

## Chapter 2 Methods and Procedures

### Design

"As an innovation or program change is implemented, it frequently unfolds in a manner quite different from what was planned or conceptualized in a proposal....Case studies...become particularly useful where one needs to understand some... unique situation in great depth" (Patton, 1990, pp. 53-54). The use of case study methodology would permit me, the researcher, to identify issues, perceptions, satisfactions, problems, and practices related to algebra instruction in teachers' classrooms (with each teacher representing one case.) Michael Quinn Patton's *Qualitative Evaluation and Research Methods* (second edition) served as a guiding reference in conjunction with Robert E. Stake's *The Art of Case Study Research*. The qualitative design employs the theme of naturalistic inquiry, "studying real-world situations as they unfold naturally; non-manipulative, unobtrusive, and non-controlling; open to whatever emerges with a lack of predetermined constraints on the outcomes." (Patton, 1990, p. 40). My primary task was to understand the case--to look for confirmation through multiple sources and to seek the contradiction as well. "Case studies are not known by their problems....[The] issues...are good windows for examining the complexity...of the case....A case is an entity [to be studied]....[It] has a unique life. It is a something we do not sufficiently understand and want to--therefore, we do a case study" (Stake, 1995, p. 127-133)

Figure 1 represents the instructional framework underlying relationships among the essential variables in this study. This conceptual map is influenced by a model for curriculum design by Fenema, Carpenter, and Petersen (Rachlin, 1989, p. 261). Against a canvas representing time as the variable that bounds classroom algebra instruction are situated the three key components--teacher, instruction, and student. Teacher actions are directly influenced by knowledge (of algebra content, local and state algebra standards, required algebra assessments, and the psychology of adolescent students), skills (pedagogy and artistry), and dispositions (beliefs.) With these influential inputs, the teacher designs instruction (learning experiences) which directly influences the student in the domains of knowledge (learning/achievement), behaviors (engaged, not engaged, motivated, disruptive), and disposition (toward algebra.) Student behaviors (responses) in the classroom influence the teacher to alter and adjust instruction. This interactive exchange continues back and forth across the lesson

as it unfolds upon the canvas of time. The social reality of the algebra classroom is made up of individual teachers and students whose actions and interactions during the teaching event are influenced by the structure of the hundred-minute block schedule.

### Instructional Framework

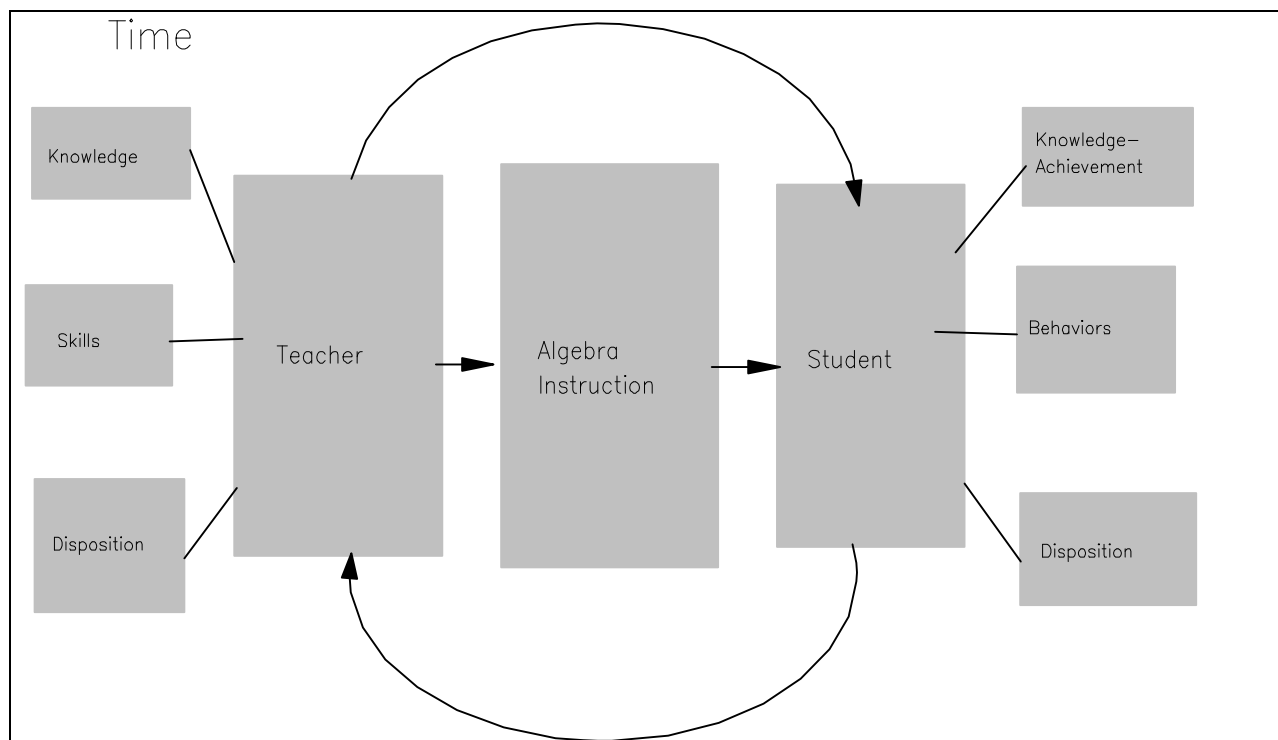


Figure 1. Algebra Instruction in an Extended Block of Time

The model may be used to illustrate the unfolding lesson beginning with the algebra teacher. Teachers incorporate their knowledge of algebra content and the local curriculum framework to choose an appropriate objective for the lesson. They combine their pedagogical knowledge of various instructional strategies with their understandings of the adolescent students in their classes to select various activities to be used in communicating the lesson's objective. Other presentation details evolve based upon teachers' disposition toward the content of the objective and the availability of appropriate materials as well as their preference for certain strategies based upon personal artistry and past experience. These variables combine in various configurations unique to the teacher and result in a plan for the algebra lesson. As the lesson is presented, teachers may make adjustments based upon feedback from the students.

Students bring their own competencies and perceptions into the algebra classroom. Students enter with a prior knowledge-base in mathematics as well as a pattern of past (and present) achievement that will influence their responses to the lesson. Students' disposition toward algebra and any personal opinions about the time requirements of the block are variables that may influence their motivation and engagement during the lesson. The knowledge and disposition variables interact with student behaviors (resulting from social interactions with other students, with the teacher, and with the content and activities of the lesson) to produce an unlimited number of student responses to the lesson. Teachers read the spoken and unspoken responses from the students and determine in what ways to alter the lesson.

The series of interactions that occurs among the variables in the model is repeated as each algebra class proceeds from start to finish within the structural limitations of time. Thus, time becomes an overarching variable in the development of the algebra lesson. Adjustments in available time influence adjustments in other variables.

#### Time Frame

This study was conducted during the 1996-97 school year and included the following events:

Summer 1996--Initial organizing details including preparation of informed consent agreements, proposal to IRB for exemption of projects involving human subjects, and proposal requesting permission to conduct the study in the local school division according to local guidelines

October 1996--Meeting with algebra teachers at each site to solicit participants in the study

October-November 1996--Agreements received from six teachers indicating willingness to participate

November 1996-February 1997--Three observations in algebra classrooms of each of six case subjects

January 1997--Distribution of surveys to each of six case teachers

February-March 1997--Individual interviews with each case teacher using structured questions

April 1997--Transcribing interviews

June-October 1997--Development of individual case reports using classroom scenario format combined with data from surveys and interviews (requiring analysis of data for individual cases)

November 1997-February 1998--Data analysis across cases and writing of final research report

### Setting

The six cases included in this report were taken from two high schools that had implemented the block schedule in 1993-94. Two teachers taught at Hamilton High School, the other four teachers at Russell High.

### Participants

All mathematics teacher assigned to teach one or more first-year algebra classes at Hamilton or Russell High Schools were invited to participate in the study. The invitation was extended orally (at an open meeting held to explain the broad parameters of the study) and later in writing. Teachers were told that the research would involve classroom visits, a survey, and an interview. They were told that the goal of the study was to describe the reality of algebra classrooms in the block schedule with the hope to capture the teaching and learning experience in a vivid way. Teachers self-selected participation and gave informed consent allowing the researcher to visit the classroom and agreeing to respond to a series of questions in writing and in an individual interview. Teachers were assured that they would remain anonymous in the final report. One teacher gave immediate consent and five others agreed over several weeks to participate. Two of five algebra teachers at Hamilton High and four of seven algebra teachers at Russell High School participated.

The six teachers reflect diversity in gender (2 males, 4 females); ethnicity (1 Black, 5 White); and years of teaching experience (ranging from two to twenty years with an average of twelve years.) Their algebra classes represent a somewhat heterogeneous mix of students in grades nine through twelve, with the majority in ninth grade. Neither teachers nor students were selected by the researcher as a representative sample. However, there is no reason to believe that the teachers or their classroom groups were atypical. If a participating teacher had an algebra class scheduled during the midday block in such a way that the class was split into two equal parts before and after lunch, then that particular class was not

included in the study. The intent was to observe only those algebra classes meeting for a full, uninterrupted block.

### Researcher

"The case researcher plays different roles and has options as to how they will be played" (Stake, 1995, p. 91). Those roles include teacher (teaching the reader), biographer (of the people involved in the cases), and interpreter. There is a connection to constructivist thinking in case studies as the researcher "tries to provide description that would allow readers to make their own interpretations" (Stake, 1995, p. 102).

"Because the researcher is the instrument in qualitative inquiry, a qualitative report must include information about the researcher" (Patton, 1990, p. 472). My educational background includes a bachelor's degree and a master's degree in mathematics with minors in secondary education. I was a high school mathematics teacher for thirteen years and taught all subjects from general mathematics to calculus, including algebra. In addition to my teaching experience, I have been a mathematics supervisor (K-12) with various responsibilities for developing, disseminating, and improving mathematics instruction by working with teachers and administrators. Currently, in addition to pursuing my doctorate, I am director of research, testing, and evaluation for my school division.

### Data Sources

The unit of analysis in this study is the individual algebra teacher's classroom. The units constitute a range intended to allow me "...to generate data, explore processes,...[examine] similarities and differences...rather than to make statistical comparisons between the units themselves." (Mason, 1996, p. 97)

Data used in the development of individual cases were taken from three major sources, classroom observations, individual interviews with teachers, and teacher responses to survey questions. "One important way to strengthen a study design is through triangulation....Combinations of interviewing, observation, and document analysis are expected in much social science fieldwork....Studies that use only one method are more vulnerable to errors linked to that particular method" (Patton, 1990, p. 187-188).

Classroom observations provided a means for me to see, hear, and experience the reality of an algebra classroom. A minimum of three complete blocks of algebra instruction were observed in each teacher's classroom (with the 'stopping point' determined

at such time as the data appeared to cease offering new insights). "During observation, the qualitative case study researcher keeps a good record of events to provide a relatively incontestable description for further analysis and ultimate reporting...The story often starts to take shape during the observation, [but] sometimes does not emerge until write-ups of many observations are poured over" (Stake, 1995, p. 62). The record of what transpired in the observations provided a series of snapshots or word pictures drawn from the algebra classroom. The observation process demanded extensive anecdotal field notes or scripts describing the setting, instructional delivery, content, methodology, teacher behaviors and student behaviors. The algebra content is explicit and based upon a written curriculum guide. However, within the explicit [algebra] curriculum is an implicit curriculum represented by the ways that teachers present the explicit curriculum (Goodlad, 1984).

Following the actual classroom visit, a contact summary form was used to record the events observed in five-minute increments. This summary provided a record of the variety, frequency, and duration of activities and practices. On- or off-task behaviors were noted as well as level of enthusiasm seen in teacher or students. Later, the observation script and the contact summary form were used to create the classroom scenarios that are the foundation for the individual case reports. The classroom scenarios, script field notes, and contact summaries were reviewed and analyzed to distill themes reported as distinctive features of each case.

Another source of data was the structured interview with each teacher. "Much of what we cannot observe for ourselves has been or is being observed by others....Qualitative researchers take pride in discovering and portraying the multiple views of the case. The interview is the main road to multiple realities" (Stake, 1995, p. 64). The researcher used a standardized open-ended interview in which the exact wording and sequence of questions were determined in advance. The questions were designed with the concept model in mind. This variation in interview instrumentation, according to Patton has its strength in the fact that "respondents answer the same questions, thus increasing the comparability of responses. Data are complete for each person on the topics addressed in the interview. This design facilitates organization and analysis of the data" (Patton, 1990, p. 289). In return, there is less flexibility in relating the interview to particular individuals and circumstances. Flexibility was achieved by use of probes when responses seemed constrained or limited by the wording of the

questions. The purpose of the interviews was to determine teacher satisfaction or disposition toward teaching algebra in the block, including (1) teacher readiness or advance preparation for teaching in the block, (2) teacher identification of the benefits and limitations presented by the block, (3) teacher perceptions of the typical strategies used in algebra lessons, (4) teacher perception of student achievement and any changes the teacher would make to benefit student learning, and (5) advice the teacher might offer to an algebra teacher whose school has decided to implement the same type of block schedule.

An interview guide (list of questions) was prepared in advance to ensure that the same information was obtained from each teacher. Each individual interview lasted approximately 45 minutes and was audiotaped in order to capture the actual words of the teacher. Care was taken before and during the interview to be sure that the recording equipment was functioning properly. In addition, I took notes as the interview progressed. Later, all tapes were transcribed.

"The purpose of interviewing is to find out what is in and on someone else's mind....What does the program look and feel like to the people involved? What are the experiences of participants? What thoughts do people knowledgeable about the program have concerning operations, processes, and outcomes?... What features of the program are most salient to the people involved? What changes do they perceive...as a result of their involvement in the program?" (Patton, 1990, pp. 278-279). The challenge was to make it possible for the teacher to reveal his or her world (the algebra classroom) to me.

"Data interpretation and analysis involve making sense out of what people have said, looking for patterns, putting together what is said in one place with what is said in another place, and integrating what different people have said" (Patton, 1990, p. 347). These processes occurred as the individual case reports were developed. During the preparation of the classroom scenarios unique to each case, the transcript from the teacher interview was studied in order to triangulate and confirm the data from the observations. Similarities between interview responses and classroom practice were inserted as text-boxes within the classroom scenarios as a means of highlighting those confirmations. If, for example, during classroom visits, I observed that a teacher often encouraged students to pair-and-share as they worked and if, in the interview, the teacher noted that 'I see myself doing more group work. I put them in pairs

and that has worked well,' then I would enclose the teacher's comment in a frame or text-box placed next to the description of the pairs working together in the classroom scenario.

The third data source for this study was a survey containing 66 statements related to teaching algebra in the block schedule. The first 26 statements required teachers to give Likert-type responses using a five-point scale to indicate strength of agreement or disagreement. The statements were designed to determine teacher perceptions regarding the potential benefits and limitations of the block as well as teacher disposition toward the block.

The next 35 items required the teacher to indicate the frequency of use of various instructional strategies (taken from a range of strategies noted in the literature review as likely to occur during the block.) At the time when the surveys were distributed, the teachers had completed the second nine-week grading period. Each algebra class meets 22 times during each nine-week period. Teachers were asked to identify how often (from zero to twenty-two times) in the most recent grading period they had utilized specific strategies.

The last five questions on the survey asked teachers to grade (A to F) the block as a contributor to improving algebra instruction, the quality of algebra lessons, and the quality of algebra instruction in their classroom/school.

The surveys were designed to gather additional information related to the research questions in the study. They were not intended to provide quantitative data but rather served as another means of triangulation. Again I compared the events in the classroom scenarios to the survey responses. When the survey response confirmed interview statements or classroom practice, a text-box was inserted into the classroom scenario to emphasize the confirmation. If, for example, a teacher was observed giving frequent one-to-one assistance to students; if the teacher's interview statements included the comment that 'the block allows more individual attention to students'; and if the teacher agreed or strongly agreed with survey items 11 and 18 (provides more individual feedback and more one-to-one assistance since implementation of the block schedule), then I would emphasize the confirmation by inserting the teacher's quote and the survey statements in a frame or text-box adjacent to the event in the classroom vignette.

Some document review was used to gather data on student achievement. A grade distribution report was gathered for each case/teacher in order to determine final grades assigned to algebra students in the teacher's classes.

The interrelationships among the data sources appear in Table 1. The actual interview questions and survey are located in the Appendices D and E respectively.

Table 1  
Data Sources Matched to Variables from the Instructional Framework

	Observation	Interview	Survey	Document
<u>Teacher:</u>				
Disposition, Satisfaction	Overt behavior during class visits	2C, 3A-3D, 5A, 5B	Q19, 20, 21, 22, 23, 24, 25, 26, 63, 64, 65	
Knowledge, Skill, Preparedness		1A, 1B, 3B, 5A, 5B	Q13, 14, 15, 16, 17, 26	
<u>Instruction:</u>				
Strategies Type Frequency Duration	Field notes from class visits	2A 2B 2C 5A	Q12, 27, 29, 30, 31, 32, 34, 35, 36, 37, 40, 42, 44, 47, 48, 49, 50, 51, 52, 53, 56, 57, 58, 59, 60, 61	
Instructional Point of View	Field notes from class visits	2B 3B 5A	Q12, 27, 29, 30, 31, 33, 34, 38, 39, 40, 41, 42, 43, 45, 46	
<u>Student:</u>				
Achievement		4A 4B	Q1, 3, 5, 6, 10, 11, 54, 56, 57, 58, 59, 60, 61	Final algebra grades
Engagement	Field notes from class visits	4A	Q4, 8, 9, 28, 33, 35, 36, 37, 43, 45, 50	
Behaviors	Field notes from class visits	4A 4B	Q2, 7, 10, 35, 36, 37, 45	

### Validity

"Careful preparation for making observations is as important as disciplined training" asserts Patton (1990, p. 201), citing

Louis Pasteur's remark, "In fields of observation, chance favors the prepared mind." As a mathematics supervisor, I have spent many hours and much effort in developing observational skills in order to provide useful feedback to teachers. The process of scripting detailed notes and then analyzing them to draw useful conclusions has been practiced repeatedly.

Multiple sources of information are sought and used because no single source of information can be trusted to provide a comprehensive perspective on a program. By using a combination of observations, interviews, surveys, and documents, the researcher is able to use different data sources to validate and cross-check findings. Using a combination of data types increases validity as the strengths of one approach can compensate for the weaknesses of another approach (Marshall and Rossman, 1989, pp. 101-107). Multiple data sources were included in this study and the validity of data collected through interviews was enhanced by the standardized format.

A degree of validity is produced by the case reports themselves. "To describe the case, we try to present a substantial body of incontestable description" (Stake, 1995, p. 110). There is an emphasis on time, place, and people along with rich descriptions recounting familiar matters. The goal is to create a vicarious experience for the reader, providing adequate raw data prior to interpretation to allow the reader to consider alternative interpretations. The reader will construct knowledge about teaching algebra in a block schedule by experiencing the six cases in this study. "People can learn much that is general from single cases...because they are familiar with other cases and they add this one in, thus making a slightly new group from which to generalize, a new opportunity to modify old generalizations" (Stake, 1995, p. 85).

After preparing the individual case reports, they were presented to an expert (mathematics supervisor and veteran algebra teacher) for consideration and a discussion of interpretations. Further validation was provided through the process of member checking. A draft of the individual case report was submitted to the case teacher for what Stake calls "accuracy and palatability" (Stake, 1995, p. 115). The teacher was encouraged to provide alternative language or interpretations. Five of six teachers responded. (One had moved and did not send a response.) All five found the classroom scenarios to be accurate. All agreed that the features of their case reflected their responses and opinions. No one suggested alterations.

### Data Analysis

We have few agreed-on canons for qualitative data analysis, in the sense of shared ground rules for drawing conclusions and verifying their sturdiness (Miles and Huberman, 1994). Meaning about the research issues arose from direct interpretation of individual instance and through aggregation of instances until something could be said about them as a class (Stake, 1995). I concentrated on the instance of each classroom visit and each interview, pulling apart aspects of the model (teacher issues, lesson issues, and student issues) and putting them back together again, seeking to collect impressions from which relevant meanings might emerge. Meaning derives from single events and from the repetition of events. Triangulation was facilitated by asking questions of teachers in interviews, looking and listening for both corroboration and contradiction between the observations and the interview responses. Relationships, issues, and new data emerged. "Triangulation encourages the researcher to approach the research questions from different angles and to explore their intellectual puzzles in a rounded, multifaceted way" (Mason, 1996, p. 149). The primary goal was to present the individual case.

The six individual case records were prepared to include richly descriptive classroom scenarios combined with text-box inserts confirming triangulation across other sources. Teacher background was provided as a frame of reference for the individual case. Careful review of the case data led me to add distinctive features of the case as part of each case report.

The search for meaning involved a search for patterns. Patterns emerged in observations, in interviews, in documents, in the results of the survey as well as in the process of coding and analysis. Patterns appeared within responses to the research questions and emerged unexpectedly at various points during analysis. I maintained a dubious view of first impressions and oversimplification of meanings. This required continual reflection and challenging the data for adequacy. It was important to constantly sift the transcripts and field notes to keep key issues in focus.

"Schools have moods and they display scenes of high drama that those who make policy and who seek to improve practice should know. The means through which such knowledge [to improve practice] is made possible are through the enlightened eye--the scene is seen--and the ability to craft text so that what the observer has experienced can be shared by those who were not there" (Eisner, 1991, p. 30). People form generalizations

through direct personal experiences and, vicariously, by well-constructed accounts that cause them to feel as if the experiences happened to them.

Each of the six cases offered rich detail about the specific algebra classroom settings and the events that occurred there. Each case provided an explanation of the practice within the case. As the cases were viewed in a holistic fashion, comparisons emerged to form the foundation for a cross-case report summarizing common findings and unique (not shared) findings. Cases were not held up feature-to-feature as though they should be alike.

#### Limitations

There are many variations included under the category of block scheduling. This study examined one particular type of block schedule (the alternate day hundred-minute block.) The research was confined to one particular discipline (mathematics) and one particular curriculum (first year algebra.) The investigation was limited by the research questions and the self-selected sample of teachers who agreed to participate (and their algebra classes.)

#### Final Product

The final product is an interpretation offering insight with the format based on Robert Stake's (1995) case study design, including: an introduction; identification of issues, purpose, methodology; extensive narrative description; development of the issues (emergent and those based on literature review); descriptive detail to confirm experiential data; and summary assertions.