Teacher Institute at Sweet Briar a workshop for the V-QUEST Student Assessment Component was provided by the State Department of Education. It was titled *Enhancing Assessment Methods As a Means to Improving Instruction: Developing a Scoring Rubric for a Performance Task*.

As the State Department's Principal Math Specialist for K-8 stated, reform of assessment is essential for the success of instructional reform. By the 1995-96 school year the DOE had provided each school with a notebook full of new assessment materials, but as the State Department's Principal Specialist for Mathematics 8-12 mentioned they wanted to provide training with the materials, and training was still in the planning stages. It was documented by the 1993-94 instructional materials data that the *Glencoe* textbook offered a variety of methods of assessment including computer generated test making software which the teachers still could not access during the 1995-96 school year.

Assessment reform was limited, and all of the following findings provide evidence concerning the limited progress toward assessment reform. (1) During the 1995-96 school year the teachers were in the process of implementing the State's new SOLs without the

benefit of professional development opportunities; therefore, assessment reform was not emphasized at the school or Division Level. (2) Although a mathematics committee was formed at the end of the 1994-95 school year to create a new County curriculum, the County's 1991-92 curriculum guideline was still in place during the 1995-96 school year, therefore assessment reform was not practical. (3) Since only the lead mathematics teacher had received any inservice on the newly suggested methods of assessment, reform of assessment was not supported. (4) Methods of assessment for the State and Division Level had not changed; therefore, the use of traditional assessment was encouraged. (5) Teachers did not have access to all of *Glencoe's* assessment materials which limited their ability to reform assessment instruments. (6) Since no inservice or professional development was provided with the State's new assessment materials package, it was difficult for teachers to successfully implement the materials. (7) There was no professional development or inservice provided to help prepare the teachers for the move to block scheduling; therefore, during the 1995-96 school year the teachers focused their attention on learning to plan and use methods of instruction that made effective and efficient use of the 90-minute instructional blocks; reform of assessment was not the top priority. (8) The NCTM *Assessment Standards* was not published until May of 1995, which was the end of the 1995-96 school year. (9) The new Principal did not attend the administrators' portion of the one-week V-QUEST Lead Teacher Institute, and he did not encourage nor support the V-QUEST Lead Teacher efforts; therefore, there was no leadership for assessment reform at the school level. New instructional materials had been purchased, a new schedule was in place and teachers were working on changing methods of instruction, and implementing the new Standards of Learning; assessment was not the focus of reform for the 1995-96 school year. When all of the evidence is considered, the fact that assessment had changed little since the baseline school year is understandable

#### Conclusion Documenting and Tracking Change in 1995-96

In order to complete the documentation of how instructional practice had change since the baseline school year, it is necessary to review the conclusions made about classroom instruction during that year. Using artifact and interview data that concerned instructional materials, curriculum and assessment, it was established in the baseline data section of this study that during the 1991-92 school year the teachers used the *Addison-Wesley* textbook for mathematics instruction. An analysis of those instructional materials showed that the textbook's design matched the methods of mathematics instruction that is labeled as traditional, which was whole-group-direct instruction followed by guided practice, and independent practice with individualized instruction. From an analysis of the 1991-92

State and County curricula and the content of the *Addison-Wesley* textbook, it was determined they all had traditional mathematics content and placed a heavy emphasis on the sequential mastery of computation skills and procedures for whole numbers, fractions, decimals, and percents with limited use of technology. It was also established that the methods of assessment in place during the 1991-92 school year were compatible with the curriculum content and methods of instruction in place during that year. During the 1991-92 school year the curriculum content, instructional materials and assessments were all designed to match the behaviorist theory of learning that was in place at the time.

Evidence from the 1995-96 observation data is used retrospectively to support that the traditional methods of mathematics instruction and materials were used in the majority of the 1991-92 mathematics classrooms. That evidence is provided in the three ways. First, results from the analysis of the thirty classroom observations provided significant detail concerning the number of times teachers still used traditional methods of instruction, whole-group-direct instruction, drill-and-rote practice, and individualized instruction. Second, the summary of the observation data provided the number of times that the mathematics lessons presented were taken directly from the County adopted mathematics textbooks. Third, an observation of one of the sixth grade teachers using the retired *Addison-Wesley Mathematics* textbook for mathematics instruction provided an example of the 1991-92 instructional materials in action.

In the analysis of the thirty classroom observations, a total of 140 instructional tasks were identified; and of those 52 were coded as level one tasks or weakly supportive of reform, and 38 were coded as marginally supportive of reform. By definition the mathematics instruction that was coded as weakly or marginally supportive of reform matched the traditional methods of instruction that were in place when NCTM published its first set of *Standards* and before the V-QUEST Systemic Reform initiative. In this study there were a total of 90 traditional instructional tasks used for classroom instruction during the 1995-96 school year. Sixty-four of these tasks involved traditional whole-group instruction and 84 of the tasks were exercise tasks, i.e., problems assigned for written practice of the skill or procedure taught or reviewed in class that day. Fifty-two of those 84 exercises were assigned as independent practice. These data support that at least 64% of the mathematics instruction observed during the 1995-96 school year was weakly or marginally supportive of reform, and, therefore, at least half of the mathematics instruction observed during the 1995-96 school year had not changed from the baseline school year of 1991-92. The data show that during the 1991-92 baseline school year that traditional methods of instruction were encouraged and endorsed by the textbook, the State and County curriculum guidelines, assessment practices, use of computers and calculators, the administrators, and,



inadvertently, by the lack of professional development opportunities and limited access to instructional materials. The fact that over 50% of the instruction observed during the 1995-96 post-reform school year was characteristic of traditional instruction, strongly supports the conclusion that during the baseline year, when classes were 45 minutes in length, the only instruction resource available was the *Addison-Wesley* textbook and the instructional materials, curriculum, assessments and Division- and State-Level administrators all encouraged the use of traditional method of instruction, traditional methods of instruction were predominate methods of instruction used in the 1991-92 mathematics classrooms.

One of the sixth grade teachers saved a class set of the retired *Addison-Wesley* textbooks, and she was observed using that textbook for mathematics instruction during the first three classroom visits. These classroom observations provided evidence of *Addison-Wesley's* traditional mathematics lessons and support the conclusion that during the baseline school year, when the teachers used the *Addison-Wesley* textbook for mathematics instruction, that they used traditional methods of mathematics instruction in their classrooms. Since a detailed analysis of these data was provided in Level I of this study in creating a snap-shot view of mathematics instructions, only a brief summary of the lesson observation data with a few quotes from the teacher are presented here to provide documentation of the traditional *Addison-Wesley* mathematics lessons and a refreshed view of the baseline year's mathematics instruction for documenting change.

All three lessons observed followed the model of traditional mathematics instruction. i.e., whole-group-direct instruction, guided practice with individualized instruction followed by independent practice. The objective of the lessons was to find and estimate products using whole numbers and decimals. The opening tasks for two of the three lessons were to have the students take turns reading aloud the lesson provided in the *Addison-Wesley* textbook. The opening task for the other lesson was for students to check the answers to their homework, and ask the teacher questions. In all three of these tasks the teacher used whole- group-direct instruction to explain the procedures and processes used to solve the textbook's example problems. The teacher worked example problems on the overhead and then assigned the guided-practice problems provided in the *Addison-Wesley* textbook. The students worked independently on these problems at their seats using paper and pencil or at the chalk boards that went around two walls of the room. As the teacher monitored and assessed the students' work, she provided individualized instruction, and she encouraged the students to do their work neatly and quietly, and she reminded them to hold up their hands if they had questions. After completing the guided-practice portion of the lessons the teacher assigned independent practice which consisted of drill-and-rote type practice problems that were to be finished for homework.

During the interview that followed these classroom observations, the teacher talked about her reasons for using the *Addison-Wesley* instructional materials, saying:

Because I just wanted to review, and the *Addison-Wesley* is much easier [than the *Glencoe* textbook], and I just wanted to review a little bit before we went on to Chapter 11. Because we had worked a little bit on multiplying decimals when we were practicing for the Passport Literacy, and we needed to go back and review, and that book is so much easier, it's just amazing. I didn't want to do any theory type things. I just wanted to review, so I used that [*Addison-Wesley* textbook]. We **always** use that book sometime during the year. (p. 5)

In addition to providing a first hand view of the mathematics instruction that was used during the baseline school year, this statement supports that preparing students for the state's Passport Literacy assessment was still a priority during the 1995-96 school, and that, therefore, it was still necessary for mathematics instruction to focus on the mastery and maintenance of basic-arithmetic skills and procedures. This statement also indicates that it was this experienced mathematics teachers' opinion that the *Addison-Wesley* materials were the best instructional materials for teaching arithmetic procedures which in turn lends support to the conclusion that the focus of mathematics instruction in the *Glencoe* instructional materials had changed from procedural knowledge to conceptual and procedural knowledge.

The 1995-96 observation data also document that the teachers used the textbooks for mathematics instruction. Data presented in the previous section showed that 58% of the 1995-96 observed instructional tasks were textbook based, and of the 42% nontextbook tasks all but three were designed to reinforce or introduce a lesson from the textbook. There were a total of 30 instructional lessons observed during the 1995-96 school year, and the mathematics textbook was used at some point during every observation. Results of the analysis of the 7th and 8th grade mathematics teachers' interview data concerning block scheduling showed agreement on the fact that implementation of block scheduling provided them twice as much teaching time which prompted them to use different methods of instructions, e.g., hands-on-learning activities, small group and partner activities, small- and whole-group discussions, cooperative-problem-solving activities, varied methods of written or oral informal-assessment techniques, and individualized instruction. All of the teachers agreed that the *Glencoe* textbook offered more instructional ideas, hands-on-labs and learning activities than the *Addison-Wesley* textbook, and the data also documented that the mathematics teachers had access to classroom sets of teaching manipulatives and calculators during the 1995-96 school year.

In comparison during the baseline school year, 1991-92, the mathematics classes were 45 to 48 minutes in length, and the artifact and interview data established that during the baseline school year, the *Addison-Wesley* textbook and its supplemental materials were the only instructional materials available to the mathematics teachers. There were no mathematics manipulatives, calculators or activity-based-resource materials available in the mathematics classrooms. In the 1991-92 school year the curriculum, assessments, and State- and County-Level administrations supported and encouraged the use of the traditional methods of instruction contained in the *Addison-Wesley* instructional materials. During the 1995-96 school year the teachers had instructional materials that encouraged the use of hands-on problem-solving activities and the instructional materials needed to teach hands-on lessons. There were supplemental resource materials (AIMs and *NCTM*) available to the teachers, and there was a trained lead teacher who modeled and tried to encourage the reform of mathematics instruction. The teachers had more time for planning and for teaching, but the fact is that the textbook was used at some point in 100% of the observations. Considering all the changes, options and resources available to the teachers during the 1995-96 school year and the fact that the textbook was still used in 100% of the classes observed it is reasonable to conclude that during the 1991-92 school year, when there were no nontextbook instructional materials or resources or encouraged reforms, that the *Addison-Wesley* textbook was used for the majority of the 1995-96 classroom instruction.

The artifact, interview and observation data triangulate to provide conclusive evidence that traditional methods of mathematics instruction were used for almost 100% of the mathematics instruction during the 1991-92 school year. The observation and interview data document that some traditional methods of instruction were present in the 1995-96 school year, and thus provide support retrospectively that traditional methods of instruction were used during that baseline school year. When the 1995-96 data are combined with the artifact data from the 1991-92 school year, there is strong evidence to support that the predominate method of instruction used in the 1991-92 mathematics classrooms was traditional instruction. Both the State and County curriculum guidelines focused on mastery of computation and procedural knowledge, and the instructional materials that were recommended by the State and adopted by the County provided traditional instruction materials and lessons. The interview and artifact data both support that the *Addison-Wesley* textbook materials were the only instructional materials available in the mathematics classrooms during the baseline school year. However, in the 1991-92 school year the County did purchase and implement a computer-assisted-instructional program (WICAT) that was designed to improve students' computation scores on the yearly County and State

assessments. It was also documented that the County and State assessments focused on evaluating computation proficiency and procedural knowledge, and that the curriculum, instructional materials, and assessments were compatible. The data overwhelmingly support that during the 1991-92 school year traditional methods of instruction were encouraged and used for almost 100% of the mathematics instruction.

#### Change in Instruction/Assessment From the Baseline School Year

These interview, observation and artifact data document that every mathematics teacher involved in the study during the 1991-92 school year had made some changes in his or her instructional practice by the 1995-96 school year. Not all of the teachers were starting from the same point so the amount of change between teachers was not comparative, but the data document that instructional change was evident to some extent in every classroom. Placing each teacher on a continuum of zero percent change to one hundred percent change the scale would show the eighth grade lead teacher closest to the one-hundred percent mark because it was typical for him to take a problem-solving approach to instruction, and for him to encourage student-to-student communication and to expect students to explain orally or in writing his or her reasoning, thinking and/or problem-solving strategies. Only two out of 21 observed tasks were coded as weakly supportive of reform; therefore, learning mathematics was not typically limited to students demonstrating mastery of computation skills and procedures. He was also in the process of changing his methods of assessment from using solely paper-pencil test to informal observations, demonstrations, projects, and authentic assessments (application), plus he was learning to design rubrics for assessment purposes.

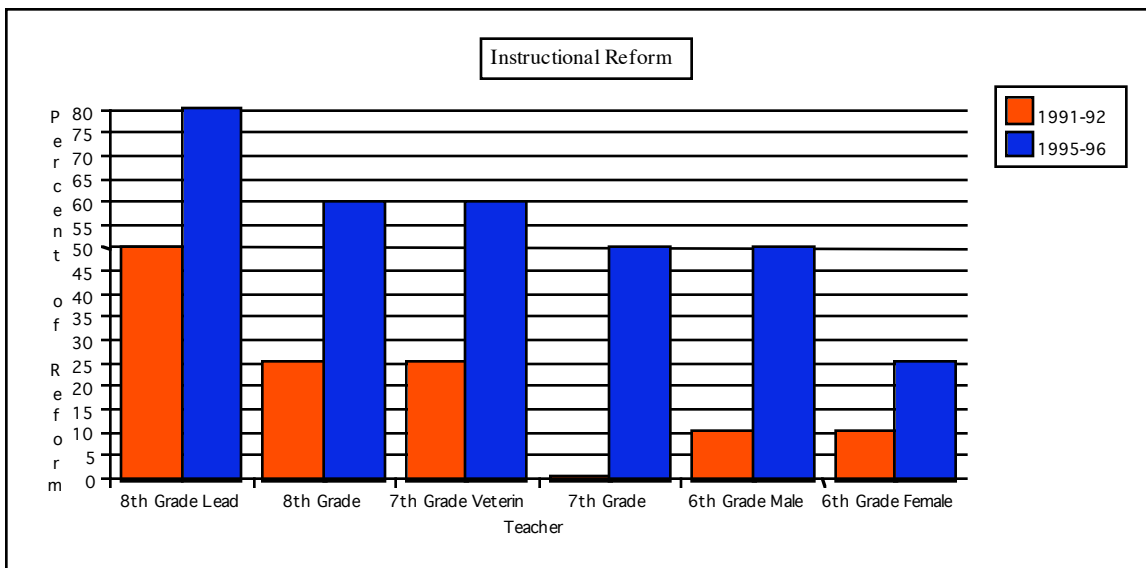
The other eighth grade teacher and the veteran seventh grade teacher would be next on the continuum. Only five of the eighth grade teachers 24 instructional tasks were coded as weakly supportive of reform, and student-to-student communication was regularly encouraged in the classroom. She often asked the students to explain orally or in writing their reasoning or thinking about problem-solving strategies, but the students were reluctant to participate in the learning activities, and she sometimes resorted to traditional direct instruction followed by drill-and-rote type practice. The majority of the seventh grade teacher's instructional tasks were coded as supportive or strongly supportive of reform, and she regularly encouraged student-to-student communication, but only occasionally required students to explain their reasoning or thinking, and she often provided the students with the problem-solving strategies needed to complete the task.

The other seventh grade teacher and the male sixth grade teacher would be placed next on the continuum between zero and fifty percent. Both sixth grade teachers used some

instructional tasks that were supportive of reform, and both used student-to-student communication, and both used a great deal of teacher-centered-direct instruction.

The female sixth grade teacher would be closest to zero percent instructional reform because the majority of her instruction focused on teaching procedural knowledge with tasks that were coded as weakly supportive of reform. Student-to-student communication was seldom encouraged, and the teacher took all responsibility for the students' learning by telling and showing them the procedures or skills that they needed to learn. Fourteen of the seventeen instructional tasks observed were coded as weakly supportive of reform, and students were seldom challenged to reason or think about problem solving.

Figure 8 displays a comparison of the amount of instructional reform present in the 1991-92, and 1995-96 school year for each teacher. This is based on the evidence that the majority of the instruction that was coded as supportive of reform was also representative of change.



**Figure 8.** A comparison of the percentage of mathematics instructional reform present in each teacher's classroom during the 1991-92 and 1995-96 school years.

Having documented that there was change and instructional reform present in each teacher's classroom, however, is only the first step in documenting systemic reform. The indicators selected to document evidence of systemic reform are from the V-QUEST Lead Teacher's indicators of success and are presented in the next and last level of the study.

Chapter VI  
Level III Analysis: Documenting Systemic Reform

The guiding question for Level III of the study is—To what extent is the documented change evidence of systemic change? Systemic change is bottom-up reform with top-down support; all Levels of education (i.e., School, Division and State) working together to bring about reform in the educational system (i.e., curriculum, instructional methods, materials, and assessment). Changes documented in the four population levels in Level II of the study are cross referenced with thirteen systemic reform indicators to create a matrix for documenting systemic reform (see Table O3 in Appendix O). The thirteen systemic reform indicators were selected from those designed to document the success of the NSF funded V-QUEST State Systemic Reform Initiative. The coding system used to categorize the data and create the matrix for documenting systemic reform is also presented in Appendix O (see Tables O1 and O2).

For each of the thirteen systemic reform indicators, relevant data were coded as to which population(s) (i.e., Classroom Level, Building Level, Division Level or State Level) it was connected and as to what stage the reform indicator was ranked for three significant reference points: the baseline school year, the year reform effort peaked and its status during the 1995-96 school year. Although change was documented in Level II of the study, the overall pattern of the change for the thirteen indicators provides documentation of the V-QUEST System Reform Initiative. Six stages of reform were identified and used to document and present the findings of Level III of this study. The stages of reform range from 0 to 5, and the coding system for and description of these stages is presented in Table 21.

Table 21  
Stages of Reform Code

<b>Stage of reform:</b>	<b>Code</b>
Implemented successfully	S5
Implemented but needs work	S4
Implemented but in the early stages	S3
Implemented but abandoned	S2
Planning to Implement	S1
Informed but no action taken	S0

Each V-QUEST systemic reform indicator is presented with a summary of the interview, observation and artifact data that documented the stage of reform and population(s). The results of these reports are organized into the matrix, previously described (see Table O3 in Appendix O), to aid in summarizing the data. The presentation of data for the indicators' summary reports begins with classroom-level data and ends with the State-Level data. Summary reports for the 13 Systemic Reform Indicators are presented next.

### **Indicator 1**

#### **Schools actively participate in ongoing telecommunications networking projects that utilize and share mathematics and science information and educational resources.**

At the classroom-level reform was at Stage 0 during the baseline school year, peaked at Stage 3 during the 1994-95 school year, and its status at the end of the study was back to Stage 2. The artifact data documented that technology was in the school during the 1991-92 school year. There was one computer in the library connected by modem to VA-PEN which provided a text-only Internet connect, and there were two computer labs (i.e., the WICAT computer lab, and an Apple II GS lab). Only the mathematics lead teacher indicated that he used the telecommunications resource during the baseline-school year, and he was the only teacher in the study that had a computer at home during the 1991-92 school year. Technology inservice for the 1991-92 school year focused on training the mathematics teachers how to use the newly installed WICAT computer lab to provided individualized-computer-assisted teaching opportunities for all of their students.

Although the potential to use telecommunications during the 1991-92 school existed, the following evidence supports that it was not used to provide professional development opportunities during the 1991-92 school year. The focus of reform that year was restructuring the middle schools to function as one of the State's Vanguard Middle Schools; therefore, teachers were in the midst of implementing interdisciplinary-instructional teams, interdisciplinary methods of instruction, a new CARE program (i.e., teachers acting as counselors for a small group of students), computer-assisted instruction, as well as an extended learning class (i.e., a nongraded class whose curriculum content was designed and created by the teacher with zero funding). The only inservice provided for teachers that year was on using the WICAT computer lab; therefore, teachers were not supported or encouraged by the administration to use telecommunications as an instructional resource. Access to telecommunication technology was extremely limited; teachers had not received training on how to use the telecommunications resource, and their

time was taken up with implementing the middle school restructuring changes. Telecommunications was not a priority for teachers during the 1991-92 school year, and only one of the six teachers in the study indicated that he used it as an instructional resource, but most of his access time was from his home computer. Although extremely limited, telecommunication technology was available at Pleasant Middle School, and the teachers and Librarian indicated that they were aware of the technology, but for the most part teachers did not utilize the resource during the 1991-92 school year. The classroom-level reform rating for Indicator 1 was Stage 0 for the baseline school year.

Part of the County's commitment to V-QUEST was to provide lead teachers, and ultimately all teachers, access to technology and encourage its use, and the County acted on this goal. During the 1993-94 school year the mathematics lead teacher provided inservice on how to use VA PEN as a resource for mathematics instruction, and he used VA PEN mathematics projects and ideas in his mathematics lessons. By the 1994-95 school year every mathematics teacher had experienced hands-on technology training, and was set up with a VA PEN account. During the 1994-95 school year access to VA PEN was free and unlimited for all teachers with accounts. The lead teacher also purchased and made available many of the NCTM instructional resources recommended by V-QUEST that provided current information on the uses of technology for classroom instruction, and he shared information that he gathered from the use of VA PEN with other teachers (i.e., problem of the week and various mathematical projects). Reform at the Classroom Level for this indicator peaked during the 1994-95 school year at Stage 3.

By the 1995-96 school year, both teachers and administrators expressed frustration when they talked about technology and telecommunications. Although the teachers received inservice training on how to use telecommunication technology, and all the teachers had VA PEN accounts, access to the necessary technology remained limited to one computer with only two phone lines. In addition to these local problems the State cut the 1995-96 funds for teacher access time in half. In his first interview the mathematics lead teacher expressed his frustration with telecommunication during the 1995-96 school year stating:

. . . In the past I've used VA PEN as much as I possibly could to do class projects, and students used it for history day projects, and we did problems of the week, but this year with access as it is from 7:00 A.M. to 7:00 P.M. you can't get through. Just disaster. (p. 5)

The status of classroom-level reform for this indicator during the 1995-96 school year was Stage 2, implemented but abandoned.

For both the Building and Division Levels the baseline ranking for reform for this indicator was at Stage 1, peaked during the 1994-95 school year, and its status during the



1995-96 school year was Stage 1. As presented in the Classroom Level data, the attention of both the Building and Division Level administrators during the baseline school year was focused on implementing the newly installed publicly funded Josten Computer Labs in every school in the County including Pleasant Middle School. One computer that provided Internet access was made available to teachers, but it was not the focus of technology reform for that year. The existence of one on-line computer indicated that the administrators were aware of technology's telecommunications capabilities, but implementing its use as an instructional resource was not a part of the reform plans for the 1991-92 school year. The former Director of New Initiatives for Pleasant County talked about a five-year technology plan that was implemented during the 1990-91 school year, and in response to a question about the plan the Superintendent made the following statement:

. . . like any action we set goals and hope you can achieve them, and some years we've been able to do better than others because of funding, and funding is a key component in this process because without it the technology simply cannot be purchased, and, as you know, we've been through some mighty rough times over the last five years. The action plan in most situations we've been able to accomplish a good percentage of the action plan each year, but not everything that's on the plan every year, but it's a constant changing project. What we don't accomplish this year we simply move into the next year's goals and objectives and try to accomplish those next year. In some cases the action plan itself has had to change because of the changing technology. An example, Internet access for the first year or two wasn't a major component. Now it is. So it's again depending on availability of equipment and funding. (p. 9-10)

During 1992-93 the Superintendent and Pleasant Middle School's Principal participated in the V-QUEST Systemic Reform Initiative, and they supported the technology reforms encouraged by the V-QUEST Lead Teacher Institute. The Principal of Pleasant Middle School made the following statement concerning technology inservice provided during the two school years after participation in the V-QUEST Lead Teacher Institute:

As a faculty we did several inservice on VA PEN. [Inter]Net, at that point wasn't really a big thing, but VA PEN, every teacher had an account. We spent several faculty inservice really learning how to use it, because for me, I needed that information. I hadn't been on it that much, and I needed some of the expertise from the ones in the building. I think that the use of technology definitely became a teaching partner. It wasn't something to be feared. (p. 10)

During the 1994-95 school year with two major goals accomplished: (1) a VA PEN account was established for every teacher at Pleasant Middle School, and (2) every teacher at Pleasant Middle School participated in hands-on inservice on using VA PEN. Although the Superintendent supported the V-QUEST suggested technology reforms, he faced the challenges of buildings with outdated infrastructures and limited funds, therefore he provided leadership and moral support, but no funds for the building improvements needed to provide every teacher easy access to telecommunication technology. He did provide teachers access to low-interest loans for the purchase of laptop computers, but none of the teachers in this study purchased a laptop. Reform at the Building and Division Level for this indicator peaked at Stage 3, implemented but in the early stages, with the inservice opportunities provided through the joint effort of the Principal and the lead teacher and the low interest loan offer provided by the Superintendent.

Teachers learned how to use telecommunications technology, but limited access made its use impractical. By the 1995-96 school year reform efforts for this indicator for both the Building and Division Levels were back to Stage 1, planning to implement. At the Classroom Level no progress had been made towards a one-computer classroom which was a goal for the V-QUEST Lead Teacher Systemic Reform Initiative, and teacher access to the Internet was actually more limited this year than during the baseline year of the study. Access to the Internet was still limited to the link offered by VA PEN which was a text-only system. The Principal expressed his frustration concerning the status of technology during the 1995-96 school year in the statement that follows:

I would like to encourage it [use of technology] more than I do. I know the system is trying to encourage it and have made several offers to help people purchase computers and things like that. My problem with encouraging it is, it is hard to encourage it when you **don't** have access. If we had access people would be drawn to it, versus encouraging it and having people trying to find their own access. (p. 4)

Also, at the Building Level the infrastructure remained a serious roadblock to computers in the classrooms. The Principal acknowledged this problem while he discussed future plans in the statement that follows:

Yes, we purchased five computers for next year, and we are going to try and set up a teacher resource area, and I am trying to get some data lines put in now. Phone lines seem to be the glitch because there is a problem with putting them on a long term operating budget or something, but we are working on that. (p. 4)

As the Principal's statement implies, there was no dedicated phone line for telecommunications during the 1995-96 school year, but there were **plans** to improve teacher access to the Internet in the future. The Building Level was at Stage 1 for this indicator by the end of this study.

At the Division Level the administrators were just beginning to evaluate the current use of technology in the middle school which was a computer lab used to provide students individualized-computer-assisted instruction in mathematics. A Technology Task Force committee was organized, and data were being collected at the end of the 1995-96 school year so that future technology goals could be established. In the statement that follows the Superintendent talked about the status of the current use of technology saying:

. . . right now our staff is reviewing the current methods that we are using with the WICAT lab. Ah, we don't think, we, it has been as effective as maybe we thought it would be in a lab situation. (p. 9)

In the next interview excerpt the Superintendent talked about the major roadblock to technology reform. His comment follows:

Now it is— so it's again depending on availability of equipment and funding. One thing we run into is even if we had enough money to buy eighty truckloads of computers and servers and provide the access. I don't have the infrastructure to support such technology right now. Our school buildings need to be changed and we've got an action plan on that, but that's major. That's going to involve about fifty million dollars with the renovation and building, and in order to do what's going to have to be done with technology. We're going to have make those significant changes and funding is holding us up of course. (p. 10)

The status of reform for both the Building and Division Levels during the 1995-96 school year was back to Stage 1.

At the State Level reform for indicator 1 during the baseline year was ranked at Stage 3, and it peaked at Stage 5 during the 1994-95 school year moving back to the status of Stage 4 for the 1995-96 school year. During the baseline school year VA PEN was established and potentially could reach every mathematics teacher in the State, but most schools were not equipped or prepared to receive the resources available. It was documented that Restructuring the Middle Schools was the emphasis of the VDOE's Vanguard School reform efforts for the 1991-92 school year; therefore, improving the use of telecommunications for professional development was not an immediate goal for the State. Thus, the reform ranking at the State-Level for indicator 1 was Stage 3, implemented but in the early stages.

During the 1994-95 school year teachers from all over the State were trained at the V-QUEST Lead Teacher one- and two-week institutes on how to use telecommunications as an instructional resource, and they were expected to share that information with teachers in their schools as did the mathematics V-QUEST Lead Teacher for teachers in Pleasant County. In addition to the hands-on technology experienced, all lead teachers shared their e-mail addresses and were encouraged to network and form a support group for reform. V-QUEST's newsletter which provided current information on professional development opportunities was published electronically, and the state's VA PEN node offered links to various universities, and current practice information. The State funded 24-hour a day access for all teachers with accounts. Reform efforts at the State Level for indicator 1, peaked at Stage 5 during 1994-95, the last full year of the V-QUEST Lead Teacher Institute.

By 1995-96 State support for telecommunications through VA-PEN, though not totally abandoned, was greatly reduced. The amount of access time provided for the teachers was cut in half with network time available only between the hours of 7:00 a.m. and 7:00 p.m. The reduction of available VA PEN access time after school hours combined with the system's limited user capacity made it extremely difficult for Pleasant Middle School's Teachers to use VA PEN's resources during the 1995-96 school year. Therefore, the status of reform for this indicator during the 1995-96 school year had fallen back to Stage 3, or possibly Stage 1. Since VA PEN was a text-only based system and for most schools provided the only link to the Internet, by 1995-96 the system was outdated, and it is possible that the State was planning to abandon or replace the system with a more up to date telecommunications system which would put the ranking back to Stage 1.

## **Indicator 2**

### **Schools have participants at statewide mathematics and science conferences and professional meetings.**

At the Classroom and Building Levels, reform for Indicator 2 was ranked at Stage 0 during the base-line school year, reached its peak ranking of Stage 4 during the 1993-94 school year and its status at the conclusion of the study was S 2. There were no records that any mathematics teachers participated in any statewide mathematics conferences or professional meetings during the base-line school year, and the school did not fund an institutional membership to the NCTM that year; therefore, the Classroom Level and Building Level rankings for this indicator were Stage 0.

During the 1993-94 school year the Principal used site-based funds to purchase an institutional membership to the NCTM. The mathematics lead teacher attended the two-

week V-QUEST Lead Teacher Institute, and the Principal for that school year attended the two-day administrative session that was a part of the V-QUEST Lead Teacher Institute. Both the lead teacher and his Principal attended the V-QUEST follow-up drive-in workshops held in the fall and spring of the 1993-94 school year and the V-QUEST conference held in Richmond that year. The mathematics lead teacher also attended the Regional NCTM conference held in Richmond. The institutional NCTM membership provided teachers with reduced rates for the NCTM regional conference, and site-based money was allocated to fund travel and attendance to State conferences and professional development. Although attendance to conferences and profession development opportunities increased and was encouraged and funded by the school, attendance was limited to the lead teachers and the Principal. Reform at the Classroom and Building Levels for this indicator peaked during the 1993-94 school year at Stage 4, implemented but needs work.

During the following year a new Principal was assigned to Pleasant Middle School, and the NCTM membership renewal was not funded. The V-QUEST Lead Teachers fulfilled their commitment of attending the one-week V-QUEST Lead Teacher Institute in the summer of 1994, and they attended the two follow-up drive-in workshops held during the 1994-95 school year, but the new Principal did not attend the administrative portions of these V-QUEST events. The lead teacher also attended the Regional NCTM conference held during the 1994-95 school year, and during the next school year, 1995-96, the lead teacher attended Virginia's First Joint Conference on Teaching Mathematics and Science held November 10-11, 1995, in Williamsburg, but he paid his own expenses. Again the new Principal of Pleasant Middle School did not attend any of these conferences.

The new Principal was not involved with V-QUEST during the 1994-95 school year, and his comments concerning professional conference attendance during the 1994-95 and 95-96 school years follows:

I don't know how many policies we have that relate to that [attending professional conferences], but we encourage as much as we can. We have sent a lot of teachers to different conferences this year.

Interviewer: And they get reimbursed for the expenses?

Principal: No.

Interviewer: Do you personally encourage your teachers to attend professional conferences and meetings?

Principal: Yes.

Interviewer: Do you know how many of your math teachers, how many math teachers would you estimate have attended one or more professional conferences this year?

Principal: Probably at math we are at a lower rate than others. I know [eighth grade mathematics lead teacher] had done some things, and we have had, I don't know we have had anything specific for math this year in the County. We did have a math committee everybody worked on. As far as conferences not that many in mathematics, actually. . . (p. 4-5)

Since the school's membership to the NCTM was dropped during the 1994-95 school year, mathematics teachers lost the benefit of reduced conference rates, and were not provided access to professional conference information. The County did pay for substitutes for teachers taking approved-professional leave of absence, but during both the 1994-95 and 95-96 school years teachers were expected to pay their own conference expenses. For both the Classroom and Building Levels of the study the status of reform for Indicator 2 during the 1995-96 school year was Stage 2.

At the Division level the baseline ranking for this indicator was Stage 0; its ranking peaked during the 1993-94 school year at Stage 3, and ended at a Stage 2 status ranking. Professional development for teachers was one of the items that all of the administrators saw as a need, and they all agreed that lack of funds was the problem. During the 1991-92 school year middle-school teachers implemented interdisciplinary teaming and interdisciplinary methods of instruction, a CARE program, and extended learning without any professional development opportunities. The only inservice provided that school year was for the WICAT computer lab, and that inservice was part of the purchased package. Teacher travel for attendance to the regional NCTM or VCTM conferences was not funded at the Division Level. The baseline reform ranking for Indicator 2 at the Division Level was Stage 0.

The Superintendent saw the V-QUEST Systemic Reform Initiative as a funded Initiative that was compatible with the needs of Pleasant County, and applied to be a participant. According to the Superintendent, he was an active participant in V-QUEST conferences in the early part of the program. His comment follows:

Well the V-QUEST conferences, I try to attend religiously especially in the early beginnings of the program, and those were related directly to mathematics and science, and we lent our support to those conferences, participated in the actually planning of them, and I attended them. I think at least three and maybe more. I had a number of subcommittee meetings on the topic of mathematics and science where I was in attendance, and I was the only Superintendent on the State-wide Steering Committee on leadership for mathematics and science. (p. 26)

As the Superintendent indicated he was an active V-QUEST participant during the 1993-94 and 94-95 school years, and he encouraged the middle schools' participation during the 1993-94 school year. Although the Superintendent did support mathematics reform efforts in the County's elementary schools during the 1994-95 school year, the middle-school teachers were not supported in professional development endeavors, therefore as far as Pleasant Middle School was concerned Division-Level reform efforts for Indicator 2 peaked during the 1993-94 school year at S3.

By 1995-96 the Superintendent no longer participated in any mathematics related conferences or V-QUEST related activities, and the responsibility for funding teachers' professional development was delegated to the Principals without any increase in site-based funding. So, at the Division Level the status of reform for this indicator was S2.

At the State Level the reform ranking for this indicator was Stage 4, it peaked with a Stage 5 ranking during the 1994-95 school year, and its status during 1995-96 was Stage 4. More State sponsored or endorsed mathematics and science conferences and professional development opportunities were available for the teachers during the years that the V-QUEST Lead Teacher Institutes were funded and active, and there was more observable leadership. The VDOE did maintain the VA PEN telecommunications site during the baseline school year which provided teachers access to all the latest information concerning conferences and staff development opportunities available from the NCTM and VCTM, but there were no inservice provided by the State and no evidence of leadership in this area. Therefore, the State-Level ranking for this indicator during the baseline school year was Stage 4.

It was after two full years of V-QUEST Lead Teacher Institutes that Virginia's First Joint Conference on Teaching mathematics and Science was organized and sponsored by six organizations (i.e., V-QUEST, VAST, VCTM, VSLA, SSMA, and VCMS) following V-QUEST's lead in working together to provide leadership in utilizing technology to enhance mathematics and science learning, and making connections between technology, science and math. The State Level reform efforts for this indicator peaked at during 1994-95 at Stage 5 with the planning of the Joint conference on Teaching mathematics and Science during the 1994-95 school year, and declined to the status of Stage 4 during the 1995-96 school year with the withdrawal of support for the final V-QUEST Lead Teacher Institutes.

### **Indicator 3**

**Teachers are provided access to national mathematics and science conference, workshops, and other professional development opportunities via telecommunications.**

At the classroom-level reform was at Stage 3 in the baseline year, and its status at the end of the study was Stage 1. The only telecommunications discussed other than VA PEN during the course of this study was one video discussion panel concerning the Core Curriculum Project that was abandoned, but that indicated that the technology was available and the school was capable of using it. The librarian described the limited telecommunications resources that were available in her comments which follow:

Librarian: . . .Of course we have a telecommunication station here. Our students are not on Internet as yet. We have some bugs to work out of that, work out with that first. . . .

Interviewer: On the telecommunications, are the teachers using it?

Librarian: Some of our teachers are using it. It's difficult right now to get through. We have to go through VA PEN and it's difficult because we never can, the access is not there right now but NRV Net has given us three free hook ups so as soon as we get our phone lines in place. You know [we laugh at this] really! (p. 2)

The technology was available for teachers to participate in staff development via telecommunications, but there was no evidence that any of the teachers participated in any such activities. As mentioned in the previous indicator, the focus of reform was not on telecommunications during the 1991-92 school year. Classroom Level reform for this indicator was ranked Stage 3 during the baseline school year.

For both the Building and Division Level, reform for this indicator was at Stage 3 during the baseline year, and declined to the status of Stage 1 by 1995-96. As evidenced by the 1990 purchase, installation and implementation of the WICAT computer labs for mathematics instruction in all of Pleasant County's schools, the administrators endorsed the use of technology for mathematics instruction. However, by the 1995-96 school year the benefits of the use of individualized-computer-assisted instruction for every student in the County were being questioned and the system was described by the County's Director of New Initiatives as archaic. There was a Technology Committee in place during the 1995-96 school year, but there were no data to document this committee's accomplishments or activities.

All of the Building and Division Level administrators interviewed about technology stated that they viewed the Internet as a valuable resource for teachers, but they all agreed that Pleasant Middle School lacked the infrastructure, technological hardware and software necessary to improve teacher access to the Internet and telecommunications. The school did have closed circuit television, cable for access to PBS, Channel One, and VDOE professional development opportunities via telecommunications, but availability and access



to VDOE professional development opportunities via telecommunications were documented to be extremely limited.

Although the administrators encouraged the appropriate use of technology for the improvement of mathematics instruction, there was an on-going discussion as to exactly what the appropriate use of technology for mathematics instruction was. It was not possible to upgrade the existing WICAT computers for access to the Internet or telecommunications, and budgetary concerns dictated the amount of technology improvements possible. Therefore, during the 1995-96 school year teacher access to the Internet was limited to one computer station in the library and to 12 hours a day, and that connection was through VA-PEN, which was a text-only based system. The administration had made an effort to bring technology into the mathematics classrooms, but technology reform remained in the early stages, and due to the rapid changes in technology, reform for this indicator at the Building and Division Level tended to regress to Stage 1, planning to implement.

The State Level ranking for this indicator during the baseline school year was S3, and its status at the conclusion of the study was S3. Their data indicated that the VDOE had VA PEN in place during the 1991-92 school year, but there was little evidence of its use other than the recollections of the mathematics lead teacher, but the fact that the system was up and running indicates that reform for this indicator was at Stage 3.

With the VDOE endorsement of the NCTM *Standards* and the V-QUEST Systemic Reform Initiative the State had taken a leadership role in bringing technology reform into the classroom. By making the Virginia Public Education Node (VA PEN) available to teachers for free and providing training through the V-QUEST Lead Teacher Institutes on how to use the service, the VDOE had opened up a new world of resources to all of its teachers. So reform efforts for making professional development opportunities available via telecommunications peaked at Stage 4 during 1994-95.

As mentioned, VA PEN was a text-based only system, which made its usefulness as a connection to the Internet extremely limited, not to mention slow and cumbersome. By 1995-96 VDOE had cut financial support for VA PEN in half, which left teachers in Pleasant Middle School with less access than ever to information concerning national mathematics conferences, workshops and professional development via telecommunications. At the conclusion of this study State-Level reform for this indicator was ranked at Stage 3.

#### **Indicator 4**

**Teachers of mathematics know where and how to access the most up-to-date technical assistance in mathematics and science pedagogy, content, and educational research.**

For the Classroom and Building Levels, reform was ranked at Stage 0, peaked at Stage 4 in 1994-95, and declined to Stage 3 during 1995-96. During the baseline school year the teachers and Principal were working to implement all of the middle-school restructuring changes, and although reform of methods of instruction was expected, reform of mathematics instruction was not the focus of these changes. As documented previously, teacher inservice opportunities were for implementing computer-assisted instruction. Teachers were told to implement academic instructional teams and interdisciplinary methods of instruction, but no inservice or professional development opportunities were provided, and no funds were available to purchase instructional materials. Only the lead mathematics teacher was a member of the NCTM, and the move to interdisciplinary teams meant that the mathematics department was abandoned; thus, the lead teacher had no opportunity to share information with other mathematics teachers. At both the Classroom and Building Levels, reform efforts for this indicator were at Stage 0 during the baseline school year.

After attending the first V-QUEST two-week Lead Teacher Institute, the mathematics teacher decided to create a mathematics resource center for Pleasant Middle School's mathematics teachers. He worked with the Principal to get access to a small room across the hall from his classroom, and then he scavenged the building to find shelves and tables to organize the instructional materials that he accumulated. These materials included all the NCTM *Standards*, hands on instructional materials, displays of interdisciplinary projects, and current issues of the NCTM *Middle School Journal*. Artifact data confirmed that the former Principal purchased an institutional membership to NCTM during 1993-94, and that the new Principal did not renew the subscription. Although the lead teacher had not completed the mathematics resource room during the 1993-94 school year, the leadership demonstrated by the Principal's funding of the NCTM membership for the school indicated that the 1993-94 school year was the year that classroom- and building-level reform peaked at Stage 4 for this indicator.

Of the six teachers in the study only the two eighth-grade teachers were members of NCTM, but the lead mathematics teacher shared information with the other mathematics teachers via conversations and handouts placed in mailboxes. The lead teacher knew where to access the most up-to-date technical assistance, and he was willing to share his knowledge with other teachers through inservice sessions or individual conversations, but he described his efforts as not well received in the building.

The move to block scheduling during the 1995-96 school year forced teachers to move away from using strictly traditional methods of mathematics instruction, and thus lines of communication opened up as the mathematics lead teacher's colleagues started asking questions and looking for solutions. During the 1995-96 school year three of the six

teachers in the study indicated that they discussed mathematics instruction with the mathematics lead teacher and that they had used ideas shared in these discussions in their classrooms. As the male sixth grade teacher proudly displayed his students' scale model projects, he credited the mathematics lead teacher with the project idea. Both sixth grade teachers consulted with the lead teacher concerning the use of the *Glencoe* textbook and its instructional resources. The eighth grade mathematics teachers had a common planning time, and often shared ideas for interdisciplinary instructional units or hands-on instructional activities, but none of the teachers had visited the mathematics resource room. Although the mathematics teachers were beginning to talk and share ideas, the current Principal did not fund the school's NCTM membership, and he did not participate in the V-QUEST reform initiative; therefore, the Classroom and Building Levels' rankings for this indicator were Stage 3.

At the Division Level reform for this indicator was ranked at Stage 0, and it peaked at Stage 3 in 1993-94 declining to Stage 2 in 1995-96. During the baseline school year the County was involved in the State's Vanguard Middle School initiative, but any communication from the VDOE was passed to the Principals who were responsible for sharing the information with the teachers. Teachers were told what to change to meet the requirements of being selected as a model middle school, but no mathematics teacher was told who to talk to for technical assistance in making these changes in mathematics. Teachers worked as an interdisciplinary team and suggestions and assistance came from their team members. The County was not a member of the NCTM during the 1991-92 school year, and the emphasis of reform at that time was on interdisciplinary instruction, academic teams, and computer-assisted instruction. The County provided no leadership in terms of providing teachers access to technical assistance for implementing interdisciplinary instruction or successful teaming. The baseline Division Level reform ranking for this indicator was Stage 0.

As documented the County participated in the V-QUEST Systemic Reform Initiative, which promoted reform in science, technology and mathematics education, and reform of mathematics instruction was the emphasis of the County's reform efforts for both the 1992-93 and 1993-94 school years. During the 1993-94 school year the County supported its V-QUEST Lead Teachers' efforts to implement reform which included sharing pedagogy, and information concerning technical assistance. The Superintendent worked closely with the V-QUEST Administrative component and fulfilled the obligation of funding release time for the V-QUEST Lead Teachers to plan the implementation of mathematics and technology reforms. Reform efforts at the Division Level peaked at Stage 4 for this indicator during the 1993-94 school year.

By the 1994-95 school year Division Level support for the Middle School V-QUEST Lead Teachers was not provided, and by the 1995-96 school year the County abandoned the V-QUEST Lead Teachers. Financial constraints made it impossible for the County to put up-to-date technology in every classroom, and funding for professional development opportunities for teachers was not a top budget priority. The Superintendent passed any memos that he received concerning mathematics instruction along to the Principals, and the middle school Principal in turn passed the information to the lead mathematics teacher, but no time or money was spent on providing teachers with technical assistance.

All of the administrators indicated that they believed access to the Internet, telecommunications, professional development through conferences, and inservice opportunities were important for all teachers. Yet at the conclusion of this study the facts were that access to technical assistance via telecommunications and the Internet at Pleasant Middle School had not improved since the base-line school year. During the 1995-96 school year teacher access to telecommunications and the Internet was limited to one computer that was located in the library. There were still only two phone lines that served the entire school building, and access to the Internet was through VA PEN, which supported text-only information. Funds for teachers to attend professional conferences were designated as site-based budget concerns, but adequate funding was not provided for Principals to support and encourage mathematics teachers' attendance of professional conferences. Teachers were expected to attend or even provide inservice opportunities on their personal time without any type of compensation.

The former Principal of Pleasant Middle School allocated funds for the V-QUEST Lead Mathematics Teacher to attend State conferences and V-QUEST Workshops during the 1993-94 school year, but the County did not provide any extra funds for these expenses. When the current Principal was asked about the policy on teachers attending conferences he said:

I don't know how many policies we have that relate to that, but we encourage as much as we can. We have sent a lot of teachers to different conferences this year.

Interviewer: And they get reimbursed for the expenses?

Current Principal: No. (p. 5)

He went on to say that all the administrators saw a need for extensive staff development in mathematics education, but that there was no real commitment to it, saying, "I think it is basically because there is only so much money to spend" (p. 7). The former

Principal's comments concerning funding from the Division Level for professional development follow:

Interviewer: Did the amount of funding for mathematics education change during this time [V-QUEST 1992-93 and 93-94]?

Former Principal: Other than what I could free up? No, it didn't improve at all.

Interviewer: Now along that line, do you think the lead teachers were encouraged to work for change? Do you think it was supported?

Former Principal: I would hope that they saw it as being supported ah, from my part I tried to do everything I could, again from the County's part I would have to say no. It wasn't supported from the top. . . . What I tried to do as much as possible, through site money, I tried to make sure that I had money for the teacher who attends the conferences, and I tried to make sure as a school we joined any of the mathematics or science organizations that brought reduced rates at conferences that brought us information on. I tried again to pick up what I could to help out either through site-money, or it was a thing of feeling very strongly about a conference, and I didn't have it in site, then I would take it out of the local activity funds to pay for some of it.

(p. 12)

Although the County had funded released time for the lead teachers during the 1993-94 school year, no additional funds were provided to the middle school's site budget for supporting building- and classroom-level reform efforts. Both Principals indicated that funding for professional development and conferences was not adequate, and all of the Division-Level administrators agreed that they would like to do more to support and provide teachers needed professional development opportunities. Since the County did not continue to provide financial support or leadership for the middle school V-QUEST Lead Teachers, Division-Level support for reform efforts related to this indicator declined during the 1994-95 school year.

As for a professional library at the Division Level, the Superintendent acknowledged the existence of a professional library, but the Coordinator of Elementary and Middle School Instructional Programs best described the County's resources in the statement that follows:

[The] County needs a curriculum library. They need a place to have inservice, a place for teachers to go and check things out. They need a resource center and somebody to manage the resource center and somebody to make good decisions, to bring things in, to preview them, to say this is

here come and look at it. It needs a commitment of funds. We are spending a minuscule amount of our budget on professional development and a minuscule amount on professional library things. When I personally have more than the County curriculum library, we have a problem. So, again, I think though it goes back to, I don't think that's been seen as a priority. (p. 14)

The Director of New Initiatives provided a similar description of the County's Professional library in the interview exchange that follows:

Interviewer: I know the County has a professional library available for the teachers to use, do you have any role in selecting material for that?

Director of New Initiatives: Yes, but see, I wouldn't call it a professional library because we've had no money for it for more than five years.

Interviewer: OK

Director of New Initiatives: [Nervous laugh] So no one selects it. I suppose I do, but I have no budget so.

Interviewer: OK. Not funded.

Director of New Initiatives: And I wouldn't even call it a library. It is a pathetic collection of books which may be moved any day because we're out of space. (p. 13)

The Superintendent stated that each school was encouraged to maintain a professional library for the teachers, but during the 1995-96 school year Pleasant Middle School was not a member of the NCTM, and were it not for the mathematics lead teacher none of the NCTM *Journals* or *Standards* materials would have been available at Pleasant Middle School. When the Superintendent was asked if the County encouraged institutional or individual memberships in professional organizations such as the NCTM, he made the following reply:

We certainly don't discourage it. . . . [W]e think that's an individual responsibility on your part to join the organization that best meets your need as a professional and there may be several. (p. 15)

When Pleasant Middle School's librarian was asked if there was an institutional group membership for any of the professional organizations such as the NCTM, National Council of Teachers of Mathematics, or VCTM, she stated the following:

No, I think most of that just goes, comes through the central office, I mean the Principal's office, but I don't really subscribe to those. In other words those aren't in my budget. I don't handle those. We get something from the National Middle School Association but as far as— (p. 11)

When the current Principal discussed Pleasant Middle School's professional library, he acknowledged that there was one and stated that the librarian was responsible for selecting the materials (p. 7). The former Principal also indicated that the librarian was responsible for selecting and purchasing materials for the professional library (p. 13). Although artifact data documented that the former Principal had funded an institutional membership to the NCTM during the 1993-94 school year, no Division-Level funds were provided for the purchase of professional library materials. This evidence pushes the ranking for the Division Level for this indicator towards Stage 0, but since the County did participate in and enthusiastically supported the V-QUEST Lead Teacher Initiative, the ranking that best described the Division Level's reform ranking for the 1995-96 school year was Stage 2, implemented but abandoned.

It was difficult to determine the status of the ranking for this indicator because there were several points of access to the most up-to-date technical assistance in mathematics pedagogy, content and educational research, i.e., reading professional journals, attending professional conferences, interacting with other professionals, utilizing Internet resources, sharing information via telecommunications with other professionals, and participating in inservice, and the County was not at the same point on all of these fronts. As for technology reform the Division Level was at Stage 1, Planning to Implement. The County had made a large investment in technology, but at the end of this study the County was in the process of evaluating its current technology and creating an improvement plan. Support of the V-QUEST Lead Teachers was withdrawn, and funding for professional development was consistently inadequate. Support of the network of V-QUEST Lead Teachers equaled support for teachers to access up-to-date technical assistance in mathematics pedagogy, content and educational research, and the withdrawal of financial support equaled abandonment of this reform effort. Therefore, even though progress at the Division Level on various aspects of reform for this indicator were at different rankings, the status for the 1995-96 Division level ranking for this indicator was at Stage 2.

During the baseline school year State Level Reform for this indicator was at Stage 3, and it peaked at Stage 5 with the second year of the V-QUEST Lead Teacher Initiative, declining to the status of Stage 2 during the 1995-96 school year. During the 1991-92 school year the State's reform efforts were focused on identifying Vanguard Middle Schools, which were to serve as model middle schools. In this case technical assistance was provided by site visits to these middle schools. The VDOE did take an active role in providing teachers with access to technical information, but the emphasis of reform was not on mathematics. Therefore, during the baseline school year the State Level's ranking for this indicator was Stage 3.

During the 1993-94 and 1994-95 school years the State took leadership of reform for mathematics instruction as well as for science and technology with the V-QUEST Systemic Reform Initiative. By participating in the V-QUEST Lead Teacher Initiative teachers, Principals and Superintendents were encouraged to implement constructivist-based hands-on instruction and to use telecommunications to share ideas, concerns and information. The State provided 24-hour access to VA PEN, and all the VDOE personnel involved with V-QUEST shared their e-mail address with all participants and offered assistance. State Level reform efforts for this indicator peaked at Stage 5 during 1994-95, the last year of V-QUEST Lead Teacher Initiative was fully funded.

In 1995-96 the State withdrew financial support for the V-QUEST Lead Teacher Initiative and cut funding of teacher access time to VA PEN in half. These changes indicated that the support for the reform for this indicator had been withdrawn; therefore, the status of the State Level reform ranking for this indicator was Stage 2, implemented but abandoned.

### **Indicator 5**

#### **School division personnel know how to access and work collaboratively with instructional materials producers.**

At the Division Level the ranking for this indicator during the baseline year was Stage 0 and its status at the end of the study, 1995-96, remained at Stage 0. There was little evidence related to this indicator, but during the baseline school year the administration worked with Josten Company to implement computer assisted mathematics instruction, and they collaborated to provide inservice to the County's teachers. The same relationship was evidenced with the purchase of the *Glencoe* mathematics textbook series during the 1992-93 school year; the administration worked with the company to secure a half day of inservice on using the new mathematics instructional materials. There is no evidence that Division Level personnel collaborated with instructional materials producers at any other time, or in any way that would influence the design of instructional materials. The Division Level ranking of Stage 0 remained consistent from 1991-92 to 1995-96.

However, at the State Level the baseline year reform ranking for this indicator was Stage 1, but by the 1994-95 school year the ranking was Stage 0. This indicator had to do with the Instructional Materials Criteria instrument developed in part by the VDOE Specialist of Instructional Media and Training. During the baseline school year she and another VDOE employee worked to create the document that would in 1993-94 become an instructional evaluation tool suggested for use by localities for review of textbooks or instructional materials that were considered for adoption. Therefore, during the baseline school year the State Level ranking for this indicator was Stage 1.



The true power of the instrument was to be in the consortium of states that adopted it as a instructional evaluation tool; thus, by the power of numbers gaining influence over the content and design of instructional materials. As it turned out the State did not adopt the instrument and although for two years lead teachers were instructed in how to use the instrument for textbook evaluation, it was never distributed for use in Pleasant County. The State did not join the consortium, and there was no evidence that personnel at the Division Level worked collaboratively with instructional materials producers in any other way. At the conclusion of the study, the status of the State Level's ranking for this indicator had declined to Stage 0.

### **Indicator 6**

**School division personnel know how to access and work collaboratively with local, regional, State, and national museums, public and private agencies, and professional mathematics organizations.**

During the baseline school year the Division-Level reform ranking for this indicator was Stage 3, peaked at Stage 5 during the 1993-94 V-QUEST school year, and it declined to Stage 2 in the 1995-96 year. During the baseline school year there was evidence that Division Level administrators collaborated with regional Colleges and Universities in that certificate renewal college credit courses were offered to Pleasant County Teachers in Teaching the Gifted and Talented. The County did not fund NCTM or VCTM memberships for its schools, nor did any of the County Administrators attend any of the Regional conferences during the 1991-92 school year; none of the Division Level administrators were members of the NCTM. There was evidence of collaboration with one of the local universities, but there was no other evidence to indicate that these resources were used to enhance or reform mathematics instruction. The Division Level ranking for this indicator was Stage 3 during the 1991-92 school year.

The first collaborative venture described by Division Level administrators was with the State in 1992-93 when the County applied to become a participant in the State's Systemic Reform Initiative, V-QUEST. This venture was described as a partnership with V-QUEST for improving instruction in Science, Mathematics and Technology. The Superintendent took on a leadership role in the Administrative portion of this Initiative and participated in all of the workshops and administrative sessions offered by V-QUEST. The Superintendent served on the statewide steering committee for V-QUEST, and he made presentations for conferences a local university and for V-QUEST Lead Teacher Institutes.

The Superintendent described his involvement in the V-QUEST Systemic Reform Initiative in the portion of his interview that follows:

Yes. Well, the V-QUEST conferences I tried to attend religiously especially in the early beginnings of the program, and those were related directly to mathematics and science, and we lent our support to those conferences, participated in the actually planning of them, and I attended them. I think at least three and maybe more. I had a number of subcommittee meetings on the topic of mathematics and science where I was in attendance, and I was the only the Superintendent on the State-Wide Steering Committee on Leadership for mathematics and Science.

Interviewer: And you even served as a presenter at one of those conferences for our lead teachers.

Superintendent: Right. I forgot about that. Actually I presented in two conferences now that I think about it. There was a conference at [local] university about three years ago, and I made a presentation on the mathematics, science demonstration school that we were beginning at the [Duncan] Elementary, and then I think last summer was the one you were referring to, it was either last summer or the summer before that, in Abingdon. It was last Spring. (p. 27-28)

After being involved with V-QUEST, other collaborative ventures with public and private agencies were undertaken by Pleasant County and described by Division-Level administrators. The administrators worked with [local] University to write a grant to fund a Mathematics and Science demonstration school at Duncan Elementary; they collaborated with local banks and IBM Corporation to create an incentive plan to help teachers purchase laptop computers, and they worked with [local] Community College to design a joint Tech Prep program to help improve students' performance in mathematics, other work related skills, and organizing partnerships between local businesses and schools, however, most importantly during the 1994-95 school year the County developed a business school partnership and arranged for every school in the County to have at least one business partner.

One of the reform goals of the V-QUEST Lead Teacher Institutes was to develop working partnerships between local businesses and schools. Interview data from the Superintendent, the former Director of Research Development and Technology, the former and current Principals of Pleasant Middle School, and the V-QUEST Lead Teacher are presented to document the progress of Pleasant Middle School school/business partnership.

The Director of Research, Development and Technology's comment about the business partnerships follows:

Yes now the business partnership program that you alluded to a moment ago had really grown from zero to ah, having at least one business partner for every school, and generally speaking schools had more than one business partner, and those partners would focus on different kinds of things. The school system tried to be systematic in that regard in that they did have about three different levels of community and business partnership involvement suggested where you could sponsor an entire school and program, programs so you could sponsor a particular departmental initiative, or you could sponsor particular events, and again that's an evolutionary kind of thing. I would say that there are still some model programs that [Pleasant] might want to look to for guidance, and how to make that more an integral part of the community. I mean of the school visions— because still a lot of the activities that resulted were feel good things, is the way I would classify them, buying the Tee-shirt kind of things. Not that that's not important, to just have the connection between the business and the schools, and I think that you know we hadn't gotten really sophisticated in that, and perhaps again, one of the ways that you make that sophistication happen is that you build it into part of the structure, and I think they're on the way to doing that. (p. 20-21)

The former Principal indicated that Pleasant Middle School had a good partnership with Appalachian Power Company as he described some of the ways that the school and business worked together. That interview exchange follows:

Former Principal: We developed a very strong partnership with Appalachian in particular. They really became a true partner. Some of the other business partnerships were more fringe players. There wasn't active involvement that we got from Appalachian.

Interviewer: They set up a tutorial program right?

Former Principal: That was probably the year I left. We had talked it, and I think the follow-up was lead by one of the sixth grade teachers. You know, we had talked it as a faculty, that there was an opportunity there. I talked with people at Appalachian. You know, we didn't want them to spend money, you know we wanted a true partnership. We wanted their involvement.

Interviewer: Do you think you played a role in getting that collaboration going?

Former Principal: I would like to think so. I would like to think that I encouraged the businesses that we had identified for us to be partners. We tried to use them at awards assemblies. We tried to invite them in for lunches, just anything to get them in the building . . . (p. 13-14)

The Superintendent's comments concerning business partnerships supported that at the Division Level reform efforts for this indicator peaked during the 1994-95 school year. His interview data follow:

. . . and ah, certainly our business folks. We have a Business Advisory Council. It doesn't meet but ever so often. The first year or two we met with them very often to assess their needs, and we've taken their feedback and we've incorporated it into our planning, and a lot of what we're doing now is a result of feedback we got from that Advisory Council. Mathematics was one of the areas they were most concerned about, that our students simply were not able to perform the way they need for them to perform on the job. (p. 22)

Planning for school/business partnerships started during the 1993-94 school year after participation in the first two-week V-QUEST Lead Teacher Institute, by the 1994-95 school year Pleasant Middle School had a successful partnership with APCO. Although the Superintendent provided examples of at least two collaborative ventures at the Division Level during the 1995-96 school year, none impacted Pleasant Middle and none were related to school/business partnerships. Therefore, Division Level reform efforts for this indicator peaked at Stage 5 during 1994-95, which was the last year that the County supported the V-QUEST Systemic Reform Initiative.

Both the Principals and lead teacher indicated that the partnership Pleasant Middle School had with APCO was developed during the 1993-94 school year, and that it resulted in a successful Pleasant Middle School mathematics tutoring program during the 1994-95 school year. This partnership died in 1995-96 with the transfer of one key APCO employee to an adjoining County's APCO office, but it is significant to note that no effort was made at the Administrative level to renew or maintain this school/business partnership.

The Principal of Pleasant Middle School described the school's relationship with Appalachian as positive. His comments follow:

We have had some pretty successful business relationships. We had Appalachian. . . . Appalachian, actually what I meant to say is Appalachian Power. I guess it is American Electric Power. We had a very good tutor program where last year their engineers came over to work with our kids.

The person who was kind of in charge of that got transferred to [adjoining County] so we, that has kind of died on the vine. (p. 9)

The lead teacher's comments also described the school's business partnership with APCO as successful, but not continued into the 1995-96 school year. The mathematics lead teacher's comments follow:

Mathematics Lead Teacher: Well, we have business partnerships—

Interviewer: Are they active?

Mathematics Lead Teacher: They were; the one with APCO was very active, but now with the restructuring of APCO— NO. They provided tutors here for us that would come in and work with the kids during the day or after school or before school. That's gone. I'm not sure who else our business partners are. . . (p. 9)

The Superintendent's comments concerning the County's business partnership were presented in the peak year data, but the fact that school/business partnerships was not mentioned in his 1995-96 interview description of school/business collaborative ventures indicated that school/business partnerships were no longer a priority. The interview question is presented with the Superintendent's response to show that school/business partnership was pointedly referred to in the question; therefore, the omission of their mention was not inadvertent on the Superintendent's part. He talked about the County's collaboration with a local community college to create a Tech Prep program designed to ultimately provide High School students with remedial mathematics that would be compatible with the needs of the local employers.

The only other school/business collaborative ventures mentioned by the Superintendent were the laptop computer buying incentive plan that had been arranged between a local Pleasant County bank and the IBM Corporation and collaboration with a local university. His comments about this plan follow:

. . .everything from our interest in trying to get people to buy their own computers, i.e., laptops, so that they can carry these to inservice training sessions, and we've had a good number, and I believe right now that we've had forty to fifty teachers that have laptops in our County that we enabled due to a financing arrangement through a local bank and a lower price due to mass purchase from the IBM corporation. (p. 7)

Interviewer: Has the County been involved with any collaborative ventures with groups outside of the schools that would develop a relationship that might impact mathematics education or the mathematics program, and here

I'm thinking of our local business partnerships or partnerships that we have developed with the local universities or colleges.

Superintendent: Well certainly both are true. We've had partnerships with [local] University, [local] Community College; we've collaborated with both. [local] Community College ah, in specifics we were concerned about the entry rate of our students there and the fact that so many were having to take remedial math classes, and so we meet with the faculty at [local] Community College, specifically the mathematics faculty, and we shared results, we shared information, and we took that information that told us who these students were, what their scores were, what their weakness, what seemed to come out in a way of a profile, and we took that back to the high school. Meet with the mathematics department there and ah, decided to make some changes that would address these things.

We're still making those changes, this coming year we will have an exerted effort to try to grapple with the fact that we have low achieving students coming into the high school. So it's an improved effort to try an address a problem that came as a result of collaboration with the local Community College, with what they're seeing at the university level. (p. 22-23)

The Associate Superintendent talked about the County's collaboration efforts on the Tech Prep Initiative in the interview exchange that follows:

I think we can always do better there [partnerships with local colleges and universities], but we do have for example in the Tech Prep program, and I don't know if you're aware of Tech Prep, but it's more of a Community College program, but it's trying to infuse work place skills into the curriculum so that there is a mesh between your English curriculum and your work place skills. . . . We have a very, there is a thing called the [local] River Tech Prep Consortium which Pleasant County is a part of it, [local] City, [adjoining County], [another adjoining County], several divisions are part of that, and we, this year were able to administer Work Keys which is a program that matches the work place skills of students to job profiles in industries, and we're in the process of ah, profiling jobs in industries that says if you want this job at Volvo White you have to have a rating of five in your math, or in your technology, and then we have a test that actually says your skill is here if you want this job you've got to get your skill up to here, and it's a very prescriptive kind of thing, and we administered that to every

eighth grader this year, and we also administered it to every senior so we can get baseline data as to how the students who are leaving the high school looked.

In fact I have a whole project right over here that I've written around that and one of the things we're looking at next year, which doesn't impact the middle schools as much, but its a transitional English and a transitional Math program at the high school which would take these Work Key skills and match the children's need to that, and try to raise the level of their work place proficiency. So that when they leave school we'll be able to say to employers here's where their level of certification is, and here are the jobs that you need the, most jobs have been profiled, and students can readily see what they need to do. . . . We had a grant from Blue Ridge training council this year for \$15, 000.00 to ah, supply the materials and do the first year testing. Next year we have to carry on that ourselves. Part of that is the job profiling in the industries next year, but we will continue to test the youngsters at the middle school level. (p. 14-15)

In her response to a question about the County's collaborative ventures with groups outside the schools, the Coordinator of Elementary and Middle School Instructional Programs talked about the Tech Prep program:

I think that's the intent of the Tech Prep, but so far I'm not sure where that is. In the first year that I was involved in that it didn't seem to go any where, and I know that [Associate Superintendent] worked on a grant just recently, and they gave some assessments to some of those kids at the high school about work place competency so I guess the Tech Prep Program is the only thing right now that's even remotely in place. (p. 15)

The Director of New Initiatives also made reference to Tech Prep program that resulted as a joint effort between [local] Community College and Pleasant County. Her comment follows:

You know, ah yeah, [local community college] for instance does a lot with the High School in something called Tech Prep, and every person in the Math Department attended a weeks' inservice last summer, and then several times during the year too. That was a 100 percent participation. [The Associate Superintendent] can tell you about that. ah, [a State university] has offered courses. We haven't had many of them make. The only ones that were made were in the Gifted. (p. 15)

The Director of New Initiatives provided other examples of the County working collaboratively with [local] University and other local colleges to develop and take advantage of staff development and distance learning opportunities. Details are provided in the comments that follow:

Every year we've sent some of our teachers to the Southwest Virginia Technology Consortium Workshop that [Roger] University has, a residential summer program, and we have five from [Duncan] middle school going this year. (p. 8)

. . . We've done some ah, we're in a collaborative program right now with [Local] University, [Roger] college and [Local] River Community college and some high schools: Christiansburg, Shawsville, and Radford High school. So next year we'll be offering through distance learning classroom discrete mathematics, which we have never taught at our high school but our kids will be able to get that for the first time and also statistics from [Roger] University will be offered at our high school. (p. 14)

The former Director of Research, Development and Technology also talked about how the County worked collaboratively with local Universities, colleges and school systems on a curriculum development project with the V-QUEST preservice, inservice program. She described this as the County's largest collaborative effort to impact mathematics and science education. Her comments follow:

That was with [Local] University, Henry County, [Roger] County, ah, and ah, [Local] River Community College and with both math and science departments at [Local] University and it was math and science in all of those areas, and so they were working on curriculum development, streamlining the curriculum, and kind of taking a good hard look at courses now they began to focus at the 9 through 12 because so much of the lead teacher effort had gone elementary middle. . . (p. 13-14)

Not one of the administrators mentioned the school/business partnerships that were implemented during the 1993-94 school year, but they all commented on the collaboration with the local community college to develop the Tech Prep program. Although collaboration with local colleges and universities was evidenced, by 1995-96 the Division Level administrators had abandoned leadership responsibilities for the school/business partnerships thus the status ranking for this reform indicator, as it related to V-QUEST Systemic Reform of mathematics education at Pleasant Middle School, was Stage 2, implemented but abandoned.



## Indicator 7

### **School personnel consistently involve and utilize parent and community resources in their mathematics programs.**

The status at the Classroom Level during the baseline-school year for this indicator was Stage 0, classroom reform peaked during the 1994-95 school year at Stage 4, and declined to Stage 2 during the 1995-96 school year. The interview and artifact data evidenced an active Parent Teacher Organization (PTO) at Pleasant Middle School during the 1991-92 school year and that teachers held parent-teacher conferences twice a year, but there was no evidence of community or parent involvement in the mathematics program. Therefore, the status at the Classroom Level for this reform indicator was Stage 0.

After attending the two-week V-QUEST Lead Teacher institute Pleasant Middle School's lead teachers implemented interdisciplinary methods of instruction into their classrooms with at least two projects and for several different concepts. The bridge project they implemented brought the community's businessmen and women into the classroom as guest speakers, and it was written up in the local newspaper. This project was implemented during the 1993-94 school year and its use was continued through the 1994-95' school year. The lead teacher's comments concerning these interdisciplinary instructional units follow:

Ah, when we do Stock Market I have a broker come in, and when we do our toothpick bridges, [lead science teacher] and I used to do that together, but I'll be doing it by myself this year. We bring in an engineer, bring in an architect, and a carpenter and people like that to talk to the kids. (p. 9)

As the lead mathematics teacher talked about how his homework assignments had changed, he provided another example of how he tried to get parents involved in their child's education. His comment follows:

—but yeah, it [type of homework] has, it really has [changed]. I used to use [the] textbook for everything and a few activities, but I do a whole lot more activities at home, and I try to get the parents involved. You see the kids go home, and they have an activity to do, and then I ask the parents to sign the paper saying they discussed it, and they get a bonus that way. (p. 15)

Data concerning the mathematics tutorial program established as a result of the school's business partnership with APCO were presented with information for Indicator 6, but, it also documents community involvement in the mathematics program for this indicator. The mathematics lead teacher conducted an ongoing recycling project, and a beautification of the school project, which also brought in the local news paper for publicity of mathematics education. The 1994-95 school year was the last year that there were

clippings in the School's scrapbook of newspaper stories about interesting mathematics lessons at Pleasant Middle School, and it was the last year that guest speakers were brought into the mathematics classroom. Classroom reform efforts for this indicator peaked during 1994-95 at Stage 4.

The 1995-96 school year was the year that Pleasant Middle School implemented Block Scheduling, and due to conflicts in scheduling created by semester long science and social studies classes, the interdisciplinary teams could no longer successfully implement interdisciplinary instructional units. Guest speakers were not invited to the mathematics classrooms during the 1995-96 school year, but the lead teacher indicated that he tried to get parents involved in doing mathematics projects at home with their children, but that it was difficult to get them interested, and he had little success. The data documented that the mathematics teachers communicated student progress to parents through report cards, midterm reports, phone calls, written correspondence and in parent-teacher conferences, but there were no data to indicate that teachers utilized parents or the community as resources in their mathematics program during the 1995-96 school year, and there was no publicity of things happening in the mathematics classroom; therefore, the Classroom-Level ranking for this indicator declined to Stage 2 for the 1995-96 school year.

The Building Level's baseline status for this reform indicator was Stage 0, reform efforts peaked at Stage 4 during the 1993-94 school year, and declined to Stage 2 during the 1995-96 school year. Again, there was evidence of an active PTO, but there was no evidence that the community or parents were utilized as resources for the school's mathematics program during the baseline school year; therefore, the baseline status for the Building Level for this indicator was Stage 0.

In the 1993-94 school year, after attending the Principal's portion of the two-week Lead Teacher V-QUEST Institute, the former Principal introduced once-a-month coffees with the Principal for the purpose of having open dialogue with parents about school reform. These conversations were not limited to mathematics, but parents did have a venue for sharing and gathering information about changes in the school. According to newspaper clippings the PTO remained active and the County's participation in the V-QUEST Systemic Reform was publicized with its goal of getting parents, and communities involved in improving mathematics education. The former Principal's comments about how he tried to get parents involved follow:

. . . I've always been one that wanted parents in the building. I think it was probably one of the hardest things for the parents at [Pleasant] Middle School to get accustomed to. Ah, I wanted them there. I wanted them actively involved. It never got to the point that I wanted it, but it was better than it had

been. Ah, parents were willing to help out financially. They were willing to support some changes, and I think it was maybe the two things coming together: my approach to it, plus V-QUEST, plus the lead teachers all of that, that parents suddenly started realizing we were serious that we did want their input, we valued what they had to offer.

We had Principal's Coffees once a month where the parents could come in and meet with the Principal and the faculty, and there were days that we would have one or two parents and there were days that we would have a dozen plus. We picked up a lot just from those coffees. Ah, had a Parent Advisory Group and they would meet on a monthly bases, and again we didn't talk just little piddely things, we really got into some things that were impacting on the school. I know that as a group they purchased some equipment there in the library for us. They really became an active part. So, I think, it grew during those three years. (p. 14)

This Principal believed that open communication between school and parents was essential to successful reform, and he wanted teachers and parents to know that their input had value. As he said, "You've got to stay abreast of what's going on, be out there and talk to the students, talk to the teachers and talk to parents and being willing to listen and accept some criticisms that go with the job" (p. 7). Reform efforts for this indicator at the Building Level peaked in 1993-94 at Stage 4 with the efforts of this Principal who was an avid proponent of the V-QUEST Lead Teacher Initiative.

The 1995-96 school Principal was not nearly as enthusiastic about parental involvement in education, and had few details to share about efforts to get parents involved in the school. The interview exchange with the Principal follows:

Interviewer: . . . does anyone in this school do anything to encourage community or parent involvement in the mathematics program?

Principal: Probably not specifically.

Interviewer: Is there a school policy concerning community and family involvement?

Principal: In math?

Interviewer: Yes.

Principal: No, I think we have school philosophies and policies about trying to have parents involved in school. Not specifically for math instruction.

Interviewer: OK, is

Principal: Should they're be?

Interviewer: . . . Do you have any projects or programs that have been successful in involving the community and parents in the school? Now here I am thinking the lines of science fairs, family math nights, things like that.

Principal: Not geared towards math specifically. (p. 10)

Since the questions focused on parental and community involvement with mathematics, the Principal did not mention the PTO, or the Parent Advisory Council, but the artifact data showed that both were still active during the 1995-96 school year, but Coffees with the Principal were not continued in the 1994-95 or 1995-96 school years. This Principal was not a V-QUEST Lead Teacher's advocate, nor did he provide leadership for the reform of mathematics education. By the 1995-96 school year reform efforts for this indicator as far as community and parental involvement mathematics reform was concerned had declined to Stage 2.

Reform efforts for this indicator at the Division Level were limited to leadership and support, and the Division Level's baseline status for this indicator was Stage 0, it peaked in 1993-94 at Stage 3, and it declined to Stage 2 during the 1995-96 school year. During the 1990-91 school year County Administrators had convinced the public to fund a bond to purchase computer labs for every school in the County. Therefore, a successful case was made to the public to support computer-assisted mathematics instruction for all of Pleasant County's students to improve their performance in mathematics, but there was no evidence of parent or community involvement in the mathematics program during the 1991-92 school year. The school board meetings were open to the public, and parents and community members had the opportunity to voice their questions, concerns, and opinions at these meetings, but there was no evidence that Division-Level Administrators took any action at all to utilize parents or the community as resources in the mathematics program during the baseline school year; therefore, the Division Level status for this reform indicator during the baseline school year was Stage 0.

After participating in the Administrative portions of the V-QUEST Lead Teacher Initiative, the Superintendent mandated during the 1993-94 school year that each school organize and implement a Parent Advisory Council and a Parent Teacher Organization. The Superintendent's comments concerning parents' involvement in mathematics education are presented in the interview exchange that follows:

Interviewer: Does the County do anything to encourage community or parent involvement in our mathematics program?

Superintendent: Well in all of our programs, and we would hope mathematics as well, we encourage parental involvement. I've asked each school to set up a PTA/PTO, again we're using an invitational approach on

most everything we do. Some schools have done that better than others. Some faculties do a better job of it than others. As a division we strongly encourage parental involvement and support.

I communicate every year by letter to all of our parents and try to let them know what our basic goals are and ah, what changes have come about and what we expect of them. I put a sort of a State of the schools address in the paper every year and we try to inform parents of what we're doing. We open our meetings. The school board meetings are open for the public to come and listen and engage in dialog with us about concerns that they might have, and I have periodic meetings with PTA presidents and listen to their concerns and share, you know, concerns that we have. (p. 24)

In the following statement the Superintendent talked about the importance of involving the community and parents in educational decisions concerning educational reform. His comment follows:

OK. I started in November of 1990 as Superintendent of School and have been here since that time. The present time being July the second 1996, and each year ah, we progressively developed goals and objectives involving our community, our faculties, and a vision, a common vision for the County and as a result of that vision we embarked on major restructuring that is necessary to take us from where we were then to where we want to be in the future, and the journey to this point has been simply trying to carry out the goals that were set earlier and that are still being established as we learn more about ah, everything: technology, new materials, software. (p. 3)

The Associate Superintendent also talked about the importance of having community and parents' involvement in the County's schools, and she provided another example of how parents were encouraged to be actively involved with the community schools. In the interview exchange presented next the Associate Superintendent described two programs that were put in place during the 1993-94 school year, which were designed to facilitate parent involvement in the County's schools. When the Associate Superintendent was asked if the County did anything to encourage the involvement of the community or parents in educational programs, she made the statement that follows:

Yes, that's a major thrust; in fact every school is asked to have a Parent Advisory Council and to involve parents in the ah, bringing them into the school when it's planning the curriculum, and some programs, such as the Title-One program, something that we've been able to add to the budget; our Home-School Coordinators, and they're hired specifically to get in touch

with parents to bring them in, to provide materials for them to have make-and-take workshops, just a whole list of things that we've been doing in the Title-One schools with the position that we call home-school coordinator. (p. 15)

The Director of New Initiatives' response to the question concerning whether the County did anything to encourage community or parent involvement in the schools was short and to the point. Although short, her comment supports that the parental involvement with education was encouraged by Pleasant County administrators. Her statement follows:

Again, I'd say that the County's stated philosophy is that we need to encourage parents and do what we can. Some schools are more effective than others. I think [elementary school] does a good job with having different things like Parent Night and you know activities, I think they even had a Parent Math Night and they came in and did stuff. So it is—it depends on the school. (p. 15)

The former Director of Research Development and Technology's interview data concerning the different levels available for community involvement in school partnerships was presented in the previous section, so it will not be repeated for this section, but simply referred to here as additional documentation of administrations' leadership for community involvement in the mathematics program that was present during the 1993-94 school year.

The Coordinator of Elementary and Middle School Instructional Programs described the responsibility for parental involvement in education as belonging to the individual schools, and like the Director of New Initiatives she cited the elementary schools as the best examples. Her comments follow:

I think that again, depends on the individual schools. I know a couple of our schools do have like, Family Math Night and things like that. A couple of the elementary schools do, and they have real good turn out with that. . . . It's the go getters at the individual schools, and you know when that happens I usually share that with other schools, that such and such is happening, and I'll try to do it. Again, I think it's a function of who ever is in this job, and how they define that job because I now define it very differently than [former employee] did. . . (p. 16)

The data indicated that during the 1993-94 school year a Parent Advisory Council was established at Pleasant Middle school as directed by the Superintendent. As the Superintendent stated, schools were left to their own design as to how to organize and administer the Council. So at the Division Level reform efforts for this indicator peaked

during the 1993-94 school year with the Superintendents' leadership in establishing a Parent Advisory Council at Stage 3.

There was no evidence that the Superintendent or any other Division Level administrator interacted with the Parent Advisory Council, nor that any goals or expectations were set for the Councils other than involving Parents in making decisions. The administrators offer several examples of how some schools in the County involved their parents in mathematics education, but Pleasant Middle School was not one of these schools. By the 1994-95 school year, Division Level Administrators focused support for mathematics reform on the County's elementary schools and nearly of the positive examples provided of involving parents in mathematics education were from elementary schools. As far as systemic reform for the middle school mathematics, Division Level Leadership and support was withdrawn from the middle school during the 1994-95 school year, therefore the status of Division Level reform for this indicator declined to Stage 2 during the 1995-96 school year.

### **Indicator 8**

#### **School personnel consistently utilize college and university resources in their mathematics and programs.**

The baseline Classroom-Level status for this indicator was Stage 0, peaked during the 1993-94 school year at Stage 3 and remained Stage 3 during the 1995-96. Teacher participation in the Gifted-and-Talented courses offered on location in the County by a University from the surrounding area was the only evidence that Pleasant Middle School teachers utilized the resources of local colleges or universities during the 1991-92 baseline school year. There was no evidence to support that teachers utilized college or university resources in their mathematics programs during the baseline school year; therefore, the Classroom Level status for this indicator was Stage 0 in 1991-92.

When the teachers attended the two-week V-QUEST Lead Teacher Institute in the summer of 1993, they immediately started working with University personnel to reform mathematics instruction, and they learned how Universities' resources could be utilized to facilitate mathematics reform. During the two-week and one-week residential V-QUEST Lead Teacher Institutes, the V-QUEST Lead Teachers developed relationships with several of the university personnel who organized and conducted the V-QUEST Lead Teacher Institutes, and telecommunications turned these contacts into links between public school classroom teachers and University resources. During the 1993-94 and 1994-95 school years the Classroom Level ranking for this indicator moved to and remained at Stage 3.

During the 1995-96 school year the mathematics lead teacher, working in conjunction with one of the V-QUEST local University's presenters and the County's Coordinator of Elementary and Middle School Instructional Programs, helped write a grant to fund a two-day inservice on implementing hands-on mathematics instruction into the classroom. Although only one Pleasant Middle School mathematics teacher other than the lead mathematics teacher attended this two-day inservice, the professional development opportunity provided during the 1995-96 school year was a direct result of the contacts made during the V-QUEST Lead Teacher Institute. The data indicated that the mathematics teachers used one of the teacher work days provided during the 1995-96 school year to investigate another local University's Mathematics Instruction Resource Materials Laboratory. The use of local colleges and universities by the Pleasant Middle School mathematics teachers as a mathematics resource was minimal during the 1995-96, but there was evidence that it did exist thus, the Classroom Level ranking for this indicator remained at Stage 3 during the 1995-96 school year.

At the Building Level the baseline status for this indicator was Stage 0; it peaked during the 1993-94 school year, and it declined to Stage 2 during the 1994-95 school year and remained at Stage 2 during the 1995-96 school year. As documented, during the 1991-92 school year the Principal's attention was focused on implementing computer assisted instruction and several Vanguard Middle School Concepts (i.e., academic instructional teams, interdisciplinary methods of instruction, small-group advisory program (CARE) and extended learning classes). There was no evidence that the Principal worked with any colleges or university on improving mathematics instruction during the baseline school year, thus the Building Level status for this indicator during the baseline school year was Stage 0.

During the 1992-93 school year Pleasant Middle School's Principal participated in the administrative meetings conducted by and for the V-QUEST Systemic Reform Initiative. The Principal as well as Division Level administrators participated in a required V-QUEST orientation session and at least two planning sessions for selection of the lead teacher representatives and to discuss methods of support. In the summer of 1993 Pleasant Middle School's Principal attended the two-day administrative portion of the V-QUEST Lead Teacher Institute and worked enthusiastically with both his lead teachers and the V-QUEST staff. The Principal learned to use the telecommunication resources available, and he made several new contacts with local University personnel as his lead teachers made introductions at the V-QUEST Lead Teacher functions. The Building Level ranking for this indicator peaked at Stage 3 during the 1993-94 school year as the Principal made every effort to support his lead teachers in their efforts to reform mathematics instruction.



As documented earlier, a new Principal was assigned to Pleasant Middle School at the beginning of the 1994-95 school year. This Principal was not from the area, had not participated in the V-QUEST Lead Teacher Institutes and did not have the benefit of the University contacts that were established as a result of these interactions. The new Principal did not take on the leadership role for mathematics reform, and there was no evidence that college or University resources were utilized in any way to improve mathematics instruction. Therefore, the building-level ranking for this indicator declined to Stage 2 during the 1994-95 school year and remained at that status for the 1995-96 school year.

The Division Level's baseline status for this indicator was Stage 0, peaked at Stage 4 during the 1993-94 and 1994-95 school years, and declined to Stage 2 during the 1995-96 school year. During the baseline school year the Division-Level administrators focused on successfully implementing a Josten Computer Assisted Instructional Lab in every one of the County's schools. There was no evidence that the Division-Level administrators worked with any of the colleges or universities on mathematics reform during the 1991-92 school year. Therefore the Division Level's baseline status for this indicator was Stage 0.

The County's partnership with the V-QUEST Systemic Reform Initiative provided opportunities for the Superintendent and the V-QUEST administrative contact to work with local University personnel on reform of mathematics instruction. The only portion of that program that reached the middle school was assessment, which provided data for the High School to schedule remedial mathematics educational opportunities. The Superintendent took a leadership role in the Systemic Reform Initiative, serving as a member of the State's V-QUEST Leadership Steering Committee, and as a public speaker for V-QUEST. He showed enthusiastic support for the V-QUEST Systemic Lead Teacher Initiative and attended all the administrative functions held during the 1993-94 school year. The Building Level's reform ranking for this indicator peaked during the 1993-94 school year at Stage 4.

During the 1994-95 school year support for the V-QUEST Middle School Lead teachers was withdrawn, the Division Level V-QUEST administrative contact changed, and again links to the University Personnel were lost at the administrative level. By the 1995-96 school year the County administration had totally abandoned support for the V-QUEST Lead Teachers and was focused solely on implementing the Tech Prep program that was being designed with a local Community College. The Division-Level administrators were utilizing a local college to improve mathematics instruction, but it did not utilize the links formed during the V-QUEST Lead Teacher Institute, and it did not address reform of mathematics education at the middle school; therefore, as far as reform of mathematics at Pleasant Middle School was concerned leadership at the Division-Level ranking for this indicator, utilizing local colleges and universities for mathematics education, was Stage 2.

## Indicator 9

### **State has mathematics curriculum standards that are consistent with the V-QUEST goal.**

The State Level's baseline Status for this indicator was Stage 0, and peaked at Stage 3, during the 1995-96 school year with the adoption of the 1995 Mathematics Standards of Learning, but the change was not a direct path. During the baseline-school year the 1988 *Virginia Standards of Learning* were in place, but the plan was to replace the 1988 *Standards* with Core Curriculum guidelines. During the 1992-93 school year VDOE provided an interactive Core Curriculum Panel presentation via satellite TV for all educators in the State, and Pleasant County encouraged teachers to take notice and participate. Before the end of the 1992-93 school year the teachers had designed and the County had published a Pleasant County Core Curriculum guideline for every academic subject area and grade level.

A change of governors brought a change in the VDOE, and the Core Curriculum project was abandoned in favor of revising the 1988 Mathematics Standards of Learning. Therefore, the planning stage of the 1995 Mathematics Standards of Learning did not begin until the 1993-94 school year, and they were not adopted until June of 1995, the year that support for the V-QUEST Lead Teacher Initiative was withdrawn.

A copy of the State's 1995 SOLs was a part of the artifact data collected for this study, and it served to document the content of the Mathematics SOLs, the instructional framework, and the adoption date of June, 1995. State Level Administrators' interview data, that described the changes in the newly adopted 1995 Mathematics SOLs from the 1988 Mathematics SOLs which they replaced, was presented in Level II of the study to document curriculum change. Parts of those interview data are presented again here to document that the State's 1995-96 mathematics curriculum standards were consistent with V-QUEST's goals.

The goals of the V-QUEST Lead Teacher Initiative were (1) to change the way mathematics is taught in the classroom and (2) to change the focus of instruction from strictly procedural knowledge to relational understanding. The V-QUEST Lead Teacher Institutes taught teachers to be facilitators of knowledge rather than dispensers of knowledge and helped teachers learn how to use calculators, computers, interdisciplinary-instructional units, hands-on learning activities, and problem-solving challenges to accomplish this. Teachers were encouraged to change the focus of classroom instruction to relational understanding and to utilize cooperative-learning techniques which encouraged more student-to-student discourse. The State's K-8 Principal Mathematics Specialist

described the changes included in the 1995 SOLs for the mathematics curriculum at the middle-school level in the statement that follows:

. . .well they [1995 mathematics SOLs] have significantly changed what the mathematics curriculum would look like at the middle school. There is a significant amount of new content and earlier content in the math standards as well as a new focus so, those are three areas. (p. 7)

As she talked about these changes, she provided statistical data concerning the new curriculum content at the middle school level and specifics about new curriculum topics such as statistics, geometry and probability. In the statement presented next she described the change in the focus of instruction. The State's K-8 Principal Mathematics Specialist's comments concerning the purpose of instruction follow:

. . .So, there's earlier content, new content, and the third thing of course is the new emphasis, and at the middle school of course that means much more of an emphasis on problem solving. So ah, in essence kids have to learn the skills, but then they have to be put in situations where they can apply the skills, ah making those connections, and often those connections should be presented in the form of a problem where we're asking kids to draw upon their knowledge and skills and try and, you know, solve the problem and often, hopefully, in a real world context. They have to use their reasoning skills ah, whether it be inductive [or] deductive reasoning. They should be developing those skills so they can justify their work, and ah, also, they need to communicate their answer. No longer are we just looking for a number answer, we're looking for some kind of analysis, some way where they can discuss it or communicate it whether it be written oral or whatever. . . . (p. 7)

When the State's Secondary Principal Specialist for Mathematics was asked, "Do you think that the implementations of these Standards of Learning will encourage a change in the way that mathematics is taught?" She replied:

Ah, yes I do, because if nothing else, the role of technology, because the standards call, explicitly call for the use of technology, and with the possibility of students being allowed to use technology on the assessment, it would definitely affect instruction, and the same thing is true with manipulatives. Concrete objects are called for in the *Standards* ah, so I suspect that the teachers would want to teach at least to the intent of the *Standards*, and therefore they would use manipulatives to develop the concepts and skills. . . . (p. 5)

Interviewer: Do you think that the Standards of Learning are compatible with the goals that V-QUEST had for improving mathematics education?

Secondary Principal Specialist for Mathematics: I think they're one and the same, ah, I mean V-QUEST really resulted from the vision that we had in mathematics and science, and the SOLs represent the visions for mathematics and science so I think they're one and the same. (p. 7)

These data document that the State's 1995 Mathematics SOLs were compatible with the V-QUEST Lead Teacher goals, and were adopted by the State in June of 1995. During 1995-96 school divisions were expected to update curriculum guidelines and implement the 1995 VA SOLs. The State divided its school divisions into regions and provided curriculum development inservice opportunities for each region. During the 1995-96 school year Pleasant County attended the State's curriculum inservice, but worked under the 1988 SOLs throughout the 1995-96 school year. The State Level's reform ranking for this indicator peaked at Stage 3 during the concluding, 1995-96, year of this study.

### **Indicator 10**

#### **Middle school has mathematics curricula based on the State framework.**

The baseline Division Level status for this indicator was Stage 0, and peaked during the 1995-96 school year at Stage 1, but even this change was not a direct path. As documented, during the baseline school year the 1988 SOLs were in place, and the County's curriculum was compatible with those standards, but following State leadership Pleasant County designed and published a Core Curriculum Guideline during the 1992-93 school year. The State, however, did not adopt the Core Curriculum, but opted instead to revise the 1988 SOLs, and Pleasant County never implemented its Core Curriculum, thus the 1988 SOLs remained in effect throughout the course of this study. Although the Pleasant County was in the process of writing its new curriculum, technically during the 1995-96 school year the curricula was not based on the State framework. The 1988 SOLs remained in place throughout the 1995-96 school year.

As documented in Level II of this study in the Division and School levels' data that tracked change of curriculum, all levels of the Pleasant County School system were involved in creating new curriculum guidelines to implement the States 1995 SOLs during the 1995-96 school year. As a result of the Restructuring the Middle School Initiative a Mathematics Curriculum Committee was in place during the 1995-96 school year, and a Mathematics Task Force meet at the school board once a month throughout the year, but no change of curriculum was documented. The County's Gifted Resource Teacher for K to 5, who had

served as the last administrative V-QUEST contact, was designated as the chairperson for the Mathematics SOL Committee, and her comments about the committee's goals for the summer of 1996 document that no change in Pleasant County's curriculum was made during the 1995-96 school year. Interview data from the Superintendent, Associate Superintendent, and two mathematics teachers who served on the committee substantiate that no changes were made to the County's Curriculum Guidelines during the 1995-96 school year. The Mathematics SOL Committee Chairperson statement follows:

I'm the chairperson for the Math SOL Committee. My responsibilities for that include, I have a core committee of eighteen other people from all the elementary, middle and high schools. . . . and our goal this summer was to find out what we are doing right now in math in [Pleasant] County and to hopefully evaluate that a little bit, give some suggestions for improvement that hopefully don't cost a lot of money because it's just not there, but then next year, all during the year, we'll be meeting with people in the County who are interested in math. Everybody in the County, is what I've been told, has to commit to one of the core curriculums so, I could have even a hundred people possibly on a committee. It's going to really be a challenge and ah, so, we will be working on writing the objectives, the activities, the resources and the assessment for all the SOLs.

Interviewer: I assume this committee was formed as a response to the new SOLs—

Gifted Resource Teacher for K to 5: —Absolutely right, it was formed, it was actually formed out of that Math Task Force that was meeting on Wednesday once a month at 7:00 AM. It came, well this math one (committee), a lot of the people came from that one, and it's got to be done. Every County has been told that they have to write their curriculum, so this is the, what, the best way they can come up with in Pleasant County to do it.

Interviewer: Ah, who are your representatives from [Pleasant] Middle School, do you know?

Gifted Resource Teacher for K to 5: [Lead Mathematics Teacher] and [Male sixth grade teacher].

Interviewer: Was the committee fairly active last year?

Gifted Resource Teacher for K to 5: The Math Task Force? Met regularly, I'm not too sure the outcomes of the meetings were followed through totally, but they were followed through some, because one of the things that came

out of that was the testing in sixth grade to determine if children should be accelerated a little bit more or not. So I feel like we've made some head way.

Interviewer: Have you done any meeting this summer?

Gifted Resource Teacher for K to 5: Yes. We meet. We've already worked one full day, but we broke it up into two-part days, and what we did on those days were to create a survey which we gave to all the teachers, all the teachers that teach math. Hundred ninety-two surveys went out and a hundred-two came back, so that was pretty good representation, and then the second time we meet to go through the surveys. We typed up the results, and now it has to be made into the presentation and it will go to [Associate Superintendent].

Interviewer: Did you have, have you been given any directives to follow?

Gifted Resource Teacher for K to 5: Yes [Associate Superintendent] gave each of the chairmen a notebook with pretty much a scope and sequence of what we're suppose to be doing. . . . We're doing this piece by piece slowly, we're starting with just the objectives first. Taking each SOL writing the objectives, and then we'll go on to write the other pieces as the [1996-97] year goes on. (p. 2-3)

The mathematics lead teacher made some remarks about the mathematics committees he was serving on during the 1995-96 school year. He verified that he had helped design a new sixth grade placement test and that there had been no progress made on writing the County's new curriculum during the 1995-96 school year. His comments follow:

These committees that we are working on now, no changes have been made.

They haven't told us what we are suppose to decide yet.

Interviewer: You're involved in this committee?

Lead Mathematics Teacher: Right now I'm involved in three committees. I got assigned to do a math assessment for incoming sixth graders.

Interviewer: What else besides that?

Lead Mathematics Teacher: Ah, we have to still finish up our recommendations for algebra and the SOLs.

Interviewer: Tell me a little about the middle school math committee

Lead Mathematics Teacher: Well they are in limbo waiting on the SOL committees. Our last meeting was that the SOL committees would be set up.

(p. 5)

The male sixth grade mathematics teacher's interview was conducted on May 26, 1996, and in his interview he states that he just received a letter from the Associate

Superintendent asking him to serve on the Mathematics Curriculum Committee. His interview data concerning mathematics committees follows:

Yeah, right now I am on a steering committee, a math restructuring committee [Math Task Force], that has been meeting. I guess we have been meeting six to eight months out of this year. Because of the changing SOLs in the State, we have to set up a curriculum based on that. As a matter of fact I got a letter yesterday from [the Associate Superintendent] asking me if I would participate on the steering committee on that matter. So, we are going to work on that, restructuring the middle school curriculum as a whole. (p. 26)

Since he was just invited to join the Mathematics Curriculum Committee at the end of the 1995-96 school year, the committee could not have made any progress in writing a new mathematics curriculum during the 1995-96 school year.

The Superintendent stated that work on writing the County's new mathematics curriculum would begin in the 1996-97 school year and in the interview exchange presented next he talked about the goals of that committee. Those data follow:

Interviewer: You've already mentioned the Mathematics SOL Committee that is formed, have they participated or have the teachers participated in any activities to help them become familiar with the new SOLs?

Superintendent: That's a little premature. That will be going on this year [1996-97]. As part of the planning process not only will they be gathering data and information about what the content ought to be including on the SOL. The SOLs are part of what we're doing. We're revamping our curriculum using SOLs as sort of a center piece, but it's not going to be limited to the SOLs they're minimal standards. So, as we develop the curriculum for each content area certainly what our aim is, is to use those Mondays to engage in dialog and inform people about what the new standards are going to be and engage in training activities that are necessary to help people in support of it, that new curriculum. (p. 25-56)

The Mondays that the Superintendent refers to in this comment is a scheduled change planned for the 1996-97 school year that will provide two hours of teacher work time every Monday. This was accomplished by providing for a one hour early release for students while adding one hour to the teacher's work day. These data support that at the end of the 1995-96 school year systemic reform in terms of the curriculum at the Division and School level was in Stage 1, planning to implement.

## **Indicator 11**

### **Building and central office administrators participate annually in professional development activities that focus on leadership in mathematics.**

The baseline status for both the Building and Division Levels for this indicator was Stage 0; they peaked in 1993-94 at Stage 5 and declined to Stage 2 during the 1995-96 school year. Implementation of Computer Assisted Mathematics Instruction was the focus of mathematics reform during the 1991-92 school year, and money was, as mentioned by every administrator, was tight. There was no evidence that the Principal or any Division-Level administrators participated in any professional development activities related to leadership in mathematics reform. The status at both the Building and Division Level for this indicator was Stage 0.

As documented both the Superintendent and Pleasant Middle School's Principal attended all the V-QUEST functions, and they were advocates of the County's V-QUEST Lead Teacher providing them with leadership and support during the 1993-94 school. The Superintendent stated, "Well, the V-QUEST conferences I tried to attend religiously especially in the early beginnings of the program. . ." (p. 27). The Principal indicated that he thought attending professional development conferences was important, and he stated that he attended the all the V-QUEST functions including the V-QUEST Conference held in Richmond during the 1993-94 school year. His comments follow:

Yelp. The conference was the blizzard if I remember; the ice storm. Afton mountain was a real joy, ah, yeah, because I thought if it was important for me to ask teachers to attend those things, then I thought it was important for me to be present and to be aware of what was going on and just again just trying to stay abreast of what was going in math and science. (p. 8)

This was the last and only year that the two administrators, Superintendent and Pleasant Middle School Principal, attended every mathematics related conference or professional development opportunity offered, and the only year that they worked together to provide leadership and support to Pleasant Middle School's V-QUEST Lead Teachers, therefore building- and Division-Level reform efforts for this indicator peaked during the 1993-94 school year at Stage 5.

In 1994-95 Pleasant Middle school was assigned a new Principal who did not attend any professional development conferences for mathematics reform during the 1994-95 or 1995-96 school years, and the data indicated that he did not take on the leadership role for mathematics reform. The Superintendent shifted the focus of mathematics reform to the County's elementary schools, and he did not attend any of the V-QUEST drive-in



conferences nor did he attend the regional NCTM conference during the 1994-95 school or 1995-96 school year.

During the 1995-96 school year all of the Division-Level administrators were asked if they were encouraged to attend leadership conferences for mathematics reform, and the responses varied from “Yes I am supported” to “No, I am not supported,” but they all agreed that funding professional development opportunities for administrators and teachers was a problem. When the Associate Superintendent was asked if she was encouraged to attend leadership conferences for mathematics reform, she said, “Yes, all the time. Yes, we try to keep up. You know we try to be aware of what the research is saying and attend as many meetings as we can” (p. 9). The Director of New Initiatives’ response to the same questions was, “I think the Superintendent encourages us to do that, but [he] leaves it up to our own judgment” (p. 10). When the Coordinator of Elementary and Middle School Instructional Programs was asked if she was encouraged to attend professional conferences and workshops, she made the response that follows:

At the central office level I wasn’t. I probably did more than people have done in the past, but, I know that things that I did, if they weren’t in the scope of what everybody’s defined, then I ended up paying myself, or I ended up taking leave without pay because my definition wasn’t liked— and sometimes I could justify, and sometimes I just said it wasn’t worth the hassle. I think we should be encouraging teachers to attend and present at State, regional, national conferences. (p. 11-12)

The former Director of Research, Development and Technology made the comment presented next when asked if she had been encouraged to attend conferences while working as an administrator for Pleasant County. Her comment follows:

Well I wasn’t encouraged, but I think what, the way I say that, and I don’t say that that’s totally wrong because again how do you encourage people when you don’t have the money to underwrite it? I wasn’t necessarily discouraged, but it was up to me to come up with the suggestions, the ideas, and to say that I don’t recall people ever coming to me and saying this would be wonderful for you to attend conference X. Because things were, were restricted in terms of finances, and people were very cautious about that. I would say administrators were almost discriminated against frankly, because people would feel that there might be a misperception if administrators went to conferences and teachers weren’t able to do that. (p. 15)

Division level administrators did not participate annually in professional development activities that focused on leadership in mathematics. The Regional NCTM conferences always offer special sessions for administrators, and none of the administrators indicated that they had attended those. The data indicated that the Superintendent did not encourage membership in the NCTM, and that financial support for professional development for building- and Division-Level administrators was extremely limited. Therefore, by the 1995-96 school year the status of both the Building and Division Level's reform efforts for this indicator were Stage 2.

### **Indicator 12**

#### **School division uses a significant portion of discretionary funds to support educational programs in mathematics and meeting the V-QUEST goal.**

The baseline status of both the Building and Division Levels for this indicator was Stage 0; the indicator peaked during the 1993-94 school year at Stage 4 and declined to Stage 2 during the 1995-96 school year. During the baseline school year the discretionary funds spent in support of educational programs in mathematics were minimal while the use of budgeted funds were maximal. The County made a major investment of funds to equip each school with a computer lab and provide training for mathematics teachers to implement computer-assisted-mathematics instruction during the 1991-92 school year. However, artifact and interview data indicated that during the 1991-92 school year mathematics instructional materials in the classroom were limited to the *Addison-Wesley* textbook, an overhead projector, and a chalk board. There was one classroom set of calculators available per grade level in the school's library; the school was not a member of the NCTM, and no discretionary funds were spent on classroom mathematics instructional materials. Obviously no discretionary funds were spent in meeting the V-QUEST goals during the baseline school year, since the goals were not provided to the administration until the 1992-93 school year; therefore, the baseline status for the Building and Division Levels for this indicator was Stage 0.

Artifact and interview data concerning tracking change in instructional materials presented in Level II of the study documented that during the 1993-94 and 1994-95 substantial portions of the site-based school's funds and discretionary funds were spent purchasing the new *Glencoe* mathematics textbooks, classroom sets of calculators and instructional manipulatives, NCTM membership, and for teachers to attend professional mathematics conferences. The former Principal made every effort to support his lead teacher's efforts to implement mathematics reform. The 1994-95 Principal did not fund

teacher travel to mathematics conferences, and he did not renew the schools NCTM membership, but he did complete the purchase of calculators needed to provide each mathematics teacher a classroom set of calculators. Although the new Principal did spend some site-based money on mathematics materials, the amount of money spent on mathematics instructional program was less than half the amount spent during the 1993-94 school year. Therefore, at the Building Level reform for this indicator peaked at Stage 4 during the 1993-94 school year with the V-QUEST trained Principal.

The former V-QUEST administrative contact for Pleasant County, the Director of Research and Technology explained how the County's Eisenhower monies had been used to support the V-QUEST reform movement in 1993-94 before she left the position. Her statement follows:

They dedicated a large portion of Eisenhower moneys to ah, filling some inventory responses while I was there, and I don't really know what's gone on since, but I know at that particular time, I think it was, all but maybe ten percent of one year's Eisenhower money went toward having the people who had been trained as lead teachers submit an inventory of requests that, I think they had done an inventory and found some certain things that V-QUEST had recommended that be a part of a program that would encourage hands-on connections with science and math and so they did order some things. . . . (p. 19)

At the Division Level, interview data documented that during the 1993-94 school year the County provided the lead teachers with a half-day released time each month to plan and implement mathematics reform initiatives. This required the County to allocate funds to pay for substitute teachers. Interview data supported that this program was continued during the 1994-95 school year with a focus on elementary schools. Therefore, as far as systemic reform for mathematics at the middle school was concerned, reform efforts at the Division Level for this indicator peaked at Stage 4 during the 1993-94 school year.

By the 1995-96 school year the State withdrew financial support for the V-QUEST Lead Teacher Initiative and the County did likewise. Although some of the decreased spending on mathematics education at the school level could be attributed to classroom needs being fulfilled during the 1993-94 and 1994-95 school years, there were noticeable decreases in spending (i.e., not funding conference travel and not funding the NCTM membership) that indicated reform of mathematics education was no longer a priority at Pleasant Middle School. During the 1995-96 school year site-based funds were not used to support mathematics reform, and attendance to regional and national conferences for professional development in mathematics education was not encouraged or supported by the

administration at any level. The focus of reform had shifted to Restructuring the Middle School Initiative and rewriting the curriculum, and zero funds were spent by the County in support of V-QUEST mathematics reform during the 1995-96 school year. Therefore, by the 1995-96 school year status of both the Building and Division Level reform efforts for this indicator were Stage 2.

### **Indicator 13**

#### **Schools support alternative forms of assessment as outlined in NCTM Assessment Standards.**

The baseline classroom status for this indicator was Stage 0; it moved to its peak status, Stage 3, in the 1993-94 school year, and remained at Stage 3 in the 1995-96 school year. Since a detailed presentation of data concerning changes in assessment at the Building Level was presented in Level II of the study, only the conclusions from the analysis of that data will be reviewed here for documentation of this indicator. During the baseline school year the mathematics teachers did not have classroom sets of calculators, and it was documented that the assessment materials provided with the *Addison-Wesley* mathematics textbook were traditional paper-pencil tests designed to assess mastery of computation skills and isolated problem-solving procedures and strategies. The artifact data from seventh and eighth grade teachers and from the instructional materials indicated that traditional assessments were used during the 1991-92 school year, and interview data supported this conclusion. Therefore, the Classroom Level's baseline status for this indicator was Stage 0.

While documenting the change of instructional materials during the 1993-94 school year to the *Glencoe* mathematics series, it was documented that alternate forms of assessment were provided with *Glencoe's* resource materials. However, assessments at the Division and State Levels had not changed, and those assessments focused on testing students for mastery of computation and procedural skills. The use of calculators was not permitted on those assessments, and, consequently, the use of calculators was not standard practice on the classroom assessments. The mathematics lead teacher had attended the two-week V-QUEST Lead Teacher Institute, but reforming methods of instruction and curriculum content were focused on more during first two-week V-QUEST Lead Teacher Institute than assessment reform. However, the former Principal stated that he observed alternative forms of assessment in practice, and the V-QUEST Lead Teacher had implemented several interdisciplinary instructional units during the 1993-94 school year which were assessed in a nontraditional manner. The former Principal's comments

pertaining to alternative mathematics assessments during the 1993-94 school year are presented in the statement that follows:

It was real interesting because suddenly students were being assessed in a way that it was real life. Instead of isolated book skills and theory, you would see groups outside doing things measuring, estimating, ah, I mean it was amazing to watch how suddenly classrooms expanded beyond the four walls, and it was a lot of estimation. I tell you if this floor tile is twelve inches how many floor tiles will cover this distance? Newspapers coming in and assessing students in again the real life applications of it; not textbook, not some bought assessment. It became to me more real life skills that would be an application where the kids were going to use it. (p. 10)

The mathematics lead teacher indicated that reform of classroom assessment was the area where he had made the most changes since attending the V-QUEST Lead Teacher Institutes (interview one, p. 1- 2). Both the Principal and the lead teacher talked about alternative assessments that were used during the 1993-94 school year, and artifact data supported that alternative assessments were used at least twice in the lead teacher mathematics class during the 1993-94 school year; therefore, the classroom status for this indicator moved to Stage 3 during the 1993-94 school year.

Alternative assessment was a major topic in the 1994-95 one-week V-QUEST Lead teacher Institute, and VDOE Principal Mathematics Specialist K-8 prepared and presented a workshop to the V-QUEST Lead teachers about alternative assessment and the need for assessment to match the methods of instruction used. During the 1995-96 school year the State adopted and introduced the new 1995 Virginia Standards of Learning, and the *NCTM* published their *Assessment Standards* in May of 1995, but State Level assessment practices had not changed. Considering these facts and the fact that every teacher was at a different point on the continuum of assessment change, it was difficult to determine a ranking for classroom-level reform efforts for this indicator at the end of the 1995-96 school year.

Both Pleasant Middle School Principals indicated that they had observed some teachers using projects or other forms of nontraditional types of assessment in the school building, and three of the six teachers indicated that they had started using a limited number of projects since the implementation of the *Glencoe* textbook. It was documented in Level II of the study that by the 1995-96 school year the teachers still did not have access to the technology needed to use the assessment software provided with the textbook, and for the most part the lead mathematics teacher was the only mathematics teacher that was beginning to experiment with using different forms of formal and informal assessment practices in his classroom.

The State had developed a notebook of suggested changes for assessment, and the notebook was in the school building, but none of the mathematics teachers other than the lead teacher, who had received an inservice on assessment, indicated that they had used the notebook. Although several of the teachers indicated that they occasionally used projects for mathematics assessment, **all** of them indicated that they still relied on traditional paper-pencil tests for assessment.

When the 1995-96 Pleasant Middle School Principal was asked about the types of assessments used in mathematics class, he made the comments that follow:

I think some of them [mathematics teachers] use interviews, some use the Jostens Lab to do assessment to find out where the kids are and survey. I know some of them do projects, and I guess they assess those on a subjective kind of way.

Interviewer: Has your faculty had any inservice on the use of alternative forms of assessment?

Principal: For math? Not since I have been here.

Interviewer: What type of assessment do you think is most commonly used in the mathematics classroom?

Principal: Tests.

Interviewer: What is your opinion of alternative assessment?

Principal: I don't know if I am strong enough in the mathematics curriculum to understand, to really give a valid answer. (p. 15)

The stage of reform for this indicator at the Classroom Level was somewhere between S0, informed but no action taken, and S3 implement but in the early stages. There were mathematics teachers observed at all three levels. The Principal obviously did not provide leadership for change in assessment practices; no staff development in assessment had been provided by County administrators, and State and Division Level assessment practices had not changed from the baseline school year (i.e., Literacy Passport, and ITBS). However, the *Glencoe* instructional materials provided, and encouraged the use of, alternative forms of assessment. The lead teacher had started to implement more alternative forms of assessment in his classroom, and evidence supported that two other mathematics teachers used projects for assessments during the 1995-96 school year. A copy of the State's assessment reform notebook was in the building, the lead teacher had participated in an assessment workshop conducted by the VDOE, and all of the teachers talked about investigating different forms of assessments. Although use of alternate assessment by mathematics teachers during the 1995-96 school year was limited, the Classroom Level ranking for this indicator was at Stage 3.

The baseline status for both the Building and Division Level on this indicator was not even at Stage 0, informed but no action taken. During 1991-92 the County implemented individualized-computer-assisted mathematics instruction to improve student performance on both the County's and State's assessments (i.e., Literacy Passport and ITBS). Although technology was used to provide this instruction, the methods of instruction and assessment used were strictly traditional (i.e., teach by showing arithmetic steps, practice, test, reteach, test . . .) Alternative forms of assessment were not a consideration of the administrators that proposed this mathematics instructional reform. Since the lowest ranking for this reform indicator is Stage 0, the baseline status for the Building and Division Levels was ranked Stage 0.

With participation in the V-QUEST Lead Teacher initiative came information concerning alternative forms of assessment that better matched the suggested mathematics instructional reforms. Although the 1993-94 Pleasant Middle School Principal and Superintendent supported the lead teachers' efforts to reform mathematics instruction, they did not provide any leadership in terms of mathematics assessment reform. During the 1993-94 school year the Principal purchased classroom sets of calculators for every Pleasant Middle School mathematics teacher, but due to the emphasis placed on testing arithmetic procedures on both the State and County assessments, teachers were not encouraged to use calculators with any classroom assessments and were encouraged to continue traditional forms of assessment. By the 1993-94 school year both the Building and Division Level's reform rankings for this indicator had moved to Stage 0, informed but no action taken.

Student performance on State and County assessments remained a serious concern for all Pleasant County administrators during the 1995-96 school year. As a result of this concern a mathematics Task Force was organized and met once a month at the school board to discuss improvement of mathematics instruction and to set reform goals, but neither the Principal or the Superintendent provided any support or leadership for mathematics assessment reform during 1995-96. The State had adopted its 1995-96 curriculum standards, and the VDOE offered workshops in each region of the State to help school divisions rewrite curriculum guides for the purpose of implementing the State's 1995 SOLs. The emphasis of mathematics reform during the 1995-96 school year was on curriculum not assessment.

By the end of the 1995-96 school year the County administrators had decided it was time to evaluate the effectiveness of computer assisted mathematics instruction, and they were in the process of creating a new mathematics curriculum guide. The State had provided localities with mathematics reform assessment guidelines and had just started the process of

replacing the Literacy Passport test with an assessment instrument more closely aligned to the new SOLs. During this school year the County was focused on updating its curriculum guides, and it was beginning to evaluate some of its own mathematics instruction practices; therefore, the ranking for this indicator at the close of the study for both the Building and Division Level remained at Stage 0.

At the State Level the baseline status for this indicator was Stage 0, and it moved to Stage 1 by the 1995-96 school year. During the Baseline school year the State was encouraging middle schools to implement middle school concepts of small academic teams, interdisciplinary instruction methods, and student advisory programs. Reform of mathematics instruction or assessment was not the focus of this reform; therefore, the State's baseline status for this indicator was Stage 0.

During the 1993-94 school year the State implemented the V-QUEST Systemic Reform Initiative and within this Initiative reform of mathematics curriculum, pedagogy, technology and assessment were all included. As documented the VDOE's mathematics assessment reform materials were presented to lead teachers during the second one-week V-QUEST Lead Teacher Institute. It was during the last half of 1993-94 and the 1993-94 school year that the State revised and wrote Virginia's 1995 SOLs. The focus of mathematics reform at the State Level during the 1995-96 school year was implementing the State's newly adopted SOLs, and as the State level administrators' interview data indicated, reform of mathematics assessment was in the planning stages as we spoke in the summer of 1996. State level reform efforts for supporting alternative forms of assessment in the classrooms was at Stage 1 at the conclusion of this study.

As explained in the introduction of this section, the data are summarized in the System Reform Matrix provided in Table 22. Three significant Stages of Reform ratings were provided for each of the thirteen indicators at every applicable Level of the study (i.e., Classroom, Building, Division, State). The significant Stage of Reform ratings identified were (1) the status during the 1991-92 baseline year of the study, (2) the year and rating that reform efforts peaked, and/or (3) the ranking at the conclusion of the study. For convenience of reading the System Reform Indicator Matrix the rating codes and descriptions for Stages of Reform are reviewed as follows: Stage 5 (S5) Implemented successfully, Stage 4 (S4) Implemented but needs work, Stage 3 (S3) Implemented but in the early stages, Stage 2 (S2) Implemented but abandoned, Stage 1 (S1) Planning to implement, and Stage 0 (S0) Informed but no action take. In each block of the matrix the following data were presented: (1) the 1991-92 (91-92) baseline year with its rating, (2) the year reform peaked with its rating, and (3) the 1995-96 (95-96) year with the its rating. Table 22 follows:



Table 22.

Documenting System Reform Indicator Matrix

	Years	Class Level	Building Level	Division Level	State Level
<b>Systemic Reform Indicators:</b>					
1. Schools actively participate in ongoing telecommunications networking projects that utilize and share mathematics and science information and educational resources.	91-92	0	1	1	3
	Peaked				
	Year	**3	**3	**3	**5
2. Schools have participants at statewide mathematics and science conferences and professional meetings.	91-92	0	0	0	4
	Peaked				
	Year	*4	*4	*3	*5
3. Teachers are provided access to national mathematics and science conference, workshops, and other professional development opportunities via telecommunications.	91-92	3	3	3	3
	Peaked				
	Year				*4
4. Teachers of mathematics know where and how to access the most up-to-date technical assistance in mathematics and science pedagogy, content, and educational research.	91-92	0	0	0	0
	Peaked				
	Year	*4	*4	*4	**5
5. School division personnel know how to access and work collaboratively with instructional materials producers.	91-92			0	1
	Peaked				
	Year			0	0
95-96				0	0

Peaked Year = \*1993-94 or \*\*1994-95

(table continues)

<b>Systemic Reform Indicators:</b>	Years	Class Level	Building Level	Division Level	State Level
6. School division personnel know how to access and work collaboratively with local, regional, state, and national museums, public and private agencies, and professional mathematics organizations.	91-92 Peaked Year			0  **5	
	95-96			2	
7. School personnel consistently involve and utilize parent and community resources in their mathematics programs.	91-92 Peaked Year	0  **4	0  *4	0  *3	
	95-96	2	2	2	
8. School personnel consistently utilize college and university resources in their mathematics programs.	91-92 Peaked Year	0  *3	0  *3	0  *4	
	95-96	3	2	2	
9. State has mathematics curriculum standards that are consistent with the V-QUEST goal.	91-92 Peaked Year				0
	95-96				3
10. Middle school has mathematics curricula based on the state framework.	91-92 Peaked Year		0	0	
	95-96		1	1	
11. Building and central office administrators participate annually in professional development activities that focus on leadership in mathematics.	91-92 Peaked Year		0	0	
	Year		*5	*5	
	95-96		2	2	

Peaked Year = \*1993-94 or \*\*1994-95

(table continues)

<b>Systemic Reform Indicators:</b>	Years	Class Level	Building Level	Division Level	State Level
12. School division use a significant portion of discretionary funds to support educational programs in mathematics and meeting the V-QUEST goal.	91-92 Peaked Year		0 *4	0 *4	
	95-96		2	2	
13. Schools support alternative forms of assessment as outlined in <i>NCTM Assessment Standards</i>	91-92 Peaked Year	0 *3	0	0	0 **1
	95-96	3	0	0	1

Peaked Year = \*1993-94 or \*\*1994-95

### Level III Conclusions

By the end of the 1995-96 school four years had past since the County had applied to participate in the V-QUEST systemic reform initiative and three years since the first group of lead teachers were trained. Documenting systemic reform, bottom-up reform with top-down support was complex, but looking at each Level of reform, i.e., Classroom, Building, Division and State, separately makes some generalizations possible. A summary of the thirteen Systemic Reform Indicators' data for each level of the study is followed by conclusions about the process of the V-QUEST Systemic Reform Initiative.

### Classrooms

Seven of the thirteen systemic reform indicators were applicable to the Classroom Level of the study. The results of those findings are presented here. Numbers in parentheses refer to specific indicators in Table 22. Of the seven indicators, reform efforts for one indicator (see Table 22) showed no change and maintained a Stage 3 status throughout the study: providing teachers access to national mathematics and science conference, workshops, and other professional development opportunities via telecommunications. Reform efforts for the other six indicators (see Table 22) peaked at Stages 3 or 4 during the 1993-94 or 1994-95 school years. Reform efforts for four of the indicators (see Table 22) peaked during the 1993-94 school year with two at Stage 3 (see Table 22) and two at Stage 4 (see Table 22), and reform efforts for the other two indicators

(see Table 22) peaked during the 1994-95 school year with one at Stage 3 (see Table 22) and one at Stage 4 (see Table 22). By the 1995-96 school year two of the reform efforts that peaked during the 1993-94 school year (see Table 22) maintained Stage 3, implemented but in the early stages, while one was abandoned (see Table 22) and one declined from Stage 4 to Stage 3 (see Table 22). Both of the reform efforts that peaked during the 1994-95 school year were abandoned during the 1995-96 school year (see Table 22).

The reform efforts that showed no reform activity during the 1995-96 school year were ranked at Stage 2 as abandoned (see Table 22). The three systemic reform indicators that were documented as implemented and then abandoned follow: (1) Schools actively participate in ongoing telecommunications networking projects that utilize and share mathematics and science information and educational resources, (2) Schools have participants at statewide mathematics and science conferences and professional meetings, (3) School personnel consistently involve and utilize parent and community resources in their mathematics programs. Summaries of the reform data for these three indicators follow.

During the 93-94 and 95-96 school years the mathematics lead teacher helped train teachers in the building on how to access VA PEN, and every teacher had a VA PEN account, but access at the middle school was extremely limited. By the 1995-96 school year funding for the VA PEN service was cut in half, and access at the middle school was limited to one computer without a designated phone line. Teachers new to the resource did not use it during the 1995-96 school year, and the lead teacher who had used the resource expressed complete frustration with lack of access. Due to high traffic during teaching and nonteaching hours, the lead teacher could not depend on access to the server, and he could not afford the time wasted while waiting to get on line; therefore, by the 1995-96 school year he had given up trying to use VA PEN as a resource for mathematics instruction. The Principal of the building indicated that he did not have access to the Internet from school. Money for technology at Pleasant Middle school was tied up in WICAT computer labs, and the County was just beginning to evaluate its use of individualized computer assisted mathematics instruction. The lack of infrastructure necessary to bring technology into every classroom was a topic of discussion for all levels of the study, as well as limited financial resources.

The lead teacher had attended three and four conferences or professional development workshops a year for the first two years of the V-QUEST Lead Teacher Institutes, but during the 1995-96 school year the lead teacher attended one conference, Virginia's First Joint Conference on Teaching Mathematics and Science, and other than granting professional-leave, the County did not fund this professional development for the lead teacher. Everyone in the study agreed that professional development was needed to

implement reform of mathematics instruction, and they also talked about the lack of funds available to support teachers in these endeavors.

The lead teachers worked together to implement interdisciplinary units of instruction, and brought in guest speakers from the community as a part of these efforts. The use of those interdisciplinary instructional units was extremely modified by the introduction of the block schedule during the 1995-96 school year, and as a result guest speakers were no longer visiting the mathematics classrooms. There was also a tutoring service provided by the school's APCO business partnership; this program was abandoned when the contact person at APCO was transferred to an adjoining County. The former Pleasant Middle School Principal had cultivated the APCO business partnership, and he had encouraged the teachers to pursue the tutorial program. Neither the Principal nor any Division Level administrator attempted to renew this relationship during the 1995-96 school year.

At the conclusion of the study the reform effort for one indicator (see Table 22) [teachers of mathematics know where and how to access the most up-to-date technical assistance in mathematics and science pedagogy, content, and educational research] declined from a peak status of Stage 4 to Stage 3. During the 1993-94 school year the school had a NCTM membership, but when the new Principal took over in the 1994-95 school year this membership was not renewed. Teachers knew that resources were available on line and in the NCTM journal and other *Standards*, but the school did not provide teachers easy access to these resources during the 1995-96 school year. The lead teacher had created a mathematics resource center where he provided access to all of the NCTM materials purchased with his own personal funds. All of the teachers were aware that the resource existed, and several of the teachers indicated that they wished they had time to use the resource center. Again limited finances and lack of time to take advantage of the available resources were identified as barriers to reform.

Two of the six systemic indicators peaked at stage 3 during the 1993-94 school year and maintained that during the 1995-96 school year. These two indicators follow: (1) School personnel consistently utilize college and university resources in their mathematics programs, and (2) Schools support alternative forms of assessment as outlined in NCTM Assessment Standards. A summary of the findings for this indicator show that the lead teacher was influential in keeping these reform efforts alive. Reform efforts for this indicator peaked with the V-QUEST Lead Teacher Institutes, but during the 1995-96 school year the Pleasant Middle School mathematics teachers did visit the mathematics resource lab at a local university, and the lead teacher did work with a V-QUEST presenter from VA Tech to write a grant, that was funded, to provide professional development on implementing

hands-on mathematics instruction. This inservice was provided on a weekend, and only two teachers from this study attended; they went to the University to participate in a two day workshop during the 1995-96 school year.

The *Glencoe* instructional materials provided teachers access to alternative forms of assessment, and the lead teacher shared ideas learned from V-QUEST and gathered from VA PEN resources. Every teacher in the study was observed using some type of nontraditional method of assessment, i.e., projects, interviews, models, and demonstrations. Traditional paper-pencil tests were still used in all of the classrooms, but during the 1995-96 school year assessment was not limited to traditional paper-pencil tests. It is likely that a combination of events helped reform efforts for this indicator remain consistent during 1995-96. The *Glencoe* instructional materials provided teachers access to alternative forms of assessment and encouraged the use of alternate forms of assessment to match the hands-on method of instruction. The teachers were in the third year of using the textbook, so they had time to become familiar and more comfortable with the instructional changes recommended. The mathematics lead teacher attended the state's professional development workshop on alternative assessment and shared his knowledge with several of the Pleasant Middle School teachers. Block scheduling provided teachers longer blocks of instructional time; therefore, teachers had more time to observe and talk with students during class. Progress was made on this indicator despite the fact that during the 1995-96 school year traditional assessment practices were still used at both the State and Division levels of the study.

The majority of indicators at the Classroom Level showed increased use during the 1993-94 school year just after the teachers and Principal attended the first V-QUEST Lead Teacher Institute. As documented in Level II of the study, the teachers and Principal worked together to implement reform of mathematics instruction at the middle school. The Principal showed an interest in learning about mathematics reform. He funded the purchase of mathematics instructional materials and professional development for the lead teacher, and he was described as providing enthusiastic leadership. His removal as Principal resulted in the removal of support for mathematics reform at the Building Level; within the next two years half of the reform efforts implemented during the 1993-94 school year at the Classroom Level were abandoned, and those that remained were still in the early stages of development.

### Building

The Building Level data were applicable to ten of the thirteen Systemic Indicators, and reform efforts for six indicators peaked during the 1993-94 school year (see Table 22);

four were ranked Stage 4, and the other two peaked at stages 3 and 5 (see Table 22). Reform efforts peaked in 1994-95 at Stage 3 for Indicator 1, which had to do with participation in telecommunications networking projects. The status of reform efforts for Indicator 13, alternative assessment, showed no change during the course of the study, and remained at Stage 0 in 1995-96. Reform efforts for Indicator 10, curricula, peaked during the 1995-96 school year at Stage 1, planning to implement, and the status of reform efforts for Indicator 3, providing access to telecommunications, was at its peak status during the 1991-92 school year and declined to Stage 1 by the 1995-96 school year.

Reform efforts for five of the six building-level indicators that peaked during the 1993-94 school year were abandoned by 1995-96, and a decline in reform effort was documented for the other indicator. Building-level reform efforts for three of the other four systemic indicators were ranked at Stage 1, planning to implement, during the 1995-96 school year, and reform effort for the other indicator remained at Stage 0, informed but no action taken. During 1993-94, when reform efforts for over half of the building-level systemic indicators were ranked at Stage 3 or better, it was documented that the building Principal provided leadership and support for the V-QUEST Lead Teachers. Artifact data were used to document that the 1993-94 Principal authorized the purchase of classroom sets of hands-on mathematics manipulatives and calculators for each mathematics teacher, an institutional membership to the NCTM for the school and the use of site-based funds to pay the expenses incurred by the lead teacher while attending the NCTM regional conference.

There were several changes that worked together to facilitate the successful implementation of reform efforts for at least seven of the ten building-level indicators during the 1993-94 school year. Teachers were organized into interdisciplinary instructional teams with four academic teachers having a common planning time. The new *Glencoe* mathematics textbook's design and content was based on NCTM *Professional Standards*, and it encouraged the use of hands-on activity-based mathematics instruction to provide for both conceptual and procedural understanding. *Glencoe* mathematics lessons also provided for the use of calculators and encouraged the use of technology for everything from gathering additional instructional activity ideas or information to suggested student applications and challenges. The mathematics teachers were provided classroom sets of instructional materials and calculators, and there were two V-QUEST Lead Teachers working with the support of leadership of an enthusiastic Principal. Reform of mathematics instruction was the focus of reform efforts at all levels of the school system during the 1993-94 school year. The 1993-94 school year showed systemic reform in action and making progress.

Classroom teachers and administrators faced two major problems concerning reform of mathematics instruction during the 1993-94 school year; they were (1) the 1985

*Standards of Learning* were still in place, and (2) traditional methods of assessment were still used to test students' proficiency of those standards at both the State and Division Levels. Although the informed administrators, schedule changes and up-to-date instructional materials encouraged instructional reform, student performance on computation and procedural tasks was still the driving force of curriculum content and methods of instruction used in the mathematics classrooms. When the focus of mathematics reformed was narrowed to the County's elementary schools, and the middle school Principal was moved to one of those elementary schools during the 1994-95 school year, reform efforts for the middle school declined for all seven reform indicators ranked as implemented at Stage 3 or better during the 1993-94 school year.

The only reform effort that was not abandoned during the 1994-95 school year was the efforts to train teachers in using telecommunications networking capability provided by VA PEN. The new Principal continued the Division's effort to meet the V-QUEST goal of providing every teacher access to networking through VA PEN, and by the end of the 1994-95 school year every teacher was trained in how to use the available networking capabilities and had a VA PEN account. The Principal did not show much enthusiasm for this effort because teachers had such limited access, but he completed the training as expected by the Division-Level administrators. He expressed concern over teachers' time being spent on learning how to use resources that weren't readily available, and by the 1995-96 school year access time for teachers to use VA PEN was cut in half; the use of VA PEN by Pleasant Middle School's mathematics teachers actually decreased.

By the 1995-96 school year the building-level reform efforts for five of the ten V-QUEST building-level systemic indicators were abandoned. The Principal no longer supported teacher participation in statewide mathematics conferences or professional meetings, encouraged or facilitated the use of parents and community resources in mathematics programs, worked with local universities or colleges to improve mathematics instruction, or attended professional development activities that focused on leadership in mathematics, and did not spend discretionary funds to support educational programs in mathematics to meet the V-QUEST goals. Through no fault of the Principal, teacher access to telecommunications actually decreased, and reform effort for Indicators 1 and 3, though not totally abandoned, declined back to Stage 1, planning to implement. Since the new Principal did not take on the mathematics reform leadership role, reform efforts for Indicator 4, teachers know where to access the most up-to-date technical assistance in mathematics pedagogy, content, and educational research, declined to Stage 3. Only the efforts of the lead mathematics teacher kept reform alive for this indicator. There was no progress documented at the Building Level on assessment reform, Indicator 13, but by the



end of the 1995-96 school year curriculum reform efforts, Indicator 10, were in the planning stages, and the Principal had participated in the planning stages of this reform effort in the County's Restructuring the Middle Initiative.

During the first year of the County's involvement with the V-QUEST Systemic Reform Initiative building-level reform efforts showed a sharp increase, but with the removal of the V-QUEST trained Principal there was a significant decrease in building-level reform efforts. By the time the State and Division withdrew support for the V-QUEST Lead Teachers, building-level reform efforts had declined or were abandoned for nine out of ten of the V-QUEST Systemic Reform Indicators. The exception to this was curriculum reform, and that reform effort continued in response to the State's mandate to implement the 1995-96 Standards of Learning; this resulted in curriculum reform effort moving from Stage 0 to Stage 1 at the Building Level during the 1995-96 school year.

#### Division

Twelve of the thirteen systemic indicators were applicable at the Division Level, and of those, reform efforts for six of the indicators peaked during the 1993-94 school year with rankings as follow: one at Stage 5, three at Stage 4, and two at Stage 3. Reform efforts for two of the indicators peaked during the 1994-95 school year at Stages 3 and 5, and reform efforts for Indicator 10, curriculum, peaked at Stage 1 during the 1994-95 school year. There was no evidence of reform efforts for two of the Indicators 5 and 13, collaboration with instructional materials producers and alternate assessment, and reform efforts for Indicator 3, teacher access to telecommunications, declined from the baseline year, Stage 3, to Stage 1 during the 1995-96 school year.

Reform efforts for all six systemic indicators that peaked during the 1993-94 school year and for one of the two reform efforts that peaked during the 1994-95 school year were abandoned during the 1995-96 school year. The seven reforms efforts that were abandoned by the end of the 1995-96 school year at the Division Level follow: (1) leadership in providing teachers with access to the most up-to date technical assistance in mathematics pedagogy, content, and educational research, (2) supporting teachers' and administrators' attendance at statewide mathematics conferences and professional meetings, (3) working collaboratively with public, private, and professional mathematics organizations to improve mathematics instruction, (4) leadership in utilizing parent and community resources in mathematics programs, (5) utilizing college and university resources to improve mathematics instruction, (6) administrators' participating in professional development activities that focused on leadership in mathematics instruction, and (7) spending discretionary funds to support educational programs in mathematics to meet the V-QUEST

goals. Division-level reform efforts for Indicator 1, schools actively participating in ongoing telecommunications networking projects, peaked at Stage 3 in 1994-95 and declined to Stage 1 during the 1995-96 school year. At the Division Level reform efforts for eight out of twelve systemic reform indicators were abandoned or in decline by the 1995-96 school year.

As for the other four Systemic Indicators, for two showed no evidence of progress over the course of the study, and at the end of the 1994-96 school year they maintained Stage 0 rankings. Reform efforts for the other two Systemic Indicators that were not abandoned during the 1995-96 school year were ranked at Stage 1, planning to implement. Division-level reform efforts for Indicators 3 and 10, teacher access to telecommunications and curriculum development, were in the planning stages at the end of the 1995-96 school year.

Reform efforts at the Division Level followed the same pattern as the majority of the reform efforts at the Classroom and Building Levels. For over half of the systemic reform indicators, reform efforts reached peak status during the first year of involvement with the V-QUEST Lead Teacher Institute, and then the majority of those reform efforts were documented as abandoned by the end of 1995-96 school year. The Superintendent's interview provided an informed overview of the plethora of ongoing reform implemented during the course of this study. The Division Level administrators provided enthusiastic support for the implementation of each one of these reform initiatives (i.e., Vanguard Schools, Core Curriculum, Individualized Computer Assisted Instruction, V-QUEST Systemic Reform, Restructuring the Middle Schools, Mathematics Task Force, rewriting curriculum guides to implement the 1995 Standards of Learning, and Tech Prep which did not involve the middle school). As one initiative replaced another, administrative support and encouragement for the previous reform initiative was withdrawn, and for the most part there was no follow-up on the results of the previous reform initiative. Every initiative brought changes into the classroom that were not supported by professional development, and for the most part teachers had little input on these changes.

The Division-Level administrators talked about needing and wanting mathematics instructional reform, while at the same time they continued focusing on improving computation scores on Division- and State-Level assessments through remediation. Alternative forms of assessment were not encouraged in mathematics in any way by Division-Level administrators. As the former Principal of Pleasant Middle School stated in his interview, during the summer of 1996 he and every other Principal in the County were preparing presentations of school improvement plans that explained how their schools intended to improve their students' scores on the LPT and the ITBS mathematics and reading assessments. Like the County's mathematics curriculum, there was a mismatch

between the instructional methods encouraged, the assessment practices used and the curriculum content.

The two Division-Level indicators rated S1, planning to implement, were telecommunications and the middle school curriculum. V-QUEST Lead Teachers were trained in the summer of 1993, and reform efforts were supported and strong at all levels of the study that year, but the 1985 Standards of Learning were still in place during the 1995-96 school year, calculators were not used for LPT or ITBS assessments, and improved computation skills remained the goal of mathematics reform. Mathematics instructional reform encouraged the increased use of technology for mathematics instruction, and methods of instruction promoted the development of conceptual knowledge as well as procedural knowledge. The 1985 curriculum and assessment practices were not compatible with the instructional methods encouraged by the V-QUEST Lead Teachers, and the new instructional materials; thus, the instructional reforms encouraged by the administration were supported by neither Division-Level policy or practice.

Lack of progress on the curriculum reform during the 1995-96 school year was due in part to a change of leadership at the Division Level and lack of leadership for the Mathematics Curriculum Committee. It was the summer of 1996 before the Gifted and Talented Resource Teacher was given process directives for writing the new curriculum, and at that point in time the committee had just started to collect data to determine where they needed to go. The Coordinator of Elementary and Middle School Instructional Programs, who had organized and chaired the Restructuring the Middle School Initiative which was responsible for the development of the mathematics curriculum subcommittee, left the County just as the Gifted and Talented Resource Teacher began chairing the Mathematics Curriculum Committee.

The number of administrators and teachers that attended professional development activities did increase after becoming involved with the V-QUEST Systemic Reform initiative, but financial encouragement for teachers to attend professional development activities was not offered. By the 1995-96 school year the number of teachers and administrators attending professional development for mathematics declined, but the administrators indicated that professional development was important and encouraged as much as possible. Financial encouragement was limited by the County's budget. This is best expressed by a comment made by the former Director of Research Development and Technology. Her description of the County's policy for encouraging teachers to attend conferences and professional development follows:

That was always a really interesting thing, and again its not peculiar to [Pleasant] County. You have only, generally speaking, in most school

divisions three percent of the total school budget that isn't already committed. I mean, by that I mean in fixed charges and fixed cost, so everybody is fighting for only three percent. Philosophically everybody that I ever talked to wanted teachers to be out [attending professional development], but how could they fund it? And how could they say to the teacher well we want you to go, but you are going to have to pay for it. So while there was an unwritten policy of we would really like people to go there was an actual policy of well now whose budget is that going to come out of? (p. 15)

As for professional development via telecommunications, the Superintendent and Division-Level administrators encouraged the use of technology in the schools and had developed and implemented a Technology Action Plan, but numerous improvements in the school building's technology capabilities were still in the discussion stages. At the end of the 1995-96 school year changes in the use of the WICAT computer lab were being discussed, and limited Internet access for teachers and classrooms was recognized as a problem. During the 1995-96 school year access to the Internet was still limited to the VA PEN server. The Director of New Initiatives suggested that the WICAT computer lab was outdated and needed to be replaced (p. 5). Every administrator indicated that getting technology into the classroom was essential for equitable educational opportunities of Pleasant County Students, but a limited budget made funding the purchase of equipment and the building improvements necessary for utilizing the equipment a challenge for Pleasant County's administration. The Director of New Initiatives stated point blank, "We're like a lot of poor school systems we don't have the money for that" (p. 24). As the Superintendent answered a question about the County's progress on implementing the goals of the Technology Action Plan he talked about the budget limitations. His statement concerning funding follows:

As much as is feasible [goals of the Technology Action Plan are implemented]. Like any action we set goals and hope you can achieve them, and some years we've been able to do better than others because of funding, and funding is a **key** component in this process because without it the technology simply cannot be purchased, and as you know we've been through some mighty rough times over the last five years. The action plan in most situations we've been able to accomplish a good percentage of the action plan each year. But not everything that's on the plan every year, but it's a constant changing project. What we don't accomplish this year we simply move into the next year's goals and objectives and try to accomplish

those next year. In some cases the action plan itself has had to change because of the changing technology, an example: Internet access for the first year or two wasn't a major component. Now it is. So it's again depending on availability of equipment and funding.

One thing we run into is even if we had enough money to buy eighty truckloads of computers and servers and provide the access, I don't have the infrastructure to support such technology right now. Our school buildings need to be changed, and we've got an action plan on that, but that's major that's going to involve about fifty million dollars with the renovation and building in order to do what's going to have to be done with technology. We're going to have to make those significant changes, and funding is holding us up of course. (p. 9)

Reform of technology was planned and implemented, but in the early stages. Improvements in technology were dependent on building renovations and adequate funding; thus, progress in this area was minimal.

Data indicated that school-division personnel knew how to access and work collaboratively with public and private agencies, and professional mathematics organizations. As was established with the interview data, the Pleasant Middle School former Principal and the County's Superintendent were both active participants in the V-QUEST Systemic Reform Initiative, and administrators were involved in grant writing, which resulted in several grants being funded (i.e., the Demonstration School at Duncan Elementary School, hands-on inservice workshop through VA Tech, and the Tech Prep Program). The County had organized business partnerships for each of its schools, had managed to get a bond funded to support the purchase of computer labs for the County's schools, and had orchestrated an incentive buying package for IBM with a local bank and the IBM Corp. Although Division-Level administrators had collaborated to develop the Tech Prep Program with the local community college, all efforts at the middle school level were abandoned. As mentioned previously, APCO was Pleasant Middle School's business partner, and when the contact person was transferred, the Superintendent did not renew or establish a new business partnership for Pleasant Middle School. So as far as systemic reform of mathematics education at the middle school reform efforts related to this indicator were abandoned.

The systemic indicator ratings revealed a picture of Division-Level administrators who were committed to and involved in the reform of mathematics education, but who were not able to consistently sustain support for any one reform initiative. The County's curriculum and assessment practices were still not compatible with the goals of the new

instructional materials nor the suggested methods of instruction. Although professional development for teachers was viewed as essential to the success of mathematics instructional reform, the County was able to provide little assistance or encouragement. Changes in the use of technology for mathematics instructional were planned, but no changes had occurred by the end of the 1995-96 school year. Administrative Leadership for the V-QUEST Lead Teachers had changed hands three times in two years, and the Superintendent withdrew administrative support for the middle school V-QUEST Lead Teachers at the beginning of the 1994-95 school year. This was a school system in transition with the mathematics teachers caught in the middle with no support or leadership. As the Associate Superintendent stated, “. . . what we have said to people about change is— how you change is optional, that you change is not optional” (p. 23).

### State

Seven of the thirteen Systemic Indicators were applicable at the State Level, and five of those reform efforts peaked during the first two years (1993-94 and 94-95); one ranked at Stage 1, one at Stage 4 and three at Stage 5 (see Table 22). Reform efforts for one of the indicators (see Table 22) peaked during the 1991-92 school year at Stage 1, and the peak status for reform efforts for the other indicator was reached during the 1995-96 school year at Stage 3. By the 1995-96 school year three out of the five State-Level reform efforts that peaked during the 1993-94 and 95-96 school years had declined one stage, one was abandoned and one maintained its peak status of Stage 1.

The systemic indicators that showed decline in reform efforts during the 1995-96 school year were (1) school actively participates in ongoing telecommunication, (2) schools participate in statewide mathematics conferences, and (3) teachers are provided access to national mathematics conferences and professional development opportunities via telecommunications. By 1995-96 State-Level leadership and support for reform efforts for Indicator 4, teachers know where to access the most up-to-date technical assistance, were abandoned with the withdrawal of support for the V-QUEST Lead Teacher Institute, and the cut in funds for VA PEN. Reform in technology was sporadic and frustratingly slow for all levels of the study, and the common problem mentioned by every administrator concerned with the purchase of technology was lack of funds.

The State adopted its new SOLs in June, 1995, and the Counties were given the directive to create mathematics curriculum guides to implement the new Standards. During the 1995-96 school year the State organized and presented workshops for different regions of the State on how to write curricula, and the Chairperson of the Mathematics SOL Committee for Pleasant County stated that she attended a mathematics curriculum Share

Fair held during the 1995-96 school year. At the end of the 1995-96 school year Pleasant County had just started the mathematics curriculum writing process, but there were no changes made in the middle school curriculum during the 1995-96 school year; therefore, Pleasant County's 1995-96 middle school mathematics curriculum was not based on the State's framework. Although no changes were evident in the middle school's curriculum, the State had adopted new SOLs and mandated that Counties write new curriculum guides to implement the new SOLs. The State also provided some leadership but no funds for the curriculum writing process, thus the rating of Stage 1, planning to implement, was assigned this indicator for the 1995-96 school year.

All of the State-Level administrators commented about the State's plans to replace the LPT assessment with a new assessment tool aligned with the 1995 SOLs. The State had also written, published and distributed an alternative assessment resource book for teachers, but no inservice training was provided other than to the lead teachers during the summer of 1994-95. The State-Level administrator described the process that was being used to create the new assessments, and this process was in the early stages. Although the State had provided each school with a copy of its resource guide for alternative forms of assessment for classroom use, the proposed inservice training needed to help teachers implement these changes in assessment was not provided. Therefore, reform for this indicator reached its peak status during the 1995-96 school year at Stage 1, planning to implement. This is a significant result for a State-Level system reform indicator in that the instructional changes encouraged by the State's V-QUEST Lead Teacher Institute in the summer of 1993 were not compatible with the curriculum guidelines or assessment goals that were in place at that time. As documented the State did not adopt its new curriculum until June of 1995, and Pleasant County was just beginning the process of creating its new curriculum guidelines to implement these SOLs at the end of the 1995-96 school year. In 1995-96 plans to replace the state's LPT with assessment instruments correlated to the 1995 SOLs were in the initial stages; as a result no Division-Level changes in assessment were in place by the conclusion of this study.

The State-Level results for Indicator 13, peaking in 1995-96 at Stage 1, are significant in that Pleasant Middle School mathematics teachers were expected to improve their students' performances on the State and Division Levels' yearly assessments. Consequently, teachers were required to focus mathematics instruction on improving procedural knowledge and computation skills, which was the opposite of the mathematical instructional reforms encouraged in the 1993 V-QUEST Lead Teacher Institute. Teachers were placed in an instructional dilemma because the changes in mathematics instructional material's content and the methods of instruction encouraged by V-QUEST were not

compatible with the Division- or State-Levels' curriculum guidelines or assessment practices.

Results of the State Level systemic reform indicators reveal a slow pace of State-Level reform in the two crucial areas of reform— curriculum and assessment, left the lead teachers without the structural support necessary to successfully implement mathematics instructional reform. When the State provided support and leadership for reform through the V-QUEST Systemic Initiative and the Lead Teacher Institutes, reform efforts for over half of the systemic indicators applicable at each level of the study were ranked at Stage 3 or better, but by 1995-96 the majority of the classroom, Building and Division Levels' indicators were ranked as abandoned and the majority of the State-Level reform indicators showed a decrease in activity. Through the V-QUEST Lead Teacher Institutes and the State's VA PEN technology the State literally opened up lines of communication between teachers all across the State and with the VDOE. The Principal Mathematics Specialist K-8 made presentations at the V-QUEST Lead Teacher Institutes and encouraged teachers to stop being a "sage on the stage" and become the "guide on the side". State-level leadership and support was there for the first two years of the V-QUEST Lead Teacher Initiative, but after that funds were reallocated to fit a regional model for State-Level professional development and training, the V-QUEST Systemic Reform Initiative was not supported, and reform efforts at all levels of the study dropped off accordingly.

The State Level administrators in this study indicated that the lead teachers already trained and in place should continue on with their reform efforts, but by the end of 1995-96 school the Pleasant Middle School lead teachers were totally on their own. From the perspective of Pleasant Middle School's lead teacher funds were provided to support V-QUEST's reform efforts during the first two years from the State Level and for only the first year at the Division Level. During the two years that reform was supported and encouraged, neither the State's or the County's curriculum guidelines matched the instructional changes encouraged by the V-QUEST Lead Teachers. Both assessments, the State's Passport Literacy Tests and the Standardized ITBS, prohibited the use of calculators, and both assessed learning mathematics by evaluating students' mastery of arithmetic computation and procedural skills. When the State finally adopted a new set of SOLs that were supportive of the instructional changes encouraged by the V-QUEST Lead Teacher Initiative, and started talking about reforming assessments to match the new curriculum, support for the V-QUEST Systemic Reform Initiative was withdrawn. During the 1995-96 school year, when critical pieces of systemic reform were being put into place, the lead teachers were left to implement bottom up reform with no top down support.



### Summary

There were a total of 36 systemic indicators coded for the four Levels of the study, (i.e., Classroom, Building, Division and State) with reform effort rankings provided for each indicator for three significant points in the study (i.e., 1991-92 baseline status, peak year status, and/or 1995-96 status). These data showed how reform efforts for each indicator performed over time, and each indicator's data patterns match one of the change categories described next. The change patterns for the indicators' reform rankings are defined as follows:

- (1) **Peaked and Declined**— If an indicator peaked prior to 1995-96 and then declined,
- (2) **Abandoned**— If an indicator peaked prior to 1995-96, and then all reform efforts ceased,
- (3) **Increased**— If an indicator increased by the 1995-96 school year,
- (4) **Unchanged**— If an indicator showed no change from the baseline ranking.

A summary of the change category ratings for the systemic indicators for each level of the study are organized in Table 23 according to the number of indicator patterns that were classified at each category, and a summary of the results of all 36 applicable indicators is presented in the total column.

Table 23  
Systemic Reform Indicator Change Patterns

Change Categories	Number of Classroom Level Indicators	Number of Building Level Indicators	Number of Division Level Indicators	Number of State Level Indicators	Total Number of Indicators
Declined	1	3	2	4	10
Abandoned	3	5	7	1	16
Increased	3	1	1	2	7
Unchanged		1	2		3

As Table 24 shows 72% of the reform efforts peaked prior to the 1995-96 school year and then 61% of those reform efforts were abandoned while the other 39% showed a decline in the reform efforts. It was documented that for the majority of these indicators categorized as declined, reform efforts peaked at Stage 3 or 4 during the 1993-94 and 1994-95 school years, which were the years that all four levels actively participated in the V-QUEST Systemic Reform Initiative. Only 8% of the reform efforts showed an increase in

effort during the 1995-96 school year, but those systemic indicators proved to be significant, in that they all addressed mathematics curriculum reform. It was also interesting to note that three of the four indicators that showed reform efforts maintained through 1995-96 were at the Classroom Level, which supports the findings in Level II of the study concerning the documentation of mathematics reform in the classrooms. There was evidence of some instructional reform in every classroom observed, and these data show that the Classroom Level had the highest percentage (42%) of indicators with reform efforts maintained through the 1995-96 school year. At all four levels of the study there was a pattern that showed reform efforts for the indicators peaked during the two years that the V-QUEST Systemic Reform Initiative was active, and that there was a noticeable decrease in those reform efforts at all four levels of the study after the 1994-95 school year.

Only 8 % of the systemic indicators' reform efforts were categorized as unchanged, which indicated that they showed no reform progress since the baseline 1991-92 school year. The other 92% of the systemic indicators showed progress in reform efforts at some point during the five year study. Although about half (53%) of the systemic indicators that showed progress were categorized as abandoned by the 1995-96 school year, reform efforts for other 47% of the system indicators were still active during the 1995-96 school year. The majority (71%) of the systemic indicators in which reform efforts remained active were categorized as declined, but reform efforts for these indicators were **not** abandoned. When the percentage of indicators categorized as abandoned or declined was combined with the percentage of indicators with reform efforts at Stage 1 or 3 during the 1995-96 school year, there was overwhelming evidence of success of the V-QUEST Systemic Reform Initiative with 86% of the reform indicators ranked at Stage 3 or better at some point in the study, but the problem as with all reform initiatives, was sustaining that reform. Therefore, to complete the documentation of systemic reform it was necessary to look at the status of reform efforts for each indicator at the end of the 1995-96 school year.

The number of systemic indicators ranked at the five different Stages of Reform Ratings is presented for each level of the study in Table 24 that follows. Reform efforts for fourteen of the systemic indicators were ranked at Stage 1, 3 or 4 which indicated that 39% of the reform efforts for systemic reform were active at the end of the 1995-96 school year. At the Classroom Level 50% of the reform efforts started were still active at the end of the study, and 42% of these reform efforts at the other three levels were in Stage 1, planning to implement. Although the State abandoned its Systemic Reform Initiative in 1995-96, and 58% of the indicators, status of reform efforts were ranked as Stage 2, abandoned, or Stage 0, no action taken, there was evidence to document systemic reform at each level of the study during the 1995-96 school year.

Table 24  
Indicators per Rating for Systemic Reform

Stage of Reform Rating	Number of Indicators per Level				
	Classroom	Building	Division	State	Total
Stage 5 Implemented Successfully					
Stage 4 Implemented but needs work				2	2
Stage 3 Implemented but in the early stages	3	1		2	6
Stage 2 Implemented but abandoned	3	5	7	1	16
Stage 1 Planning to implement		3	2	1	6
Stage 0 Informed but no action taken		1	3	1	5

The numerical data were deconstructed and analyzed in terms of patterns of change and the status of reform efforts for each indicator in the 1995-96 for each level of the study and then reconstructed to form generalizations. For the majority of the systemic reform indicators, reform was implemented and progress was anywhere from the early stages of reform to being implemented successfully during the 1993-94 and 1995-96 school years. It is significant to note that by the 1995-96 school year no indicators' reform efforts were ranked at Stage 5, successfully implemented. However during the peak years of the study, six systemic indicators' reform efforts were ranked at Stage five, and they all were at the Building, Division and State Levels. Most of these indicators had to do with technology telecommunications and working with Universities and professional organizations to improve mathematics education. V-QUEST provided an opportunity for all of these agencies to work together, and introduced the resources that technology made available to the classroom teacher.

Although none of the 1995-96 systemic indicators' reform efforts were ranked at Stage 5, implemented successfully, 38% of the indicators' reform efforts were ranked at Stage 1, planning to implement, or Stage 4, implemented but in the early stages. The results of the systemic reform indicators showed that reform of mathematics education was in progress during the 1995-96 school year, and the Level II classroom results showed that change in mathematics content and instruction was taking place in the classroom. These

results indicated that the V-QUEST Lead Teacher Institute did have an impact on mathematics education in Pleasant Middle School, and that systemic reform did show some degree of success in reforming mathematics education, but the majority of the reform efforts reached peak status during the years V-QUEST was active.

The curvilinear nature of the reform efforts indicated that the V-QUEST Systemic Reform Initiative fell into what is commonly referred to as the Bandwagon effect of reforms. Everyone jumped on board when the reform was fresh, but due to jumping with equal enthusiasm into the next reform movement, which in this case was reforming curriculum at the Division Level and reforming assessment at the State level, many of the reform efforts implemented with V-QUEST were not sustained. Generalizations from the numerical data alone do not provide a complete summary of the complex story of systemic reform, but they do provide a simple method of explaining the conclusions that were drawn from the analysis of Level III data.

The goal of this portion of the study was to place the change evidence that was documented in Level II of the study and in the analysis of the State Level administrators' interview data into a matrix with the thirteen V-QUEST systemic indicators to document systemic reform. Two of those indicators had to do with technology and professional development; two were concerned with professional development and professional organizations; three were concerned with connecting schools with their local communities and surrounding public and private resources for professional development and improvement of mathematics education; one had to do with administrative leadership; one was about curriculum; one was about instructional materials; one was about assessment; and one was about financial support for reform. The conclusions drawn from Level III data concerning the documentation of systemic reform of mathematics will be organized around the seven topics addressed by the systemic indicators. Since systemic reform means bottom-up reform with top-down support, the conclusions will be presented from the view point of Classroom-level reform as to the support provided by the Building-, Division- and State-level administrators.

Conclusions concerning the documentation of systemic reform are presented next beginning with technology reform in the classroom.

1. Technology— The mathematics lead teacher and a colleague provided inservice on how to use VA PEN and every teacher in Pleasant Middle School had a VA PEN account. All levels of administration encouraged this reform, but there were no funds at any level to supply the teachers easy access to the technology needed, and at the end of the study the State had cut teacher access time in half. Implemented but in the early stages.

2. Professional Development— The mathematics lead teacher attended every professional development opportunity offered, and attempted to share his knowledge with the other mathematics teachers in the building. The State provided professional development through V-QUEST, and for one year the Building and Division Levels supported the mathematics teachers in professional development opportunities. After the first year financial support for the middle school mathematics teachers was withdrawn at the Building and Division Levels and then the State cut funding for V-QUEST at the end of the 1994-95 school year. Implemented and abandoned.

3. Connections— At the Classroom Level a business partnership was established through the efforts of the Principal and Superintendent which resulted in an after school mathematics tutoring program, interdisciplinary instructional units were implemented into mathematics classrooms and guest speakers from local businesses and agencies were used. The lead mathematics teacher made connections with professional educators at VA Tech through V-QUEST, and the Superintendent worked with local universities and colleges on various grants. A change in leadership at the middle school, and a change in focus of leadership at the Division level resulted in the business partnership being abandoned. A change in schedule which resulted from the restructuring the middle school initiative caused interdisciplinary units to be abandoned. The amount of contact between local universities and the school system declined considerably with end of V-QUEST. Implemented but abandoned.

4. Curriculum— The teachers were working under the curriculum guidelines that matched the State's 1985 SOLs and assessments. The new *Glencoe* instructional materials and the V-QUEST recommended instructional reforms were not compatible with the 1985 SOLs that were in place. In June of 1995 the State adopted new SOLs, but the curriculum guideline had not changed at the Division Level. Planning to implement.

5. Instructional Materials— Teachers had the task of reviewing and adopting textbooks, and by 1995-96 State Level policies had changed to remove administrative leadership for this process. The indicator stated that school-division personnel know how to access and work collaboratively with instructional materials producers, and there was no evidence that indicated that any progress had been made on this reform indicator. Informed but no action taken.

6. Assessment— As with the curriculum the new *Glencoe* instructional materials and V-QUEST instructional reforms were not compatible with the assessments that were in place with the 1985 SOLs. The alternative assessments provided in the *Glencoe* teaching materials and with the 2nd year V-QUEST Lead Teacher Institute were compatible with the instructional reforms suggested, but did not prepare students to perform well on the

computation and procedural based assessments used at the State and Division Levels to evaluate student's progress in mathematics. Although the State had prepared an alternate assessment notebook for mathematics, no inservices were provided for teachers other than the workshop provided at V-QUEST on how to use the materials. All of the teachers talked about trying new forms of assessment, but all still relied mainly on traditional paper-pencil tests for assessment. The State was just beginning the process of reforming the State-Level assessment instrument therefore, no activity had taken place at the Division Level on assessment reform. Planning to implement.

7. Financial Support— Successful implementation of reform for everyone of these indicators depended on financial support in some way. For technology, money was needed to update the infrastructure in the building, purchase hardware, purchase software, maintenance of equipment, provide technical assistance, and provide professional development to teachers. Without the V-QUEST grant the State was hard pressed for finances to provide professional leadership and development to all its school division's mathematics teachers, the State also needed money to fund teacher access to VA PEN and to help school divisions provide the technology needed to update the mathematics classrooms. When the school system worked with the local colleges or universities, it was usually on a grant to get finances to implement a reform initiative or provide a professional development opportunity that neither of them could afford to do on their own. Every educator interviewed in this study talked about the need for professional development, but there were no finances to support these endeavors. Teachers at Pleasant Middle School received financial assistance for professional development during the first year of the V-QUEST Lead Teacher Institute, and after that financial support was withdrawn. Teachers were expected to volunteer their own time and efforts for professional development work in the school division such as writing a new curriculum, or providing teacher inservice. The systemic indicator for this specifically stated that school divisions use a significant portion of discretionary funds to support educational programs in meeting the V-QUEST goals. Implemented but abandoned.

According to these generalized results systemic reform was documented in six out of seven of the systemic indicator goals. Half of those efforts were abandoned and half were in the planning or early stages of reform by the 1995-96 school year. Therefore, for the sake of putting the V-QUEST Systemic Reform Initiative somewhere on the reform continuum between 0% successful and 100% successful; it would fall in at a little less than 50% successful. Again, mathematics reform was observed to some extent in every mathematics classroom that participated in the study.

## Chapter VII

### Summary, What Was Learned, Benefits

The last chapter begins with a descriptive summary of the results of this study with the participants' voices used when appropriate in the telling of the five-year story of reform. What was learned from the study includes a discussion of the obstacles encountered by and the facilitators of the V-QUEST reform initiative, as well as problems encountered in documenting systemic reform. The chapter concludes with this study can benefit future reform initiatives or reform research.

#### Summary of the Study and Major Events

Data were collected for this five-year study to document systemic reform at Pleasant Middle School during the 1995-96 school year through observations, interviews, and artifacts. Artifact and interview data were used to reconstruct the 1991-92 baseline data and to track and document change in mathematics education through the interim years to the 1995-96 school year. This was accomplished through instructional materials, curriculum, assessment, and administrative artifacts and interview data collected across four populations of the study (i.e., Classroom, Building, Division, and State). Since the purpose of the study was to document systemic reform of mathematics in the middle school, this summary of events is told as much as possible from the perspective of the middle school mathematics teachers. The summary begins with a brief description of the climate for reform in 1991-92 school year that was set in motion by national events.

Since the publication of *A Nation At Risk* in 1983, the need for mathematics education reform was publicized, and change was demanded. In response the NCTM published its 1989 *Curriculum Standards* which described the curriculum, pedagogical and assessment changes needed to accomplish mathematics reform to bring America's classrooms into the technology age. This was followed by the NCTM 1991 *Professional Standards* that explained how teachers could use mathematical tasks, classroom discourse, learning environment and assessments to implement mathematics reform. Mathematics reform was elevated to a national concern, and during the 1991-92 school year Pleasant County was involved in two major reform initiatives, the State's Vanguard Middle School program and the Division's Technology reform.

The first year that Pleasant Middle School was selected as one of the State's Vanguard Middle Schools was 1991-92. During 1991-92 the State was in the process of middle school reform, and middle schools that met the State's standards of middle school reform were designated Vanguard Middle Schools. Vanguard Schools were expected to

serve as model middle schools for other schools in the State to visit and emulate. To achieve Vanguard status Pleasant Middle School changed from an exemplar of a traditional departmentalized junior high school to an exemplar of a middle school with small academic instructional teams and a student advisory program. Teachers were expected to stop teaching individual subjects and to start using interdisciplinary instructional units, cooperative learning, cooperative discipline, and technology for mathematics instruction.

With a half-day cooperative-learning inservice at the beginning of the 1991-92 school year, Pleasant Middle School teachers changed from departments to interdisciplinary instructional teams, took on the role of advisors to a designated group of students, started teaching extended learning classes, and opened their classrooms to teams of visiting teachers from all over the State. In addition to all these changes mathematics teachers were also involved in implementing a major technology reform: individualized computer assisted teaching (WICAT). In a half-day workshop mathematics teachers were trained in how to use the computer lab technology, and then they were expected to provide individualized computer assisted instruction for every student in Pleasant Middle School. The mathematics teachers were told what changes to make, and, other than schedule changes which were made at the administrative level, the teachers were left on their own to make the expected changes.

The next school year, 1992-93, Pleasant County applied for and was accepted as a participant in the State's V-QUEST Lead Teacher Initiative. At the very least reform initiatives were overlapping, and in many cases there were reforms happening inside of reforms. The State initiated curriculum reform with its Core Curriculum project, and the Division, following the state's lead, had organized mathematics teachers by grade levels to reform the County's curriculum to match the State's Core Curriculum design. The teachers at each grade level worked on their own time to create a new Core Curriculum guideline that was adopted by the County in the 1993-94 school year but was abandoned almost as soon as it was published with the election of a new Governor.

In addition to writing curriculum, the 1992-93 school year was mathematics textbook adoption year in Pleasant County. As documented the State no longer published a recommended list of textbooks, but instead moved the responsibility of overseeing the textbook review process to School Divisions. Pleasant County in turn passed the responsibility to the mathematics teachers, and the teachers again worked on their own time with no support, leadership or guidance to develop a textbook selection process that resulted in the adoption of the *Glencoe* mathematics textbook for the County's middle schools.

This was also the year the V-QUEST Lead Teachers were selected, and during the summer for 1993 the two teachers selected to represent Pleasant Middle School attended a



two-week V-QUEST Lead Teacher Institute in Clinch Valley. The lead teachers were supported by their Principal who attended the two-day administrative portion of the Institute, where he enthusiastically worked with them to set reform goals for the following school year. The Superintendent was also an active V-QUEST participant. He was supportive of the County's lead teachers and agreed to fund released time, two hours a month during 1993-94, for the County's V-QUEST Lead Teachers to share ideas and support one another as they worked together to implement mathematics reform. The Superintendent also agreed to fund professional development for the lead teachers, and he appointed a Division Level administrator as the coordinator of the V-QUEST Lead Teachers' activities. The County had 16 V-QUEST Lead Teachers trained during the summer of 1993, but only four of those were middle school lead teachers; the others were elementary teachers.

The first change in Pleasant Middle School's mathematics classrooms occurred during the 1993-94 school year that the replacement of the traditional *Addison-Wesley* textbook by the NCTM-based *Glencoe* textbook. This was the second time in less than three years that teachers were expected to change their methods of instruction, and again no inservice or professional development other than a half-day inservice provided during the summer by the textbook company to familiarize the teachers with the book's design and available resources. Mathematics teachers were expected to change from a traditional behaviorist method of instruction to a constructivist method of teaching using hands-on materials, new methods of discourse, new content, and alternate forms of assessment. The lead teacher offered to provide the mathematics teachers inservice after school on using hands-on activity based instruction and problem solving to create student-centered classrooms, but the mathematics teachers expressed no interest in attending after-school workshops.

With the support of the school's Principal, the lead teacher did accomplish one of the reform goals that they created during the summer of 1993, to conduct a needs assessment among the mathematics teachers. As a result for this assessment, calculators and new instructional manipulatives were purchased for every mathematics classroom teacher. Every teacher and County administrator in the study expressed the need for staff development in how to use these new materials, but other than the V-QUEST Lead Teacher Institute and follow-up drive-in workshops no inservice was provided during the 1993-94 school year.

As agreed the Superintendent funded two hours of release time for the County's V-QUEST Lead Teachers to meet at the school board to share ideas for the implementation of mathematics reform and act as a support group for reform. Leadership for the V-QUEST Lead Teachers was provided by the County's V-QUEST administrative contact, but before

mid year she left the County and the V-QUEST coordinator's position was passed to the Director of Research Development and Technology. She stated in her interview that she was not a mathematics educator and felt that she was out of the V-QUEST loop in the County. She also stated that she thought the V-QUEST Lead Teacher coordinator's position should have been given to a curriculum person, and in the 1994-95 school year the position was passed to the Gifted Resource Teacher K-5. Pleasant Middle School's V-QUEST Lead Teacher attended these meetings and used the time to develop the survey used to determine the instructional needs of the mathematics teachers at Pleasant Middle School and to prepare an inservice on teaching mathematics through problem solving, which he presented to the elementary teachers.

Pleasant Middle School's Principal had proved to be an enthusiastic leader of reform: His school was in the newspaper; he brought parents into the building with the Principal's Coffees; he funded the purchase of instructional materials for mathematics teachers, professional development and membership to NCTM; and he developed the school's business partnership with APCO into a working relationship (in his words for "more than just giving donations"). The middle school V-QUEST Lead Teachers lost support and leadership for mathematics reform in the summer of 1994. During the summer of 1994 the V-QUEST Lead Teachers learned that their Principal had been moved to one of the County's elementary schools, and that a new Principal was hired for Pleasant Middle School. When they attended the one-week V-QUEST Lead Teacher Institute, the new Principal did not attend the administrative portion of the Institute, and he never took on the leadership role of mathematics reform at the middle school. The Superintendent narrowed the focus of mathematics reform to the elementary schools, and he put V-QUEST trained administrators in strategic positions of leaders for the County's elementary schools. The County's Gifted Resource Teacher K-5 had been trained as a lead teacher before taking that administrative position and becoming the Coordinator for the County's V-QUEST Lead Teachers.

To be accepted as a participant of V-QUEST the Superintendent had pledged to support the County's lead teachers for five years of professional development and reform efforts, and during 1994-95 the County honored that pledge to its Elementary V-QUEST Lead Teachers. They continued to receive two hours a month release time, and with the Gifted and Talented Resource Teacher's leadership they continued to actively work to reform mathematics in the County's elementary schools. The middle school V-QUEST Lead Teacher, however, was placed on the task force of a new reform initiative, Restructuring the Middle School. In the middle of the V-QUEST mathematics reform initiative, the Superintendent introduced this new reform initiative which, after a year of

work, resulted in the second schedule change since the beginning of this study and in the formation of a mathematics curriculum subcommittee. In addition to his work on Restructuring the Middle School Initiative, the lead teacher did manage to create and, for the most part, fund a mathematics resource center for Pleasant Middle School's mathematics teachers, and he continued to relay information concerning professional development when it was provided to him. He provided inservice on the use of VA PEN and helped set up VA PEN accounts for all teachers in the building.

During the 1995-96 school year State-Level funding for teacher access to VA PEN was cut in half, and funding for the V-QUEST Lead Teacher Institutes was withdrawn. At the Division level support for the County's V-QUEST Lead Teachers was not renewed, and the administrators focused on reforming mathematics at the high school level with the implementation of the new Tech Prep program. At Pleasant Middle School the new block schedule was implemented and, again, teachers were strongly encouraged by the administration to change methods of instruction, but, again, no inservice or staff development was provided. The move to block scheduling was not a direct result of the V-QUEST Systemic Reform Initiative, but it was systemic change that supported the implementation of the NCTM suggested mathematics reforms, and the mathematics lead teacher was an active member of the Restructuring the Middle School Committee. With the length of mathematics classes doubled, teachers could no longer rely solely on traditional methods of instruction; they were forced to incorporate different methods of instruction. By the 1995-96 school year every mathematics teacher in the study was observed using methods of instruction suggested by the NCTM *Standards* to some extent.

The change to the new *Glencoe* instructional materials and then the move to block scheduling prompted several of the mathematics teachers to consult with the lead mathematics teacher and observe his class instruction, and they talked about making time to use the mathematics resource room that the lead teacher had single handily set up and organized. He worked with the Coordinator of Elementary and Middle School Instructional programs in conjunction with one of the V-QUEST instructors and VA Tech to secure a grant to fund a two-day hands-on mathematics instruction workshop at VA Tech that was attended by the V-QUEST Lead Teacher and one seventh grade mathematics teacher. The V-QUEST Lead Teacher took an active part in all of these reform initiatives, and he functioned as a reform leader in his school. However, when the mathematics lead teacher was asked in 1995-96 if he had positively influenced other mathematics teachers in the building, he said emphatically, “**Nope**” (p. 2).

Although the lead teacher did not feel successful, the data indicated that he was an active V-QUEST Lead Teacher who had many successes. After attending the two-week V-

QUEST Lead Teacher Institute, he completed a needs assessment for the mathematics department, and, with the Principal's approval, site-based funds were used to purchase needed mathematics materials for every mathematics classroom. For two years he conducted workshops on VA PEN and problem solving, but mathematics teachers from his building did not attend his workshops. He attended NCTM regional conferences and all of the professional development opportunities offered by V-QUEST. He set up and partially funded a mathematics resource center at Pleasant Middle School where he made available all of the NCTM *Standards*, the related *Addenda* various sources of hands-on instructional ideas such as the *AIMs* materials, examples of projects used for assessment and instruction, and professional journals. He provided teachers with copies of all professional materials that he received, and he offered to share teaching ideas with all of his colleagues in any manner that they preferred, i.e., inservice workshops, one-on-one conferences, or sharing written materials. He acted as a reform leader by modeling many of the suggested instructional reforms and opening his classroom to any teacher interested in visiting. He was an active member of every Division Level reform initiative that involved the middle school or mathematics. He took on the responsibilities of co-writing a grant that funded the two-day, hands-on mathematics instruction workshop in conjunction with VA Tech and created a mathematics pretest for the County's sixth graders. For the second time in less than five years, he was involved in rewriting the County's middle school mathematics curriculum. But, when the mathematics lead teacher was asked if he felt that he had made any progress in reforming mathematics instruction in his own school, he said, "NO" (p. 3).

The accounts of the mathematics lead teacher's activities during the 1995-96 school year provide contradictory evidence. With the assistance of new instructional materials, technology, and block scheduling the reform of mathematics instruction had progressed. Every mathematics teacher in the study was observed using small-group hands-on methods of instruction at some point during his or her five-day observation. The *Glencoe* mathematics instructional materials were based on the NCTM *Standards* and included mathematical content and instructional methods supportive of the NCTM recommendations. The use of calculators or instructional manipulatives was observed at least once in every class room, and there was evidence of an increased use of projects for instructional and assessment purposes. Although the use of technology for mathematics instruction was minimal, it was built into every mathematics teacher's schedule. Interview data concerning the activities of the mathematics lead teacher indicated that with all these changes, lines of communication for sharing ideas about new instructional techniques, methods, and materials opened between the mathematics teachers and the lead teacher. The lead teacher readily

agreed that as a lead teacher he had many additional responsibilities, and he had a long list of accomplishments, but at the end of the 1995-96 school year he did not feel that his efforts as a lead teacher had been successful in his own school.

The following interview data depict how the mathematics lead teacher was actively involved in reforming mathematics instruction at Pleasant Middle School one teacher at a time. The 1995-96 Principal's comment about the reform of mathematics instruction and then the mathematics teachers' comments about working with the mathematics lead teacher help tell this story. As the new Principal of Pleasant Middle School talked about the reform of mathematics instruction he stated the following:

Well, I think that [reform of mathematics instruction] is the intent of the V-QUEST Lead Teachers. [The mathematics lead teacher] has made efforts to do that, and in some cases [he] has been well received. Other teachers have been a little more hesitant. (p. 5)

When asked if the mathematics teachers were made aware of the available resources for mathematics instruction, the mathematics lead teacher made the statement that follows:

Everything I get I make copies of and pass it on to the teachers. There is a *GEMs* workshop this summer that they have a chance to go to if they want to. I have bought with my own money *AIMs* books and walked around and said, look what I have. This is great; you might want to try it, and it was always I don't need that stuff, but, yes, anything I get I pass on, **on time**. It either come[s] directly to me or [the Principal] passes it on— (p. 17)

The eighth grade teacher was asked if she interacted with other teachers in the building to improve mathematics instruction, and her response included information about working with the mathematics lead teacher. Her response follows:

I think so. Well [name of mathematics lead teacher], of course, is a lead teacher, he is up on what materials we have and that kind of stuff. He is always telling me, you know, like the other day, I said, I needed something on scale drawings, and he said there were some math activities in this *AIMs* book that are good. . . . It used to be that everyone went in their own little room, and shut the door, and nobody really knew what anybody else was doing. I think it helps us all when somebody else has tried something different and says it works, makes you more willing to try it too. (p. 14)

In the statement that follows, the female sixth grade teacher stated that the mathematics lead teacher did help her:

I talk with [the lead mathematics teacher]. He helps me occasionally, helps me if there are some interesting problems for me to do. (p. 16)

The male sixth grade mathematics teacher indicated that he collaborated with the lead mathematics teacher. His statement:

Yeah, I talk to [lead mathematics teacher] all the time. If something comes up in that book that I am not sure of, or that I am not real comfortable with, . . . and they [students] have heard me say several times, hold on to this. I will find out from someone else. I will talk to [lead mathematics teacher] this afternoon, and I will have your answer tomorrow. I talk to [lead mathematics teacher], I talk to several others, you know in finding out what this means, and what do I need to do there, or is this answer right. Sometimes we have found mistakes in the book. (p. 25)

The former Principal made the following comment concerning the lead teachers' progress in implementing reform in mathematics instruction:

. . . I know that the two lead teachers had some real battles, but they kept just chipping away at, and you started seeing it creeping into the classroom, and I think it was, the thing that, the good I saw out of the V-QUEST project, it wasn't really administrative pressure, it was more of a peer pressure. Sometimes it was hard to, to deny that good things were going on in these classrooms because you could see it. You could see it with the kids. You could see excitement. (p. 4)

Just as the data document that the mathematics lead teacher did take an active role as leader of mathematics educational reform, they also document that the lead teacher faced numerous obstacles. When all of the obstacles to reform are collected and presented at one time it is easy to understand why the mathematics lead teacher did not describe his efforts as successful. As the lead teacher talked about his years as a V-QUEST Lead Teacher, there was a sound of defeat in his voice.

### What Was Learned

This section the obstacles that were encounter in implementing systemic reform are identified and discussed as well as the facilitators of reform. These are followed by a discussion of the problems encountered in documenting systemic reform.

Systemic reform was defined as bottom-up reform with top-down support. All areas and levels of education were expected to change and work together to support mathematics reform in the classroom. The ultimate goal was to get instructional change into the mathematics classrooms, which for V-QUEST meant changing teachers' beliefs and practices. The areas of education that needed to change to support systemic reform of mathematics were identified in V-QUEST's Systemic Indicators, and various levels of the

educational system were responsible for making these changes. They all eventually affected the classroom teacher, some more profoundly than others. Regardless of the number of successful administrative changes made, if changes in the mathematics classroom did not occur, then reform did not occur.

For reform to be successful classroom instruction had to change. Teachers had to change the mathematics content and what they were doing in the classrooms so that students became active learners instead of passive learners. For this to happen teachers had to change their beliefs about teaching and learning; no administrative changes in policy, procedures or mandates could accomplish this. The lead teacher was the key to successful bottom-up reform that was required for teachers to change their beliefs about teaching and learning. Teachers needed to be informed of the latest research on best practice for teaching and learning, and the lead teacher was both trained and knowledgeable of the pedagogy encouraged by the NCTM *Standards* and had experience with constructivist methods of instruction. For reform to take place, mathematics teachers needed to be knowledgeable of the subject matter, and they needed to know how to use that knowledge to facilitate students in making connections with mathematics and how to distinguish between conceptual and procedural knowledge. The lead teacher was knowledgeable of mathematics content, and his classroom served as a model of teaching by guiding rather than by telling.

Obviously the best chance for successfully changing teachers' beliefs about teaching and learning, and, thus, changing mathematics instruction in the classrooms, was to provide extensive and on-going professional development for every mathematics teacher in the State. However, finances at all levels of education made this solution impossible. The next best scenario for successful change, therefore, was to train lead teachers so that they could take the message of reform back to their schools' teachers and function as local leaders of mathematics reform. The key to success here being that the lead teachers took responsibility for reform leadership, and that they provided teachers with the quality on-going professional development necessary for this mathematics reform to be implemented. This is why V-QUEST asked the Superintendent for a five-year commitment of financial and administrative support for the County's lead teachers. Change would not happen overnight, and it would not happen all at once. For mathematics reform to be successful, teachers had to have time to learn, and they had to have support for implementing changes into the classroom; the lead teachers could not accomplish this single handedly.

The lead teachers needed time to plan and conduct the professional development necessary to implement reform, and this required top-down administrative support. The lead teachers needed money to purchase materials and supplies for quality professional development, and they needed administrative leadership to arrange for professional

development opportunities to be offered so that teachers participated. Just as important to the success of the lead teachers in implementing reform was the need for support and encouragement for these efforts from Building and Division Level administrators and fellow lead teachers. The regular, but limited, and funded released time of two hours a month for the County's V-QUEST Lead teachers to meet and work together with the Division's V-QUEST Lead Teacher Coordinator was provided for one year for the middle school V-QUEST Lead Teachers.

For Pleasant Middle School's V-QUEST Mathematics Lead Teacher to actually effect change in veteran mathematics teachers (who had experienced reform after reform and were so comfortable in the traditional methods of instruction that their lesson plans consisted mainly of a page number with a set of problems), it took more than just a knowledgeable lead teacher with leadership ability and administrative support. Major changes in the system were needed. There needed to be a reason other than "current research says the best practice is. . ." for teachers to change. Teacher resistance to putting time, energy and effort into reform was embedded with the unspoken learned attitude of "this too shall pass." Major changes in the school system or the "status quo" of the business of teaching were needed for the lead teacher to successfully implement mathematics reform, and these changes in curriculum, assessment practices, instructional materials, and organization could only come from Division and State Level administrators.

The findings of this study of systemic reform revealed the following:

1. The V-QUEST Lead Teacher was the key component of the systemic reform Initiative for implementing mathematics reform in the classrooms. The lead teacher was responsible for implementing bottom-up reform.

2. The V-QUEST Lead Teacher's success was confounded by inconsistent Building and Division Level administrative support over time in providing:

- time for planning and implementing necessary professional development
- encouragement, particularly in the form of financial support of, professional development, purchase of instructional materials and current technology, and
- leadership in organizing reform efforts and involving the community, local colleges and university, and professional organizations in improving mathematics instruction.

3. The V-QUEST Lead Teacher's success was frustrated by the failure of Division and State Level administrators in making the essential policy and procedural changes that supported and encouraged mathematics reform in classrooms, especially those essential changes listed here:



- timely design and implementation of curriculum guidelines that were supportive of the recommended mathematics instructional reform,
- timely provision of assessments that were compatible with and supportive of the methods of instructions and curriculum recommended by mathematics reforms,
- timely provision of instructional materials necessary to implement instructional reform,
- timely implementation of organizational structures and schedules that facilitate instructional reform in the classroom, and
- timely and consistent provision of leadership and support for reform efforts over time.

4. The pattern of reform efforts documented in the study revealed the band-wagon effect; participants jumped in enthusiastically but did not sustain the reform effort.

5. The study documented a rather overwhelmingly continuous flow of reform initiatives that often overlapped. This supports Fullan's conclusion that knowing how one single innovation is implemented is not the complete story. He stated that schools are not in the business of implementing one innovation after the other but are in the business of implementing multiple innovations simultaneously (Fullan, 1993, p. 120).

### Obstacles to Reform

The data provided evidence of many obstacles to reform faced by the lead teacher. There were the obvious obstacles of money, time and inconsistent leadership, and then the not-so-obvious obstacles of resistance to change and conflicting educational policies and beliefs. Perhaps the mathematics lead teacher could not see his successes because he was overwhelmed by the many obstacles that he encountered in his attempts to reform mathematics teaching in his building. Each obstacle to reform faced by the lead teacher is presented as much as possible through the voices of the participants beginning with obvious obstacles of money and time, then by the problems caused by changes in leadership and ending with documentation of the not-so-obvious obstacles of reform, resistance and conflicting educational policies.

#### Obstacles: Money, Time and Administrative Expectations

Every mathematics teacher and administrator interviewed stated that inservice and professional development was needed for mathematics educational reform, but the mathematics teachers would not voluntarily participate in after school inservice opportunities offered by the mathematics lead teacher, and the County did not have the resources to fund inservice during the school day. Pleasant Middle School was a member of the NCTM for only one of the five years covered by this study, and, although the administrators all

encouraged teachers to participate in professional development, there was little money available for supporting teachers in these endeavors. For two years beginning in the 1993-94 school year, the mathematics lead teacher conducted at least two workshops a year on how to use the Internet, problem solving and manipulatives for teaching mathematics. With no compensation for his time or efforts, the mathematics lead teacher presented these workshops to elementary teachers in the County and to groups of teachers in other school divisions, but the mathematics teachers in Pleasant Middle School did not participate. Only one of the other five mathematics teachers in the study attended the hands-on workshop for teaching mathematics that was provided at Virginia Tech during the 1995-96 school year by a grant that the Lead Mathematics Teacher helped write.

Time, or more appropriately the lack of time, was a major obstacle to the reform effort. Although Pleasant County's lead teachers were provided two hours of release time each month during the 1993-94 school year to plan methods of implementing mathematics instructional reform, there was no time provided during the school day for the lead teachers to meet or work with colleagues. For the mathematics lead teacher, time to work with other teachers was only one concern. He also had to make time to serve on numerous committees, attend professional development opportunities and to do all the extra jobs that were assigned, i.e., writing curriculum, grants, and assessments; designing and presenting workshops; organizing and establishing a mathematics resource room; inventorying and ordering teaching materials; working with fellow mathematics teachers one on one, and participating in this study.

Time was also one of the major obstacles to the reform of the use of technology for mathematics instruction. There was not enough time provided for the students to adequately benefit from the use of the technology that was available. There was not enough time available for teachers to use the limited technology resources available to them; therefore, there was little incentive for teachers to attend the lead teacher's workshop that was designed to help teachers learn how use the computer to enhance mathematics instruction. As documented throughout the study, both time and money were significant obstacles to the advancement of the use of technology for mathematics instruction.

Another serious obstacle that had to do with time was being involved with so many reform initiatives that there was never enough time for consistent leadership; therefore, once reforms were implemented, there was no follow-up support for or evaluation of the reforms. The exception to this was the Individualized Computer Assisted Instruction. The County provided support for this educational reform by providing funds for a lab technician at each school in the County, and five years after the implementation of the computer labs, success of computer-assisted teaching program was being assessed. The amount of time spent

preparing teachers for change was minimal, and there was **no** time spent supporting teachers in making changes or evaluating progress during this five-year study.

Although attempts were made to involve teachers in planning change and opportunities were provided for teachers to have a say in the decision making process, few of the teachers in this study, other than the lead teacher, invested any time in the decision making or planning stages of any of the reform initiatives. Teachers were expected to change, but no time or money was invested by the administration on professional development to prepare teachers for change or on follow-up evaluation or support of change. After each change was mandated, the administrators moved on to making preparations to implement the next reform initiative, and there was no time to provide follow-up support for the previously mandated reforms.

During the five years of this study teachers were expected to change methods of classroom management three times, moving from *Assertive Discipline* to *Cooperative Discipline* to Glasser's (1992) *Quality Schools*. At the same time mathematics teachers were expected to change methods of classroom instruction from whole-group direct instruction to small-group, hands-on instructional activities, from instruction that focused on teaching isolated subjects to the use of interdisciplinary-instructional units. Teachers were also expected to change from the traditional *Addison-Wesley* behaviorist-based instructional materials to *Glencoe's* constructivist-based instructional materials. The mathematics departmental organization for teachers was replaced with academic teams of teachers; individualized instruction was replaced with cooperative learning; teacher-centered mathematics classrooms were expected to change to student-centered classrooms; and the daily schedule changed from 45-minute class periods to 90-minute blocks of instructional time!

In addition to all these changes mathematics teachers were expected to implement a CARE program where they were to serve as counselors to students, design and implement extended learning classes (eliminated with the move to block scheduling), implement computer-assisted teaching, use calculators and manipulatives in the classroom, and utilize the resources provided by telecommunications technology to enhance mathematics instruction in the classroom. As a Vanguard School for the State, classroom teachers were expected to serve as models of best middle school practice for teachers from all over the State. They were also expected to write and implement the new Core Curriculum (abandoned in the same year it was published). Reforms were prolific, and every reform except computer-assisted instruction was implemented with little to no time or money invested in preparing teachers for change and with no money or time spent on follow-up support or evaluation.

The former Principal talked about the V-QUEST mathematics reform efforts his last year as Principal in the statements that follow:

Interviewer: . . . Did the County do anything to encourage your involvement [in V-QUEST reform]?

Former Principal: **NO.** (p. 4) . . .

Interviewer: Did you find anything in particular that hindered progress; was there any roadblock that you felt got in the way of making changes?

Former Principal: Teacher resistance, financial— I mean, oh, you can never have enough money, but at the same time operating on a shoe string is tough. Having the resources necessary for supporting a quality program. Having support from the top down not just in the, I reckon, it's easy to say yeah I support the program, but to actually show it. I think of [Director of the V-QUEST Lead Teacher Program] and the way he shows support, the support for the program. He's willing to go the extra distance that's required. (p. 24)

The money was simply not available to provide the lead teacher with the time and materials necessary to conduct professional development within the school day, and, with all the other reforms that teachers were expected to implement as best they could with no compensation for time spent outside of school, it is not surprising that they were not jumping at the change to attend after school inservice sessions offered by the lead teacher.

#### Obstacles: Leadership and Support

The V-QUEST Lead Teacher program was designed to provide support and leadership for the lead teachers' reform efforts by involving every level of education in the V-QUEST Systemic Reform initiative. State level administrators were involved with the V-QUEST Systemic Reform initiative from its inception, and only school divisions that could provide a designated County level administrative contact and follow-up support for its trained V-QUEST Lead Teachers were chosen to participate in the program. The Principal of every school that was selected to participate in the V-QUEST program was expected to participate in at least three days of inservice training with the V-QUEST Lead Teacher program, and finally the two-week and one-week Lead Teacher live-in Institutes were designed to build enthusiastic supportive communities of teachers dedicated to the reform of mathematics instruction. In the three years after Pleasant Middle School's teachers and Principal attended the first two-week lead teacher Institute, the administrative contact for Pleasant County's V-QUEST Lead Teachers changed three times.

When the mathematics lead teacher was asked if there had been any feedback or follow up or evaluation as to whether mathematics instruction had improved since being involved with V-QUEST, he said, “**NO**, [laughs] if there has been any feedback it’s been from myself” (p. 16).

The Principal who attended the administrative portion of the V-QUEST Lead Teacher institute with Pleasant Middle School’s lead teachers described how he tried to support mathematics reform and how the support from the top seemed to erode after the first year. His comments:

Lot of trying to get V-QUEST in front of the Board, a lot of meetings still continuing to meet with the lead teachers throughout the County on a regular bases. Trying to keep that spirit that was there at Clinch Valley alive. A lot of frustrations were starting to creep into it. That feeling that maybe from the top down it wasn’t viewed as something important, and so it was still a very active involvement with it. I know that some of us went and talked to the summer group that next summer when they went to Hollins college. I reckon my feeling over all was this County abandoned it. It was there, and then suddenly it was like well we’ve done that and now we don’t have to do anything else with it. I doubt seriously that the [1995-96] Board members even know what V-QUEST is. (p. 8)

Leadership at the Division Level was inconsistent. In less than three years the administrative contact who was in charge of coordinating Pleasant County’s V-QUEST Lead Teacher reform efforts changed three times. Initially the Director of Research Development and Technology was the V-QUEST administrative contact, but when she changed jobs and left the County, the Director of Research and Technology was appointed as the V-QUEST Administrative Coordinator midway through the 1993-94 school year. She stated that there was not a good match between her expertise and the expertise that she felt was needed for the Coordinator of the County’s lead teacher program. After the one-week V-QUEST Lead Teacher Institute in the summer of 1994 the County shifted its focus of reform to the elementary schools, and the Gifted and Talented Resource Teacher was placed in the position of V-QUEST Administrative Coordinator for the 1994-95 school year.

There were twenty lead teachers trained in Pleasant County, and four of those were middle school teachers from two different middle schools. The other sixteen V-QUEST Lead Teachers were from eight elementary schools. Although this study did not focus on all the lead teachers in the County, the data implied that educational reform in mathematics, science and technology was more active at the elementary level than at the middle school

level during the 1994-95 school year. There was a stronger support base for reform initiatives at the elementary level that helped perpetuate a climate for change thus reducing resistance to change.

An even more significant administrative change for Pleasant Middle School's lead teachers was the Division Level decision to transfer Pleasant Middle School's Principal to one of the County's elementary schools and to hire a new Principal for the middle school. With this administrative change the mathematics lead teacher lost the supportive leadership and encouragement necessary for implementing Classroom and Building Level reform. He did not get the enthusiastic support from the new Principal that he had received. The former Principal had visited his classroom and showed genuine excitement for what was going on in the classroom. The former Principal of Pleasant Middle School stated that he had selected the eighth grade mathematics teacher as the V-QUEST Lead Teacher representative for Pleasant Middle School because he had a great deal of confidence and faith in this teacher's ability to influence change in mathematics instruction. The data also documented that the former Principal was involved in the V-QUEST reform initiative, that he championed the lead teacher's cause and that he provided support and encouragement. The mathematics lead teacher's comment concerning the new Principal conveys disappointment. His comment follows:

. . . [The 1995 Principal] will not come to my room. I invite him to come see activities. He will not set foot in my room. . .when we build our measurement activities and things like that, I'd say, come on up and watch them build their houses. It's real interesting, well anyway. . .

Interviewer: Do you interact with any school division noninstructional personnel to improve mathematics instructions such as the Principal—

Mathematics Lead Teacher: —I've talked with [Gifted and Talented Resource Teacher], I've talked with [Director of the Gifted and Talented Education], and I guess that's it.

Interviewer: How about with the [new] Principal, or—

Mathematics Lead Teacher: —well I've tried to talk to [new Principal] but he's computation oriented. (p. 8)

Although the V-QUEST Systemic Reform Initiative was intended to be a five-year program, the State eliminated support for V-QUEST at the end of the third year; thus, by 1995-96 all administrative support for V-QUEST Lead Teachers was withdrawn. Although the V-QUEST reform initiative had a longer life with more follow-up support than most reforms implemented by the County, by the 1995-96 school year bottom-up reform with

top-down support did not exist. The bottom was left with no support and leadership from the top.

### Obstacle: Teacher Resistance

The data document teachers' resistance to reform resulted from three sources: (1) resentment of what was perceived as power, (2) a firm belief in traditional methods of instruction, and (3) general apathy that resulted in passive resistance to reform. Interview and observation data from the participants are used to illustrate the resistance that the mathematics lead teacher encountered while attempting to lead the reform of mathematics instruction at Pleasant Middle School. Much of the interview data contain evidence that applied to more than one reason for resistance; therefore, the presentation of the data will overlap in some cases.

Presentation of data concerning teachers' resistance to reform due to resentment of the lead teacher's power begins with a statement made by the former Principal while he talked about the lead teacher's accomplishments. His comments follows:

Pleasant Middle School is a school that does not accept change, does not want in some cases to change, very comfortable with the status quo. Very comfortable with— I've done it this way for years it's worked before, and it will work again. So there were deep pockets of resistance ah, there were some pockets of resentment that these two people were selected ah, that there wasn't a lot of faculty input on it. I made the decision, so I know that the two lead teachers had some real battles, but they kept just chipping away. . . (p. 4)

. . . [Pleasant] Middle School is probably one of the most unique places that I've every worked in my life. Some very deeply embedded ideas and beliefs that will probably never change. Reform is hard at best. Change is difficult even in the best of situations. It is something that I feel as a County that needs to be looked at. There needs to be some shifting of personnel between the middle schools, and there needs to be a refocus of leadership. . . . (p. 25)

In the interview exchange that follows the mathematics teacher expressed his frustration in trying to be an effective lead teacher.

Interviewer: Do you interact with other teachers in the building to improve mathematics instruction?

Mathematics Lead Teacher: I attempt to, but I'm not successful with that.

Interviewer: Well now two of the teachers I worked with said that they worked with you.

Mathematics Lead Teacher: Mr. [sixth grade mathematics teacher] and Mrs. [sixth grade mathematics teacher], OK yeah, yeah. Sixth grade teachers are great. Seventh grade teachers hate me. [Eighth grade teacher] is resentful. [Seventh grade teacher] is real friendly to me, but I know she talks about me behind my back. . . . [Eighth grade social studies teacher] and I have always been friends, but he has talked about me for the last two years now. . . . Well, you know what they say? That I have [the Principal] in the palm of my hand. That I had [the former Principal] in the palm of my hand. . . I tried, when I came back from V-QUEST I was excited. This is reinforcement. I know these people [Pleasant Middle School mathematics teachers] are doing these things, but now I've got more activities and ideas that I can share with them. They were resentful.

Interviewer: Well, give me some examples of when you did get to share.

Mathematics Lead Teacher: Well a bunch of times we just sit down and talk. Like with [the sixth grade teacher] we just sit down and talk about some math stuff, individually. I tried to do workshops, and I would send out a needs assessment, and I say— OK. I would send out a note that we are going to try and have this workshop would you attend it ? **NO**— so. (p. 21)

As the science lead teacher talked about working at Pleasant Middle School as a V-QUEST Lead Teacher she said, “Meeting the other [V-QUEST Lead] Teachers certainly made it worth while. Even if we come back to our own schools, and our teachers are mean to us, the fact that we all have each other, has just been great, it really has” (p. 3). When asked what her biggest road block was to reform, she made the comment that follows:

Probably the teachers at our school not understanding why the two of use were chosen to be the lead teachers, and they don't. They sometimes feel threatened or insecure about V-QUEST because they don't really understand what's going on, and I would wish that people would choose just to be positive about it, and use us as a resource, and not be threatened by anything we say or do, or be aloof or be negative. . . . and there is a lot of that insecurity or negativity. (p. 12)

After the first year the V-QUEST Science and Mathematics Lead Teachers conducted a satisfaction survey, and the results were disappointing. The science lead teachers' description of those results follows:



. . . after that first year of V-QUEST, we did a survey, and everything, and they really didn't feel like a lot had been done for them. Even though we did exactly what they wanted [or] asked us to do, which was to put notes in their mailboxes and pass things around and give them money. But they really did feel like not very much had been [done]. . . (p. 2)

The seventh grade teacher expressed her view of mathematics instructional reform in the statement that follows:

At the beginning of the year, all of the students were given a survey test based on what they came to me able to do. Basic skills are the weakest point. Simple addition, subtraction, multiplication, and division for all of them. I understand students are no longer being required to learn multiplication tables. I differ with that greatly, and I cannot let it, let them leave me without having to learn some, and one of the reasons so much of what I have taught this year, the basic math of adding, subtraction, multiplying and dividing is just a step in the process of solving the problem, but if you can't do that then they are lost with the other concepts. They should in my opinion be able to recall simple facts without thinking. I know that it is a great exercise, but the thinking should be reserved for a higher level. (p. 6)

It was this teacher's view that reform of mathematics instruction equaled handing the students calculators and not teaching basic arithmetic skills and procedures anymore, and she was definitely opposed to this and not supportive of the reform initiative.

The majority of the instruction observed for the female sixth grade teacher was traditional, and when asked about any changes in her methods of instruction over the past five years she stated, "I don't really think so. I did it long enough, and I decided my way" (p. 9). It was documented that the other sixth grade and seventh grade teachers were in the process of changing their methods of instruction, both tried to make more connections between mathematics and the real world and between mathematical concepts that were taught. Both teachers attempted to develop conceptual understanding as well as procedural understanding and both teachers were observed using small group instructional activities and problem solving, but both teachers continued to think for the students and tell them how to solve the problems that were posed. Even though both teachers were introducing new content and incorporating many of the suggested instructional reforms, the traditional method of teaching by telling was still the dominant method used by the teachers for mathematics instruction. As a matter of fact, every teacher in the study was observed at some point during the five days of observation using the traditional methods of whole-group-direct instruction and drill-and-rote paper-pencil practice.

### Obstacle: Multiple Reform Initiatives/Administrative Expectations

The data were used to establish a history in Pleasant County of participation in multiple reform efforts with little or no inservice training provided for teachers, and no follow-up support or evaluation of reform initiatives. The State Department K-8 Principal Mathematics Specialist described this obstacle to reform as “change undoing change.” In the following excerpt from her interview she describes the problem saying:

. . . there are teachers out there that I don't know how we're going to change them. You know change is very difficult, and ah, because change has been undone so many times in the past people are just waiting for this, you know, they say— this, too, will pass. . . and unfortunately people are just hanging back, and they're doing it the same old way.

Interviewer: Change has been undone, I haven't heard that phrased quite that way.

K-8 Principal Mathematics Specialist: Well unfortunately, [we both say] It has! Every time we [laughs], every time, you know, something's put in, then everyone jumps on the band wagon tries to implement it, and then it's undone by something else or even the fact that new things come along and undo what you've worked up in the past. So truthfully, it's kind of an elective kind of an approach. I think the best teachers are the ones that save the best from the past and find some new things ah, I think, you know, you have to use the computers at times, you use calculators at times, you do direction instruction at times, you do cooperative learning at times. You know, you use all kinds of instructional strategies, and teachers that have been in the business for a while will have developed wonderful lessons for this or that, and I guess I think even my own experience in teaching as, you know, over time I worked on— I chose a new topic, and I worked it up in a new way, and then I had that lesson in place for years to come, and, I guess, that's what we would have to hope for teachers they are, they are putting effort into making some changes each year to improve what their doing, and they're picking up on new bandwagon ideas, and trying to implement them on things that seem to align best with them and so, I mean that's what I would hope for teachers. That's what I would be doing. (p. 15)

During the course of this study there were at least six examples of change undoing change.

(1) The implementation of the *Quality Schools* Program replaced the changes made by the *Cooperative Discipline* Program.

(2) The move to block scheduling made it extremely difficult for teachers to continue the use of interdisciplinary instructional units in the seventh and eighth grades.

(3) Block Scheduling eliminated the extended learning classes that teachers had created.

(4) The efforts of the Core Curriculum Project were undone by the initiative to rewrite the 1985 Standards of Learning.

(5) the change of instructional materials from the *Addison-Wesley* textbook to the *Glencoe* textbook attempted to replace years of traditional-focused instructional practice.

(6) The adoption of the *Glencoe* instructional materials and the instructional reforms promoted by the V-QUEST Lead Teacher Initiative were not compatible with the computer assisted teaching goals.

One of the sixth grade teachers verbalized the sentiment of jumping on the reform bandwagons as she talked about teachers having or not having input in reform decisions. Her comment follows:

I think that when we restructured the middle school that was the point in involving us, because they wanted to or not, but I was never asked. I think it was just done. Because [Pleasant] always just says— OH! in California they are doing this, but of course by the time that we get around to doing it, California has decided it doesn't work, but we go ahead and do it anyway. So, I don't think that it [heterogeneous grouping] will last very many years. Hopefully not, of course I don't know. (p. 20-21)

Not only was there no consistent leadership for reform, there was not a consistent vision for reform. In a climate of constant change, which often seemed to happen just for the sake of change, it was extremely difficult to maintain enthusiasm for any one reform initiative, including the V-QUEST Systemic Reform Initiative. Then there was the more serious problem of reform goals being incompatible of educational policies of curriculum and assessment.

#### Obstacles: Incompatible Reform Goals, State Standards and Administrative Expectations

In 1995-96 the Associate Superintendent and Superintendent were still promoting memorization of procedural knowledge or instrumental understanding as the focus of mathematics instruction; therefore, the philosophy of the administration did not match the instructional philosophy of the V-QUEST Lead Teacher Initiative or of the NCTM *Standards* which encouraged educational experiences that facilitated construction of

conceptual knowledge to support procedural knowledge, or relational understanding. There was a definite conflict of philosophies apparent in many of the mathematics teachers as well. There were teachers who were knowledgeable of the reform recommendations but did not agree with them and would continue teaching in their tried-and-true methods.

As documented in this study it was three years after the implementation of the V-QUEST Systemic Reform Initiative that the State adopted a curriculum that was compatible with the changes promoted by the reform. Although counties were mandated to rewrite curriculums to implement the State's new SOLs, this had not happened during the 1995-96 school year at Pleasant County. The mathematics teachers were just beginning the task of rewriting the curriculum during the summer of 1996.

#### Obstacle: Conflicting Assessment Practices

Another serious conflict existed between instructional methods, curriculum and assessment practices. The State's Literary Passport Test and norm referenced Iowa Test for Basic Skills were still the assessments in place for the 1995-96 school year. Neither allowed for the use of calculators, and both focused on testing for mastery of computation skills and procedural knowledge. Mathematics instruction reforms suggested the focus of instruction be on teaching for relational understanding, and it was recommended that more emphasis be placed on conceptual understanding and less emphasis be placed on procedural knowledge, however, the emphasis of the assessment instruments did not reflect this change, and teachers and students were still held accountable for mastery of basic skills, first and foremost. In the following statement, the Superintendent of schools talks about the need to improve students' performance on these assessments saying:

Well just that I think we ah, this [reform of mathematics education] is one of our greatest areas of concern right now. We have some bright spots in mathematics in the County and in one classroom in one grade level in one school to another, but we are not consistent across with that success, and right now our concern is to get our mathematics program up to speed with respect to new demands in society, and have our teachers and our program lined up with those needs to where we see results that are much better than the results that we've been seeing, i.e., the ITBS or our own assessment strategies that we're using, but we need to see a better performance on the part of our students, and its going to take some overhaul. (p. 33)

When the Superintendent was asked if he had noticed any changes in the mathematics program at Pleasant Middle school he made the statement that follows:

Changes in the program? . . . I'm not aware of any unique material or programmatic changes. I am aware that the block schedule has been added. I am aware that the computation scores are the lowest in the County, and we're very concerned about that. (p. 30-31)

It is obvious from this statement that teachers at Pleasant Middle School were strongly encouraged to improve students' computation scores, which placed an instructional emphasis on an area that reform suggested receive decreased attention. For reform to happen in the classroom, teachers had to change what they were doing in the classroom which required them to change their beliefs' about teaching and learning; and for that to happen assessment had to be compatible with the beliefs about teaching and learning. The mathematics lead teacher faced an up-hill battle in implementing mathematics reform. In an interview that followed the classroom observations, he explained that he used the drill-and-rote computation practice to prepared the students for the ITBS test that was coming up in the next couple of weeks. He also indicated that written practice was essential in learning rote computation. Every mathematics teacher in the study relied mainly on traditional paper-pencil tests for assessment because the use of calculators was not permitted on the ITBS or LPT assessments. Even the teachers who were trying to change what they were doing in the classroom felt compelled to continue to teach by showing and telling and then having the students copy what they had shown them. The assessments used in the 1995-96 school year were not compatible with the instructional reforms that V-QUEST recommended be implemented into the 1993-94 mathematics classes.

#### Obstacles: Summary

The obstacles faced by the mathematics lead teacher were extensive, ranging from (1) conflicting educational polices, to (2) lack of consistent administrative support, expectations and leadership, to (3) constantly changing expectations from multiple reform initiatives that were seldom evaluated or supported with professional development or follow-up. These circumstances made it extremely difficult to generate any real excitement or enthusiasm for any one particular reform initiative. The County Superintendent made it clear that success of the mathematics program was measured by the students' scores on the Standardized ITBS test and the State's LPT assessment, and these data indicated that due to the latest test scores the use of individualized computer assisted instruction was to be reevaluated. Assessment practices had not changed at the State or Division Level, and the curriculum had not changed at the County level, but mathematics teachers were expected to change methods of instruction. For teachers to implement the suggested instructional reforms the focus of mathematics instruction had to change; this resulted in instruction that

was not compatible with the County's Curriculum Guidelines or Division and State level assessments. Not only were the teachers bombarded by reform initiatives that were not supported with needed professional development, teachers were placed a professional dilemma.

Despite all these obstacles the mathematics lead teacher acted as a leader for reform, and, rather remarkably, instructional reform was documented to some extent in every classroom in the study. With so many on-going reform initiatives it is difficult to attribute success to any one aspect of reform including the efforts of the V-QUEST Systemic Reform Initiative and its Lead Teacher Program, but in the same vein it is impossible to ignore the influence of this initiative in the changes that took place. By definition, systemic reform is all levels of education working together to implement change through policy, structure, and practice. Bottom-up reform with top-down support existed for two years in Pleasant County, and in that time progress was made. Although changes in policy were slow, every educator was aware that changes in curriculum and assessment were underway.

#### Change Facilitators

Several changes at Pleasant Middle School facilitated the mathematics lead teacher's efforts to reform mathematics instruction in the classrooms: (1) first, the adoption of the new *Glencoe* instructional materials which promoted the changes in content and instructional practice recommended by the NCTM *Standards* and by the V-QUEST Lead Teacher Institute; (2) second, the move to block scheduling which doubled the length of seventh and eighth grade mathematics classes; (3) third, the change to heterogeneous grouping for mathematics instruction in sixth grade classrooms; (4) fourth, the purchase of manipulatives and calculators for mathematics classrooms; (5) fifth, changes in the use of computers for mathematics instruction; (6) sixth, changes in the use of calculators for mathematics instruction; and (7) seventh, the adoption of new State SOLs.

The change of instructional materials and the move to block scheduling were pivotal changes for instructional reform. Although the mathematics teachers showed no interest in attending inservice or workshops offered by the mathematics lead teacher, after the instructional materials and schedule changed one-on-one communication between the lead teacher and the mathematics teachers increased. Both changes forced teachers to make changes in their methods of instruction, and several teachers turned to the lead teacher for ideas, suggestions and leadership. Two of the sixth grade teachers visited the lead teacher's room to observe his instructional methods, and all of the teachers expressed an interest in sharing ideas about instructional activities that worked. All of the participants acknowledged the need for inservice training to learn how to use the new materials, manipulatives,

calculators and computers to enhance mathematics instruction; all of the participants were aware of the changes recommended by the NCTM *Standards*. When the Coordinator for the V-QUEST Lead Teachers, Gifted Resource Teacher for K to 5, was asked if the lead teacher concept was successful she made the following statement:

I don't think its working as well as originally hoped it would, but certainly it's working. I mean, any time you can reach a small portion of the teachers that you hope to reach, then it's going to be successful, but I know the people who were directly trained are doing things differently, and I think its branched out to quite a few other people, too. So I think yeah its successful, but I'm sure not what they originally had hoped. (p. 9)

At the end of the 1995-96 school year reform of mathematics instruction was underway to some extent in every classroom involved in the study, and, although the V-QUEST Lead Teacher did not feel successful, the evidence documents that his efforts were an essential part of the progress made in reforming mathematics instruction at Pleasant Middle School.

#### How What Was Learned Fits into Current Research

This section begins with the presentation of a brief history of the progress of NSF Statewide Systemic Initiatives that were funded around the same time Virginia's V-QUEST Systemic Reform Initiative was funded and implemented. After the general accomplishments and goals of systemic reform are discussed, the findings of this study are connected to the current research by comparing them to the strengths and weaknesses identified in various Statewide Systemic Initiatives (SSI). This section concludes with a summary of how the findings of this study informed current research.

#### A Brief History of the Progress of NSF Statewide Systemic Initiatives 1991-2003

According to the *1998 Program Effectiveness Reviews (PER) Report Statewide Systemic Initiatives (SSI) Program [1998 SSI Report]*, since 1991 NSF funded Statewide Systemic Initiatives (SSI) for 25 states for terms of up to 5 years of funding and of up to approximately \$2.0 million per year. As of 1998, the Foundation had provided approximately \$265 million to stimulate and catalyze selected, high-quality, systemic reform efforts (p. 3). After describing the method of evaluation used for the SSI programs, the report provided information on what was called the phase-out process that follows:

Phase-out process: As a result of the SSI management and oversight system, the NSF determined that some initiates had not achieved an acceptable level of development in their science and mathematics education reform efforts.

Therefore, SSI awards were phased out in Rhode Island in FY 1994; Florida in FY 1995; and North Carolina and Virginia in FY 1996. (p. 7)

Of the SSI programs that were not phased out, two were awarded grants in 1996 to continue their reform efforts for up to five additional years of funding of up to \$1.4 million per year, and three states and Puerto Rico were funded for five more years in 1997, and at least two states were funded for five more years during 1998 (p. 7).

An explanation of why Virginia's V-QUEST Systemic Reform Initiative was "defunded" was provided in Charles Bruckerhoff's (1997) report on Statewide Systemic Reform Initiatives, *Lessons Learned in the Evaluation of Statewide Systemic Initiatives*. Bruckerhoff (1997) stated that when there was turnover of key SSI project personnel, then there are problems with development and evaluation of the program. Some problems that participants cited as a result of key personnel changes were described by participants in Bruckerhoff's study as follows:

. . . false starts, loss of momentum, a need for regrouping and reviewing, hiring of new personnel, and retraining. All of these take substantial time and energy from the goals of the initiative and the accomplishments of remaining personnel. Participants reported that, in some instances, NSF was insensitive to, and impatient with turnover problems. (p. 15)

At the State level in Virginia two significant key players (the Governor and the Superintendent of the VDOE) were replaced in the middle of the V-QUEST Systemic Reform Initiative. Bruckerhoff (1997) wrote the following concerning the importance of key administrative personnel:

All the participants in the study called attention to the perennial mischief of state politics, especially with regard to the fortunes of an initiative of such great scope and requiring so much time and collective energy for development—and from so many key people in state politics—as a statewide systemic initiative. . . . A key operating principle for every successful SSI is that it must continuously interact with all the key players in the state's political arena, regardless of their stance *vis a vis* the SSI. However, the sand is constantly shifting.

. . . the election of a governor (the state's equivalent to the nation's president) would occur at least once during every SSI's five-year time frame. Also, depending on the outcome of that election, the governor may change key personnel in the various state departments, such as the commissioner of education, who are the greatest concern to the initiative. . . legislature's enactment of new laws and public policy all can develop in



ways that are impossible for the initiative to anticipate. (It cannot control them.) Sometimes the results are favorable. At other times the consequences for the SSI are costly or even disastrous. . . (p. 13)

The events that lead to the Virginia's V-QUEST Systemic Reform Initiative's defunded status were depicted in this description.

Clune (1998) used four variables, reform, policy, curriculum, and student achievement, to describe the typical profile of successful SSIs in his Research Monograph No. 16, *Toward a Theory of Systemic Reform: The Case of Nine NSF Statewide Systemic Initiatives*. The description of the first variable's profile of typical successful SSIs follows:

(1) Reform. A reform agency with independence but strong connections with the scientific disciplines in higher education; strong networking of reformers with supportive professional leadership organizations in the state; a mission including both math and science; long-term support of key policymakers, especially the governor. . . (p. 18)

Although significant progress in the implementation of standards-based science and mathematics curricula had been made, the statewide impact was still limited (*1998 SSI Report*). Even those states that made noticeable progress in this respect only reached slightly over 50% of the school districts with full implementation of standards-based curricula. Standard-based assessment was described as being in need of special attention. This problem was described in *1998 SSI Report* as follows:

. . . misalignment among assessment systems used at the state level, district-wide, school-wide and in classrooms prevails. The understanding of assessment standards as well as the design, development, adoption, and effective use of standards-driven systems and tools needs to be aggressively addressed.(p. 19-20)

In 1999 Hiebert described the current state of classroom teaching as quite consistent and predictable explaining that mathematics teachers in the United States have used the same basic methods of instruction for nearly a century (Fey, 1979, Hoetker & Ahlbrand, 1969, Stake and Easley, 1978; Stigler & Hiebert 1997; Stodolsky, 1988, Weiss 1978). Hiebert (1999) provided this account from a researcher's observations of mathematics as an example of this instruction:

First, answers were given for the previous day's assignments. A brief explanation sometimes none at all, was given of the new material, and problems were assigned for the next day. The remainder of the class was devoted to students working independently on the homework while the teacher moved about the room answering questions. The most noticeable

thing about math classes was the repetition of this routine. (Welch, 1978, p. 6, as cited in Hiebert, 1999, p. 11)

Hiebert indicated that, even in the face of pressures to change, in 1999 this traditional method of teaching persisted, stating:

After a decade of mathematics reform in the 1960s, the Conference Board of the Mathematical Sciences (1975) found that ‘Teachers are essentially teaching the same way they were taught in school’ p. 77. And, in the midst of current reforms, the average classrooms show little change (Dixon et al, 1998; Stigler & Hiebert, 1997). (p. 11)

Although a few summary reports and studies (Dalyo, 2002; Hiebert, 1999; Westat McKenzie Consortium, 1998) showed positive results for systemic reform initiatives, overall progress towards mathematics reform has been slow. Feldman, (2003) described the progress made in educational reform as “heartbreakingly slow” (p. 5). She stated that 49 states now have content standards for most subjects and assessments to measure student achievement, but she added that curriculum and assessment quality remain weak points in most state systems. She concluded her commentary on the status of reform twenty years after the publication of *A Nation at Risk* (1983) with the following statement:

We’ve tried a lot of things, and we still have a long way to go. Maybe that’s because successful reforms—the ones that focus on teaching and learning—have not been widespread. In principle, the standards movement has the potential to provide that focus and, if adequately funded, to solve our equity problems as well. Let’s hope we don’t have to wait another 20 years for these promises to be realized. (p. 5)

Gordon (2001), writing about the 18 years of educational reform since the publication of *A Nation at Risk* in 1983, identified the current reform movement as Systemic Educational Reform (p. 1). He described the recommendation for the establishment of varied school and community partnerships or collaborations as the foremost achievement of systemic reform noting that these collaborations found the corporate community, the higher education community, political agencies, and parents, among others, working together to reform public education (p. 1). According to Gordon these partnerships were illustrative of the quality of educational change accomplished through citizen cooperation (p. 1).

Ball (1996) indicated that since mathematics reforms challenge culturally embedded views of mathematics, of who can—or who needs to—learn math, and of what is entailed in teaching and learning it, we will find that realizing the reform visions will require profound and extensive societal and individual learning—and unlearning—not just by teachers, but also by players across the system (p. 501). This supports Gordon’s claim that

collaborations between all stake holders involved in the systemic reform is one of the reform's foremost achievements.

In 1999 Deborah Shifter opened her editorial for the *Journal for Research in Mathematics Education* with the statement that, once again, the fundamentals of mathematics education are the subject of a national discussion that inevitably involves claims of what research has or has not shown (p. 2). Daiyo, S. Piburn, M., Eugene, J., Turley, J., Falconer, K., Benford, R., & Bloom, I (2002) indicated that the construction of classroom observation instruments for measuring the degree to which classrooms were aligned with reform principles had just started and that it was a difficult and controversial endeavor. These authors stated the following about the status of systemic reform during 2002.

In the absence of strong quantitative evidence, debate over the impact of systemic reform rages unabated (Calhoun, Bohlin, Bohlin, & Tracz, 1997; Mayer, 1999). The evidential basis supporting reform remains soft . . . . For example, a 5-year, \$4.6 million evaluation of National Science Foundation's program of Statewide Systemic Initiatives concluded that the impact of this \$300 million program 'has been extremely hard to measure' and that 'evidence of improved test scores as a direct result of the reforms is even more tenuous' (Mervis, 1998, p. 1800). (p. 245)

As a means of developing a coherent vision and providing reliable guidance for change and improvement for school mathematics, NCTM for the past 15 years has invested enormous institutional resources and energy in its *Standards* documents and associated materials and activities (Research Advisory Committee, 2002). A new version of the *Principles and Standards for School Mathematics* was published in 2000, and in the following statement the Research Advisory Committee expressed NCTM's hopes for the future:

Standards-based reform has coevolved with ideas about systemic reform, curricular innovation, teacher education, and state policy. So it is both natural and essential that NCTM provide intellectual leadership, in concert with the research community, to nurture and foster ongoing research that will further this movement, increase our understanding of it and facilitate ongoing mid-course corrections. (p. 314)

This brief overview of the history of Statewide Systemic Reform Initiatives indicated that in 2003 promoting Statewide Systemic Initiatives and developing methods of research to evaluate and document systemic reform were still concerns and were major issues for discussion among educators and researchers. The research also indicated that although some progress was made towards implementing NCTM's suggested mathematics reforms,

success was limited in two ways (1) in states that had successful programs reform was implemented in 50% of the states' schools or less, and (2) in classrooms where reform was implemented methods of instruction did not change 100% with teachers usually picking parts of the suggested instructional reforms to implement (e.g., new tasks, use of calculators for instruction, cooperative learning). In the next section a comparison of this study's findings to the strengths and weakness identified in the SSI literature and research will highlight some of the reasons to which the lack of implementation can be attributed.

### A Comparison of the Strengths and Weaknesses of SSIs and the Findings of This Study

In this section the findings of this study in terms of obstacles and facilitators to implementing system reform are compared to the results in current literature and research on systemic reform. Some of these findings were addressed in the history of SSI (e.g., turnover of key personnel, misalignment of educational policies and practices, and collaborative partnerships between stake holders). Other connections presented are (1) teachers as the critical link to successful implementation of systemic reform, (2) the need for long-term support for teachers to have time to change, and (3) financial support for change.

### Teachers: Critical Link to Systemic Reform

The findings of this study indicated that teachers were the critical link to successful implementation of systemic reform. The lead teachers were responsible for the bottom-up portion of systemic reform; the bottom-up portion of systemic reform was the part of the systemic reform initiative that focused on changing what teachers were doing in the classroom, and changing what teachers were doing in the classroom was the ultimate goal of mathematics systemic reform.

The Report of the National Commission on Teaching and American's Future noted, "[O]n the whole the school reform movement has ignored the obvious: What teachers know and can do makes the crucial difference in what children learn" (p. 2). Gordon went on to say that it took 13 years for reformers to recognize that teachers are the most critical component of student success (p. 2). Gordon (2001) used this quote from Robert Slavin (2001) to support his argument:

whatever impact. . . years of systemic reform may have had or may have in the future, there is a limit to what can be achieved in education reform unless the reforms can improve the methods and materials every teacher uses with every student, in every subject, every day. (Slavin, 2001 as cited in Gordon 2001, p. 7)

One of the most reliable findings from research on teaching and learning is that students learn what they have an opportunity to learn (Hiebert, 1999). Hiebert (1999) made the following statement concerning mathematics instruction in America's classrooms:

In most mathematics classrooms students have more opportunities to learn simple calculation procedures, terms, and definitions than to learn more complex procedures and why they work or to engage in mathematical processes other than calculation and memorization. (p. 12)

Improving the learning opportunities for students is dependent, in part, on coming up with new ideas—new ways of teaching, new curriculum materials, new ways of organizing schools (Hiebert, 1999). Teachers need to be involved in planning, and implementing mathematics reform (Cusick & Borman, 2002; Hiebert, 1999; Tyack & Cuban, 1995). Hiebert (1999) explained that research can help educators make informed decisions, but that the development of creative ideas for implementing reform of mathematics instruction must come from the people involved:

Generating new ideas depends on the creative acts of the human mind. Research, by itself, is no substitute. Of course, the research process can place people in position to see things in a new way and imagine new possibilities, but it is the individual's interpretation, not the research evidence alone that generates the new ideas. (p. 7)

Reform will not happen unless teachers generate and try new ideas in the classroom. The findings of this study indicate that the teachers were the critical link in successful classroom reform, and, therefore, the lead teacher was a critical link in successful systemic reform. This study revealed that even against numerous obstacles mathematics reform did make it into the classrooms and that the lead teacher facilitated this process.

The *Program Effectiveness Reviews Report; Statewide Systemic Initiatives Program* indicated that establishing partnerships and collaborations has been a successful and productive systemic reform activity stating:

Parent organizations, community-based organizations, professional associations, business, industry, and the higher education sector have responded positively in support of the science and mathematics reform agenda promoted by the SSI Program. (p. 17)

Gordon (2001) identified collaboration as the foremost achievement of SSIs stating:

Collaborations represent one of the most significant outcomes of recent educational reform that can lead to long-term systemic change in teaching and learning. The organization of these partnerships shows a promising practice leading to educational change (Gordon, p. 3)

For systemic reform of mathematics to be successful, collaboration that involves the classroom teachers is essential.

In the statement that follows, Hiebert (1999) attempted to explain the lack of implementation of mathematics:

The new, more ambitious instructional programs require teachers to make substantial changes. This change doesn't happen automatically; it requires learning. And learning for teachers, just as for students, requires an opportunity to learn. But most teachers have relatively few opportunities to learn new methods of teaching (Cohen & Hill, 1998; Lord 1994; O'Day & Smith, 1993 Weiss, 1994).

Research on teacher learning shows that fruitful opportunities to learn new teaching methods share several core features: (a) ongoing (measured in years) collaboration of teachers for the purposes of planning with (b) the explicit goal of improving students' achievement for clear learning goals, (c) anchored by attention to students' thinking, the curriculum, and pedagogy, with (d) access to alternative ideas and methods and opportunities to observe these in action to reflect on the reasons for their effectiveness. (p. 15)

Since most classroom teachers did not have learning opportunities of this kind, it is not surprising that standard-based reform methods of instruction were not widely implemented in America's classrooms (Hiebert, 1999).

Alternative programs consistent with the NCTM *Standards* often require considerable learning by the teacher. Without new opportunities to learn, teachers must either stick with their traditional approaches or add on a feature or two of the new programs (e. g., small group activity) while retaining their same goals and lesson designs (Hiebert, 1999, p. 16). Every teacher in this study was observed using both traditional and suggested reform methods of instruction at some point during the study, and the evidence indicated that most of the teachers had added on some of the features of reform instruction while maintaining the belief that the teacher was ultimately responsible for showing and telling the students what they needed to learn. Although the teachers in this study were not provided professional development on new methods of mathematics instruction, teachers were provided new mathematics instructional materials that supported and encouraged NCTM instructional reforms: they were encouraged to change their methods of instruction by the administration; they had a trained V-QUEST Lead Teacher who was knowledgeable of recommended reforms, shared current pedagogy information, offered assistance and opened up his classroom for peer observations, and in 1995-96 the 90-minute block schedule was

implemented. With these changes, particularly new instructional materials and the move to block scheduling, teachers were forced to change what they were doing in the classroom, and most of them used the mathematics lead teacher as a resource for making this change.

Hiebert concluded his 1999 article with the following statement:

We know that we can design curriculum and pedagogy to help students meet the ambitious learning goals outlined by the NCTM Standards. The question is whether we value these goals enough to invest in opportunities for teachers to learn to teach in the ways they require. (p. 16)

### Consistent Administrative Support

Turnover of key State-Level administrative personnel was mentioned in the history of systemic reform as a problem for development and evaluation of Systemic Reform Initiatives, and in this study the turnover of key administrative personnel at the Division and School levels was identified as an obstacle to the successful implementation of systemic reform of mathematics. Hiebert (1999) indicated that the high rate of Principal turnover resulted in a relatively weak implementation plan and fewer and more superficial changes in classroom instruction (p. 10). The *1998 Program Effectiveness Reviews (PER) Report and Statewide Systemic Initiatives (SSI) Program* made the following statement about top-down administrative leadership and systemic reform:

State leadership is critical to reform efforts in schools because states not only have the constitutional authority for education, but they are the only level of the education system that can influence all of the K-12, as well as many aspects of postsecondary education, such as teacher preparation, certification, and licensure. They are in a position to coordinate resources from a variety of public and private sources and change regulations and policies. In addition they are able to allocate resources across the state fairly and equitably. (p.2)

Since the lead teacher lacked the authority to make decisions that directly supported teachers' learning and experimentation, the lead teacher had to rely on the power of persuasion and collegial support to motivate and sustain teachers' implementation efforts; thus, the need for ongoing administrative support was crucial (Cohen, S., & Hickman 1998, p. 10). For systemic reform to have the best chance at successful implementation of mathematics instructional reform, collaboration of all levels of educators and stake holders was essential, and that collaboration depended on consistent key administrative leadership.

### Misalignment of Educational Policies and Assessment Procedures

Misalignment of educational policy and assessment procedures was identified in this study as another obstacle to successful implementation of reform. Specifically, the State and Division level curriculum guidelines, suggested methods of instruction, and methods of assessment were not compatible with the instructional reform promoted by the V-QUEST Systemic Reform Initiative. In the history of systemic reform, assessment was identified as an area that needed special attention (*1998 SSI Report*), and in 2003 Feldman wrote the following:

An over reliance on off-the-shelf tests instead of assessments based on what has been taught in class continues to hold back progress by narrowing instruction instead of deepening and broadening it. (p. 5)

Dalyo (2002) indicated that almost every article written about the reform movement in mathematics and science education emphasizes the need for appropriate assessment. (p. 251). Since assessment provides a universal link between the top and bottom and, therefore, provides strong instructional guidance, assessment was identified as the lead policy instrument in successful implementation of systemic reform (Clune, (1998), p. 19).

### Time for Teachers to Change and Learn.

Fully aligned systemic elements of curricular framework expectations, textbooks and assessments do not guarantee reform in classroom instruction (Cohen & Ball, 1990; Knapp 1997). Teachers need leadership, support and time to learn and change. Gann (1993) described change as a two to three year process that goes through seven stages involving three levels, the initiation phase, the implementation phase and the institutionalization phase. Hiebert (1999) stated that one of the reasons for the lack of implementation of systemic reform was that teachers did not have the time to learn new instructional practice(p. 10). Ball (1996) wrote the following concerning the time needed for teachers to change their methods of instruction:

Learning to create the kinds of teaching envisioned by the mathematics reformers is thought to be hard and to take a long time. Changes do not happen overnight or simply as a result of deciding to teach differently. (p. 501)

There needs to be time for teachers to develop an understanding of new ways of teaching, reflecting, and assessing his or her own work; there needs to be time for reflection and time for follow-up with long-term support, coaching in teachers' classrooms, modeling instructional approaches, or ongoing interaction with colleagues (Ball, 1996).



The goal of the V-QUEST Lead Teacher Program was to train lead teachers to be leaders of mathematics instructional reform in their schools. It was documented that Pleasant Middle School's mathematics lead teacher served as a leader for mathematics instructional reform, and it was documented that neither the State or the Division invested the time pledged and required to support the V-QUEST Systemic Reform Initiative. Clune (1998) stated that one of the lessons learned from the study of nine SSIs was that reform takes more time than the five years allowed in one cycle of NSF funding (p. 18).

#### Funding for Systemic Reform at the Division Level

A significant obstacle to implementing mathematics reform in the classrooms that was documented in this study was the lack of professional development provided for mathematics teachers. Although the V-QUEST Lead Teacher had received training and released time of two hours a month was funded for the lead teacher to plan implementation of systemic reform, there was no money to fund professional development opportunities for the rest of the mathematics teachers. The mathematics lead teacher offered to conduct workshops after school, but the teachers showed no interest in attending such after-school activities. Pleasant County also faced a problem of shortage of funds for providing teachers with access to up-to-date technology. As Pleasant Middle School's Principal stated, it was difficult to implement reform on a shoe-string budget. Feldman (2003) noted the following concerning funds for educational reform:

Teachers in poor areas are still struggling without basic supports they need, and lack of attention to curriculums. Poor districts lack the capacity to implement strategies on the scale necessary to train teachers in the instructional strategies that work best, and capacity is a resource issue. (p. 5)

#### How the Findings of This Study Inform Current Research

In this last section, generalizations are made about how the results of this study connect to and inform the current research on systemic reform. The big ideas or questions that were present in the current literature on systemic reform are presented along with how the results of this study relate to help answer those questions and to add to the body of knowledge needed to answer those questions.

In the following statement Dalyo S. (2002) described the problem of documenting teacher change independently of student learning saying:

Procedures need to be developed to assess curricular innovation and teaching strategies independently of student learning. Just as goals can be

set for student learning, so they can be for teaching. Teaching can then be evaluated against these goals. (p. 251)

This study of V-QUEST Systemic Reform provides a classroom observation checklist and a set of guidelines for evaluating reform mathematics instruction in middle school classrooms.

In response to the criticism that NCTM *Standards* were not researched based Hiebert (1999) identified four expectations of research that follow:

- (1) Research can influence the nature of standards.
- (2) Research can document the current situation.
- (3) Research can document the effectiveness of new ideas.
- (4) Research can suggest explanations for successes and failures. (p. 8-10)

The present study provides data that documented the status of mathematics education in 1991-92 and 1995-96 classrooms, data that indicate the effectiveness of a new idea, systemic reform. The present study also offers explanations for successes and failures of implementation of mathematics reform. Hiebert (1999) stated that research can provide information about how we are doing at the moment—how we are teaching, what curriculum materials we are using, and how students are learning. He went on to say that although this is an obvious role for research, it often is underutilized. Without knowing what was happening in classrooms, how can the effectiveness of reform be assessed? He pointed out that few states regularly collect information on what is happening inside classrooms saying:

The absence of data collection is unfortunate because without information about the current situation, we make unwitting mistakes and produce the pendulum swings often evident in education. (p. 9)

Bruckerhoff (1997) indicated that baseline data concerning the description of the population prior to the impact of the reform initiative would be a valuable asset for measuring SSI impact, but participants indicated that these baseline data were either missing, incomplete or disputable (p. 16). He described the need for baseline data as follows:

Baseline data is [*sic*] an important benchmark from which to assess progress. However, the concern for getting valid baseline data on the SSIs raises a number of questions. What will be designated as the baseline data? Who will make this determination? How will the data be secured after the passage of five or six years? What are the implications for SSI, for NSF evaluators when the question of what is the baseline data is determined *post hoc*? (p. 17)

Hiebert (1999) described the need for data collection that can be used to distinguish between new ideas that can be implemented effectively and those that can't as crucial. He

stated that without such information, we can engage in debates concerning reform and never have resolution (p. 9). The results of this study indicated that systemic reform is possible, in that even under less than perfect conditions there was evidence that mathematics reform was found in classrooms. Hiebert also indicated that researchers can probe beneath the surface and collect information to help understand the situation and prevent others from making mistakes and engaging in fruitless debates. This study provides data that can inform future systemic reform initiatives, and future research on systemic reform, by providing baseline data, guidelines for evaluating reform instruction in middle school mathematics classrooms and a research model for documenting systemic reform.

Dalyo's (2002) study showed that when teaching is highly reformed, student learning is significantly enhanced, and that this relationship between reformed teaching and student achievement holds across a variety of public school grade levels and college and university settings (p. 251). The appearance of NCTM's (2000) revised Principles and Standards for School Mathematics, and continued encouragement and funding of systemic reform of mathematics by NSF indicates that in 2003 systemic reform is still considered a viable method of educational reform. The present study provides data that facilitate the understanding of systemic reform, how to plan implementation for optimal success, and a research model for meeting the complex challenges inherent in documenting systemic reform.

### Benefits of the Study

First this section presents a discussion of how what was learned benefits future systemic reform efforts that use a lead teacher model and offers recommendations for future systemic reform efforts. Then considerations for future research on systemic reform are presented.

### Recommendations for Future Systemic Reform

Recommendations for future reform efforts using the lead teacher model come from the conclusion of this study. The first major conclusion is that for systemic reform to be successful the lead teacher must be successful. Different components of systemic reform may be successful, but if reform is successfully impact mathematics classrooms and if bottom-up reform is to occur, the lead teacher must be a knowledgeable, respected and dynamic reform leader. Thus, the selection of lead teachers is extremely important to the success of the program. The Principal who selected the eighth grade mathematics lead teacher stated that he did so because he was a leader who was open to change and willing to put in the extra time it was going to require. The lead teacher needs to be an experienced and

respected teacher, knowledgeable of mathematics content, knowledgeable of current research and trends in education, and needs to have leadership ability; the conditions simply cannot be met by a first year teacher, or a teacher who is just earning Professional Development points to renew a teaching certificate. Criteria for selecting lead teachers needs to be stringent, and those criteria need to be adhered to in order to maximize the success of the program.

Top-down administrative support for lead teachers is essential to their success. A good lead teacher typically has knowledge and leadership ability, but little power. The administrators exercise considerable control of money, schedules, curriculum content, assessment practices, availability of instructional materials and supplies, and teachers' time; therefore, the administrators have the power. Administrators need to provide paid time and other forms of support for the lead teachers to work closely with colleagues. If reform is important, it should be treated as such by administrators so that teachers know it is valued. Administrators need to provide the personnel and funds and help the lead teachers organize and facilitate professional development in which teachers participate. This support needs to be long term and ongoing. Reform will not happen in one year or even two, and there needs to be time for reflection, feedback and inservice. To paraphrase the Principal, it is easy to **say** we support reform, but lip service will not accomplish the job. When school systems enter into systemic reform, it should be understood that all levels of administration need to invest time and money for an extended period of time. The goal set by V-QUEST was five years, which, according to results of this study, would have given reform a chance to be successful.

Also, State- Division- and Building-level educational policies and procedures need to be compatible with the recommended instructional reforms. Lead teachers do not have the power to change the curriculum or the assessment practices, therefore, cannot resolve conflicts between instructional reforms recommended and the educational outcomes mandated by the State and the Division. The probability of success of systemic reform at the Classroom Level is greatly increased if the curriculum guide and the assessment practices are in alignment with the instructional reforms being encouraged and implemented.

Two other administrative changes noted in this study that facilitated reform efforts were (1) a change in instructional materials, and (2) organizational changes (i.e., interdisciplinary instructional teams, and block scheduling). At the Division and Building Levels, the administrators supported the purchase of instructional materials that matched the mathematics instructional reforms recommendations (*Glencoe* textbook, scientific calculators, classrooms set of manipulatives and interdisciplinary-instructional materials). Also, a change in the daily schedule seemed to clearly facilitate teacher change. Organizing

the teachers into academic teams for making interdisciplinary connections and implementing block scheduling are both changes that appeared to facilitate reform in mathematics classrooms. As Bruner's (1961 and 1990) theory of learning states, there must be a mismatch or a desired state of learner equilibrium articulated for the learner to want to change or to want to bring in new information and use it to solve problems, fulfill needs or resolve confusion; for teacher change it is also necessary to acknowledge this mismatch or desire. Further, there needs to be opportunities to change; the selection of new textbooks combined with the change to 90-minute classes created this mismatch for the teachers in this study.

A guarantee of administrative follow through also helps insure the success of lead teachers in implementing mathematics instructional reform. It was documented in this study that the lead teacher worked closely with the former Principal to plan and implement instructional reform, and that Division Level administrators encouraged and supported the V-QUEST Lead Teachers for the 1993-94 school year. Participation in the V-QUEST Lead Teacher Program required a five-year commitment from Division- and Building-Level administrators. A full five years of enthusiastic leadership and support from the Superintendent and Principal would almost certainly have improved the chances for successful implementation of instructional reform in Pleasant Middle School's classrooms. Though it is not possible to predict or control all future events, any planned changes or moves of strategic administrators should be taken into account and planned for in advance to avoid negative set backs for the reform initiative. The mathematics lead teacher accomplished much more with the supportive Principal than he did without him. With the change of Principals the lead teacher lost his enthusiasm and excitement for the reform movement. As the lead teachers and Principal talked about their experiences with the V-QUEST Lead Teacher Institutes, their excitement was almost tangible. There was a connection between the lead teachers and the Principal, and their excitement seemed to be contagious. When this connection was broken, the spirit of the mathematics lead teacher was broken, and the lead teacher's reform efforts were no longer supported or encouraged by anyone at the Building, Division or State Levels.

The last recommendation for future reform efforts is simple but crucial: If technology reform is part of systemic reform, then administrators need to make sure that teachers have easy access to the technology before the teachers spend time learning to use it. Conducted in the reverse order, teachers see it as a huge waste of precious time, and they lose faith in the reform effort. As in this study, by the time the County could afford the technology, the technology information the teachers had learned was outdated and obsolete.

Planning ahead to avoid the obstacles noted in this study would give systemic reform a much better chance of success. As stated in Chapter I when the reasons for the study were provided, bottom-up and top-down methods of reform were used independently for educational reform for over 100 years, and they were not successful. The fact that these reforms methods were used time and time again throughout the history of education with little success is evidence of their impotence. The pattern of reform efforts documented for Pleasant Middle School indicate that this cycle of reform was not broken by the V-QUEST Systemic Reform Initiative; however, only part of this systemic reform effort was actually in place and functioning successfully. Although the V-QUEST Lead Teacher Institutes provided teachers with (1) professional development, (2) a support group to work with, and (3) follow-up (all of which were essential for the success of bottom-up reform, the State and Division curriculum policies and assessment practices were not compatible with the V-QUEST Lead Teacher reform efforts. Despite all the obstacles encountered, implementation of classroom instructional reform was somewhat successful at Pleasant Middle School; in the judgment of this researcher, this indicates that systemic reform should not be counted as an unsuccessful method of reform.

#### Considerations for Future Research on Systemic Reform.

Since the present study was conducted in 1995-96, there were no real precedents for the study of systemic reform; therefore, much was learned by trial-and-error. A discussion of the solutions to problems encountered with this study are presented here to facilitate the design for future research studies examining systemic reform. The discussion opens with the obvious problems in the study: (1) the magnitude of systemic reform, and (2) specification and collection of *post hoc* baseline data. Then there is a presentation of solutions to problems that were encountered as the study unfolded. The last set of problems presented are problems that were encountered that were not completely resolved and which pose research challenges for future studies. This study concludes with a brief look at where Pleasant County was heading in the school year following the study.

The nature of systemic reform required that the focus of the study be comprehensive, encompassing all levels of education and all aspects of instruction. Therefore, there were massive amounts of data to organize and analyze. Deconstructing each Level of data separately while looking for connections and then reconstructing the pieces based on those connections revealed the full story of systemic reform. In the beginning of the study the information was full of detail specific to its Level, and by the end of the study the connections between the Levels were revealed, and generalizations about systemic

reform emerged. Knowing this ahead of time can help future researchers organize data for analysis and in presenting results.

Documenting change in the mathematics classrooms posed a challenge that was solved by looking at artifacts related to curriculum, instructional materials, and assessment. These three aspects of classroom instruction provided data that could be triangulated at the Classroom/Building, Division and State Levels. For studies that need to collect *post hoc* baseline data, recommendations for artifact data collection follow. Do not count on lesson plans. Though they are the most desirable artifact for documenting classroom instruction, the results of this study revealed that teachers were protective of lesson plans, and, when asked to share them, teachers were anywhere from reluctant to share written lessons plans to almost hostile that the question was asked. Not one teacher in the study had lesson plans from previous years, and, when the Principal was asked about teachers' lesson plans or documentation of what was taught, he had no information to share. What was helpful were copies of the baseline-year curriculum guide, the mathematics textbook and its resource materials, inventory lists, purchase orders, teacher-made classroom materials, assessment information, correspondence from the Principal, minutes from meetings, newspaper articles, teacher evaluation instruments, and copies of student work.

The next problem was how to use these materials to document change. The textbooks provided information concerning the methods of instruction and the type of lesson plans encouraged. A study of the types of word problems, how they were presented, how problem solving strategies were taught and the percentage of the lesson devoted to problem solving and computation revealed the role that problem solving and computation played in mathematics education . A similar analysis of types of tasks, assessment, and technology materials provided data for documenting baseline conclusions about instruction that allowed for comparisons for documenting change.

The content of the textbook as well as Division- and State-Level curriculum guidelines provided means to document curriculum content and instructional methods encouraged by administrators. Correlation of these curriculum guidelines to the State- and Division-level assessments provided the third piece of data for triangulation of baseline data conclusions. Administrative records, such as budget proposals and purchase orders were helpful in tracking change of instructional materials, and newspaper articles as well as professional correspondence between administrators and teachers were all useful in tracking change of instructional methods in the classroom.

How to compare these data to instruction observed in the 1995-96 school year to document change was solved by looking at types of lessons (i.e., textbook or nontextbook; whole-group, small-group, partner, or individual), types of instructional tasks and types of

homework tasks (i.e., project, exercise, question, construction, application, or problem solving), types of discourse (i.e., student to student, student to teacher, teacher to student), types of questions asked (i.e., higher level thinking questions or low level thinking questions), and types of assessment (i.e., paper-and-pencil tests, interviews, demonstration, application, project or informal observation). Knowing these themes before data collection begins can help focus observations and data collection.

One of the major problems encountered in Level III, documenting systemic reform, was that the V-QUEST Systemic Reform Initiative did not happen in a vacuum. As reforms were prolific and ongoing in Pleasant County, not all change that happened could be attributed to V-QUEST (e.g., the schedule changes, purchase of the *Glencoe* textbook), but they facilitated systemic reform. There is no way to separate one initiative from the other, but, as a result of all the combined efforts, systemic reform occurred. Systemic reform is bottom-up reform with top-down support; if the top-down support is inadvertent or a result of different initiatives, does it still qualify as systemic reform? Fullan (1993) addressed the problem of multiple reforms and suggested that more research on the dynamics of change is needed. He noted that although we can identify and list “determinants of implementation,” we do not know how these factors interact and unfold. More information is needed concerning the “microprocesses” of successful change projects (p. 120). The results of this study support this research recommendation.

The next question, “How much change is necessary before reform can be designated as successful?” Each teacher started from a different point and moved at a different pace, often in a different direction. Therefore, theoretically they will all never get to the same point at the same time. Is it reasonable to expect 100% reform in every classroom in a certain amount of time before reform can be designated as successful, or is the fact that every teacher in the study made a move in the right direction enough to claim success? If every teacher in the study improved by having at least 60% more instruction that matched recommended reforms even though some teachers only reached 50% of the goal, is this enough to be considered successful?

Although a satisfactory solution to these problems was not found, for this study there were enough indicators of systemic reform and enough change in the mathematics classrooms to indicate that at the end of this study 1995-96 systemic reform this researcher was comfortable in concluding that it was somewhat successful, but it was finished.

### Looking to the Future at Pleasant Middle School

As the Superintendent ended his interview, he talked about the schedule changes planned for the 1996-97 school year. On Mondays students are to be released one hour



early and teachers are expected to work one hour later providing a two hour block of **paid** time every week for professional development and planning the implementation of the State's new SOLs. Details concerning the early release schedule planned for the 1996-97 school year were provided by the Superintendent in the statement that follows:

Oh yes, Its not just a, ah we didn't just build it in for people to do what ever they want [laughed] which we would hope would be to develop themselves or the organization ah, most every Monday session will have a plan of some kind. It will be devoted to either SOL committee work or situations within each school that need to be addressed (p. 21)

Pleasant Middle School's Principal expressed his hopes for the future of mathematics education in the statement that follows:

I want all the education in the school to be as good as it possibly can. I am hoping that the curriculum revisions and things that we do though will make a difference. I think, that we all are called to do so much more than we have ever been expected to do, and I hope we can find the way to meet the needs of the kids better than we have been. I think, if we doubled our staff we can start to make a difference, but I doubt if that is going to happen. . . . So I don't know, I think we need to look at grouping kids for more hands-on instruction, I think we need to look at revising methodologies and get people excited about it some how. I certainly don't think it is where it should be. Looking for improvements though. . . .I think, there are some teachers just busting a gut to do the best that they can, and I am satisfied with their performance. I think, the mathematics textbooks are good books. I think, if teachers used the extended things in there, that they could apply the mathematics concepts, too; there are a lot of good things in there. If they use those instead of just working the problems and things like that. The program, generally County wide, I think, there is a lot of teacher autonomy, there is a lot of inconsistency from one place to the next. I think we need to shoulder up the basic instruction from kindergarten all the way from elementary school and work on concepts, work on applications, work on kids really understanding what they are doing versus just doing the problems. (p..25)

During the summer of 1995 The Gifted Resource Teacher K to 5 attended a GEMs workshop in West Virginia and she arranged for an inservice to be offered to the teachers in Pleasant County during the summer of 1996. Her immediate plans for mathematics education were expressed in the statement that follows:

Well we got one or two GEMS that we just, they said these are GEMS activities, and we did them, and I said OH! I really like these, but that's all we got of it. Well the gal who is at Sunrise Museum in Charleston, and she came here from California which is where the GEMS program initiated, and so as soon as I got back I called [the Associate Superintendent] right away and said this was absolutely wonderful, and I said wouldn't it be nice if we could get some Pleasant County teachers in on this, and she said— well, see about, if you want to see about setting it up, if we can use some Eisenhower funds for that. So I got right on the stick, and I called and set up a contract and ran it by her and [the Director of New Initiatives] both, and it's very reasonable. We were hoping to have about thirty participants, and so I had it set up by last October and feet were dragged ah, and I know that [the Associate Superintendent] has a lot to do, but we tried to advertise a little bit I was advertising through my Principals. Then [Pleasant Middle School Principal] was real good to put it in his Monday Memos. Every Monday from like the middle of March on, and so we only had twelve people signed up, but I think eight of them were [Pleasant] Middle people because they were the ones that were hounded every week to keep it in mind, keep it in mind. (p. 13)

True to form, Pleasant County was continuing to actively implement reform efforts one on top of another to improve mathematics instruction without any follow-up on the current or previous reforms. But it is important to note that in these future plans there was an attempt to address the need of inservice and professional development opportunities for hands-on instruction, and Pleasant Middle School teachers were taking advantage of the offer. There was a definite change in the administration in that teachers were going to receive **paid** time to be used for writing new curriculum guides and for professional development. Had V-QUEST made an impression on the Superintendent that if reform is important then it should be treated as important for reform to be successful? Would the implementation of the State's new SOLs through the County's updated curriculum change the way mathematics instruction was conducted in the classroom? Would the emphasis of assessment change to match the suggested methods of instruction and the curriculum content? Would teachers continue to make progress in instructional reform, or in the day-to-day workings of the classroom, or would they slip back into the more comfortable tried-and-true traditional methods of instruction? As from the beginning of the study, each reform initiative was dropped into the middle of an existing reform effort, and it was impossible to discern where one initiative left off and the next started. The teachers in this study were

professionals who attempted to comply with every mandate received, but most of all they attempted to provide the students with the best education possible according to whatever they believed that to be. . . .

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Appendix A

Table A

Summary of Background Data for Observed Mathematics Teachers

Teacher	Mr. A	Mrs. D	Mrs. N	Mrs. L	Mr. M	Mrs. W
Grade Level	8	8	7	7	6	6
Sex	male	female	female	female	male	female
Race/Ethnicity	Caucasian	Caucasian	Caucasian	Caucasian	Caucasian	Caucasian
Type of Math Class	pre- algebra	pre- algebra	general math	general math	general math	general math
Type of Grouping	homo- genous	homo- genous	hetero- geneous	hetero- geneous	hetero- geneous	hetero- geneous
Professional Memberships	NCTM NEA VEA PCEA	NCTM NEA VEA PCEA	NEA VEA PCEA		NEA VEA PCEA NMSA VMSA	NEA VEA PCEA
Number of years teaching experience	22 years	26 years	24 years	7 years	23 years	22 years
Number of years teaching mathematics	22 years	26 years	24 years	1 year	23 years	22 years
Number of years teaching math in this school	20 years	22 years	24 years	1 year	21 years	22 years
Number of years teaching math at this grade level	22 years	26 years	10 years	1 year	21 years	19 years



Appendix B

Table B  
Observation and Interview Schedule for Mathematics Teachers

Teacher	Observation #1 (three days)	Interview #1	Observation #2 (two days)
Sixth Grade	April 9, 10 & 11	April 15, 1996	April 22 & 23, 1996
Mrs. W	9:50 to 10:45	1:37 to 2:45	9:50 to 10:45
Mr. M	April 9, 10 & 11 11:35 to 12:30	May 26, 1996	May 7 & 8, 1996 11:35 to 12:30
Seventh Grade	March 18, 19 & 20	April 3, 1996	April 25 & 26, 1996
Mrs. N	first block 8:45 to 10:09	12:15 to 1:25	first block 8:45 to 10:09
Mrs. L	March 11, 12 & 13 first block 8:45 to 10:09	April 16, 1996 12:15 to 1:15	April 15 & 16, 1996 first block 8:45 to 10:09
Eighth Grade	March 4, 5 & 6	March 19, 1996	April 30 & May 1,
Mr. A	third block 11:40 to 1:10	10:30 to 11:40 (Interview #2 May 1, 1996 10:30 to 11:40)	1996 third block 11:40 to 1:10
Mrs. D.	March 4, 5 & 6 fourth block 1:30 to 3:05	April 2, 1996 10:30 to 11:35	April 16 & 17, 1996 fourth block 1:30 to 3:05

Appendix C  
Observation/Summary Sheet

Observer: \_\_\_\_\_ School \_\_\_\_\_ Date \_\_\_\_\_  
 Time: \_\_\_\_\_ to \_\_\_\_\_ Teacher code: \_\_\_\_\_ Time of write up \_\_\_\_\_  
 Number of students: \_\_\_\_\_ Teacher M F 25 35 50 65 Experienced: L--H

**Synopsis of Lesson, Activities**

**Mathematics Education Issues**

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**Description of Room**

modern - antiquated M - - A  
 mobile - fixed eqpmt M - - F  
 open - regulated 0 - - R  
 formal - casual F - - C

**Knowledge Used**

active - still A - - S  
 a learning place N - - Y  
 a math place N - - Y  
 a library place N - - Y  
 a cooperative place N - - Y

**Reference made to:**

roles of mathematicians  
 mathematics as problem solving  
 mathematics as reasoning  
 mathematics as communication

**Mathematics to life**

politics, government 0 - - M  
 ecology, environment 0 - - M  
 math skills needs 0 - - M

**Time allocation:**

lesson \_\_\_\_\_  
 other education \_\_\_\_\_  
 administration, other non-academic \_\_\_\_\_

**Pedagogy**

text orientation N - - Y  
 test orientation N - - Y  
 experienced based N - - Y  
 objective based N - - Y

problem oriented N - - Y  
 operations, drill N - - Y  
 rules, examples N - - Y  
 integrated subj m N - - Y  
 diversions N - - Y

0 - - M  
 0 - - M  
 0 - - M  
 0 - - M

0 - - M  
 0 - - M  
 0 - - M

**Teacher Aim**

didactic N - - Y  
 heuristic N - - Y  
 philetic N - - Y

replicative N - - Y  
 associative N - - Y  
 applicative N - - Y  
 interpretive N - - Y

mathematics and tech 0 - - M  
 mathematics as  
 interconnections 0 - -

community, national 0 - - M  
 courses yet to come 0 - - M  
 math clubs, fairs etc. 0 - - M

**Homework:**

drill-and-rote problems  
 or nontraditional D - - N

Appendix D  
Teacher Interview Instrument

This interview has been designed with two goals in mind: (1) to provide details related to the classroom observation that will help me in creating a snap shot view of what mathematics education looks like today, and (2) help me discover any ways or areas in which your classroom instruction has changed over the last five years. The interview is organized into two areas of information: demographics, and the classroom observations. Questions about the classroom observation range from questions about some specific things noticed during the classroom observation to related questions about what happen before and/or after the lessons observed.

Professional background demographic questions:

1. How long have you been teaching?

2. Have you always taught mathematics?

Probe: If “no” ask— How long have you been teaching mathematics?

What other subjects have you taught?

Why did you change teaching areas?

Probe: If “yes” ask— Did you request or apply for this particular teaching assignment?

3. How long have you taught mathematics at this middle school?

Probe: Have you always taught \_\_\_\_\_ grade level mathematics?

Probe: If response is “no” ask— What other grade levels have you taught and why did you change grade levels?

4. To what professional organizations do you belong?

Specific questions about the lesson observed:

5. Tell me about your planning for the [unit, chapter or block]

A. Is there any particular format you follow when you write your plans?

Where did this format come from?

B. What are your overall objectives for the - - - -?

C. Has this objective always been a part of your curriculum? (If no ask—)

Probe: Why is it included now?

Probe: Did it replace anything in the curriculum?

D. Has anything about your planning changed in the past five years?

Probe: How?                      probe: When?

E. Anything else. . .?

6. Would you talk about what kinds of things you focused on or considered while you were creating your lesson plan for this class?

Probe as below, but only for topics mentioned

Probe: How did your thinking about the mathematics content influence your planning?

Probe: How did your thinking about the students in your class influence your planning?

Probe: How did your thinking about the materials you wanted to use influence your planning?

Probe: How did your thinking about the assessment you wanted to use influence your planning?

Probe: How did your thinking about the connections you wanted to make influence your planning?

Probe: How did your thinking about \_\_\_\_\_ influence your planning?

**Probe: Anything else?**

7. How did you feel about this lesson?

Probe: Was there anything you were pleased about?  
What? Why?

Probe: Was there anything you were concerned about?  
What? Why?

8. Did you do anything differently than you had planned during the lesson I observed?

Probe: What? Why?

9. If you taught this lesson again is there anything you would do differently?

I would now like to talk to you about some of the things I observed in your classroom during my three day visit, and I would like for you to talk to me about how your thinking on any of the topics listed on this card influenced your teaching decisions. [For questions 10 and 11 insert as many of the following tasks as appropriate and recycle the questions— ask some of the questions about each task selected.]

List of possible Tasks:

- a. Hands on activities or worksheets, drill and rote practice problems from the textbook, board or overhead (hands on activities include manipulative, calculators, experiments, projects, or constructions)
- b. Problem solving approach or explained problem solving process and assigned problems

from the textbook (for both instances routine problems and/or nonroutine)

c. Writing activities explaining reasoning or writing answers (drill and rote practice)

d. Integrated with other subjects or isolated focused on one "mathematical objective"

10. One of the things I'm interested in is how teachers decide to do what they do in class. I noticed that you used/ did (task) \_\_\_\_\_ as a part of your instruction. Why did you decide to do/use this (task) \_\_\_\_\_?

Probe as below, but only for topics mentioned:

Probe: How did your thinking about the mathematics content influence your decision?

Probe: How did your knowledge of students' questions or conjectures influence your decision?

Probe: How did your thinking about the way students learn influence your decision?

Probe: How did your thinking about the materials you wanted to use influence your decision?

Probe: How did your thinking about the assessment you wanted to use influence your decision?

Probe: How did your thinking about the connections you wanted to make influence your decision?

Probe: How did your thinking about \_\_\_\_\_ influence your decision?

Probe: Did you consider using a different task \_\_\_\_\_? (Explain)

11. If they do not mention this in the reasons for choosing this task \_\_\_\_\_ then ask: Have you always used/done this task \_\_\_\_\_ when teaching this mathematics concept or objective?

Probe: (if "yes") Do you find that there are any particular advantages in using/doing this \_\_\_\_\_?

Probe: (if "yes") Do you find that there are any particular disadvantages in using/doing this \_\_\_\_\_?

Probe: (If no) How does using this \_\_\_\_\_ change the way you teach this lesson?

Probe: (If no) Describe how this \_\_\_\_\_ impacts the presentation of this lesson?

Probe: (If no) Why and when did you change the way you teach this lesson?

12. Would you use this (task) to teach this lesson next year? (Why or why not)

13. What was the source for this (task)?

Probe: (depending on the answer) How does this compare with suggestions in the textbook? or Did you vary the textbook suggestions for this (task) in any way? (Explain)

[For questions 14 through 17 insert specific discourse techniques noted during the classroom observation and recycle through the questions—ask some of the probes for each discourse technique of interest.]

Following is a list of possible classroom discourse techniques:

- a. Student-to-student communication and/or teacher-to-student communication  
—Cooperative learning, paired problem solving, small-group instruction,
- b. Teacher communication—or whole-group direct instruction, demonstration teaching, or lecture
- b. Teacher-to-student communication— Guided questioning asking students to clarify their thinking and/or justify their ideas, listening to student responses and student questions.
- c. High level questioning or low level questions.
- d. Making hypotheses, explanation, and arguments or memorizing rules and procedures.
- e. Oral presentations and dramatizations or paper pencil computation
- f. Writing explanations (or drawing diagrams, pictures, tables) or writing only answers.
- g. Writing metaphors, analogies and stories or memorizing rules.

14. During my observations I noticed that you encouraged/used (discourse) as an instructional technique. Was this (discourse) a part of your lesson plan?

( if response is “yes” ask:)

Probe: Do you prepare any lesson questions ahead of time? (Explain)

Probe: What influenced your decision to use this (discourse) technique?

(if response is “no” ask:)

Probe: Do you routinely use this (discourse) technique in your teaching?

(Why?)

15. Has your use of this (discourse technique) changed in the last five years? Explain (if response is “yes” ask:)

Probe: Why? and When?

[Questions 16 and 17 are to be included only if the use of guided questioning was observed during the classroom visits.]

16. Tell me a little bit about your use of guided questioning and your mathematics instruction.

Probe: How does your use of questions direct the flow of the lesson?

Probe: How do you determine when to pose a questions?

Probe: Do you have a management system, or technique for eliciting student responses?

Probe: Explain . . .

Probe: How do you decide specifically when to do this?

17. Do student responses play any particular role in your lesson? (Follow-up on any responses about evaluation, future lesson planning and immediate impact on the flow of the lesson)

18. Were the classes I observed examples of a typical mathematics class?

Probe: Has the " picture" of your typical mathematics class changed in the past five years? Why? and When?

19. You assigned (what ever observed) for homework for this lesson. Would you explain why you selected this homework assignment?

Probe: What do you hope the students will get out of the assignment?

Probe: What do you intend to do with the assignment?

Probe: What kind of role does homework play in your teaching?

Probe: Was this an example of a typical homework assignment? (If “no” — explain)

20. Has your concept or use of homework changed over the past 5 years?

(If response is “yes” ask:)

Probe: Explain how your concept and/or use of homework has changed?

Probe: Why has this change occurred?

Probe: When did you make this change?

21. What are the main forms of assessment you use?

Probe: Are there any forms of assessment that you use only occasionally?

Probe: How do you decide when to use them?

22. Have the methods you use for assessment changed over the last five years?

(If response is “yes” ask:)

Probe: Explain how your method or use of assessment has changed.

Probe: Why did you make this change?

Probe: When did you make this change?

23. To what extent do you think mathematics teaching is something that you plan for or something that happens?

24. How do you report student progress to parents?

Probe: Have you always used this method?

(If response is “no” ask:)

Probe: What influenced you to change and why?

Probe: When did you make these changes?

25. Do think there is any difference between a classroom used for teaching mathematics and a classroom used for teaching other subjects?

Probe: Do you think there should be any particular differences noticed in a mathematics classroom?

26. To what extent do you think mathematics teaching is something that you plan for or something that evolves in the classroom?

27. How would you describe a successful mathematics teacher?

28. If a team of teachers from another school that is considering moving to block scheduling visited your school and talked to you about block scheduling and teaching mathematics, what would your recommendations be?

Probe: Ask the same questions in regards to team teaching.

Probe: Ask the same question in regards to the textbook.

29. Describe any opportunities for professional development that the county has offered in the past five years.

Probe: Have you participated in any of these programs?

30. Have you participated in any professional development activities not sponsored by the county? (If “yes” ask for details.)

31. Do you interact with other teachers in the building to improve mathematics instruction?

(If response is “yes” ask:)

Probe: Give me an example of how you did this.

Probe: How often do these types of activities occur?

Probe: Has this type of professional collaboration changed in the last five years?

Probe: How? and When?

(If response is “no” ask:)

Probe: Why do you think this does not occur?

32. Do you interact with other teachers in the county in an effort to improve mathematics instruction?

(If response is “yes” ask:)

Probe: Give me an example of how you did this.

Probe: How often do these types of activities occur?

Probe: Has this type of professional collaboration changed in the last five



years?

Probe: How? and When?

(If response is “no” ask:)

Probe: Why do you think this does not occur?

33. Do you interact with any school divisions non-teaching staff to improve mathematics instruction?

Probe: Give me an example of how you did this.

Probe: How often do these types of activities occur?

Probe: Has this type of professional collaboration changed in the last five years?

Probe: How? and When?

(If response is “no” ask:)

Probe: Why do you think this does not occur?

34. To what extent do you feel you are in control of your professional life?

Probe: In respect to curriculum and materials?

Probe: In respect to professional growth activities?

Probe: In respect to selection of methods of assessment?

35. To what extent do you feel you are treated as a professional?

Probe: By your colleagues?

Probe: By the administration?

Probe: By parents and/or students?

36. Is there anything else you would like to add?

Appendix E  
Building Level Interview Instruments

Principal Interview Instrument

This interview has been designed with two goals in mind: (1) to provide details related to the systemic reform that will help me in documenting systemic reform of mathematics education, and (2) to provide information related to mathematics education at [Pleasant] Middle School. I am interested in getting the principal's perspective on many issues related to the mathematics program, mathematics instruction, and mathematics reform. Since many of the questions I ask may involve issues that are not exclusively limited to mathematics educators, please do not feel that your information must concern only mathematics educators. The interview is organized into three areas of information: (1) demographic questions, (2) questions related to selected V-QUEST systemic reform indicators, and (3) questions about the principal's role in mathematics education at [Pleasant] Middle School.

Part I Demographic Questions

1. First I would like to find out a little about your background in public education. How long have you been serving public education as a principal?

Probe— Has all of your experience as principal been at the middle school level?

How long have you served as the Principal of [Pleasant] Middle School?

Have you served in any other capacity in public education?

What did you do? What grade level and for what length of time?

Part II [The questions in part II of this interview have been designed to correlated with preselected V-QUEST Systemic Reform Indicators]

(Questions 1 and 2 match indicator #1)

1. Do you and your teachers have access to the Internet and or Virginia Pen (VA PEN)?

Probe if "yes" — Ask for details about where, how many terminals and if there are any restrictions or time limits?

Would you explain in general how you use the Internet/VaPen in relation to school business?

Do you or your teachers use it in any way for supporting the mathematics program?

Does Pleasant Middle School use the Internet for participating in educational projects?

Is [Pleasant] Middle School] involved in any “on-line projects” right now? Would you tell me about these?

Has the school’s participation in on line educational activities changed in the last five years? (If there are changes ask for description of the change)

Probe if “no”— Why don’t you have access to the Internet/ VA pen? (Are there plans to change this situation?)

2. Would you describe how technology is used in mathematics education at [Pleasant] Middle School?

Probe— Is the use of technology in mathematics education encouraged?

Probe—Could you give me an explain of how you as the principal have encouraged or facilitated the use of technology in mathematics education?

(Indicator #2; Questions 3, 4, 5, 6 and 7)

3. What is the school’s policy on teachers attending conferences and professional meetings?

Probe— Do you have any particular perspective about teachers attending conferences and/or professional meetings?

4. How many of your math teachers would you estimate have attended one or more professional meetings and/or conferences this year?

Probe — Is this attendance rate fairly typical or has the number of math teachers attending professional meetings and/or conferences changed in the last five years?

Probe if changed — Would you describe the change?

To what do you attribute this change?

5. Do you have any math faculty members that make presentations at these professional conferences?

Probe if “yes”— Which mathematics teachers make presentations?

How often and to what organizations or meetings?

6. Is there any documentation concerning the teachers’ attendance at professional meetings or conferences?

7. Does the school have any math or non-math group memberships in professional organizations which would be helpful to the mathematics teachers?

Probe—Where would I find documentation concerning this membership?

(Indicator number 3; Question 8)

8. Does this school do anything in particular to help teachers be aware of up-to-date technical assistance in mathematics pedagogy, content, and educational research?

Probe— Does the county or do you recommend or provide any particular resource books or other such materials?

(If “yes”—Do the math teachers take advantages of these resources?)

Probe—Does the county or your school recommend or provide any inservice or professional development opportunities related to math?

(If “yes”—Do the math teachers take advantages of these resources?)

Probe—Does Pleasant Middle School have a professional library available to the teachers?

Probe if “yes”— What is your role in supplying materials for this resource?

Could you give me some examples of some of the materials that are available?

Do the math teachers take advantage of these resources?

Probe—Where would I find documentation concerning these materials and/or opportunities?

Probe if “no”—Given a perfect set of conditions, is there anything different that you would recommend concerning making these professional development resources available to mathematics teachers?

(Indicator #5; Question 9)

9. Is Pleasant Middle School involved in any collaborative ventures with any groups outside the school that have any relationship to or impact on the math program?

Probe— Such as local businesses, local colleges and/or universities, local, state or national museums, professional organizations, any others)

Probe if “yes” to any of these— Would you describe this collaboration?

Do any of these collaborations focus on mathematics education?

(or what is the purpose or goal of this collaboration?)

Do math teachers take advantage of the opportunities?

(Indicator #6; Question 10)

10. Does anyone at this school do anything to encourage community and/or parent involvement in the mathematics program?

Probe—Is there a school policy concerning community and parent involvement in education?

Probe if “yes”—Tell me about this policy.

Probe—Is there anything you do as a principal to encourage the faculty to

involve the community and parents with education here at Pleasant Middle School?

Do you have any projects or programs that have been successful in involving the community and/or parents in the school?

(Indicator #7; Question 11)

11. Are the local universities or colleges used as an educational resource in any way by Pleasant Middle School to support your mathematics program?

Probe—Are teachers encouraged to use these local resources?

Do you have an open line of communication with the local universities and colleges?

(Indicators #8 & 9; Question 12, 13 and 14.)

12. Has your faculty participated in any activities to help them become familiar with the states' new mathematics SOLs?

Probe— Would you describe these activities?

Were there any others?

13. Has implementing the news SOLs for mathematics changed the mathematics curriculum in anyway?

Probe if “no”—Are there any plans being made to insure that the current mathematics curriculum is compatible with the new SOLs?

(Indicator # 10; Question 14)

14. What is your view concerning the role of the textbook in mathematics instruction?

(Indicator #11; Question 15)

15. Are there any policies or procedures that the school follows for evaluating and selecting mathematics instructional materials (includes textbook, supplementary materials, computer software and hardware, manipulatives, and calculators) ?

Probe—Would you explain this process or policy?

Are there any records of the last mathematics textbook adoption process?

(Indicator #12; Question 16)

16. Have you participated in any workshops or conferences related to leadership in mathematics education reform in the past 5 years? (Ask for explanation of any that are identified)

(Indicator #13; Question 17)

17. Does [Pleasant] Middle School have access to discretionary instructional funds?

Probe if “yes”—Is there a division level and/or a school level policy for managing these funds? (Is site based management being used?)

Probe if “yes”—would you briefly explain this or these policies to me?

Probe—Are any Eisenhower Funds available for instructional purposes this year?

Probe if “yes”—Is this amount about the same each year?

Probe—What portion of the available instructional funds went to support the mathematics program this year?

Probe—Is this amount typical? (Explain)

Probe—Do the teachers have any voice in how these instructional funds are allocated or spent? (Would you explain this)

Probe—Would you like to see any changes in how the instructional funds are managed?

(Indicator #14; Question 18)

18. Do your math teachers use alternative forms of assessment in their math classes?

Probe—Has your faculty been provided any inservice on the use of alternative forms of assessment?

Probe if “yes”—tell me about this or these inservice(s).

Probe—What type of assessment do you think is most commonly used in the mathematics classrooms?

Probe—What is your opinion of alternative assessment?

Part III. These questions are about the mathematics program at [Pleasant] Middle School and about issues that were uncovered during the initial classroom observations and/or interviews with the mathematics instructors.

19. Do you think that block scheduling has had any impact on your mathematics program?

Probe—Has this impact matched your expectations?

20. How was the decision made to go to block scheduling?

Probe—What role if any did the teachers play in this decision?

Probe—Were the math teachers in agreement with this decision?

Probe if not—What were their objections and how were their concerns handled?

Probe—What, if anything, has been done to help mathematics teachers adjust to the block schedule?

Probe—Will block scheduling remain in place for next year?

Probe—Will the teachers have any voice in this matter?

21. If a math teacher needs something to make instruction in their classroom more effective is there some procedure to follow to get those resources?

Probe—What would be the chances of getting a request funded for say \$25.00? for \$100.00? or for over \$1000.00?

Probe—Do the teachers have any influence in deciding what professional development opportunities or in-services are funded?

22. When you need to cover a math class, are there any standard procedures that you follow?

Probe—Do the team members have a say in who is selected?

Probe—Are there any minimum qualifications?

Probe—Are there any circumstances under which standard procedures are not followed?

23. Approximately how much time do you spend in the mathematics classroom observing (formally or informally) the mathematics instruction as it is taking place?

24. I have observed the following mathematics teachers and I am interested in any candid insights you would share concerning these individuals as mathematics teachers, as professional educators, and particularly in any professional growth that you might have noticed in your short tenure here:

Probe—Mr. A

Probe—Mrs. N

Probe—Mrs. W

Probe—Mr. M

Probe—Mrs. D

Probe—Mrs L

24. What are your goals for mathematics education?

Probe—What kinds of things make you feel satisfied with a mathematics program?

Probe—What kinds of things make your feel dissatisfied with a mathematics program?

### **Former (1991 to 1993) [Pleasant] Middle School Principal Interview Instrument**

1. Has all of your work in public education been as a principal?

Probe—What grade level did you teach?

Probe—Did you specialize in any particular subject area?

Probe—How would you describe your mathematics background?

Probe—When did you take on the responsibility of being a school principal?

Probe—When did you take the job as principal of Pleasant Middle School and how long did you hold that job?

2. You were serving as the principal of Pleasant Middle School during the school's initial involvement with the V-QUEST Lead Teacher Program. Where you involved with making the decision to participate in this program?

Probe—Why did Pleasant Middle School choose to participate in the lead teacher program?

Probe—How were the lead teacher representatives selected?

Probe—What was your faculty's response to the idea of the V-QUEST lead teacher program?

Probe—Did you do anything to encourage your teachers to get involved with V-QUEST?

Probe—Where you encouraged to get involved with V-QUEST?

Probe—What was your reaction to the idea?

3. Your lead teachers participated in their first two week V-QUEST institute during the summer of 1993, and during this time principals were expected to participate in three days of activities and inservice. As principal of Pleasant Middle School did you attend this V-QUEST institute?

Probe—Would you briefly describe your experience?

Probe—Did you and your lead teachers work on plans for improving instruction in mathematics and science? (Tell me about those plans)

Probe—Did your participation in this program have any affect on your views of mathematics education?

Probe—Did participating in this program have any noticeable affect on your lead teachers? (Explain)

4. During the following, 1993-94, school year you continued to serve as the Principal of Pleasant Middle School, were you involved with any V-QUEST activities?

Probe—Any activities organized by the county?

Probe—Any activities organized by the lead teachers?

Probe—Did you organize any V-QUEST related activities?

Prove—Any of the V-QUEST follow-up activities: fall and spring drive in work shops, V-QUEST conference, or anything else?

5. Were your lead teachers involved in any V-QUEST related activities?

Probe—Any activities organized by the county?

Probe—Any activities organized by the lead teachers?

Probe—Any activities organized by you?

Prove—Any of the V-QUEST follow-up activities: fall and spring drive in work shops, V-QUEST conference, or anything else?

6. One of the goals of V-QUEST was to improve mathematics education; as principal of Pleasant Middle School did you notice any progress in this area?

Probe—In the area of instructional materials?



Probe—In pedagogy?

Probe—Professional development activities?

Probe—Curriculum?

Probe—Assessment?

Probe—Technology (graphing calculators, Internet, computers)?

Probe—Did the amount of funding for mathematics education change?

Probe—Were the lead teachers encouraged to work for change?

Probe—Were the lead teachers active in any of these area?

7. Did you do anything to encourage teachers to attend mathematics related conferences or professional meetings?

Probe if “yes”—Please explain.

Probe—Did attendance at these type of functions change?

8. Did any of your mathematics faculty members make presentations at conferences, professional meetings or inservice programs?

Probe if “yes”—Was this typical of your faculty or was this a change?

Which mathematics teachers made these presentations?

How often and to what organizations or meetings?

9. Did the school do anything in particular to help teachers be aware of up to date technical assistance in mathematics pedagogy, content, and educational research?

Probe—Did the amount or availability of materials change after V-QUEST?

Probe—Did the use of these materials change after V-QUEST?

Probe—Who was responsible for selecting and purchasing these materials?

Probe—Did the lead teachers have any input into the selection of these materials?

10. Was Pleasant Middle School involved in any collaborative ventures with any groups outside the school that would have had an impact on the mathematics program?

Probe—Such as local businesses, local colleges, and/or universities, museums, professional organizations, or any others?

Probe If “yes”—Would you describe this collaborations?

Do any of these collaboration focus on mathematics education? (Appalachian Power Tutorial program)

What was your principal’s role in these relationships?

Did the lead teachers have any role in these relationships?

11. Was parental or community involvement in mathematics education encouraged in any way?

Probe If “yes”—Was this involvement typical, or did this change after being involved with V-QUEST?

Probe—Can you think of any particular programs or projects that were successful in getting the community and/or parents involved in mathematics education?

12. Were any efforts made to utilize the local universities or colleges to support the mathematics program?

Probe—Explain

Probe—Did you have an open line of communication with the local universities/colleges?

13. What was your view concerning the role of textbooks in mathematics instruction?

Probe—Were you involved with [Pleasant Middle School’s] latest mathematics textbook adoption?

What role did you play in that process?

14. Did you participate in any workshops or conferences related to leadership in mathematics education reform while principal of Pleasant Middle School?

Probe—Was your attendance at such activities encouraged by the county?  
(By your faculty?)

15. Did mathematics educational reform receive support?

Probe If “yes”—In what ways? (increased financial support, time for lead teachers to plan/organize activities related to improving mathematics education, professional development opportunities, scheduling of the day, anything else?)

Probe—What was your role in determining how discretionary funds were spent?

Probe—Where additional funds made available to support mathematics education reform? (Explain)

Probe If “no”—Why do you think it was not supported?

Were there any efforts made to remedy this situation?

16. During your last year at Pleasant Middle School did you notice any changes in mathematics education?

Probe—Materials being used or requested?

Probe—Materials purchased (software, hardware, manipulatives, instructional materials for interdisciplinary teaching or using a problem solving such as AIMS or GEMs)?

Probe—Instructional practices used by the teachers (cooperative learning, problem solving approach, projects, hands-on activities, conceptual focus)

Probe—Collaboration among the teachers?

Probe—Assessment practices?

Probe—Did the emphases on mathematics education change? (In what ways)

17. Did you and/or your lead teachers set any goals for change in the mathematics program?

Probe If “yes”—What were these goals?

What was done to accomplish these goals?

Were any of these goals accomplished? (Explain )

Probe If “no”—Was there any discussions about mathematics reform?

Was mathematics reform encouraged?

What do you think hindered the setting or making change related goals for mathematics education?

18. Would you have considered any of your mathematics teachers models for mathematics reform? (Explain who and why)

19. Do you know if your successor was provided with any details about V-QUEST?

Probe—Did he contact you for information pertaining to the V-QUEST Lead Teacher program?

Probe If “yes”—What information did you provide?

Probe If “no”—Do you think the association with V-QUEST was viewed as important to the school?

20. Did you take any ideas from V-QUEST with you to your new school?

Probe If “yes”— Would you provide a few details concerning this.

### **Interview for Librarian**

1. What technology do you have available for instructional purposes?

(multimedia sources, telecommunications, CD-ROM, laser discs, computers, calculators, films/videos)

Probe—Do students have easy access? (Has this changed over the last five years?)

Probe—Do teachers have easy access? (Has this changed over the last five years?)

2. Have the teachers been trained how to use the equipment?

Probe If “yes”—would you tell me about this training: who was responsible, how long did it take, how many teachers attended and when?

Probe If “no”—how do the teachers learn to use the technology?

3. Do the mathematics teachers make use of the technology?

Probe If “yes”—In what ways? Which kind? Who? How often?

Has this changed over the last five years?

Probe If “no”—Is this typical of the rest of the faculty?

Who does use the services?

Why do you think they use it more or less than the math teachers?

4. Is the technology available to students?

Probe if “yes”— Must their teacher be present?

Who is responsible for training the students?

How many students can access information at one time?

How often do students use the technology?

Do students use the technology for the study of mathematics?

Probe If “no”— Are there any plans for changing this policy?(explain)

5. Who is responsible for managing the computer software?

Probe— Who is responsible for purchasing the software?

Who makes the decisions concerning what software is purchased?

How would you describe the selection of mathematics related software that you have on hand?

Do the mathematics teachers make suggestions concerning the purchase of software?

Has the math software inventory changed over the last five years?

How?

Questions 6- 13 are related to indicator #4

Teachers of mathematics and science know where and how to access (locally, regionally, statewide, and nationally) the most up-to-date technical assistance in mathematics and science pedagogy, content, and educational research.

6. Does the library have an institutional group membership for the school to the National Council of Teachers of Mathematics? (VCTM?)

Probe—Has this changed recently?

Probe —Does the library carry any professional materials for mathematics teachers, specifically?

Ask for details?

To what extent do the mathematics teachers use the available materials?

Probe—Have mathematics teachers requested any professional development related materials?

Probe—How would you describe the professional library?

7. Do the mathematics teachers have their students do research in the library?

Probe if “yes”—Would you tell me a little about the research project (does the class come as a whole for a certain amount of time or do they come in pairs, etc.)

Probe—has this changed over the last five years?

8. Do any of the teams use the library in conjunction with interdisciplinary units?
9. Do you have copies of the NCTM *Professional, Curriculum, and Assessment Standards* in the professional library? (SOLs)
10. Does the library have any of the NCTM *Yearbooks* or *Addendum Series* on hand for teachers?

Probe—Who makes the decisions concerning what materials are placed into the professional library?

Probe— How is the professional library supported, financially?

11. Do you have any mathematics related magazines for students?

Probe— What are they?

Who makes the decisions concerning what periodicals are purchased for the library?

12. Do you do anything to encourage the students to use the library?
13. Are the teachers encouraged to use the library with their students?

### **Science Lead Teacher Interview Instrument**

This interview is to collect information about your role as a lead teacher and your work as a lead teacher here at [Pleasant] Middle School.

1. Of particular interest is how have you worked with the math department or math teachers since being involved with V-QUEST?

Probe Has the way you worked with the math teachers changed since being involved with V-QUEST?

Probe Since block scheduling puts your science classes on semesters has this affected how you are able to work with the other math teachers?

Probe What are the advantages and disadvantages of block scheduling?

2. How long have you been teaching?

Probe Have you always taught science?

Probe How long have you been teaching at [Pleasant] Middle School?

3. Does [Pleasant] Middle School have a Science Lab?

(If “yes”) Probe Are you in charge of the science lab?

(If “no”) Probe Why not?

4. How did you get involved with the V-QUEST Lead Teacher program?

5. What information were you given about the program?

6. How would you describe your experience with V-QUEST?

7. Did you learn anything new?
8. Have you shared any ideas with other teachers?
  - Probe When? How many times?
  - Probe How were the ideas received?
  - Probe Did any of the activities that you shared influence instruction in a positive way?
9. Do you share a common planning time with the other eighth grade teachers?
10. Could you give me an example of an interdisciplinary unit that your team implemented?
  - Probe Have you used this unit more than one year?
  - Probe Has the number of units increased?
  - (if “yes”) Probe Tell me about those units that are new or that are in the planning stages.
11. Have your efforts been supported by the administration?
  - Probe: Do you feel that you have been empowered?
12. Has the County administration, your principal or the school board supported you in professional development endeavors?
  - Probe: Tell me about them.
13. Has being a lead teacher placed additional responsibilities on you?
14. Do you use technology in teaching science?
  - Probe: Do you have access to technology in your classroom?
  - How do you use this technology?
15. Do you use the library for academic instructional purposes?
  - Probe: Could you give me some examples of how you use this facility?
16. Have you had any influence over the curriculum at [Pleasant] Middle School?
  - Probe: Could you provide some details about your involvement?
17. Do you involve parents or the community in your science instruction?
  - Probe: Is there time scheduled for this type of dialogue? How? How often?
  - Probe: Has this changed since being involved with V-QUEST? Explain.
  - Probe: Have you influenced other teachers in these endeavors?
18. Do you have professional communication about pedagogy?
  - Probe: Tell me about this. How often, and how you are involved?
  - Probe: Has this changed since being involved with V-QUEST?
  - Probe: Do you and Mr. A work as a team?
19. Do you utilize the local colleges and universities as a resource?
  - Probe has this changed? Explain.
20. How would you evaluate the mathematics program at [Pleasant] Middle School?

21. Do you have any input into the master schedule?
22. Are you treated as a professional?  
Probe: Give an example.
23. Is there anything about teaming that you would like to see changed?
24. What is the role of textbooks in the classroom?
25. What has been your biggest success as a lead teacher?
26. Do you have any future goals?
27. What has been your biggest road block, if there has been one?
28. How have your instructional practices or philosophies changed over the past five years?
29. What would your recommendations be to a team of teachers that is teaming for the first time?
30. Do you interact with any of the school division's noninstructional staff in improving instruction at [Pleasant] middle school?  
Probe Give some examples of this (if "yes")
31. Were you more actively involved in reforming instruction right after the initial two week training than you are now?
32. What professional organizations do you belong to?
33. Do you work with teachers outside this school?
34. Does [Pleasant] Middle School have a professional library available to you as a teacher?
35. Do you have any input into what educational materials are selected for the library?
36. Have your methods of assessment changed since being involved with V-QUEST?  
Probe Have you shared new assessment ideas with other teachers?  
Probe: Are you involved in professional dialogue about assessment reform?
37. Is there anything that you would like to add?

### **Mathematics Lead Teacher Interview**

This interview was designed with two goals in mind (2) to collect data that pertain to changes in your classroom instruction over the past five years, and (3) to document your activities as a V-QUEST Lead Teacher.

1. How long have you taught mathematics?
2. Have you changed the way you teach math in the past four or five years?  
Probe: Could you give me an example?
3. What is your target objective for this year?
4. Has the new textbook changed the way you teach mathematics?  
Probe: Could you give me some examples?  
Probe: Is there anything else?

5. Did the V-QUEST Lead Teacher training program influence your classroom management or instruction in any way?
6. Do you have more responsibilities as a lead Teacher?  
Probe: Would you elaborate on these responsibilities?
7. Have you influenced other mathematics teachers in the building?  
Probe (if “yes”): In what ways?  
Probe (if “no”): Why not?
8. Have you influenced mathematics teachers outside of this building?  
Probe (if “yes”): In what ways?  
Probe (if “no”): Why not?
9. Have you conducted any workshops since being trained as a lead teacher?  
Probe: How many of those have you done?  
Probe: What were they about?
10. Have you been involved in any reform efforts?  
Probe: Are the reform efforts making progress?
11. How about the selection of materials; have you made any new adoption or material selection?  
(if “yes”)Probe: How did you determine what items should be purchased?  
Probe: What items did you purchase?  
Probe: Who received the materials?  
Probe: Was there any training involved with the new materials?  
Probe: Was technology a part of these purchases? Explain
12. Do you have a computer in your classroom?  
(if “yes”) Probe: How do you use this technology?  
Probe: What software do you have available?
13. What technology is available in the school?  
Probe: How often do you have access to this technology?  
Probe: How do you use this technology to facilitate instruction?
14. Are there professional magazines available in the school?
15. Are there any technical mathematics of science oriented magazines available to students?
16. What do you see as the biggest roadblock to reform?
17. Have you had any input into the county’s mathematics curriculum?  
Probe for details: When? How often? Who? What has been accomplished?
18. Are you empowered as a teacher to make decisions?
19. How has block scheduling impacted your instruction?
20. Is the ability to mathematics a talent?



Probe Explain

21. How do students learn mathematics?
22. What have been your experiences with the use of cooperative learning in the classroom?  
Probe: Who determines the groups?  
Probe: How long do the groups remain intact?  
Probe: How do you assess group work?
23. What is your opinion on all students taking algebra?
24. Have you received support from the administration on changes you have tried to make in your classroom?  
Probe: Specifically alternative assessment and technology?
25. What role does the textbook play in your mathematics instruction?
26. How do you handle the introduction of new material?
27. Have the number of projects you use in the classroom increased over the past four or five years?
28. Do you advocate parental or community involvement in mathematics education?  
Probe: Explain or give an example of how you do this
29. Have you changed the way you teach mathematics since being involved with the V-QUEST Lead Teacher program?
30. What role do grades play in your teaching?
31. Are you treated as a professional?  
Probe; give me some of examples.
32. What role does competition play in your instruction?  
Probe: Has this changed in the past four or five years?
33. To what professional organizations do you belong?
34. Has the way you use problem solving in your instruction changed?
35. What role does problem solving play in your mathematics instruction?
36. Do you use manipulative in your mathematics instruction?  
Probe: Has this changed in the past four or five years?
37. Do you use reflective type activities in your instruction?  
Probe: Has this changed?
38. Have you changed the type of questions you use during mathematics instruction?  
Probe: Has this changed?
39. What role does commutation play in your classroom?  
Probe: Has this changed?
40. How would you describe the balance of time spent on focusing on understanding basic skills versus reasoning and logic?

41. Would calculators always be made available for student use?  
Probe: Why or Why not?
42. How important is estimation?
43. What is your practice for homework assignments?  
Probe: What type of homework assignments do you give?  
Probe: Has this changed over the past four or five years?
44. Does your team make plans to make connections between mathematics and other subjects?  
Probe: How often?  
Probe: Give me some examples.  
Probe: Has this practice changed over the past four or five years?
45. Do you analyze your own teaching?  
Probe: How?  
Probe: How often?  
Probe: Give me an example.  
Probe: Do you deliberate with colleagues about your teaching and their teaching?  
Probe: Do you deliberate with the administration about your teaching?  
Probe: Has this practice changed over the past four or five years?
46. Have you been involved in any professional development other than V-QUEST?  
Probe: has there been any feedback after professional development?
47. Has block scheduling changed your instructional practices in any way?  
Probe: Have you changed the type of tasks you use in mathematics instruction?  
Probe: What are the advantages and disadvantages of block scheduling?  
Probe: Will there be an evaluation of the effectiveness of block scheduling?
48. Has the availability of resources changed?  
Probe: have mathematics teachers been made aware of what resources are available?  
Probe: Explain
49. Are you encouraged to attend national mathematics and science conferences?
50. Do the teachers know where to access up to date science and mathematics pedagogy suggestions?
51. Do you utilize the local colleges and universities as an educational resource?
52. Do you receive financial support for your reform initiatives?
53. How has your use of assessment changed?
54. Has the content of your classroom changed?

55. Do your lesson plans focus on what you will be doing or what the students will be doing?

Probe: Give me an example

Probe: Has this changed over the past four or five years?

56. Is there anything you would like to add?

### **Eighth Grade Language Arts Interview Instrument**

The purpose of this interview was to collect data for triangulation purposes for documenting interdisciplinary teaching with the mathematics lead teacher.

1. I spent five day observing Mr. A's math classes and when I interviewed him he talked about doing some interdisciplinary work with language Arts and one of the things he mentioned that he did was a limerick activity. Are you familiar with the limerick activity?

Probe: Would you tell me a little bit about your side of that activity?

2. Have you done any other interdisciplinary units together?

Probe: Would you tell me about those?

3. Did you work as a team to plan the projects?

probe: How often did you meet to plan?

probe: How much time did you spend planning a typical interdisciplinary unit

4. Did you work together on the Hover Craft Unit?

Probe: What did you do in L.A. as a part of the Hover Craft Unit?

5. How about the travel unit, did you work together on the travel unit?

Probe: What was your role in the travel unit?

Probe: How successful was this unit?

6. Do you think you do more of these type of interdisciplinary units now than you did in the past?

Probe: What do you see as the advantages of interdisciplinary teaching?

7. Do you like the block schedule?

Probe: Does the block schedule facilitate teaming and teaching interdisciplinary units?

8. Is reform in mathematics education necessary?

Probe: Do you see any reform happening in this building?

9. Is there anything you would like to add about connections with math and language arts?

10. Is there anything you would like to add pertaining to changing educational practices?

Appendix F  
Division Level Interview Instrument

This interview is designed to provide information related to systemic reform at [Pleasant] Middle School. I am particularly interested in the mathematics program at [Pleasant] Middle School, the activities of [Pleasant] Middle School's lead teachers and your role as the administrative contact for the V-QUEST Lead Teacher program. You do not have to limit your thinking or answers to these topics, but any specific information that you can provide which relates to these particular topics would be extremely helpful.

A. Please give a brief summary of your work as an administrator for [Pleasant] County Schools.

Probe—When did you take the position?

Probe—How long have you served in this capacity?

Probe—Do you have any teaching experience?

What grade level(s)? How long? What subjects did you teach?

Probe—How would you describe your mathematics background?

Probe—What are your responsibilities in terms of mathematics at the middle school level?

B. Why did the county choose to participate in the V-QUEST Systemic Reform movement?

Probe—Did reform of mathematics education influence this decision?

(Explain why or why not.)

Probe—What was your role in making this decision?

C. Was there any particular reason for choosing the two middle schools to participate in the first year of involvement with the program?

Probe—Was anything done to encourage participation in the program?

Probe—Were schools given an option to participate, or was participation mandated?

D. Who was responsible for selection of the lead teachers [Pleasant] Middle School?

Probe—Why were the two lead teachers, Mr. A and Mrs. S selected?

Probe—Where you satisfied with their performance lead teachers?

*Questions 1-4 are related to Systemic Indicator #1 and technology in general: Virginia's K-14 schools actively participate in ongoing telecommunications networking projects that utilize and share mathematics and science information and educational resources.*

1. To what extent do you think it is important for mathematics teachers to have access to the Internet and/or VA Pen? (Explain)

Probe— Describe the telecommunications technology resources that are available to the [Pleasant] middle school teachers.

Probe— Can you give me some examples of how the mathematics teachers use these telecommunication resources? (Networking to improve pedagogy, student involvement in projects, or sharing of instructional materials and/or ideas for activities)

Probe— What role have you played in making technology accessible to the classroom teacher?

Probe— Have there been any activities which would encourage classroom teachers to use this technology in the classroom? (Any professional development opportunities, grants, or special projects)

Probe— Has the use of this technology in the middle school's mathematics classroom changed? (explain)

Probe— What if anything would you like to see changed about this area of technology?

Probe— Is there anything else you would like to add?

2. The use of technology in mathematics education is not limited to telecommunications; in what other ways do you think it is important for technology to be used to support middle school mathematics education?

Probe— What role does the WICAT computer lab play?

Probe— Has the use of this technology changed over the last five years?

Probe— Have there been any professional development opportunities related to the use of WICAT and mathematics instruction? (Were the Lead teachers involved?)

Explain—)

Probe— Are there any changes in the use of the WICAT lab that you would like to see made?

Probe— If another school system were considering the purchase of a system for computer assisted instruction and came to [Pleasant] County to observe the WICAT system in action, what would your recommendation be?

3. What is your opinion concerning the use of computers in middle school mathematics classrooms?

Probe— What should the ratio of computer to student be?

Probe— How should these computers be used?

Probe— Have you always felt this way or have your opinions on computers in the classroom changed?

Probe—What would your recommendations for [Pleasant] Middle School’s mathematics classrooms and computers be?

Probe—Is there a policy or set of guidelines used concerning the purchase of software? (Explain)

Probe—Have staff development opportunities been available for teachers with regards to using computers in the classroom? (Were the Lead teachers involved? explain)

Probe—Would you like to add anything about the use of computers and mathematics education?

4. What do you think is the appropriate role of calculators in the middle school mathematics classroom?

Probe— Does the current use of calculators match your expectations?

Probe— Have there been any professional development opportunities related to calculators and mathematics education? (Were the Lead teachers involved? Explain)

Probe— Has your opinion of the use of calculators in mathematics education changed over the last five years? (Explain)

Probe— has the use of calculators in mathematics education changed over the last five years? (Explain)

*Questions 5-9 are related to indicator #2)*

*K-14 schools have participants at statewide mathematics and science conferences and professional meetings.*

5. Does the county have any policies concerning teachers attending conferences and professional meetings?

Probe— Please explain. (Encouraged? Financially supported?)

Probe— What is your opinion concerning teachers attending conferences and/or professional meetings?

Probe—Any special decisions related to the presence of lead teachers?

Probe— Are you encouraged to attend?

6. How many [Pleasant] middle School math teachers attended a math conference or professional meeting this year?

Probe— Is this attendance fairly typical, or has the number of math teachers attending professional meetings or conferences changed in the last five years? (Describe that change)

7. Do any of the math faculty members make presentations at professional conferences?

Probe if “yes” — Which mathematics teachers make presentations? How often and to what organizations or meetings? Is this activity encouraged?

8. Is there any documentation concerning the teachers’ attendance at these professional meetings or conferences?

9. Does the county encourage personal or institutional math or non-math group memberships in professional organizations which would be helpful to the mathematics teachers?

Probe—Where would I find documentation concerning this membership?

*Question 10- is related to indicator #4*

*Teachers of mathematics and science know where and how to access (locally, regionally, statewide, and nationally) the most up-to-date technical assistance in mathematics and science pedagogy, content, and educational research.*

10. Does the county do anything particular to help teachers be aware of up to date sources of technical assistance in mathematics pedagogy, content, and educational research?

Probe—Does the county recommend or provide any particular resource books or other such materials?

If “yes”—Describe these please.

Do the math teachers take advantage of these resources?

Probe— Has the county recommend or provided any inservice or professional development opportunities related to math technical assistance?

(Ask about the math meeting between the two middle schools. Any records of these meetings? What was your role in these meetings. What was accomplished?)

(Ask about curriculum consistent with the SOLs.)

(What portion of the available funds are used for professional development related to mathematics?)

(Do teachers have any input into what professional development opportunities are offered? Has the amount of teacher involvement changed?)

Probe—Does the county maintain an up to date professional library?

What is your role in selecting materials for the professional library?

Where would I find documentation concerning these materials and opportunities?

Probe— What are your recommendations for future professional development opportunities? (Any special role for the lead teacher in this)

Probe—Is there anything else you would like to add concerning professional development?

*Question 11 is related to indicator #5*

*School division personnel know how to access and work collaboratively with instructional materials producers.*

11. Do you have any control over the instructional materials selected and used for mathematics education?

Probe—Do Lead teachers have any role in the selection of mathematics educational materials? (explain)

Probe— Are there any guidelines for the selection of software or supplemental materials? What portion of the available budget is spent for mathematics related materials?

*Question 12 is related to indicator #6*

*School division personnel know how to access and work collaboratively with local, regional, state, and national museums; public and private agencies; and professional mathematics and science organizations.*

12. Is it now or has the county been involved in any collaborative ventures with any groups outside the schools that have any relationship to or impact the mathematics program?

Probe—Such as local businesses, local colleges and/or universities, local state or national museums, or professional organizations. (Describe them and how mathematics teachers or classrooms benefit from these collaborations.

Probe—Any joint grant applications? Ask about [VA Tech Mathematics Professor] grant for mathematics instruction.

Probe—Have the Lead Teachers been involved with these ventures? (Explain)

*Question 13 is related to indicator #7*

*K-14 school personnel consistently involve and utilize parent and community resources in their mathematics and science programs.*

13. Does the county do anything to encourage community and/or parent involvement in the mathematics program?

Probe— Is there a county policy concerning community and parent involvement in education? (Explain)

Probe— Is there anything you do as an administrator to encourage the faculty to involve the community and parents with education at [Pleasant] Middle School?

Probe—Do you have any projects or programs that have been successful in involving the community and/or parents in the school? (Business partnerships, community organizations and local careers)

Probe—Has the stance on community involvement with mathematics education changed over the past five years?



*Question 14 is related to indicator #8*

*K-14 school personnel consistently utilize college and university resources in their mathematics and science programs.*

14. Are the local universities or colleges used as an educational resource in any way to support the mathematics program?

Probe—Are teachers encourage to use these local resources?

Probe—Do you have an open line of communication with the local universities and colleges? (Explain) Has this relationship changed over the past five years?

Probe— What types of projects have you worked on with the universities?

Probe— Any related specifically to mathematics education? (Explain)

Probe—Would you describe your role as the contact person for the V-QUEST Lead Teacher program?

*Questions 15 and 16 are related to indicators #9 and #10*

*The state has mathematics and science curriculum standards that are consistent with the V-QUEST goal. K-12 schools have mathematics and science curricula based on the state frameworks.*

15. Have the mathematics teachers participated in any activities to help them become familiar with the state's new mathematics SOLs?

Probe—Would you describe these activities?

Probe—What role did the mathematics lead teacher play?

Probe—Has implementing the new SOLs for mathematics changed the mathematics curriculum in anyway?

Probe—Have any steps been taken to insure that the current curriculum is compatible with the new SOLs?

16. Are alternative forms of assessment encouraged in the mathematics classrooms?

Probe—Have inservices on alternative forms of assessment been provided?

Probe—What type of assessment do you think is most commonly used in the mathematics classrooms?

Probe—What is your opinion of alternative assessment?

Probe—What role do standardized scores have in the mathematics program?

Has this changed over the past five years?

Probe—To what extent do you think the assessments are compatible with the SOLs and Mathematics Standards?

*Question 17 is related to indicator #11*

*The state has redefined “textbook” to be consistent with the instructional materials, resources, and technology that support high inquiry, and conceptual mathematics and science program; and incorporated these changes in the appropriate statutes and regulations.*

17. What is your view concerning the role of textbooks in mathematics instruction?

Probe—What do you think about the possibilities of doing away with textbooks?

Probe—Can software and technology be purchased with textbook funds? (Explain)

Probe—Has the emphasis on the importance of textbooks in mathematics education changed in the past five years?

*Question 18 is related to indicator #12*

*Virginia and a mini-consortium of states formally recognize and apply a standard set of criteria, indicators, and processes to evaluate instructional materials and resources.*

18. Are there any policies or procedures that the county follows for evaluating and selecting mathematics instructional materials (includes Textbook, supplementary materials, computer software and hardware, manipulative, and calculators)?

Probe—Would you explain this process or policy?

Probe—Has this policy changed in anyway in the past five years? (Explain)

*Question 19 is related to indicator #13*

*Building and central office administrators participate annually in professional development activities that focus on leadership in mathematics and science reform.*

19. Have you participated in any workshops or conferences related to leadership in mathematics education reform in the past 5 years? (Explanation for any identified)

Probe—Has [Pleasant] Middles School’s principal participated in any workshops or conferences related to leadership in mathematics education reform in the past five years?

*Question 20 is related to indicator #14*

*School divisions use a significant portion of discretionary funds to support educational programs in mathematics and science meeting the V-QUEST goal.*

20. In what ways does the county financially support mathematics educational reform?

Probe— What portion of the Eisenhower funds are spent for this purpose?

Probe— What portion of the budget is spent on mathematics reform?

Has the amount changed over the past five years?

Are there records that I could look at to document this spending?

Probe—Do the teachers have a voice concerning how these funds are spent?

Probe— Would you like to see any changes made in how funds are distributed?

The following questions are related directly to issues uncovered during the initial classroom observations and interviews with the mathematics instructors.

21. How do you think block scheduling has impacted the mathematics program?

Probe—Has this matched your expectations?

22. How was the decision made to implement block scheduling?

Probe—What role if any did the teachers play in this decision?

Probe—Did the math teachers support this decision?

Probe—How were concerns or objections handled?

Probe—What if anything has been done to help mathematics teachers adjust to the block schedule?

23. If math teachers need something to make instruction in their classrooms more effective is there some procedure to follow to get those resources?

Probe—Which would be more likely to be funded, requests for workbooks, calculators, manipulatives, software, or inservice training?

24. Has the county done anything that would encourage mathematics teachers to work together as professionals to improve mathematics education?

Probe—Do the lead teachers conduct workshops?

Probe—Has the number of teacher-lead inservices changed over the past five years?

Is there any documentation of meetings or inservices that were conducted?

Probe—How have you worked with teachers to improve instruction?

Probe—Have the mathematics teachers taken an active role in reforming mathematics instruction? (Explain)

Probe—Could you give me some examples of how the county has supported teachers in this endeavor?

25. How would you describe a successful mathematics program?

Probe—How does [Pleasant] Middle School's mathematics program compare with this ideal?

26. Have you noticed any other changes in the mathematics program at [Pleasant] Middle School?

Probe—Have teachers implemented any changes?

Probe—Has the county recommended any changes?

Probe—Do you see any areas that are in need of change?

Probe—Are there any mathematics educators at [Pleasant] Middle School who would stand out as models for change? (Explain)

Probe—Is there anything else you would like to add concerning the reform of mathematics education at the middle school?

27. Does being a lead teacher mean extra responsibilities for the teacher?

Probe—Explain with middle school in mind please.

Probe—Are the Lead Teachers supported by the administration? (How?)

Probe—Has the amount of responsibility changed over the past five years?

28. Describe how you have worked with the V-QUEST lead teachers and mathematics reform for the county.

Probe—Accomplishments?

Probe—Roadblocks?

Probe—Any areas that were not as successful?

Probe—Any future goals or plans?

29. Do you have anything you would like to add concerning the status of mathematics education at [Pleasant] Middle School or in the county?

## Appendix G

Table G1

### Interview Schedule for Other Members of the School's Population

Member of the School Population	Interview Date	Time
Current Principal (1995-96) Mr. G	May 20, 1996	3:45 to 4:45
Science Lead Teacher Mrs. S.S.	June 3, 1996	5:00 to 7:00
Librarian Mrs. H	June 13, 1996	11:00 to 12:00
Team Teacher Mrs. G (Language Arts)	June 13, 1996	1:00 to 2:00
Former Principal (1991-93) Mr. O	June 20, 1996	9:00 to 10:30
Mathematics Lead Teacher Mr. A	July 22, 1996	12:00 to 1:30

Table G2

### Schedule of Division Level Interviews

Division Level Administrator	Interview Date	Time
Supervisor of Technology Instruction & 1995-96 contact for the V-QUEST lead teacher program— Mrs. I.B.	June 12, 1996	9:00 to 10:00
Associate Superintendent for the County Schools— Mrs. B.	June 20, 1996	2:00 to 3:00
Coordinator of Elementary and Middle School Instructional Programs— Dr. S	June 24, 1996	11:00 to 12:00
1994-95 Administrative Contact for V-QUEST— Dr. C.	June 27, 1996	11:00 to 12:00
Superintendent of the School System— Dr. A	July 2, 1996	9:30 to 10:30
Supervisor of K-8 Gifted and Talented Instruction— Mrs. T	July 8, 1996	11:30 to 12:30

Appendix H  
State-Level Staff Interview Instrument

The purpose of this interview is to collect data on state-level educational policies, mandates and programs that have a direct connection to educational practice that is taking place in the middle school involved in this case study. Systemic reform of mathematics education in one middle school is the study's focus, and any information you can provide about how the leadership role of the State Department of Education has changed in the past five years would be extremely useful in competing this study.

A. Would you begin by telling me your job title and briefly describe your job responsibilities?

B. Do you have any experience as a classroom teacher?

Probe if "yes": Would you tell me a little bit about your teaching background?

1. Why were the Standards of Learning for mathematics updated or rewritten?

Probe: When was the decision made to rewrite these SOLs?

Probe: Were you involved with this decision in any way?

Probe: What do you think were some of the strengths of the old SOLs? What about the new ones?

Probe: What do you think were some of the weakness of the old SOLs? What about the new ones?

2. Would you explain your understanding of the process that was used for writing the new mathematics SOLs?

Probe: What groups or key individuals were involved at the state and local levels? (Teachers, administrators, educational consultants, or professional organizations?)

Probe: What was the approximate time line?

Probe: What was the overall process or procedure?

Probe: What resources were available for the process to help make decisions about what the content of the mathematics SOLs and about what objectives should be at what grade level?

Probe: What was your role in this process?

3. What are the expectations at the state level about how these new SOLs will be used by Virginia's school divisions?

Probe: Have any mandates or expectations concerning curriculum been given to the school systems?

Probe: Do the SOLs represent some kind of minimum or maximum expectations for mathematics students?

Probe: Will students be held accountable for mastery of each SOL? (How)  
(Assessment)

Probe: Will teachers be held accountable for matching instruction to the SOLs?

Probe: Do you think that implementation of the mathematics SOLs will encourage change in the way mathematics is taught?

What changes would you particularly like to see?

Are any changes mandated at the state level?

4. Have any professional development opportunities or teacher inservices been planned at the state level to help teachers become familiar with and implement the new SOLs in their classrooms?

Probe: Have any of these opportunities already occurred?

Probe: Are any being planned at the state level?

Probe: Are individual school systems encouraged by the state to plan and use professional development to help implement these new SOLs?

If “yes”: How is this encouraged?

If “no”: Why do you think this is not the case?

5. In what ways do you think the SOLs will influence the selection of instructional materials?

Probe: Can you site any specific illustrations?

Probe: Anything else?

6. To what extent do you think the SOLs are compatible with the goals of V-QUEST for improving education in mathematics, science and technology?

Probe: How or Why not?

7. Is there anything else you would like to say about the state’s mathematics SOLs?

8. In your view what is the role of textbooks in mathematics instruction in middle school classrooms?

Probe: Has the role of the textbook changed in the last five years?

If “yes”: In what ways?

If “no”: Do you think it needs to change? Why or why not? How?

Probe: Has the concept changed?

Probe: Do you think it’s necessary for every child to have a mathematics textbook?

Why or why not?

9. What do you think is the appropriate role of technology in middle school mathematics classrooms?

Probe: Is the use of technology in the teaching of mathematics encouraged at the state level? (Explain.) Why or why not? How?

Probe: What do you think is the minimum technology for middle school mathematics classrooms?

How does the state support this?

In what ways does the state encourage this?

10. Who has responsibility for approving the instructional materials that are purchased by the school systems?

Probe: Has the role of state level administrators in the adoption of mathematics instructional materials changed in the past five years? (How or what is their role?)

Why or why not?

Probe: Does the state have a written policy or set of guidelines for adoption and/or purchase of mathematics instructional materials? (Could I have a copy of this document?)

Probe: What in your view is the role of teachers in the development of policy or guidelines?

Probe: What in your view is the role of teachers in the implementation of these policies or guidelines?

Probe: Do you think there are circumstances under which teachers should be provided with release time or be compensated for time spent outside the regular teaching day when evaluating instructional materials?

Does the state have any guidelines that relate to this?

11. Do you think mathematics instructional materials selected should support the *NCTM Standards*?

Probe: Why or why not?

Probe: Does the state have any recommendations concerning the NCTM Standards and instructional materials? (Explain)

Do ours? How? How are they implemented?

12. [Associate Specialist of Instructional Media and Training] worked with a mini-consortium of states on a set of criteria, indicators and processes for evaluating instructional materials and resources, has the state of Virginia formally adopted or approved this instrument?

Probe If “yes”: When?

What benefits do you see coming from this?

Do you see any significant changes between this evaluation process and the process that was in place? (Explain what or why not.)



Probe If “no”: What does the future look like?

Does it appear that the instrument will influence future decision making? How?

Why do you think the instrument was not adopted?

What does the state want that is different?

Do you think there is a possibility that this instrument will be adopted?

Probe: Is there anything else you would like to add concerning Virginia’s affiliation with this mini-consortium or the documents it produced?

13. Is there anything else you would like to add about instructional materials or technology?

14. The state is in the process of providing directives concerning the new state assessment mandates; do you think these assessment tools are compatible with the new SOLs (NCTM Assessment Standards)?

Probe: What assessments do you think will be mandated or are already being mandated? (Barrier testing and Standardized testing)

Probe: What role do you see these playing in the development of local mathematics curriculums?

Probe: Do you think these assessments will affect mathematics instruction?  
(Explain how or why not)

Probe: Does the state encourage alternative forms of assessment in mathematics?  
In what ways? (Inservice training, professional development opportunities, site visits, financial or polices)

Probe: Do you think that assessment has changed in the past five years?

Probe: Do you see a need for changing the way students are assessed?

Probe: Is there anything else you would like to add?

15. In your view what has been the role of Virginia’s Department of Education in making technical assistance available to mathematics teachers?

Probe: Could you give me some examples of how technical assistance has been provided to [Pleasant] County in the past five years?

Probe: Do you think the department is more active or less active in this area now than it was five years ago?

Probe: Have you had any responsibilities in providing technical assistance?

Probe if “yes”: Would you briefly describe this for me?

Probe if “no”: Who has been responsible for this?

Probe: What other forms of technical assistance beyond the local level can [Pleasant] middle school teachers access?

Probe: Is there a structure or set of guidelines in place that pertain to the administration of technical assistance for teachers?

Probe if “yes”: Could I have a copy of this document?

Are you satisfied with these guidelines (or structure)?

Is there anything that you would like to see changed? (What?)

Have these guidelines changed in the last five years? How?

Probe if “no”: Is technical assistance for (mathematics) teachers supported in any way?

Has the amount of support changed over the last five years?

Probe: Does the VDOE make any recommendations to local school divisions for mathematics teachers or information pertaining to technical assistance? (What conferences that would be most beneficial, what associations teachers should belong to, what professional materials they should be familiar with, what services are available, etc.)

Does the state provide any support for teachers in these areas? (Explain)

Probe: Does the state participate in any telecommunication type professional development activities that provide technical assistance? (Explain)

Has this changed in the past five years?

Probe: Is there anything else you would like to add?

Thanks for your time and ideas.

## Appendix I

Table I  
Schedule of State Level Interviews

Division Level Administrator	Interview Date	Time
Director of the Administrative Component of V-QUEST and former Coordinator for Special Programs in the County (1994-95) —Dr. C	June 27, 1996	11:00 to 12:00
State Department’s Associate Specialist of Instructional Media and Training, responsible for the criteria referenced instrument for adoption of instructional materials and the textbook consortium committee— Mrs. K	Aug. 6, 1996	11:30 to 12:30
State Department’s Associate Specialist of Assessment and Director of the Assessment Component of V-QUEST—Dr. R	Aug. 7, 1996	10:00 to 11:00
Committee member writing middle school mathematics SOLs and training team leader for the southwest region school divisions— Mrs. Q	Aug. 7, 1996	9:30 to 10:30
Mathematics Coordinator for Fairfax County Public Schools and leader for the development of the Virginia’s new SOLs— Mr. N	Aug. 9, 1996	10:00 to 11:00
State Department’s Principal Specialist for Mathematics, and one of the authors of the V-QUEST proposal, liaison between the State Department of Education and the standards of learning development committee— Dr. W	Aug. 21, 1996	3:00 to 3:40

## Appendix J

### The First Four NCTM (1989) Curriculum Standards:

#### **Standard 1: Mathematics as Problem Solving**

In grades 5-8, the mathematics curriculum should include numerous and varied experiences with problem solving as a method of inquiry and application so that students can—

- use problem-solving approaches to investigate and understand mathematical content;
- formulate problems from situations within and outside mathematics;
- develop and apply a variety of strategies to solve problems, with emphasis on multistep and nonroutine problems;
- verify and interpret results with respect to the original problem situation;
- generalize solutions and strategies to new problem situations;
- acquire confidence in using mathematics meaningfully. (p. 75)

#### **Standard 2: Mathematics as Communication**

In grades 5-8, the study of mathematics should include opportunities to communicate so that students can—

- model situations using oral, written, concrete, pictorial, graphical, and algebraic methods;
- reflect on and clarify their own thinking about mathematical ideas and situations;
- develop common understandings of mathematical ideas, including the role of definitions;
- use the skills of reading, listening, and viewing to interpret and evaluate mathematical ideas;
- discuss mathematical ideas and make conjectures and convincing arguments;
- appreciate the value of mathematical notation and its role in the development of mathematical ideas. (p. 78)

#### **Standard 3: Mathematics as Reasoning**

In grades 5-8, reasoning shall permeate the mathematics curriculum so that students can—

- recognize and apply deductive and inductive reasoning;
- understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs;

- make and evaluate mathematical conjectures and arguments;
- validate their own thinking;
- appreciate the pervasive use and power of reasoning as a part of mathematics. (p. 81)

#### **Standard 4: Mathematical Connections**

In grades 5-8, the mathematics curriculum should include the investigation of mathematical connections so that students can—

- see mathematics as an integrated whole;
- explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations;
- use a mathematical idea to further their understanding of other mathematical ideas;
- apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, psychology, sciences, and business;
- value the role of mathematics in our culture and society. (p. 84)

## Appendix K

### Definitions for Analysis of Mathematics Instruction Categories

Following are the complete definitions provided by the *Professional Standards* (NCTM, 1991) for the categories of analysis:

- *Tasks* are the projects, questions, problems, constructions, applications, and exercises in which students engage. They provide the intellectual context for students' mathematical development.
- *Discourse* refers to the ways of representing, thinking, talking, and agreeing and disagreeing that teachers and students use to engage in those tasks. The discourse embeds fundamental values about knowledge and authority. Its nature is reflected in what makes an answer right and what counts as legitimate mathematical activity, argument, and thinking. Teachers, through the ways in which they orchestrate discourse, convey messages about whose knowledge and ways of thinking and knowing are valued, who is considered able to contribute and who has status in the group.
- *Environment* represents the setting for learning. It is the unique interplay of intellectual, social, and physical characteristics that shapes the ways of knowing and working that are encouraged and expected in the classroom. It is the context in which the tasks and discourse are embedded; it also refers to the use of materials and space.
- *Analysis* is the systematic reflection in which teachers engage. It entails the ongoing monitoring of classroom life—how well the tasks, discourse, and environment foster the development of every student's mathematical literacy and power. Through this process, teachers examine relationships between what they and their students are doing and what students are learning. (p. 20)

Appendix L  
Task Indicators

Using recommendations from the NCTM *Curriculum and Evaluation Standards*, *Assessment Standards* and *Professional Standards* the following indicators were developed to determine if the observed mathematical tasks, discourse and environment were consistent with the NCTM recommendations reforms.

**Table L1**  
**Indicators of Mathematics INSTRUCTIONAL TASKS that are Supportive or Nonsupportive of Reform**

<b>Coded Tasks</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Prob- lem Solving	<p>Most major classroom tasks are characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• lectures and/or demonstrates the manipulation of symbols</li> <li>• treats students as passive listeners</li> <li>• regularly uses textbook routine, one-step problems for student practice</li> <li>• emphasizes lists of key words for students to memorize (e.g., total, sum, more than, difference)</li> <li>• uses practice problems categorized by types (e.g., time, money, age)</li> <li>• guides students through textbook practice problems step by step</li> <li>• provides the “best” strategies for solving problems, and students practice their application</li> <li>• focuses on memorizing procedures</li> <li>• validates students’ work or solutions as correct or not</li> </ul>	<p>Most major classroom tasks are characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• actively engages students in problem solving</li> <li>• uses a variety of instructional methods</li> <li>• emphasizes that students demonstrate their understanding in a variety of methods (e.g., modeling solutions, drawing pictures or diagrams, explaining solutions orally or in writing to partners, small groups, whole group or the teacher)</li> <li>• poses open-ended problems</li> <li>• engages students in extended problem-solving projects</li> <li>• focuses on investigating and formulating questions from real world problem situations</li> </ul>

(table continues)

<b>Coded Tasks</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Problem Solving	<ul style="list-style-type: none"> <li>• assigns fill-in-the-blank worksheets and drill and rote practice</li> <li>• assigns independent problem solving practice</li> <li>• emphasizes paper-and-pencil algorithms</li> <li>• emphasizes the mastery of symbolic knowledge</li> <li>• emphasizes problems that have only one correct solution</li> <li>• focuses attention solely on solutions</li> </ul>	<ul style="list-style-type: none"> <li>• uses problems that encourage the utilization of a variety of problem solving strategies</li> <li>• engages students in verification, and interpretation of results (e.g., justifying, interpolating, extrapolating and making predictions)</li> <li>• engages students in metacognitive activities</li> <li>• uses a variety of problem solving situations (e.g., cooperative groups, pair sharing, whole group discussion, and independent)</li> <li>• uses computers and calculators for problem solving</li> <li>• represents situations in a variety of ways (not limited to a symbolic focus)</li> <li>• engages students in solving problems verbally, numerically, geometrically, and symbolically</li> <li>• focuses on solution strategies</li> </ul>
<b>Coded Tasks</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Communication	<p>Most major classroom tasks are characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• explains solutions</li> <li>• explains solution strategies</li> <li>• dominates question posing</li> <li>• asks lower order questions (a la Bloom)</li> <li>• emphasizes student listening</li> </ul>	<p>Most major classroom tasks are characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• provides opportunities for students to communicate mathematical ideas, defend answers, make conjectures, explain, etc.</li> <li>• has students participate in mathematical discussions with small groups, partners, whole group and with the teacher</li> </ul>

table continues



<b>Coded Tasks</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Com- muni- cation	<ul style="list-style-type: none"> <li>◦ has students read aloud from the textbook</li> <li>◦ emphasizes student observation</li> <li>◦ uses teacher-to-student communication almost exclusively</li> <li>◦ engages student in communicating arithmetic answers, short oral recall responses, and answering procedural questions</li> <li>◦ provides students with definitions tells students content to memorize asks questions without providing wait time</li> <li>◦ grades or evaluates papers while students work</li> <li>◦ assigns grades for students' verbal responses</li> <li>• engages students in tasks that do not match their needs (e.g., not challenging, or frustrating)</li> <li>• acts as the mathematics authority and regularly explains problem solving strategies for the students</li> </ul>	<ul style="list-style-type: none"> <li>• emphasizes the use of mathematical terminology in discussions, summaries and explanations</li> <li>• provides opportunities for written, oral and visual</li> <li>• has students discuss and analyze situations</li> <li>• has students synthesize and explain their conclusions orally and in writing</li> <li>• has students analyze situations, create problems, and share ideas</li> <li>• engages students in making predictions</li> <li>• engages students in comparing results</li> <li>• has students interpret results and share ideas</li> <li>• asks higher level order questions (a la Bloom)</li> <li>• provides time for thinking and reasoning</li> <li>• provides wait time</li> <li>• provides for multiple lines of communication (e.g., students listening to students, teacher listening to students, and students listening to teacher)</li> <li>◦ provides opportunities for written, oral and visual communication in context of problem-solving activities</li> <li>• monitors classroom discourse and provides opportunities for all students to participate</li> </ul>

(table continues)

<b>Coded Tasks</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Reasoning	<p>Most major classroom tasks are characterized by several of the following. The teacher</p> <ul style="list-style-type: none"> <li>• engages students in computation practice</li> <li>• engages students in practice that involves following directions, steps, and examples</li> <li>• engages students in repetitive practice</li> <li>• regularly poses low level questions</li> <li>• engages students in copying definitions and examples</li> <li>• engages students in practicing math skills out of context</li> <li>• engages students in problem solving practice that consists of routine one step word problems</li> </ul>	<p>Most major classroom tasks are characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• engages students in challenging tasks and provides time for students to reason</li> <li>• regularly poses questions to extend students' capacities for reasoning</li> <li>• engages students in exploring different scenarios of events and in using inductive reasoning to generate hypotheses about the mathematical nature of events</li> <li>• provides students opportunities to share their mathematical reasoning by defending their interpretations and choices</li> <li>• has students validate their own thinking</li> <li>• engages students in persuasive mathematical arguments/discussions</li> <li>• provides opportunities for students to explain their understanding of mathematical relationships</li> </ul>

(table continues)

<b>Coded Tasks</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Con- nec- tions	<p>Most major classroom tasks are characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• focuses instruction on topics isolated from broader mathematical, contextual and interdisciplinary contexts</li> <li>• develops students skills out of context</li> <li>• emphasizes the need to cover the book</li> </ul>	<p>Most major classroom tasks are characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• has students make connections among mathematical concepts and procedures</li> <li>• connects new concepts to prior mathematical knowledge</li> <li>• connects mathematical problem solving to other disciplines</li> <li>• connects mathematics to the real world</li> </ul>

**Table L2**

**Indicators of Mathematics INSTRUCTIONAL DISCOURSE that are Supportive or Nonsupportive of Reform**

<b>Coded Dis-course</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Problem Solving	<p>Most major classroom discourse is characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"><li>• uses whole group direct instruction</li><li>• has students listen and watch demonstrations of example problems</li><li>• has students copy example problems</li><li>• engages students in repetitive practice of the procedures demonstrated</li><li>• has students read example problems from the textbook</li><li>• explains how to solve problems</li><li>• asks lower order questions (a la Bloom)</li><li>• asks computational questions</li><li>• encourages only confident students' participation in question-answer sessions</li><li>• selects inattentive students to answer questions (i.e., usually boys)</li><li>• has students copy definitions and rules</li><li>• has students work independently</li><li>• has students direct their questions to the teacher</li><li>• limits student to student communication</li></ul>	<p>Most major classroom discourse is characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"><li>• uses an inquiry approach in a variety of instructional settings</li><li>• engages the students in sharing and exploring their ideas</li><li>• provides hints or leading questions</li><li>• provides opportunities for students to talk and help other students</li><li>• encourages students participation</li><li>• poses new problems or questions designed to extend the students understanding of the concept being covered</li><li>• engages many students in sharing ideas or guesses about problem solutions</li><li>• engages students in discussing and evaluating ideas</li><li>• directs discussion by asking mathematical questions designed to help students clarify their thinking</li></ul>

(table continues)

**Coded Dis- course**  
**Indicators which are weakly or nonsupportive of reform**

- Problem Solving
- has students wait for assistance from the teacher
  - helps individual students by re-explaining and/or demonstrating the example problems
  - limits instructional information to the symbolic information provided in the textbook
  - engages students in computational practice
  - stresses that students be attentive and follow the steps provided in the example problems
  - monitors independent practice by walking around the room looking at students' work, commenting on their answers, repeating instructions and reminding them to focus their attention on their work
  - answers students' questions by providing the correct solution or solution strategies
  - focuses attention on manipulation of symbols
  - limits explanations to computational procedures
  - regularly provides the correct solutions
  - takes responsibility for explaining why students' solutions are incorrect
  - emphasizes speed
  - checks for understanding by

**Indicators which are clearly supportive of reform**

- provides students with some choices related to the learning activities in which they participate
- monitors progress by consulting with work groups and individuals
- engages students in consulting with each other and with the teacher to organize, prepare and share presentations of their results
- uses inquiry method to get the students engaged in investigating and formulating questions from real world problem situations
- uses a variety of instructional strategies (e.g., demonstrations, cooperative learning groups, pair sharing, and whole group discussion) to encourage mathematical discussions and investigations
- engages students in sharing their ideas and thinking
- listens to students and designs questions to facilitate learning
- engages students in asking questions and helping each other
- engages students in comparing different strategies

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(table continues)

<b>Coded Dis-course</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Problem Solving	<ul style="list-style-type: none"> <li>• checks for understanding by asking the students leading questions (recall and computation) about procedures</li> <li>• goes over work by drafting students to share answers orally with the whole class or drafts students to copy their procedures on the board or overhead</li> <li>• has students self evaluate their work by checking their answers as they are called out by the teacher or by selected students</li> <li>• has students help a fellow student by telling them the correct answer</li> <li>• emphasizes the importance of correct answers and correct procedures</li> <li>• tells students exactly what they need to do to correct mistakes</li> <li>• acknowledges and accepts first correct response provided</li> <li>• provides opportunities for students to ask questions about computation</li> <li>• talks to students about the number of problems they got right, the number of problems they completed, or the amount of time they spent on the computer</li> <li>• questions about directions, or computation</li> </ul>	<ul style="list-style-type: none"> <li>• poses questions that elicit, engage and challenge each students' thinking</li> <li>• engages students in reading, writing and talking about problem solving</li> <li>• regularly engages students in mathematical discussions (e.g., explaining, justifying, generating ideas, summarizing)</li> <li>• interacts with groups by listening to students' explanations of their problem solving and posing guiding questions to facilitate learning</li> <li>• promotes the use of different problem solving strategies by encouraging students to share and discuss their ideas</li> <li>• regularly engages students in discussions about different problem solving strategies</li> <li>• engages students in making decisions about which strategy works best or is most efficient in a given problem solving situation and in explaining why (oral or written summaries)</li> <li>• uses computer-generated graphs and charts to stimulate classroom discussion about mathematics</li> </ul>

(table continues)

<b>Coded Dis-course</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Problem Solving	<ul style="list-style-type: none"> <li>• implicitly has students competing with one another (e.g., comparing scores or the number of problems or assignments completed)</li> </ul>	<ul style="list-style-type: none"> <li>• listens to student responses and comments and gives hints to help students be persistent in problem solving efforts</li> <li>• provides opportunities for students to ask questions and respond to each others' comments</li> <li>• answers students' questions with guiding questions or helpful hints</li> <li>• engages pairs and groups of students in solving problems, concretely, verbally, numerically, geometrically, and symbolically</li> <li>• engages students in writing stories to fit their problems or vice-versa</li> <li>• regularly shares information in more than one way (e.g., demonstrating problem solving concretely with manipulatives, semi-concretely with pictures or diagrams)</li> <li>• engages students in discussions to facilitate the connection of mathematical concepts and procedures</li> <li>• regularly asks questions like — Is there another way?, Did anyone do this problem another way? Do you agree? Do you disagree?</li> </ul>

(table continues)

<b>Coded Dis-course</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Problem Solving		<ul style="list-style-type: none"> <li>• engages students in justifying their answers</li> <li>• provides opportunities for students to self evaluate their work by participating in small group and whole group discussions about their work</li> <li>• provides opportunities in whole group and small groups for students to explain or justify why their solutions are correct or not</li> <li>• asks higher order questions that extend student thinking and understanding</li> <li>• listens to students and asks guiding questions to facilitate discussion</li> <li>• provides opportunities for students to ask questions</li> <li>• uses metacognitive activities that encourage communication about student understanding (e.g., writing or giving summaries of what they did in class, summarizing the process they just learned, making a comparison of what they did today to what they did last week)</li> <li>• shares data with other classrooms electronically</li> </ul>

table continues



<b>Coded Dis-course</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Com-muni-cation	<p>Most major classroom discourse is characterized by several of the following. The teacher :</p> <ul style="list-style-type: none"> <li>• lectures</li> <li>• explains procedures</li> <li>• works and explains examples</li> <li>• asks lower order questions</li> <li>• asks for computation answers</li> <li>• answers his or her own questions</li> <li>• waits less than three seconds for students to respond</li> <li>• reads examples from the textbook</li> <li>• engages students in listening</li> <li>• engages students in copying examples and information from the board</li> <li>• dominates question posing</li> <li>• accepts first correct solution given</li> <li>• discourages student questions</li> <li>• drafts students to answer questions</li> <li>• embarrasses or penalizes students when they give a wrong answer or do not know the answer</li> <li>• focuses on covering curriculum objectives and does not modify his or her behavior based on students' comments</li> <li>• poses questions that students answer with yes or no</li> <li>• engages students in working problems quietly and independently</li> <li>• repeats the same recall questions</li> </ul>	<p>Most major classroom discourse is characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• provides opportunities for students to communicate mathematical ideas, defend answers, make conjectures and support, etc.</li> <li>• regularly asks— why?</li> <li>• engages students in making and defending conclusions</li> <li>• engages students in mathematical discussions</li> <li>• listens to students and provides helpful leading questions</li> <li>• has students write explanations of their problem solving strategies</li> <li>• has students write justifications for their decisions or conclusions</li> <li>• engages students in sharing ideas with other students (small group and whole group)</li> <li>• asks for volunteers to share their thinking</li> <li>• asks for many responses to a question</li> <li>• asks for students' opinions about responses</li> </ul>

(table continues)

<b>Coded Dis-course</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Com-muni-cation		<ul style="list-style-type: none"> <li>• uses questions skillfully to extend the students' thinking or understanding about a problem</li> <li>• engages students in discussions by asking things like— does anyone else have an answer or does anyone else have a comment or did anyone else do this in a different way or what if type questions</li> <li>• uses waits time effectively</li> <li>• engages students in analyzing situations and explaining their conclusions</li> <li>• engages students in analyzing situations and creating problems</li> <li>• engages students in making predictions</li> <li>• engages students in comparing results</li> <li>• provides frequent and varied opportunities for students to engage in mathematical discussions</li> <li>• asks higher order questions</li> <li>• listens to students and encourages all students to participate</li> </ul>

(table continues)

<b>Coded Dis-course</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Reasoning	<p>Most major classroom discourse is characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• does not emphasize reasoning</li> <li>• consistently asks lower order questions</li> <li>• stresses the importance of computation</li> <li>• tells the students the problem solving strategies needed</li> <li>• explains why answers are right or wrong</li> <li>• explains how students should verify answers</li> <li>• emphasizes students repeating or parroting what they are told</li> </ul>	<p>Most major classroom discourse is characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• provides time for students to reason</li> <li>• provides opportunities for students to discuss their reasoning</li> <li>• provides hints to help the students reason when they are getting frustrated</li> <li>• provides challenges that require students to be persistent non-routine problem solvers</li> <li>• listens to students' reasoning and asks leading questions</li> <li>• engages students in explaining mathematical relationships</li> <li>• engages students in demonstrating their understanding in more than one way</li> <li>• provides opportunities for students to share and defend their conclusions or findings</li> <li>• has students validate their own thinking</li> <li>• asks questions that encourage reasoning (e.g., Why?; How do you know?; Can you explain that to another student?; Is that a reasonable answer?)</li> </ul>

(table continues)

<b>Coded Dis-course</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Reasoning		<ul style="list-style-type: none"> <li>regularly asks questions that help students develop number sense (e.g., how are these the same?; how are these different?; how does this compare to ____?; What is the relationship between ____?; Can you show me how you know)?</li> </ul>
<b>Coded Dis-course</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Connections	<p>Most major classroom discourse is characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>focuses on students learning mathematics as a set of isolated topics</li> <li>relies on the textbook to provide the curriculum and content of the class</li> <li>makes no connections from one lesson to the next or from one concept to another</li> <li>engages students in practicing and developing skills out of context</li> <li>makes no connections between math and the real world and other disciplines</li> <li>lectures and uses textbook scripting to teach mathematics</li> <li>engages students in reciting content information</li> </ul>	<p>Most major classroom discourse is characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>uses classroom discussions to connect math concepts and procedures</li> <li>focuses on connecting new math content to students' prior mathematical knowledge</li> <li>uses leading questions to help students connect mathematical concepts</li> <li>provides demonstrations, experiences, and discussion questions that connect mathematical concepts</li> <li>uses interdisciplinary projects to connect the mathematics concepts to other disciplines</li> </ul>

(table continues)

<b>Coded Dis-course</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Con-nec-tions	<ul style="list-style-type: none"> <li>• emphasizes the importance of students doing well on speed drills while ignoring their appropriate application</li> <li>• has students show all their work on their paper</li> <li>• emphasizes computation and showing correct procedures</li> </ul>	<ul style="list-style-type: none"> <li>• spends time talking about, demonstrating, or exploring how math fits with other disciplines</li> <li>• engages students in discussing and experiencing how math is used in the real world</li> <li>• has students use metaphors, analogies, and stories to explain their thinking</li> <li>• involves students in demonstrations or projects that show how mathematics fits into real life</li> </ul>

**Table L3**

**Indicators of Mathematics INSTRUCTIONAL ENVIRONMENT that are Supportive or Nonsupportive of Reform**

<b>Coded Envi-ron-ment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Class-room envi-ron-ment related to prob-lem solving, math-	<p>The classroom environment is characterized by several of the following—</p> <p>The teacher selects <b>tasks</b> that do not place an emphasizes on communication, problem solving, reasoning or connections. The teacher selects tasks which:</p> <ul style="list-style-type: none"> <li>• emphasize procedures and correct solutions</li> </ul>	<p>The classroom environment is characterized by several of the following—</p> <p>The teacher selects <b>tasks</b> which emphasize communication, problem solving, reasoning or connections The teacher selects tasks which:</p> <ul style="list-style-type: none"> <li>• actively engage students</li> <li>• stimulate students’ interests and present challenges</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Classroom environment related to problem solving, mathematical communication, reasoning and connections	<ul style="list-style-type: none"> <li>• do not encourage students to participate in metacognitive activities</li> <li>• engage students in working independently on assignments involving computational problems</li> <li>• limit writing in math class to copying notes or doing practice problems</li> <li>• provide students opportunities to give one word or short answer responses</li> <li>• involve most time on direct instruction and little on student participation in problem solving activities</li> <li>• stress that math is a set of rules and symbols that the students are responsible for memorizing</li> <li>• limit the amount of time students spend on problem solving</li> <li>• emphasize speed, accuracy, and quantity of problems completed</li> <li>• do not provide opportunities for students to think mathematically or communicate mathematically</li> </ul>	<ul style="list-style-type: none"> <li>• provide time for students to think and puzzle on challenging problems</li> <li>• present mathematical challenges that are interesting and exciting to the students</li> <li>• engage students in investigating and explaining why and how rules work</li> <li>• engage students in investigating their own ideas to see if they work and determining what methods are most efficient and appropriate</li> <li>• engage students in working together to solve, and reason how to complete challenges</li> <li>• provide opportunities for students to reason mathematically</li> <li>• provide opportunities for students to be active participants in the learning through problem solving experiences</li> <li>• provide opportunities for students to formulate conclusions, share ideas, justify their reasoning and communicate mathematically in a variety of forms</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Classroom environment related to problem solving, mathematical communication, reasoning and connections	<p>The teacher uses <b>discourse</b> that does not develop communication, problem solving, reasoning and connections.</p> <p>The teacher:</p> <ul style="list-style-type: none"> <li>• does not encourage mathematical reasoning and risk taking (e.g., criticizes students when they give wrong answers, tells students that's not how you do it, explains why their answers or thinking is wrong, students laugh at students, students make fun of others' ideas)</li> <li>• asks recall or computational questions</li> <li>• consistently asks low level questions</li> </ul>	<ul style="list-style-type: none"> <li>• provide opportunities for students to participate in activities which require them to draw and validate their own conclusions</li> <li>• engage students in investigating interesting and real problem situations</li> <li>• provide time for and encourage metacognitive activity</li> <li>• enable students to share their ideas and ask questions</li> </ul> <p>The teacher uses <b>discourse</b> to encourage communication, problem solving, reasoning and connections.</p> <p>The teacher:</p> <ul style="list-style-type: none"> <li>• asks for volunteers and asks if anyone else would like to contribute a response</li> <li>• asks questions which probe the students' thinking</li> <li>• asks students to provide hints or counter examples</li> <li>• consistently asks for alternative problem strategies (e.g., Who did it another way?, Any other ideas? Did anyone find an easier way?)</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Classroom environment related to problem solving, mathematical communication, reasoning and connections	<ul style="list-style-type: none"> <li>• does not ask questions or lead discussions to help students build connections or relationships between mathematical concepts</li> <li>• does not encourage students to discuss problem solving strategies or alternative solutions</li> <li>• encourages students to listen and take notes</li> <li>• focuses on telling students what they need to memorize and provides them with enough practice to ensure that material is memorized</li> <li>• has the same few students volunteering to answer most teacher questions</li> <li>• asks another student in the room to provide the correct answer when an incorrect answer has been given</li> <li>• tells students what they need to know</li> <li>• takes responsibility for validating student reasoning and does not provide opportunities for students to justify their solutions and reasoning about problems</li> <li>• equates mistakes with failure</li> <li>• focuses solely on answers and correct procedures</li> <li>• summarizes and makes generalizations for the students</li> </ul>	<ul style="list-style-type: none"> <li>• encourages students to try alternative methods for solving problems</li> <li>• asks leading questions and provides hints to encourage students to be persistent problem solvers</li> <li>• encourages students to share their thinking and understanding with one another</li> <li>• encourages students to work with one another to facilitate their learning and understanding</li> <li>• engages all students in discussions and expects all students to explain how they know their solutions are reasonable</li> <li>• engages students in discussions about the various ways to solve problems</li> <li>• engages students in talking about their thinking</li> <li>• engages students in working collaboratively and actively to solve problems and validate proposed solutions (NCTM, 1991, p 115)</li> <li>• engages students in writing about their thinking</li> </ul>

(table continues)



<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Classroom environment related to problem solving, mathematical communication, reasoning and connections		<ul style="list-style-type: none"> <li>• expects and encourages different solutions by asking numerous students to share their solutions</li> <li>• facilitates student learning and reasoning by watching what students do, listening to what students say and then interacting with the students asking questions and providing hints</li> <li>• fosters mathematical communication by using small groups, large group discussions, and the presentations of individual and group reports—both written and oral— to create an environment in which students can practice and refine their growing ability to communicate mathematical thought processes and strategies (NCTM, 1989, p 79)</li> <li>• listens to what the students say and asks leading questions to help facilitate their understanding and to help students make connections within mathematics and with the world outside the classroom</li> <li>• provides hints and counter examples</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Classroom environment related to problem solving, mathematical communication, reasoning and connections	<p>The tasks selected and discourse utilized by the teacher creates an environment that is <b>teacher centered</b>.</p> <p>The teacher:</p> <ul style="list-style-type: none"> <li>• lectures while students listen</li> <li>• acts as the mathematics authority</li> <li>• asks most of the questions</li> <li>• attends strictly to his or her own agenda ( e.g., teacher having all questions prepared before class and following a rigid lesson plan which covers the objectives that the student should master that day)</li> <li>• does not provide opportunities for students to share their ideas, or comments</li> <li>• groups students by ability for mathematics instruction</li> </ul>	<ul style="list-style-type: none"> <li>• takes an inquiry-approach to mathematics instruction</li> <li>• uses questioning to encourage discussions about multiple solutions (e.g., Which answer do you think is most reasonable and why?; Which answer makes the most sense to you and why?; Explain why all of these answers could be correct?; Which of these answers could not be correct and why?; Are any of these answers correct, why?)</li> </ul> <p>The tasks selected and discourse utilized by the teacher creates an environment that is <b>student centered</b>.</p> <p>The teacher:</p> <ul style="list-style-type: none"> <li>• actively engages students in solving interesting and challenging problems</li> <li>• encourages students to be independent thinkers</li> <li>• encourages students to take responsibility for their own learning and sense making</li> <li>• engages and encourages student participation in discussing and sharing ideas</li> <li>• generates interest and excitement in learning and reasoning by varying</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Classroom environment related to problem solving, mathematical communication, reasoning and connections	<ul style="list-style-type: none"> <li>• monitors students' work and encourages them to follow instructions</li> <li>• does most of the talking</li> <li>• does not provide opportunities for students to participate in discussions about how they solve problems</li> <li>• encourages only one line of communication, teacher to student or student to teacher</li> <li>• takes little or no time to listen to students' ideas or comments</li> <li>• provides individualized instruction for students having difficulty (goes over the steps in the procedure at slower pace)</li> <li>• provides individualized assignments, additional practice, work for students having difficulty (e.g., doing more of the same type practice problems in the form of a worksheet, additional practice problems from the back of the textbook, or computer generated drill-and-rote practice problems)</li> <li>• tends to cut off student initiated discussion with short or sharp comments</li> <li>• monitors students' progress by checking their written work for accuracy, quality, and completeness</li> </ul>	<p>instructional techniques</p> <ul style="list-style-type: none"> <li>• has students validate their own reasoning by explaining and justifying their solutions</li> <li>• listens to students and asks leading questions to help them clarify their thinking</li> <li>• listens to students and incorporates their ideas into the lesson</li> <li>• monitors students' progress and offers hints or asks leading questions</li> <li>• provides opportunities for students to generate their own questions or problems</li> <li>• provides students some choices in their assignments</li> <li>• provides students time to share their conclusions</li> <li>• provides students with different settings for practicing and developing reasoning skills (e.g., students are expected to work independently, in pairs, in small groups and as a whole group to make sense; no one method is used all the time)</li> <li>• provides students with opportunities to do self evaluations</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Classroom environment related to problem solving, mathematical communication, reasoning and connections	<ul style="list-style-type: none"> <li>• diagnoses student problem(s) and <u>tells</u> students how to fix or remedy them</li> <li>• provides remediation for students who fail to master concepts taught</li> <li>• rigidly follows a routine mathematics lesson plan which does not encourage mathematical reasoning (e.g., check homework by calling out the answers, lectures and completes examples from the book to introduce new material or review previously taught concept, guides students through five to ten practice problems from the book, assigns independent practice, and if any students finish early provides them with an enrichment exercise— a worksheet with more of the same type problems)</li> <li>• teaches mathematics in terms of objectives that need to be covered</li> <li>• takes responsibility for student learning</li> <li>• does not provide time for students to share their ideas or comments</li> <li>• does not provides class time for metacognitive activities</li> <li>• shows students how to manipulate symbols</li> </ul>	

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Classroom environment related to problem solving, mathematical communication, reasoning and connections	<p>The task and discourse environment created by the teacher conveys that <b>mathematics is a set of rules to be memorized</b>. The teacher's use of discourse and selected tasks:</p> <ul style="list-style-type: none"> <li>• focuses on students providing correct answers rather than on explaining how they arrived at answers</li> <li>• encourages students to work quickly</li> <li>• emphasizes the importance of students reproducing the correct mathematical forms (e.g., showing all the steps or the procedure used)</li> <li>• evaluates students on their ability to manipulate symbols correctly</li> <li>• focuses on procedural content</li> <li>• uses mastery learning (i.e., students can not move to the next mathematics objective or concept until they pass a written test on the current concept)</li> <li>• conveys that learning mathematics requires good listening skills, being able to follow directions, and completing lots of independent practice to memorize procedures and rules</li> <li>• engages in repetitive practice to memorize rules and steps for manipulating symbols</li> </ul>	<p>The task and discourse environment created by the teacher conveys that <b>mathematics is a subject to be explored and created both individually and in collaboration with others</b>. The teacher's use of discourse and selected tasks:</p> <p>Most of the classroom environment is characterized by several of the following. The teacher:</p> <ul style="list-style-type: none"> <li>• asks questions that encourage students to make decisions about the reasonableness of solutions</li> <li>• asks students to explain their understanding in more than one way (e.g., pictures, diagrams, manipulatives, calculators, computers, stories, demonstrations, charts, graphs)</li> <li>• focuses on the students developing their own number sense</li> <li>• does not act as the sole authority of mathematical knowledge in the classroom</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Classroom environment related to problem solving, mathematical communication, reasoning and connections	<ul style="list-style-type: none"> <li>• emphasizes the idea that mathematics problems have only one correct answer</li> <li>• views using calculators as a hindrance to student mathematics learning</li> </ul>	<ul style="list-style-type: none"> <li>• emphasizes that understanding mathematics means connecting concepts and procedures</li> <li>• emphasizes the importance of communication in mathematics class</li> <li>• focuses on sense-making</li> </ul> <p>“Mathematical concepts and procedures—indeed, mathematical skills—are central to making sense of mathematics and to reasoning mathematically. Teachers should consistently expect students to explain their ideas, to justify their solutions, and to persevere when they are stuck.” (NCTM, 1991, p. 57-8)</p> <ul style="list-style-type: none"> <li>• has students explain, orally or in writing, which is the most efficient problem solving strategy for them and why</li> <li>• models being a problem solver</li> <li>• provides opportunities for students to explore the history of mathematics and develop an understanding of the importance of logical thinking</li> <li>• provides opportunities for students to see that mathematical reasoning is a part of their lives</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Class-room environment related to problem solving, mathematical communication, reasoning and connections	<p>The teacher utilizes resources and classroom space to create a learning environment that encourages students to be <b>passive learners</b>. The teacher:</p> <ul style="list-style-type: none"> <li>• uses posters and displays in the room that do not create an interesting place for exploring mathematics</li> <li>• arranges students' desks in straight rows to facilitate individuals in doing their own work</li> <li>• relies solely on the textbook for problem solving information</li> <li>• limits the use of calculators to checking computation</li> <li>• uses individualized computer-assisted instructional assignments, if they are used at all</li> <li>• uses technology to facilitate drill-and-rote practice for individuals</li> </ul>	<ul style="list-style-type: none"> <li>• relates mathematics to real life</li> <li>• has students demonstrate their understanding of a concept in more than one way</li> <li>• stresses that mathematics is more than just manipulating symbols and memorizing rules; it is away of thinking</li> <li>• uses math history and applications as regular components of the mathematics lesson</li> <li>• views making mistakes as a natural part of learning mathematics</li> </ul> <p>The teacher utilizes resources and classroom space to create a learning environment that encourages students to be <b>active learners</b>. The teacher:</p> <ul style="list-style-type: none"> <li>• arranges students' seats or desks to facilitate student to student communication in whole group or small group situations (e.g., circle or horseshoe shape for whole group discussion, for small groups desks rearranged into groups of two, three or four depending on what the activity calls for)</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Classroom environment related to problem solving, mathematical communication, reasoning and connections		<ul style="list-style-type: none"> <li>• encourages students to use calculators to develop number sense</li> <li>• encourages students to use technology to enhance their understanding of mathematics concepts</li> <li>• has students share computer generated data and work collaboratively to analyze and make sense of the data</li> <li>• uses posters and displays in the classroom that reflect the nature, beauty, and spirit of inquiry associated with mathematics, focusing on creating a place where students are interested and comfortable to explore and investigate mathematics through problem solving (e.g., manufactured or student made posters about math concepts, patterns, puzzles, real life uses, math history, newspaper clippings, real world information, and data that encourage or facilitate problem solving, models of geometric solids, three-dimensional stimulate students' mathematical puzzles, students' mathematics projects)</li> <li>• uses technology to create excitement and interest</li> </ul>

(table continues)



Coded Environment	Indicators which are weakly or nonsupportive of reform	Indicators which are clearly supportive of reform
		<ul style="list-style-type: none"> <li>• uses the textbook as one of many resources for creating interesting activities, investigations and challenges to reasoning</li> <li>• uses the textbook as one resource for problem solving material</li> </ul>
Coded Environment	Indicators which are weakly or nonsupportive of reform	Indicators which are clearly supportive of reform
Environment related to students disposition towards learning math	<p>The task and discourse environment has a <b>negative impact on student disposition towards learning mathematics</b>. This negative impact is characterized in several of the following ways. The teacher:</p> <ul style="list-style-type: none"> <li>• discourages independent thinking</li> <li>• does not encourage or expect students to think mathematically or communicate mathematically</li> <li>• drafts students to give oral responses</li> <li>• embarrasses or penalizes students who offer incorrect solutions</li> <li>• emphasizes the reasons that students should do their work is to get a grade, or finish the book</li> </ul>	<p>The task and discourse environment has a <b>positive impact on student disposition towards learning mathematics</b>. This positive impact is characterized in several of the following ways. The teacher:</p> <ul style="list-style-type: none"> <li>• respects students and helps them develop respect for one another</li> <li>• creates a comfortable atmosphere for discussing and questioning each others' solutions</li> <li>• remains nonjudgmental in metacognitive activities; consistently listens to students; develops and poses questions to help students clarify their thinking</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Envi- ron- ment relate to stud- ents dispo- sition to- wards learn- ing math- ematics	<ul style="list-style-type: none"> <li>• treats students as passive learners</li> <li>• encourages students to wait patiently for the teacher when stuck or stumped by a problem</li> <li>• evaluates or stands in judgment of student responses</li> <li>• shows little interest in student ideas or thinking</li> <li>• stresses the reasons to learn mathematics are to pass next years' class, get into college, or pass the tests</li> <li>• makes no connections between the mathematics covered in class and students' lives outside the classroom</li> <li>• presents lessons that are not stimulating, exciting or interesting to the students</li> <li>• spends quite a bit of time attending to off task behaviors (e.g., socializing, being uncooperative; drawing pictures; writing letters; reading books; wandering around the room, repeatedly going to the pencil sharpener or trash can; disturbing other students by hitting, kicking, throwing things; talking out)</li> <li>• implicitly encourages competition between students with the use of individualized assignments (e.g., who can do the most, or who can make the best grade, or who can finish first)</li> </ul>	<ul style="list-style-type: none"> <li>• uses small groups to help students learn how to interact with one another respectfully (e.g., students practice asking questions, discussing ideas, experiencing making mistakes, learning to listen to others' ideas, learning to make and take constructive criticism, and learning to summarize discoveries orally and in writing)</li> <li>• uses whole-group discussions to help students learn how to evaluate ideas, record data, share solution strategies, summarize collected data, invent notation, hypothesize, and construct simple arguments</li> <li>• encourages mathematical communication by being sensitive to students' ideas (e.g., no ridicule or embarrassment, respect students' ideas, support students' ideas, and help the students learn communication skills (NCTM, 1991, p 115) )</li> <li>• encourages students to be risk takers by developing a safe, comfortable and collaborative learning</li> </ul>

(table continues)

<b>Coded Environment</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Environment relates to students' disposition towards learning mathematics	<ul style="list-style-type: none"> <li>• shows disrespect for the students' thoughts, conclusions or ideas</li> <li>• does not encourage mathematical reasoning and risk taking (e.g., criticize students when they give wrong answers, tell students that's not how you do it, explains why their answers or thinking is wrong; students laughing at students, students making fun of others ideas)</li> </ul>	

**Table L 4**  
**Indicators of mathematics INSTRUCTIONAL ANALYSIS that are Supportive or Nonsupportive of Reform**

<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Assessment of Learning Related to Tasks	<p>Most classroom task-related assessment is characterized by several of the following.</p> <p><b>How students are assessed</b>— the teacher:</p> <ul style="list-style-type: none"> <li>• relies mainly on formal assessment (e.g., written tests or quizzes)</li> <li>• uses textbook provided tests</li> <li>• limits testing formats to multiple</li> </ul>	<p>Most classroom task-related assessment is characterized by several of the following.</p> <p><b>How students are assessed</b>—the teacher:</p> <ul style="list-style-type: none"> <li>• uses both formal and informal assessment</li> <li>• uses multiple assessment techniques, including written, oral, and demonstration formats</li> </ul>

(table continues)

<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Assessment of Learning Related to Tasks	<p>choice and short answer</p> <ul style="list-style-type: none"> <li>uses exercises and word problems requiring only one or two skills and steps</li> <li>excludes calculators, computers, and manipulatives from the assessment process (NCTM, 1989, p. 191)</li> <li>makes limited use of informal assessment (e.g., observing and listening to students)</li> <li>tests at the end of a chapter or unit of study</li> </ul>	<ul style="list-style-type: none"> <li>develops assessment tasks that require the application of several mathematical ideas and interdisciplinary contexts (e.g., performance-based assessment)</li> <li>uses calculators, computers and manipulatives in assessment (NCTM, 1989, p. 191)</li> <li>engages in ongoing assessment of what students are learning by observing and listening to students</li> <li>engages students in self evaluation</li> </ul>
	<p><b>What is assessed</b>— the teacher selects tasks which:</p> <ul style="list-style-type: none"> <li>focus on specific and isolated skills</li> <li>focus on low levels of skill development</li> <li>assess what procedures students do not know</li> </ul>	<p><b>What is assessed</b>— the teacher:</p> <ul style="list-style-type: none"> <li>focuses on a broad range of mathematical tasks and takes a holistic view of mathematics</li> <li>assesses what students know and how they think about mathematics</li> </ul>
	<p><b>Purpose of assessment</b>— the teacher:</p> <ul style="list-style-type: none"> <li>uses assessment to assign students' grades</li> <li>uses assessment to determine the students mathematical deficiencies</li> </ul>	<p><b>Purpose of assessment</b> the teacher:</p> <ul style="list-style-type: none"> <li>uses assessment for a variety of purposes (e.g., diagnosis, instructional feedback, grading, generalization of mathematical achievement, and program evaluation)</li> <li>uses assessment to show students' growth in mathematics</li> </ul>

(table continues)

<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Evaluation of Instruction-Related to Task	<p>Most of the teacher’s evaluation of instructional tasks is characterized by several of the following.</p> <p><b>Planning</b>—To select instructional/assessment tasks the teacher:</p> <ul style="list-style-type: none"> <li>• evaluates assessment tasks in terms of ease of grading, matching procedures taught in class, amount of time needed to complete the task</li> <li>• limits evaluation of instructional tasks to determining if they match curriculum objectives being covered, and materials needed</li> <li>• bases plans solely on what objectives need to be covered</li> <li>• uses the textbook to determine the sequence of objectives</li> <li>• plans for tasks which focus on the teacher (e.g., what the teacher will be doing, saying, asking, what materials the teacher will need, when the teacher will need to change tasks)</li> </ul> <p><b>During implementation of instructional tasks</b> the teacher:</p> <ul style="list-style-type: none"> <li>• examines and evaluates students’ written work to determine what students need to do to be more successful</li> </ul>	<p>Most of the teacher’s evaluation of classroom instruction is characterized by several of the following.</p> <p><b>Planning</b>—To select instructional/assessment tasks the teacher:</p> <ul style="list-style-type: none"> <li>• uses knowledge of content, research on best practice, and pedagogy to engage in mindful evaluation for selecting meaningful instructional/assessment tasks</li> <li>• evaluates the quality of mathematical tasks on several criteria (e.g., does it use sound significant mathematics, does it match students’ understanding, interests, and experiences; do they provide for student diversity in learning mathematics)</li> <li>• plans for task focus on what the students will be doing and what the students will be learning</li> <li>• bases short- and long-range instructional decisions and plans on student needs and curriculum objectives</li> </ul> <p><b>During implementation of instructional tasks</b> the teacher:</p> <ul style="list-style-type: none"> <li>• adapts or modifies tasks while teaching to facilitate student understanding</li> </ul>

(table continues)

<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Evaluation of Instruction Related to Task	<ul style="list-style-type: none"> <li>• adapts instruction by determining when, or which students, need to repeat a task, or move on</li> <li>• asks questions to determine if students understand directions</li> <li>• asks questions to determine if students are being attentive</li> <li>• monitors the quality and quantity of students' written work to ensure they are on task</li> <li>• makes decisions related to changing tasks based on the amount of time left in class</li> </ul> <p><b>Post implementation</b>—for evaluation of instructional tasks the teacher:</p> <ul style="list-style-type: none"> <li>• focuses on whether the task was completed or not</li> <li>• focuses on determining which students need extra help rather than on determining what help students need and what would be the best way to help them</li> <li>• makes decisions about plans for the next day based on what was completed in class today</li> <li>• uses students written work to decide which students need remediation and which students need enrichment</li> <li>• makes decisions concerning the introduction of new material based on the amount of time spent on the current topic</li> </ul>	<ul style="list-style-type: none"> <li>• observes and listens to students to determine how to modify tasks to facilitate student understanding</li> <li>• asks questions to help students clarify their understanding</li> <li>• provides opportunities for students to explain their understanding based on student actions, comments, and questions</li> <li>• monitors student progress by interacting with them</li> </ul> <p><b>Post implementation</b>—for evaluation of instructional tasks the teacher:</p> <ul style="list-style-type: none"> <li>• examines the effects of the task on the students' mathematical knowledge, skills, and dispositions</li> <li>• focuses on determining what help students need and what would be the best approach to help them</li> <li>• makes decisions for the next day's plans based on reflections about what the students learned in today's lesson</li> <li>• attempts to incorporate student suggestions, ideas or questions into future plans</li> <li>• makes decisions concerning introduction of new material based on extensions or challenges that naturally stem from the current lesson</li> </ul>

(table continues)

<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform.</b>	<b>Indicators which are clearly supportive of reform.</b>
<p>Assessment of Learning Related to Discourse</p>	<p>Most discourse assessment is characterized by several of the following.</p> <p><b>How students are assessed</b>— the teacher:</p> <ul style="list-style-type: none"> <li>• uses only written tests</li> <li>• uses multiple choice, or short answer test formats</li> <li>• attends to what students do not know</li> <li>• counts correct answers on tests for the sole purpose of assigning grades</li> <li>• focuses on a large number of specific and isolated skills</li> <li>• focuses on determining if students have memorized the material</li> <li>• uses exercises or word problems requiring only one or two skills</li> <li>• excludes calculators, computer, and manipulatives from the assessment process (NCTM, 1989, p. 191)</li> <li>• has students work independently</li> </ul> <p><b>The purpose of assessment</b>— the teacher:</p> <ul style="list-style-type: none"> <li>◦ uses assessment to assign students' grades</li> <li>◦ provides feedback to students (and parents) in terms of grades</li> </ul>	<p>Most discourse assessment is characterized by several of the following.</p> <p><b>How students are assessed</b>— the teacher:</p> <ul style="list-style-type: none"> <li>• uses multiple assessment techniques, including written, oral, and demonstration formats</li> <li>• focuses on a broad range of mathematical tasks and takes a holistic view of mathematics</li> <li>• focuses on whether students have internalized the material</li> <li>• develops discourse situations that require the applications of a number of mathematical ideas</li> <li>• uses calculators, computer and manipulatives in assessment (NCTM, 1989, p. 191)</li> <li>• engages in ongoing assessment of what students are learning by observing, and listening to students</li> <li>• engages students in self evaluation and discussing their conclusions</li> </ul> <p><b>The purpose of assessment</b>— the teacher:</p> <ul style="list-style-type: none"> <li>◦ assesses what students know and how they think about mathematics</li> <li>◦ uses results to facilitate instruction (e.g., setting goals)</li> <li>◦ involves students in demonstrating their growth in mathematics</li> </ul>

(table continues)

Coded Analysis	Indicators which are weakly or nonsupportive of reform	Indicators which are clearly supportive of reform
Evaluation of Instruction and Discourse	<p>The teacher's classroom evaluation is characterized by several of the following.</p> <p><b>Planning instruction</b>— the teacher:</p> <ul style="list-style-type: none"> <li>◦ bases plans on test-teach-test model of mastery learning</li> <li>◦ decides which examples to explain, which examples to use in guided practice and which examples to use for independent practice</li> <li>◦ decides when to do written assessment</li> <li>◦ prepares lectures to match objectives</li> <li>◦ bases plans solely on what objectives need to be covered</li> <li>◦ uses the textbook to determine what mathematics terminology to include in the lesson</li> <li>◦ develops plans which focus on teacher (e.g., what the teacher will be doing, saying, asking, what materials the teacher will need)</li> </ul> <p><b>During instruction</b>— the teacher:</p> <ul style="list-style-type: none"> <li>◦ examines and evaluate student written work to determine what students need to do to be more successful</li> <li>◦ examines what the students need to do to improve their listening skills</li> <li>◦ adapts instruction by determining when, or which students, need individual instruction</li> </ul>	<p>The teacher's classroom evaluation is characterized by several of the following</p> <p><b>Planning instruction</b>— the teacher:</p> <ul style="list-style-type: none"> <li>◦ bases plans on constructivist model of learning (discovery, introduce concepts, apply concepts)</li> <li>◦ determines the best method of instruction for the activity and concepts being covered (e.g., whole group, small group, pairs, or individuals)</li> <li>◦ focuses on how the students will communicate their understanding</li> <li>◦ prepares lessons around interesting real life events</li> <li>◦ carefully selects method of assessment (e.g., demonstration, interview, written explanation, written test, drawing a diagram, oral report)</li> <li>◦ bases short- and long-range instructional decisions and plans on students' needs</li> </ul> <p><b>During instruction</b>— the teacher:</p> <ul style="list-style-type: none"> <li>◦ evaluates the quality of the mathematical discourse applied in the classroom (e.g., does it extend the students' understanding of mathematical concepts, procedures and connections; does it extend the students' understanding of problem solving and their capacity to reason and communicate mathematically)</li> </ul>

(table continues)



<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Evaluation of Instruction and Discourse	<ul style="list-style-type: none"> <li>◦ monitors the quality and quantity of student written work to ensure they are on task</li> <li>◦ makes decisions about homework assignments based on the number of problems the students complete in class (e.g., finish the rest for homework)</li> </ul>	<ul style="list-style-type: none"> <li>◦ examines the effects of the discourse on the students' mathematical knowledge, skills, and dispositions</li> <li>◦ uses their knowledge of mathematical concepts, and procedures to orchestrate meaningful and significant mathematical discourse</li> <li>◦ makes instructional decisions concerning what questions to ask, what information to discuss, and when to refocus the students' attention by observations of student actions/work and carefully listening to student discussions and questions</li> </ul>
	<p><b>Post implementation:</b> For evaluation of classroom instruction</p> <ul style="list-style-type: none"> <li>◦ focuses on whether the students were attentive</li> <li>◦ focuses on determining which students need extra help rather than on determining what help students need and what would be the best way to help them</li> <li>◦ focuses on identifying students deficiencies</li> <li>◦ makes decisions about plans for the next day based on what was completed in class today</li> <li>◦ uses student written work to decide which students need remediation and which students need enrichment</li> </ul>	<p><b>Post implementation:</b> For evaluation of classroom instruction</p> <ul style="list-style-type: none"> <li>◦ evaluates the quality of the mathematical discourse applied in the classroom (e.g., does it extend student understanding of mathematical concepts, procedures and connections; does it extend student understanding of problem solving and their capacity to reason and communicate mathematically)</li> <li>◦ examines the effects of the discourse on student mathematical knowledge, skills, and dispositions</li> <li>◦ makes instructional decisions based on student needs</li> </ul>

(table continues)

<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Evaluation of Instruction and Discourse	<ul style="list-style-type: none"> <li>◦ makes decisions concerning the introduction of new material based on the amount of time spent on the current topic</li> <li>◦ evaluates the discourse based on whether it matches the curriculum objective that is being covered</li> <li>◦ examines what students need to do to improve their listening skills</li> <li>◦ bases plans on objectives that need to be covered</li> </ul>	<ul style="list-style-type: none"> <li>◦ reflects on classroom discourse, notes what worked well, and what changes could be made to better serve the students</li> </ul>
<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Assessment of Learning and Environment	<p>Most classroom assessment is characterized by several of the following:</p> <p><b>How students are assessed</b>— the teacher:</p> <ul style="list-style-type: none"> <li>◦ uses independent written tests</li> <li>◦ limits the amount of time for taking the test</li> <li>◦ focuses on what students do not know</li> <li>◦ focuses on specific and isolated skills</li> <li>◦ uses exercises or word problems requiring only one or two skills</li> <li>◦ excludes calculators, computers, and manipulatives from the assessment process (NCTM, 1989, p. 191)</li> </ul>	<p>Most classroom assessment is characterized by several of the following:</p> <p><b>How students are assessed</b>— the teacher:</p> <ul style="list-style-type: none"> <li>◦ uses multiple assessment techniques, including written, oral and demonstration formats</li> <li>◦ assesses what students know and how they think about mathematics</li> <li>◦ focuses on a broad range of mathematical tasks and discourse and takes a holistic view of mathematics</li> <li>◦ develops problem situations that require the applications of a number of mathematical ideas</li> </ul>

(table continues)

<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Assessment of Learning and Environment	<ul style="list-style-type: none"> <li>◦ creates stressful situations for students</li> <li>◦ conveys that doing math means finding quick accurate answers</li> <li>◦ conveys that there is one best method of solving problems</li> <li>◦ values students ability to memorize and follow procedures</li> <li>◦ interrupts instruction to do assessment; the process of learning all but shuts down (Brooks and Brooks 1993, p. 96)</li> </ul>	<ul style="list-style-type: none"> <li>◦ uses calculators, computer and manipulatives in assessment (NCTM, 1989, p. 191)</li> <li>engages in ongoing assessment of what students are learning by observing, and listening to students</li> <li>◦ engages students in self evaluation</li> <li>◦ conveys that problem solving, communication, and internalizing information is valued</li> <li>◦ allows for diversity in learners (e.g. multiple paths to the same end are equally valid)</li> <li>◦ accepts student responses without being judgmental</li> </ul>
	<p><b>Purpose of Assessment</b>— the teacher:</p> <ul style="list-style-type: none"> <li>◦ uses assessment for assigning grades</li> <li>◦ determines what procedures the students have memorized</li> <li>◦ determines which students need remediation</li> <li>◦ determines which procedures need individualized instruction and which should be given to the whole group</li> </ul>	<p><b>Purpose of Assessment</b>— the teacher:</p> <ul style="list-style-type: none"> <li>◦ uses assessment as an integral part of the lesson, and learning continues while assessment occurs (Brooks &amp; Brooks, 1993)</li> <li>◦ uses assessment to show growth in mathematics</li> <li>◦ uses assessment to inform the students of their process</li> <li>◦ uses assessment to make informed decisions about instruction</li> <li>◦ uses assessment for a variety of purposes: diagnosis, instructional feedback, grading, generalization of mathematical achievements, and program evaluation</li> </ul>

(table continues)

<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform</b>	<b>Indicators which are clearly supportive of reform</b>
Evaluation of Instruction and Environment	<p>Most of the teacher’s evaluation of classroom environment is characterized by several of the following.</p> <p><b>Planning instruction—</b> the teacher:</p> <ul style="list-style-type: none"> <li>• bases plans solely on the logical structure of mathematics</li> <li>• views students as dependent learners</li> <li>• focuses on what the teacher will be doing, saying, or asking</li> <li>• follows a routine lesson plan that lacks excitement or interest for the students</li> </ul> <p><b>During instruction—</b> the teacher:</p> <ul style="list-style-type: none"> <li>• evaluates student responses as being correct or not</li> <li>• defers to authority to justify their mathematical assertions (e.g., “in mathematical’ . . . ,” “they say. . . ,” “the textbook says. . .”)</li> <li>• focuses attention on getting the students to follow the classroom rules</li> <li>• expects students to adapt to fit into the learning environment provided</li> <li>• provides extrinsic motivation (e.g., making good grades, pleasing the teacher, passing seventh grade, getting into college)</li> <li>• treats students as dependent learners</li> </ul>	<p>Most of the teacher’s evaluation of classroom environment is characterized by several of the following.</p> <p><b>Planning instruction—</b> the teacher:</p> <ul style="list-style-type: none"> <li>• bases short- and long-range instructional decisions and plans on student needs and interests</li> <li>• views students as intellectual resources</li> <li>• focuses on engaging students in problem solving, communication, and reasoning</li> <li>• carefully selects topics of interest that facilitate making connections</li> </ul> <p><b>During instruction—</b> the teacher:</p> <ul style="list-style-type: none"> <li>• observes how much help the students need and what kind of help is needed to complete a task</li> <li>• evaluates the mathematical learning environment (e.g., does it convey the notion that mathematics is a subject to be explored, does it convey that mathematical understanding is to be created both individually and in collaboration with others, does it encourage participation and continued study of mathematics)</li> <li>• examines the effects of the learning environment on the students’ mathematical knowledge, skills, and dispositions</li> </ul>

(table continues)

<b>Coded Analysis</b>	<b>Indicators which are weakly or nonsupportive of reform.</b>	<b>Indicators which are clearly supportive of reform.</b>
Evaluation of Instruction and Environment	<p><b>Post instruction</b>— the teacher:</p> <ul style="list-style-type: none"> <li>• evaluates the learning environment based on whether students are on task or not</li> <li>• examines what the students need to do to be more successful in following classroom rules</li> </ul>	<ul style="list-style-type: none"> <li>• adapts or modifies the learning environment to foster students’ development of mathematical power</li> <li>• prompts intrinsic motivation (discovery and making sense of mathematics as independent learners, building self confidence and self esteem)</li> <li>• treats students as intellectual resources</li> <li>• values student explanation and discussion (e.g., spends time on it and listens attentively, encourages all members of the classroom to listen attentively and share ideas,</li> </ul> <p><b>Post instruction</b>— the teacher:</p> <ul style="list-style-type: none"> <li>• evaluates the mathematical learning environment (e.g., does it convey the notion that mathematics is a subject to be explored, does it convey that mathematical understanding is to be created both individually and in collaboration with others, does it encourage participation and continued study of mathematics)</li> <li>• examines the effects of the learning environment on student mathematical knowledge, skills, and dispositions</li> <li>• reflects on the environment and notes what is working well and what aspects need adapting to better serve the students</li> </ul>

Appendix M

Table M1

Questions Which Guided the Analysis, Teacher Responses Characteristic of Instruction Supportive of Reform and Their Matching Indicators

<b>Global Instructional Questions</b>	<b>Teacher responses that characterize instruction supportive of reform</b>	<b>Matching Indicators</b>
(1) What type(s) of instructional tasks are used for instruction?	Selects and uses a variety of nonroutine problems, applications, questions, projects, constructions, or exercises which may or may not be from the textbook, that challenge the students to investigate and construct mathematical concepts and relationships	(a) Uses a variety of nonroutine problems, (b) Does not depend solely on the textbook for instructional materials, (c) Involves students in investigation and discovery
(2) Is instruction student-centered or teacher-centered?	Regularly provides opportunities for the students to explain, justify and demonstrate their reasoning in small group and whole group situations.	(a) Is a facilitator (listens and does not do all the talking), (b) Provides opportunities for students to explain, justify and demonstrate their understanding, (c) Uses an inquiry approach
(3) What cognitive processes are involved in the lesson?	Emphasizes and focuses on complex thinking and reasoning, a variety of problem solving strategies, constructing meaning, and reflection	(a) Focuses on the problem solving process and reasoning rather than just the correct solution (b) Encourages discussion and justification of alternative solutions (c) Involves students in reflection, explaining their understanding and making connections

(table continues)

<b>Global Instructional Questions</b>	<b>Teacher responses that characterize instruction supportive of reform</b>	<b>Matching Indicators</b>
(4) What types of instructional strategies are used by the teacher?	Uses a variety of combinations of individual instruction, small-group instruction, and whole-group instruction via an inquiry or discovery approach, guided questioning (focus on higher level type questions) or demonstration	(a) Uses a variety of instructional strategies: individual, partners, small-group and whole-group, (b) Uses a variety of instructional techniques such as demonstrations, inquiry and discovery approaches, (c) Asks questions that challenge higher level thinking
(5) How is learning assessed?	Uses a variety of formal and informal assessment tools (e.g., interviews, classroom discussions, student demonstrations, projects, applications, constructions, oral explanations, written explanations, written tests) that provide students opportunities to demonstrate or explain their conceptual and procedural understanding of mathematics. Grading determines students' performance on multiple types of assessment, and assessment is an integral part of instruction. (Listening to and valuing what students say.) Teachers provide opportunities for students to participate in self evaluations and in assessing their own progress.	(a) Uses informal assessment and provides opportunities for students to demonstrate or explain their <b>conceptual</b> and procedural understanding, (b) Uses multiple types of assessment, (c) Involves students in self evaluations

table continues

<b>Global Instructional Questions</b>	<b>Responses that characterize mathematics instruction supportive of reform.</b>	<b>Matching Indicators</b>
(6) What is the purpose of assessment?	<p>Uses informal assessment to gain insight into what students are learning and uses this knowledge for making in-class instructional decisions (e.g., when to adapt ongoing instruction to make mathematical connections that lead to higher levels of mathematical abstraction — scaffolding), or to develop concrete, conceptual or procedural understanding; and to plan short- and long-term instructional challenges that match students’ needs</p> <p>Uses formal assessment to document students’ growth in mathematics, to communicate students’ progress to parents and to determine grades</p>	<p>(a) Uses informal and formal assessment to make instructional planning decisions,</p> <p>(b) Uses informal assessment to adapt on-going instruction to fit student needs,</p> <p>(c) uses formal assessment to document student growth and to determine grades</p>



Appendix N

Table N1

Level II Analysis Matrix for Overall Instructional Rankings

Participant \_\_\_\_\_

Lesson Observed \_\_\_\_\_

	Practice	Exercise	Problem Solving	Application	Construction	Project
Opening						
Task 1						
Task 2						
Task 3						
Task 4						
Task 5						
Task 6						
Task 7						

After the type of task was determined, any reform indicators that were evident were placed in the corresponding cells.

Table N2

Coded Global Indicators of Good Instruction

<b>Global Indicators of Good Instruction</b>	<b>Codes</b>
<b>Instructional task:</b>	
(a) Uses a variety of nonroutine problems	nonrt-pr.
(b) Does not depend solely on the textbook for instructional materials	not textb
(c) Involves students in investigation and discovery	disc
<b>Instruction student centered:</b>	
(a) Is a facilitator (listens and does not do all the talking).	facil
(b) Provides opportunities for students to explain, justify and demonstrate their understanding	st. expl
(c) Uses inquiry approach	not lect

(table continues)

<b>Global Indicators of Good Instruction</b>	<b>Codes</b>
Cognitive processes:	
(a) Focuses on the problem solving process and reasoning rather than just the correct solution	foc conce
(b) Encourages discussion and justification of alternative solutions	enc dis
(c) Involves students in reflection and explaining their understanding and making connections	reflect
Instructional strategies:	
(a) Uses a variety of instructional strategies individual, partners, small group and whole group	ind.; part; sm g; wh g
(b) Uses a variety of instructional techniques such as demonstrations, inquiry or discovery approaches	inq; dem; dis
(c) Asks guiding questions that challenge higher level thinking (i.e. application, comparison, connections, deductive reasoning, analysis and conjectures)	h.o.quest.
Assessment:	
(a) Uses informal assessment and provides opportunities for students to demonstrate or explain their <b>conceptual</b> and procedural understanding	inform asses asses conc foc
(b) Uses multiple types of assessment (interview, discussions, demonstrations, projects, oral explanations, written explanations, constructions, written tests)	non trad asses
(c) Involves students in self evaluations	self ev
Purpose of Assessment:	
(a) Uses informal assessment and formal assessment to make instructional planning decisions	asses/plan
(b) Uses informal assessment to adapt on-going instruction to fit the students' needs	asses/adapt
(c) Uses formal assessment to document student growth and determine grades	asses/grow asses/grades

## Appendix O

Table O1  
Codes for Level III Systemic Indicators

<b>Systemic Reform Indicators:</b>	<b>Code</b>
1. Schools actively participate in ongoing telecommunications networking projects that utilize and share mathematics and science information and educational resources.	TeleCNP
2. Schools have participants at statewide mathematics and science conferences and professional meetings.	Conf or ProM
3. Teachers are provided access to national mathematics and science conferences, workshops, and other professional development opportunities via telecommunications.	TeleCPD
4. Teachers of mathematics know where and how to access the most up-to-date technical assistance in mathematics and science pedagogy, content, and educational research.	Ped or EdR
5. School division personnel know how to access and work collaboratively with instructional materials producers.	InM
6. School division personnel know how to access and work collaboratively with local, regional, state, and national museums, public and private agencies, and professional mathematics organizations.	Collab
7. School personnel consistently involve and utilize parent and community resources in their mathematics programs.	Commin
8. School personnel consistently utilize college and university resources in their mathematics programs.	Univer
9. State has mathematics curriculum standards that are consistent with the V-QUEST goals.	CurSS
10. Middle school has mathematics curricula based on the state framework.	CurSL
11. Building and central office administrators participate annually in professional development activities that focus on leadership in mathematics.	AdmLS

(table continues)

<b>Systemic Reform Indicators:</b>	<b>Code</b>
12. School divisions use a significant portion of discretionary funds to support educational programs in mathematics and meeting the V-QUEST goals.	FianS
13. Schools support alternative forms of assessment as outlined in NCTM <i>Assessment Standards</i> .	Assess

Table O2

Codes for Level III Systemic Indicator Attributes

<b>Systemic Indicator Attributes</b>	<b>Codes</b>
<b>Population:</b>	
Classroom Level	L1
Building Level	L2
Division Level	L3
State Level	L4
<b>Linking area of focus:</b>	
Curriculum	C
Assessment	A
Instructional Materials	IM
Technical Assistance	TA
<b>Stage of reform:</b>	
Implemented successfully	S5
Implemented but needs work	S4
Implemented but in the early stages	S3
Implemented but abandoned	S2
Planning to Implement	S1
Informed but no action taken	S0

Table 03

Matrix for Documenting Systemic Reform

Systemic Reform Indicators:	Years	Class Level	Building Level	Division Level	State Level
1. TeleCNP	91-92				
	Peaked				
	Year				
	95-96				
2. Conf or ProM	91-92				
	Peaked				
	Year				
	95-96				
3. TeleCPD	91-92				
	Peaked				
	Year				
	95-96				
4. Ped or EdR	91-92				
	Peaked				
	Year				
	95-96				
5. InM	91-92				
	Peaked				
	Year				
	95-96				
6. Collab	91-92				
	Peaked				
	Year				
	95-96				
7. Commin	91-92				
	Peaked				
	Year				
	95-96				

(table continues)

Systemic Reform Indicators	Years	Class Level	Building Level	Division Level	State Level
8. Univer	91-92 Peaked Year 95-96				
9. CurSS	91-92 Peaked Year 95-96				
10. CurSL	91-92 Peaked Year 95-96				
11. AdmLS	91-92 Peaked Year 95-96				
12. FianS	91-92 Peaked Year 95-96				
13. Assess	91-92 Peaked Year 95-96				

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Appendix P

Table P1.

Analysis Results for Mr. A's First Initial Observation

Task Descriptions	Task Rank	Dis-course Rank	Environ-ment Rank	Assessment /Evaluation Rank	Overall Task Rank Sum
<b>1. Hover Craft</b>					
AIMS activity					
Application	4	3	3	4	14
Small Group					
Nontextbook					
<b>2. Homework Evaluation of the Hover Craft Task</b>					
Question					
Individual	3	3	3	4	13
Nontextbook					
<b>3. Review</b>					
Question					
Whole-Group	2	3	3	3	11
Textbook					
<b>4. Assessment</b>					
Written explanation					
Scientific Notation					
Question	3	3	2	3	11
Individual					
Nontextbook					
<b>5. Homework on Scientific</b>					
Notation					
Exercise					
Individual	2	1	2	3	8
Textbook					
Total					57
Global Rank (Average— total divided by number of tasks)					11.4

Table P2.

Analysis Results for Mr. A's Second Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review Basic Arithmetic Skills					
Exercise					
Whole Group	2	3	3	3	11
Nontextbook					
2. Reflection on Hover Craft					
Question					
Whole Group	3	3	3	3	12
Nontextbook					
3. Introduce New Material— Looking for Patterns					
Problem Solving					
Whole Group	3	3	3	4	13
Textbook					
4. Guided Practice					
Problem Solving					
Small Group	3	3	3	4	13
Textbook					
5. Homework —computation practice					
Exercise	1	1	1	2	5
Individual					
Textbook					

(table continues)

Task Descriptions	Task	Discourse	Environ-	Assessment	Overall
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	Rank	Rank	ment Rank	/Evaluation Rank	Task Rank
6. Independent Practice—Rounding Decimals Exercise Individual Textbook	1	1	2	2	6
				Total	60
	Global Rank (Average— total divided by number of tasks)				10

Table P3.

Analysis Results for Mr. A's Third Initial Observation

Task Description	Task Rank	Discourse Rank	Environ- ment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Computer Assisted Instruction Exercise Individual Nontextbook	2	1	2	2	7
2. Paper Recycling Project Small Group Nontextbook	3	3	3	3	12
3. Guided Practice Explain Patterns Problem Solving Partners Textbook	3	3	3	3	12

(table continues)

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
4. Assessment					
Check Homework					
Exercise					
Whole Group	3	3	2	3	11
Textbook					
Total					42
Global Rank (Average— total divided by number of tasks)					10.5

Table P4.

Analysis Results for Mr. A's First Follow-up Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Computer Assisted					
Instruction					
Exercise					
Individual	2	2	3	3	10
Nontextbook					
2. Review for Test					
Question					
Whole Group	3	3	3	2	12
Textbook					
Total					22
Global Rank (Average— total divided by number of tasks)					11

Table P5.

Analysis Results for Mr. A's Second Follow-up Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Assessment					
Application					
Individual	4	4	3	4	15
Nontextbook					
2. Independent Practice					
Exercise					
Individual	2	2	2	2	8
Textbook					
3. Challenge Problem					
Problem Solving					
Small Group	4	4	3	3	14
Textbook					
4. Homework					
Exercise					
Individual	3	2	3	2	10
Textbook					
				Total	47
Global Rank (Average— total divided by number of tasks)					11.75

Appendix Q

Table Q1

Analysis Results for Mrs. D's First Initial Observation .

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Introduce new material					
Application					
Small Group	4	2	2	2	10
Nontextbook					
2. Assessment					
Question					
Individual	3	2	3	2	10
Nontextbook					
3. Guided Practice					
Question					
Whole Group	2	2	2	2	8
Nontextbook					
4. Independent Practice					
Application					
Individual					
Nontextbook	2	2	2	1	7
5. Homework					
Application					
Individual	2	1	1	2	6
Nontextbook					
6. Assessment					
Exercise					
Individual	3	1	2	1	7
Textbook					
				Total	48
Global Rank (Average— the total divided by number of tasks)					8

Table Q2

Analysis Results for Mrs. D's Second Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review/Assessment					
Application					
Individual	3	2	2	2	9
Nontextbook					
2. Introduce new material					
Exercise					
Whole Group	2	2	2	2	8
Textbook					
3. Guided Practice					
Exercise					
Whole Group	2	2	1	2	7
Textbook					
4. Independent Practice					
Exercise					
Small Group	3	3	1	1	8
Textbook					
5. Homework					
Exercise					
Individual	3	1	1	1	6
Textbook					
				Total	38
Global Rank (Average— the total divided by number of tasks)					7.6

Table Q3

Analysis Results for Mrs. D's Third Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review					
Question					
Whole Group	2	2	1	1	6
Nontextbook					
2. Assessment					
Application					
Individual	3	2	1	2	7
Nontextbook					
3. Guided Practice					
Exercise					
Whole Group	3	2	2	2	9
Textbook					
4. Independent Practice					
Exercise					
Individual	2	2	1	1	6
Textbook					
5. Homework					
Application					
Individual	2	2	1	2	7
Nontextbook					
				Total	35
Global Rank (Average— the total divided by number of tasks)					7

Table Q4

Analysis Results for Mrs. D's First Follow-up Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review					
Questions					
Whole Group	3	3	3	3	12
Nontextbook					
2. Investigation					
Application					
Partners	4	4	2	3	13
Nontextbook					
3. Assessment					
Question					
Individual	4	4	3	4	15
Nontextbook					
4. Guided Practice					
Exercise					
Whole Group	3	3	2	4	12
Nontextbook					
5. Challenge Problem					
Problem Solving					
Individual	4	3	2	4	13
Nontextbook					
				Total	65
Global Rank (Average— the total divided by number of tasks)					13

Table Q5

Analysis Results for Mrs. D's Second Follow-up Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
<b>1. Return graded assessment</b>					
Exercise					
Whole Group	1	2	2	2	7
Nontextbook					
<b>2. Review/guided practice</b>					
Exercise					
Whole Group	2	2	1	2	7
Nontextbook					
<b>3. Independent Practice</b>					
Exercise					
Individual	1	2	1	2	6
Textbook					
				Total	20
Global Rank (Average— the total divided by number of tasks)					6.7



Appendix R

Table R1

Analysis Results for Mrs. N's First Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment/Evaluation Rank	Overall Task Rank
1. Review/Assessment					
Exercise					
Individual					
Textbook	3	3	3	2	11
2. New material/ demonstration					
Question					
Whole Group	3	3	3	3	12
Nontextbook					
3. Guided Practice					
Problem Solving					
Whole Group	3	3	3	2	11
Nontextbook					
4. Independent Practice					
Problem Solving					
Small Group	3	2	3	2	10
Nontextbook					
5. Homework					
Problem Solving					
Individual	3	3	4	3	13
Nontextbook					
6. Independent Practice					
Exercise					
Small Groups	3	3	3	2	11
Textbook					

(table continues)

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
7. Reflection					
Question					
Whole Group	3	3	3	3	12
Nontextbook					
Total					81
Global Rank (Average— the total divided by number of tasks)					11.5

Table R2

Analysis Results for Mrs. N's Second Initial Observation

Task Description	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review /Reflect					
Question					
Whole Group	2	3	3	3	11
Nontextbook					
2. Review/Going Over					
Homework					
Exercise					
Whole Group	3	3	2	2	10
Nontextbook					
3. Assessment					
Problem Solving					
Individual	2	3	3	2	10
Nontextbook					
4. Introduce New					
Material					
Problem Solving					
Whole Group	3	3	3	3	12
Textbook					

(table continues)

Task Description	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
<b>5. Guided Practice</b>					
Exercise					
Partner	3	3	3	2	11
Textbook					
<b>6. Independent Practice</b>					
Exercise					
Individual	2	3	3	2	10
Textbook					
<b>7. Homework</b>					
Exercise					
Individual	2	3	3	2	10
Textbook					
				Total	74
Global Rank (Average— the total divided by number of tasks)					10.5

Table R3

Analysis Results for Mrs. N's Third Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review					
Question					
Whole Group	2	3	3	3	11
Nontextbook					
2. Review					
Exercise					
Whole Group	1	3	3	3	10
Textbook					
3. Independent Practice					
Problem Solving					
Partners					
Textbook	3	3	3	3	12
4. Computer Assisted					
Instruction					
Exercise					
Individual	2	3	3	2	10
Nontextbook					
				Total	43
Global Rank (Average— the total divided by number of tasks)					10.8

Table R4

Analysis Results for Mrs. N's First Follow-up Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review/Reflection					
Question					
Whole Group	4	4	4	4	16
Nontextbook					
2. Review/Practice					
Application					
Whole Group	2	3	3	4	12
Nontextbook					
3. Introduce New					
Material					
Exercise					
Whole Group	2	4	4	3	13
Nontextbook					
4. Practice					
Application					
Partner	3	4	4	3	14
Nontextbook					
5. Direct Instruction					
Question					
Whole Group	2	2	3	2	9
Nontextbook					
6. Homework					
Exercise					
Independent	3	3	2	2	10
Textbook					

(table continues)

Task Description	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
7. Computer Assisted Instruction Exercise					
Nontextbook	2	3	2	3	10
Total					84
Global Rank (Average— the total divided by number of tasks)					12

Table R5

Analysis Results for Mrs. N's Second Follow-up Observation

Task Description	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review/Going Over Homework					
Question Whole Group	2	3	4	4	13
Textbook					
2. Independent Practice					
Question Individual	2	2	4	2	10
Textbook					
3. Introduce New Material					
Exercise Whole Group	1	1	2	2	6
Textbook					
4. Practice					
Construction Individual	1	1	1	1	4
Nontextbook					
Total					33
Global Rank (Average— the total divided by number of tasks)					8

Appendix S

Table S1

Analysis Results for Mrs. L's First Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment/Evaluation Rank	Overall Task Rank
<b>1. Review/Speed Drill</b>					
Exercise					
Whole Group	1	1	1	1	4
Nontextbook					
<b>2. Review/ Checking</b>					
Homework					
Exercise					
Whole Group	2	2	2	1	7
Textbook					
<b>3. Guided Practice</b>					
Question					
Whole Group	2	1	2	2	7
Textbook					
<b>4. Independent Practice</b>					
Application					
Small group	3	2	2	2	9
Nontextbook					
<b>5. Homework</b>					
Exercise					
Individual	2	1	1	1	5
Textbook					
				Total	32
Global Rank (Average— the total divided by number of tasks)					6.4

Table S2

Analysis Results for Mrs. L's Second Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
<b>1. Review/speed Drill</b>					
Exercise					
Whole Group	1	1	1	1	4
Nontextbook					
<b>2. Review/ Checking</b>					
Homework					
Exercise					
Whole Group	1	1	1	1	4
Textbook					
<b>3. Assessment</b>					
Exercise					
Independent	2	1	1	2	6
Textbook					
<b>4. Review/ Student</b>					
Stories					
Project					
Individual	2	2	2	2	8
Nontextbook					
<b>5. Homework</b>					
Exercise					
Individual	2	1	1	1	5
Textbook					
				Total	27
Global Rank (Average— the total divided by number of tasks)					5.4



Table S3

Analysis Results for Mrs. L's Third Initial Observation

Task Description	Task Rank	Discourse Rank	Environment Rank	Assessment/Evaluation Rank	Overall Task Rank
<b>1. Review/Speed Drill</b>					
Exercise					
Whole Group	1	1	1	1	4
Nontextbook					
<b>2. Assessment/turn in Homework</b>					
Exercise					
Whole Group	1	1	1	1	4
Textbook					
<b>3. Practice</b>					
Application					
Small Group	3	2	3	2	10
Nontextbook					
<b>4. Homework</b>					
Application					
Individual	3	1	1	1	6
Nontextbook					
<b>5. Computer Assisted Instruction</b>					
Exercise					
Individual	2	2	1	1	6
Nontextbook					
				Total	30
Global Rank (Average— the total divided by number of tasks)					6

Table S4

Analysis Results for Mrs. L's First Follow-up Observation

Task Description	Task Rank	Discourse Rank	Environment Rank	Assessment/Evaluation Rank	Overall Task Rank
<b>1. Review/Speed Drill</b>					
Exercise					
Whole Group	1	1	1	1	4
Nontextbook					
<b>2. Review/ Checking</b>					
Homework					
Exercise					
Whole Group	1	1	1	1	4
Textbook					
<b>3. Practice</b>					
Problem Solving					
Small Group	3	3	2	2	10
Textbook					
<b>4. Independent Practice</b>					
Exercise					
Individual	2	2	1	1	6
Nontextbook					
<b>5. New Material</b>					
Question					
Whole Group	1	1	1	1	4
Textbook					
<b>6. Guided Practice</b>					
Exercise					
Whole Group	1	1	1	1	4
Textbook					

(table continues)

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
<b>7. Independent Practice</b>					
Exercise textbook	2	1	1	1	5
total					37
Global Rank (Average— the total divided by number of tasks)					5.2

Table S5

Analysis Results for Mrs. L's Second Follow-up Observation

Task Description	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
<b>1. Review/Previous Day's Assessment</b>					
Exercise Whole Group	1	1	1	1	4
Nontextbook					
<b>2. Review/Checking Homework</b>					
Exercise Whole Group	2	1	1	1	5
textbook					
<b>3. Assessment Application</b>					
Independent	2	2	1	1	6
Nontextbook					
<b>4. Independent Practice Application</b>					
Partner	2	2	2	1	7
Nontextbook					

(table continues)

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
5. Introduce New Material					
Question					
Whole Group	1	1	1	1	4
Textbook					
6. Guided Practice					
Exercise					
Whole Group	1	1	1	1	4
Textbook					
7. Independent Practice					
Exercise					
Small Group	3	3	2	2	10
Textbook					
				Total	41
Global Rank (Average— the total divided by number of tasks)					5.8

Appendix T

Table T1

Analysis Results for Mrs. W's First Initial Observation

Tasks Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Introduce New Material					
Exercise					
Whole Group	1	2	1	1	5
Textbook					
2. Guided Practice					
Exercise					
Whole Group	1	1	2	1	5
Textbook					
3. Independent Practice					
Exercise					
Individual	1	1	1	2	5
Textbook					
4. Homework					
Exercise					
Individual	1	1	1	1	4
Textbook					
				Total	19
Global Rank (Average— the total divided by number of tasks)					4.8

Table T2

Analysis Results for Mrs. W's Second Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review/Checking					
Homework					
Exercise	1	2	1	1	5
Whole Group					
Textbook					
2. Independent Practice					
Exercise					
Whole Group	1	1	1	1	4
Textbook					
3. Homework					
Exercise					
Individual	1	1	1	1	4
Textbook					
Total					13
Global Rank (Average— the total divided by number of tasks)					4.3

Table T3

Analysis Results for Mrs. W's Third Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Introduce New Material					
Exercise	1	2	1	1	5
Whole Group					
Textbook					
2. Guided Practice					
Exercise					
Whole Group	1	2	2	2	6
Textbook					
3. Independent Practice					
Exercise					
Individual	1	2	1	1	5
Textbook					
4. Homework					
Exercise					
Individual	1	1	1	1	4
Textbook					
				Total	20
Global Rank (Average— the total divided by number of tasks)					5

Table T4

Analysis Results for Mrs. W's First Follow-up Observation

Task Description	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
<b>1. Review/Direct Instruction</b>					
Exercise					
Whole Group	2	2	2	1	7
Textbook					
<b>2. Building Solids</b>					
Construction					
Small Group	3	3	3	2	11
Textbook					
Total					18
Global Rank (Average— the total divided by number of tasks)					9

Table T5

Analysis Results for Mrs. W's Second Follow-up Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
<b>1. Review/Direct Instruction</b>					
Exercise					
Whole Group	1	2	1	1	5
Textbook					
<b>2. Guided Practice</b>					
Exercise					
Whole Group	1	1	1	1	4
Textbook					
<b>3. Independent Practice</b>					
Exercise					
Individual	1	1	1	1	4
Textbook					
Total					14
Global Rank (Average— the total divided by number of tasks)					4.6



Appendix U

Table U1

Analysis Results for Mr. M's First Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
<b>1. Introduce New Material</b>					
Exercise					
Whole Group	1	1	2	1	5
Textbook					
<b>2. Guided Practice</b>					
Exercise					
Partners	2	1	2	1	6
Textbook					
<b>3. Independent Practice</b>					
Exercise					
Partners	2	1	2	2	7
Textbook					
<b>4. Homework</b>					
Application					
Individual	2	2	2	2	8
Nontextbook					
				Total	26
Global Rank (Average— the total divided by number of tasks)					6.5

Table U2

Analysis Results for Mr. M's Second Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment/Evaluation Rank	Overall Task Rank
1. Review/Sharing					
Homework					
Question					
Whole Group	2	2	2	2	8
Nontextbook					
2. Introduce New Material					
Exercise					
Whole Group	1	2	2	2	7
Textbook					
3. Guided Practice					
Exercise					
Partners	1	2	2	2	7
Textbook					
4. Independent Practice					
Exercise					
Textbook	2	1	2	2	7
5. Homework					
Application					
Individual	3	1	2	2	7
Textbook					
				Total	36
Global Rank (Average— the total divided by number of tasks)					7.2

Table U3

Analysis Results for Mr. M's Third Initial Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review/Checking					
Homework					
Exercise					
Whole Group	2	2	2	2	8
Textbook					
2. Introduce New					
Material					
Exercise					
Whole Group	1	2	2	2	7
Textbook					
3. Guided Practice					
Exercise					
Partner	2	2	2	2	8
Textbook					
4. Homework					
Exercise					
Individual	2	1	2	1	6
Textbook					
				Total	29
Global Rank (Average— the total divided by number of tasks)					7.3

Table U4

Analysis Results for Mr. M's First Follow-up Observation

Task Descriptions	Task Rank	Dis-course Rank	Environ-ment Rank	Assessment /Evaluation Rank	Overall Task Rank
<b>1. Review/Demonstration</b>					
Question					
Whole group	2	1	2	2	7
Nontextbook					
<b>2. Review/Checking</b>					
Homework					
Exercise					
Whole Group	1	1	1	1	4
Textbook					
<b>3. Assessment</b>					
Exercise					
Individual	1	2	2	2	7
Textbook					
<b>4. Introduce New</b>					
Material					
Question					
Whole Group	2	2	1	1	6
Textbook					
				Total	22
Global Rank (Average— the total divided by number of tasks)					5.5

Table U5

Analysis Results for Mr. M's Second Follow-up Observation

Task Descriptions	Task Rank	Discourse Rank	Environment Rank	Assessment /Evaluation Rank	Overall Task Rank
1. Review/Assessment					
Exercise					
Whole Group	1	1	1	1	4
Textbook					
2. Guided Practice					
question					
Whole Group	2	1	2	1	6
Textbook					
3. Independent Practice					
Exercise					
Individual	2	1	1	1	5
Textbook					
				Total	13
Global Rank (Average— the total divided by number of tasks)					4.3

Appendix V

Table V  
Analysis of Addison-Wesley's Chapter Review/Test

Chapter	Procedural Problems	Conceptual Problems	Word Problems	Total Problems
1 Addition and Subtraction of Whole Number	28	0	2	30
2 Addition and Subtraction of Decimals	24	3	2	29
3 Multiplication and Division of Whole Numbers	34	0	2	34
4 Multiplication of Decimals	27	0	4	31
5 Division of Decimals	28	0	3	31
6 Geometry	20	2	0	22
7 Number Theory and Equations	30	0	2	32
8 Addition and Subtraction of Fractions	28	4	2	34
9 Multiplication and Division of Fractions	40	0	2	42
10 Measurement: Metric Units	24	0	2	26
11 Ratio and Proportion	18	0	4	22
12 Percent	27	0	2	29
13 Circles and Cylinders	21	3	2	26
14 Probability, Statistics, and Graphs	0	0	17	17
15 Integers (Torn out of the book)				missing data
16 Measurement: Customary Units	24	0	2	26

Appendix W  
Core Curriculum  
Seventh Grade Objectives

Students will

- be confident and proficient problem solvers, able to develop and apply a variety of problem solving strategies, with emphasis on multi-step and nonroutine problems.
- apply mathematical thinking and modeling to solve problems that arise in other disciplines.
- communicate mathematical ideas and make conjectures and convincing arguments that are supported by using oral, written, concrete, pictorial, graphical, and algebraic methods.
- recognize and apply deductive and inductive reasoning.
- understand and apply ratios, proportions, and percents in a wide variety of situations.
- understand how the basic arithmetic operations are related to one another.
- develop and apply number theory concepts in real-world and mathematical problem situations.
- select and use an appropriate method for computing from among mental arithmetic, paper-and-pencil, calculator, and computer methods.
- develop, analyze, and explain procedures for computation and techniques for estimation.
- select and use an appropriate method for computing from among mental arithmetic, paper-and-pencil, calculator, and computer methods.
- develop, analyze, and explain procedures for computation and techniques for estimation.
- represent situations and number patterns with tables, graphs, verbal rules, and equations and explore the interrelationships of these representations.
- explore statistics in real-world situations.
- explore probability in real-world situations.
- study the geometry of one, two, and three dimensions.
- have extensive concrete experiences using measurement.

## Core Curriculum Mathematics

### Eighth Grade Objectives

Students will

- explore problem solving techniques and strategies. Emphasis will be on (1) computation, (2) estimation, (3) proportions, (4) verification and interpretation of results, and (5) generalization of solutions and strategies to new problem situations.
- have the opportunity to communicate with others to enhance their understanding of mathematical vocabulary and notation.
- have the opportunity to increase their reasoning ability with attention given to spatial reasoning and reasoning with proportions and graphs.
- continue to develop their understanding of numerical relationships by representation in one- and two-dimensional graphs.
- increase their knowledge of number systems and number theory by extending whole number operations to fractions, decimals, integers, and rational numbers.
- explore sequences, patterns, and functions and be able to describe relationships with tables, graphs, and rules.
- explore algebraic concepts to enable them to solve linear equations using concrete, informal, and formal process.
- statistics in real-world situations to enable them to make inferences and arguments based on data analysis.
- explore probability in real-world situations to enable them to construct sample spaces and make predictions.
- explore geometry for an understanding of properties and relationships.
- explore measurement of concrete objects to extend their understanding of perimeter, area, volume, angle measure, capacity, and weight and mass.
- build their knowledge of measurement concept to develop formulas and procedures for problem solving.

Algebra I is offered at the eighth grade level for high school credit.

Assessment



Mathematics assessment will be achieved through a holistic approach. Teachers must realize that there are many other ways to carry out assessment than the traditional paper-and-pencil test. Some possible alternatives will include (1) presentations, (2) demonstrations, (3) portfolios, and (4) evidence of knowledge by use of manipulatives.

## Appendix X

### Documentation List of Mathematics Materials Purchased in 1994-95

- Ordered by the Mathematics Lead Teacher
  - (Software) Data Insight for Apple IIE from Sunburst on October 25, 1994 for \$104.94
  - From ETA \$49.92 November 20, 1994
    - Pattern Block Activities
    - Overhead Pattern Blocks
  - Technology check number 011504 for \$144.90 Serial Card for Apple on February 16, 1995
  - Purchase Order February 10, 1995 \$666.50; payment to Summit Learning for Mathematics Manipulates and Books, February 17, 1995 totaled \$666.50
    - Balance Gram Set
    - Pattern Blocks
    - Stop watches
    - Challenge Boxes Creative Themes
    - Math Posters
    - Pentominos
- Ordered by the eighth grade mathematics teacher, on March 2, 1995
  - Packing Inventory Slip number 10298 March 20, 1995 Total \$492.77
    - Pentominos 12 Sets
    - Patter Block Activity Book
    - Pattern Block Activity Cards
    - Math Blues
    - The Write Equation
    - Weaving from Arithmetic to Mathematics
    - Cartesian Cartoons
    - How to Enrich Geometry using Student Cartesian Creations
  - Order from Spectrum. Total coast \$295.84 check number 18514
    - Geo Board,
    - Geo Blocks
    - Books on how to use Geo Boards and Blocks
  - Ordered form Summit Creative Works \$22.10 on March 2, 1995
    - Trundle Wheel
- Seventh grade teacher
  - Dale Seymore December 7, 1994 for \$169.50

### 30 Classroom Set Student Kits

- Unidentified purchaser
  - Dale Seymore \$62.58 Account and Budget number 6113-6013-6  
Mathematics Supplies
- Unidentified purchaser
  - Dale Seymore \$430.21 (Identified as Reg. #55)  
Mathematics Supplies
- Unidentified purchaser
  - Dale Seymore Math Materials Invoice number 18516 Total cost \$978.91  
Mira Math/ Geometry Connections  
Texas Instruments Kits  
Manipulation Kit Grade 5  
Manipulation Kit Grades 6/8  
Overhead Manipulatives Kit
- Sixth grade teacher
  - Kentucky School Services invoice number 082661 total \$195.00 April 18, 1995  
Department Store Mathematics  
Budget, Mathematics Around the Home  
Geo Safari
- Unidentified purchaser
  - account number 33947 invoice number 71176 December 9, 1994  
TI-108 [calculators] Classroom Kit \$186.45  
Overhead Calculator \$43.45