

Virginia's Implementation of Web-based High-stakes
Testing in Public Education

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Abstract

The purpose of this study was to investigate how online testing was implemented within a statewide high-stakes testing program in Virginia's public education system. Virginia's state assessments, known as the Standards of Learning (SOL) tests, were first administered to public school students in 1998 as paper-and-pencil, multiple-choice tests where students used a paper test booklet, an optical scan paper answer document, and a #2 pencil to complete each test. In 2000, at the direction of the Governor and General Assembly of the Commonwealth, the Virginia Department of Education (VDOE) introduced a technology initiative where, upon successful implementation, students would be able to complete their required SOL tests electronically via the Internet.

The researcher, an employee of the VDOE with direct involvement in the implementation of online testing, conducted a participant-observer case study and interviewed individuals closely associated with the Virginia Web-based Standards of Learning Technology Initiative. The interview transcripts, project documents, and experiences of the researcher as a participant-observer were used as the primary data sources. Glaser and Strauss's (1967) constant comparative method with suggested procedural additions from Lincoln and Guba (1985) and Maykut and Morehouse (1994), was applied in data analysis.

The findings are presented as a monograph with the history and implementation of Virginia's Web-based Standards of Learning Technology Initiative detailed by the participant-observer researcher. The desired outcomes of the researcher's efforts are (a) informing others of Virginia's experiences, including its successes and failures, (b) sharing the lessons learned

throughout the implementation of Virginia's Web-based SOL Technology Initiative, and (c) identifying best practices that could be transferable to other state or local organizations attempting similar large-scale initiatives.

Dedication

This work is dedicated to my parents, Bob and Peggy Susbury, who have devoted so much of their lives to the education of young people. Thank you for your love and support!

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I extend my sincere thanks to Dr. David Parks, my committee chair and advisor. His guidance and input throughout my work have been invaluable to me and will stay with me much beyond this process. His encouragement and patience have been equally as important.

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Thank you to my friends and colleagues at the Virginia Department of Education. I am blessed to work with such a talented and supportive group of professionals. I am grateful for the opportunities I have experienced in public education, and I am thankful for the many professionals I have met and worked with who truly care about students and their best interests.

In closing, I thank my parents for teaching me their work ethic and always sharing their love and their support. Thank you – for everything.

Table of Contents

Abstract.....	ii
Dedication	iv
Acknowledgements	v
Table of Contents	vi
List of Tables	viii
List of Figures.....	ix
Chronology	xii
Preface.....	xiii
Chapter 1 Prior to Virginia’s Web-based Standards of Learning Technology Initiative.....	1
The National Trends	1
Trends in Virginia.....	4
Chapter 2 Virginia’s Web-based Standards of Learning Technology Initiative	22
Three Goals of the Web-based Standards of Learning Technology Initiative.....	22
Standards of Learning Technology Initiative Funding.....	22
School Divisions’ Intent to Participate	25
Nominations for High School Demonstration Projects	31
The Plan for the Use of Funds	31
Web-based SOL Technology Initiative Project Plan.....	44
Organizational Hierarchy for the Web-based Standards of Learning Technology Initiative	45
Chapter 3 A Demonstration of Web-based Testing in Virginia	52
Demonstration Phase Request for Proposals	53
Evaluation Criteria and Evaluation Process	63
Three Successful Proposals	67
Virginia Schools as Demonstration Sites	68
Preparing for the Demonstration	73
Chapter 4 Implementing Operational Web-based Testing in Virginia	101
From Demonstration to Operational Testing.....	101
Collaboration of Assessment and Technology Staff.....	104
Phased Implementation.....	106
Assessment Considerations	108
Technology Considerations	116
Chapter 5 Implementing Web-based Standards of Learning Testing: Lessons Learned..	125

Readiness	125
Assessment	129
Leadership and Oversight	130
Project Management	131
Partnerships and Communication	133
References	141
Appendix A Context and Research Methods	156
Context of the Study	156
Statement of the Problem	157
Rationale for the Study	157
Methodology	162
Presentation of the Findings	170
Appendix B Background and Literature Review	171
Electronic Testing: Terminology and Concepts	171
Technology: Terminology and Concepts	180
Issues Related to Implementing Electronic Testing	187
Equivalency of Electronic Testing	191
Electronic Testing Environment	194
Training for Students, Teachers, and Administrators	199
System Performance Issues	200
Costs of Electronic Testing	202
Applying a Theoretical Change Model to the Implementation of Electronic Testing	203
Change Theory in Education	204
Appendix C Interview Materials	217
Appendix D Approvals and Certifications	221
Institutional Review Board Approval Letter	221
Fair Use Certifications and Permissions Letter	223

List of Tables

Table 1	<i>Four Major Elements of Virginia's Comprehensive Educational Reform</i>	5
Table 2	<i>Details From the Virginia Board of Education Resolution on Assessment</i>	9
Table B.3	<i>States Implementing Electronic Testing in the 2002-2003 Academic Year</i>	188
Table B.4	<i>Factors Affecting Initiation (Phase I) of the Change Process in Education</i>	206
Table B.5	<i>Factors Affecting Initiation (Phase II) of the Change Process in Education</i>	211

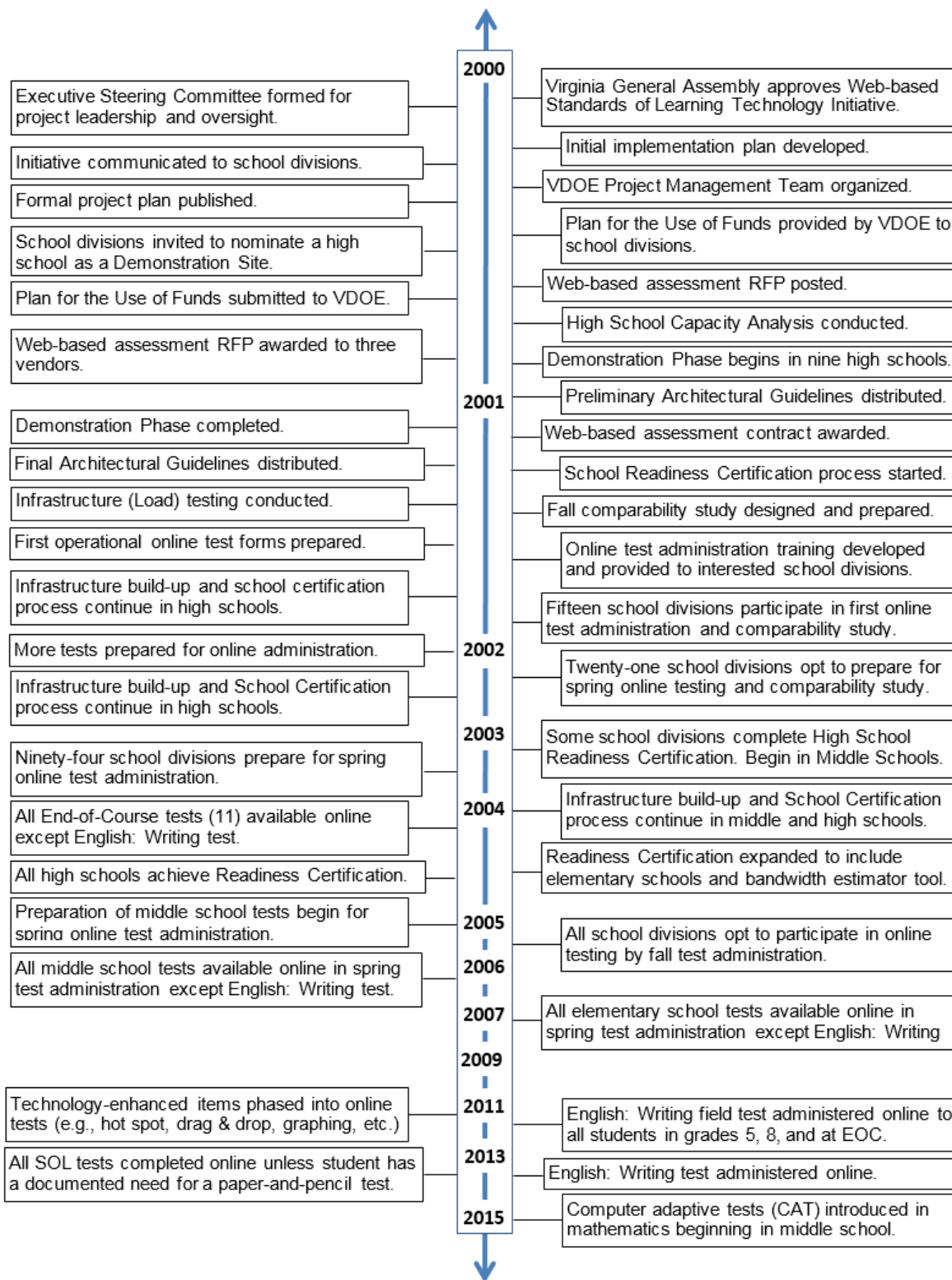
List of Figures

Figure 1	A photo of answer documents stacked on a cart waiting for acclimatization.	17
Figure 2	A photo of answer document carts waiting for processing at a high volume period.	19
Figure 3	Annual funding appropriated by the 2000 Virginia General Assembly for the Web-based Standards of Learning Technology Initiative.	26
Figure 4	The Web-based Standards of Learning Technology Initiative Division “Intent to Participate” Statement.	28
Figure 5	An annual funding scenario for a sample participating school division.	29
Figure 6	The <i>Plan for the Use of Funds</i> resource from a Microsoft Excel workbook with four individual targeted worksheets.	33
Figure 7	The <i>Division Monthly Progress</i> worksheet in the <i>Plan for the Use of Funds</i> workbook.	34
Figure 8	The Virginia Department of Education designed the Financial worksheet as a tool for each school division.	37
Figure 9	Expenditure types documented in the <i>Plan for the Use of Funds</i> workbook.	39
Figure 10	Training slides one through three for the presentation on the <i>Plan for the Use of Funds</i> workbook.	41
Figure 11	Training slides four and five for the presentation on the <i>Plan for the Use of Funds</i> workbook.	42
Figure 12	A timeline for the <i>Plan for the Use of Funds</i> workbook.	43
Figure 13	The initial release of the project plan for the Initiative.	44
Figure 14	The organizational hierarchy for the Initiative.	46
Figure 15	The defined responsibilities of each Project Work Group.	49
Figure 16	The testing and technical requirements in the request for proposals.	55
Figure 17	A description of the type and importance of the requirements.	56

Figure 18	The first testing requirements listed in the request for proposals addressed test security.	56
Figure 19	The first sample high school in the request for proposals.	58
Figure 20	The second sample high school in the request for proposals.	59
Figure 21	The third sample high school in the request for proposals.	59
Figure 22	The fourth sample high school in the request for proposals.	60
Figure 23	An email notification from the Superintendent of Public Instruction to local school division superintendents.	61
Figure 24	The procurement schedule was presented in the request for proposals.	62
Figure 25	Eleven companies responded to Virginia’s Web-based Standards of Learning Technology Initiative request for proposals.	63
Figure 26	The evaluation criteria were published in the request for proposals.	64
Figure 27	The evaluation process prescribed for the evaluation committee.	66
Figure 28	The nine high schools selected as demonstration sites.	71
Figure 29	The technology profiles for two demonstrations sites are shown with annotations.	72
Figure 30	An excerpt from the <i>Designing and Optimizing Ethernet Networks</i> guidance document.	80
Figure 31	A sample from a student log during the Demonstration Phase.	83
Figure 32	A list of participating school divisions with details of the demonstration site financial grant award.	84
Figure 33	An excerpt from the <i>Vendor Evaluation Form</i> .	87
Figure 34	A section of text from Program Management Team Meeting Minutes, April 4, 2001.	90
Figure 35	Vendor Recommendation Process for the Web-based SOL Technology Initiative.	92

Figure 36	An excerpt regarding security from the <i>Testing Manual for the Division Director of Testing</i> .	114
Figure 37	A sample test item shown with the item-choice eliminator tool being used.	115
Figure 38	The cover page of the High School Readiness Certification worksheet.	118
Figure 39	The Stage 2 Bandwidth Estimator Worksheet shown on the left with sample output messages on the right.	120
Figure 40	Training slides to be used with school divisions regarding Proctor Caching.	122
Figure 41	A summary of the lessons learned through the implementation of the Web-based SOL Technology Initiative.	126
Figure 42	The invitation sent to Internet Service Providers regarding an informational meeting held on May 13, 2002, in Richmond, Virginia.	136
Figure 43	A screen shot of the Status Page used by the Virginia Department of Education.	138
Figure A.44	The number of Virginia school divisions participating in administration of online SOL tests by date of test administration.	160
Figure A.45	The number of Virginia SOL tests administered to students online by test administration through spring 2013.	161
Figure A.46	A diagram of three proposed elements to be researched and potential categories to be explored within each element.	163
Figure A.47	A graphic overview of the constant comparative data analysis procedures utilized.	169
Figure B.48	A simplified client-server computing environment.	182

Chronology



Preface

A desired outcome of this case study was to document, from the perspective of a participant-observer, the implementation of a high-visibility, multi-million dollar initiative in Virginia's public schools. The initiative, Virginia's Web-based Standards of Learning (SOL) Technology Initiative, was introduced to school divisions in the 1999-2000 academic year as a statewide project to ensure that school divisions had Web-based resources available "to improve the SOL instructional, remedial, and testing capabilities in their schools" (Virginia Department of Education, 2009, p. 8).

This case study was conducted by a Virginia Department of Education employee in the role of a participant-observer (Bogdan, 1972; Bogdan, 1973; Bogdan & Bilken, 2003; Creswell, 1998; Huberman & Miles, 2002; Jorgensen, 1989; Maykut & Morehouse, 1994; Merriam, 1998; Rossman & Rallis, 2003). The scope of the study is limited to the state perspective of the Web-based Standards of Learning Technology Initiative as the participant-observer researcher interviewed state leaders in the Virginia Department of Education who were closely associated with the planning and implementation of the Initiative. The interview transcripts, project documents, and experiences of the researcher as a participant-observer were used as the primary data sources.

The research is not presented in the format of a traditional dissertation, but rather the findings are presented in the form of a book or monograph with four chapters about the history, development, and implementation phases of the Initiative and a fifth chapter in closing to present the lessons learned from the state perspective. The goal in using this format was to present a clear, research-based story of Virginia's efforts that may be useful and informative to a broad audience of readers.

For readers with an interest in the traditional elements of a dissertation, the appendices contain sections such as the review of literature, the methodology, and supporting documentation such as Institutional Review Board (IRB) approval letters and Fair Use documentation and permissions. The specific locations of these sections are shown in the table of contents.

Chapter 1

Prior to Virginia's Web-based Standards of Learning Technology Initiative

The initial planning and development of Virginia's Web-based Standards of Learning Technology Initiative (Initiative) took place in 1999. In this chapter, the trends in public education, student assessment, technology, and politics throughout the last two decades of the 20th century are summarized briefly at the national level and in Virginia to establish the setting for the introduction of Virginia's Initiative.

The National Trends

To begin, a series of four national milestones is presented. Each occurred prior to Virginia's thoughts of implementing Web-based testing, but the cumulative effect of these milestones may have impacted the eventual plan that the leaders in Virginia pursued.

Milestone 1. In 1983, the National Commission on Excellence in Education [NCEE] produced its landmark report entitled *A Nation at Risk: The Imperative for Educational Reform* (National Commission on Excellence in Education [NCEE], 1983). The Commission's report stated, "If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war" (NCEE, 1983, p5). In addition to promoting increased student expectations and rigorous academic standards, the Commission stated, "Standardized tests of achievement (not to be confused with aptitude tests) should be administered at major transition points from one level of schooling to another and particularly from high school to college or work" (NCEE, 1983, p28). The call for national educational reform and increased school accountability was sounded.

Milestone 2. In 1994, organizers staged the First International Conference of the World Wide Web in Geneva, Switzerland. This was four years after Tim Berners-Lee wrote a software

program he called the *WorldWideWeb* that served as the point-and-click, graphical user interface (GUI) foundation for what we now know as the World Wide Web (Web) (Connolly, 2000). One of Berners-Lee's dreams behind the Web was to create "a common information space in which we communicate by sharing information" (Berners-Lee, n.d., ¶ 3). He felt that universality was essential to the Web, and he envisioned hypertext links being able to point to any resources whether they were professional, personal, local or global. Berners-Lee shared his software application and his concept of a common information space in hopes others would use the connectivity of the Internet and begin to create public Web resources. From 1991 through 1994, the number of times the first Web server was accessed grew by a factor of 10 each year. Colleges and universities realized the benefits of the Web beginning in 1992. Business and industry joined in by 1993 (Berners-Lee, n.d.). The benefits of connectivity and readily accessible information were beginning to be recognized.

Milestone 3. In 1996, the 104th Congress passed the Telecommunications Act. The enactment of this legislation marked the beginning of an aggressive national effort to assist schools in purchasing technology equipment and services (Telecommunications Act, 1996). Through this legislation, Congress appropriated \$2.25 billion annually for technology and Internet connectivity in the form of discounts to schools and libraries. This funding initiative became known as the federal E-rate program. In 1996 when the E-rate program started, only 12% of all public school instructional areas included Internet access (National Center for Education Statistics, 2003). By 2001, Internet access for all public school instructional areas increased to 87% (National Center for Education Statistics, 2003). The acceptance of technology for use in public education was increasing.

Milestone 4. In 1997, President William Clinton challenged public education as part of his State of the Union Address. President Clinton declared, “Every state should adopt high national standards, and by 1999 every state should test every fourth grader in reading and every eighth grader in math to make sure these standards are met” (Clinton, 1997, p. 291). Continuing the national call for reform and accountability in education, President George W. Bush signed the re-authorization of the Elementary and Secondary Education Act on January 8, 2002 (No Child Left Behind Act, 2001). The legislation, also referred to as the *No Child Left Behind Act of 2001 (No Child Left Behind)* required that all state education agencies implement an assessment system aligned to state standards. The requirements of the assessment system included: (a) annual assessments of English proficiency by 2002-2003, (b) reading and mathematics assessments in grades 3 through 8 and once during grades 10 through 12 by 2005-2006, (c) and science assessments once in the elementary, middle, and high school years by 2007-2008 (No Child Left Behind Act, 2001). The call for educational reform and increased school accountability measures occurred through the 1980s and 1990s and was projected well into the 21st century.

The series of milestones. Clearly, other significant milestones occurred in education and technology during the 1980s and 1990s, but these four specific events are representative of the progress that prompted the development of electronic or computer-based testing in public education. Technology, capable of transferring words, pictures, and sounds almost instantaneously from one location to another, was making its way into K-12 classrooms. Educational reform was expanding to require school accountability and student assessments. The series of educational changes and technological advancements, and more importantly, the fact that they were occurring simultaneously, was critical in leading to electronic testing in K-12

education. Electronic testing was the efficient method needed to readily deliver student assessments to meet the demands of educational reform. Given the increased availability of technology and its rapid advancements, in education and in our global society, the implementation of computer-based testing is increasingly more common in K-12 classrooms.

Trends in Virginia

Similar to the trends that were occurring nationally, Virginia experienced its own changes in education and technology. State leaders initiated efforts in the mid-1990s to produce positive change in both areas for all of Virginia's public schools.

Virginia's educational reform. Citing a dire need to raise student achievement levels for all students in Virginia, the Virginia Board of Education initiated a widespread reform of its K-12 education system in 1994 under the leadership of Governor George Allen (Virginia Department of Education, n.d. pae1):

Virginia's comprehensive educational reform is being undertaken to address a serious problem that affects all of us, our schoolchildren and the future of our Commonwealth: the achievement levels of too many of Virginia's students in grades kindergarten through 12 are simply not adequate to compete successfully for the good, high-paying jobs in the international economy of the 21st century and fulfill their responsibilities as citizens of Virginia and the United States.

Information about Virginia's own Literacy Passport Test (LPT) indicates that nearly one in three sixth-graders does not pass all three content areas of the test at Grade 6. The failure rate has not improved since the LPT was first given in 1989, almost a decade ago. The Board of Education firmly believes that all students in Virginia, regardless of their background or where they live, deserve a

quality education based on the same standards. Parents and taxpayers should easily be able to know how well schools are doing in meeting those standards. (p.2)

Virginia's plan for educational reform included four major elements (see Table 1). The elements were to be implemented consecutively, and before progressing to the next element, each of the prior elements had to be completed successfully.

Table 1.

Four Major Elements of Virginia's Comprehensive Educational Reform

1.	Raise academic standards: Develop and implement the Virginia Standards of Learning
2.	Measure student achievement and progress: Develop and implement the Virginia Standards of Learning tests
3.	Ensure the accountability of schools for student achievement: Revise the Standards for Accrediting Public Schools
4.	Communicate with parents, taxpayers, and the community at large: Establish a school report card for parents and the school community

Note. Adapted from Virginia Department of Education. (n.d.pac1). *Virginia's K-12 education reform: Raising student achievement in Virginia*. [Document: Infopac1.pdf]. (Available from Virginia Department of Education, Division of Policy & Communications, Office of Communications, 101 N. 14th St, Richmond, VA 23219).

Virginia develops and implements academic content standards. The Virginia Department of Education, at the direction of Virginia's Board of Education, started the first element of the reform by developing a revised set of academic content standards that would serve as the minimum learning standards for all students in Virginia. To complete the task, the Department knew that input and expertise from the field was critical and that having the effort

led by school divisions would increase the likelihood of success. The agency defined a set of responsibilities and tasks that a lead school division would complete for an assigned subject area. The lead divisions would need to involve (a) other school divisions, (b) educators, (c) parents, (d) professional organizations, (e) businesses, (f) special interest groups, and (g) individual citizens of Virginia throughout their work (Virginia Department of Education, n.d.pac2). Specifically, these divisions would be responsible for proposing “standards which were rigorous, academic, measurable, and written in plain and understandable language, that is, free of ‘ed school’ jargon” (Virginia Department of Education, n.d.pac3, p. 2). The Department solicited interest in leading the development efforts from all school divisions and, ultimately, four were selected. Each school division executed a signed memorandum of agreement with the Department so the expectations and required timelines were clear to all involved (Virginia Department of Education, n.d.pac3). The four lead divisions and their assigned subject areas were (a) Virginia Beach City Public Schools - English, (b) Fairfax County Public Schools - mathematics, (c) Prince William County Public Schools - science, and (d) Newport News City Public Schools - history and social science (Virginia Department of Education, n.d.pac3).

The Virginia Department of Education indicated that over 5,000 Virginian’s participated in the various stages of developing the revised Standards of Learning and building consensus on what students in the Commonwealth should be learning (n.d.pac3). In September 1994, the resulting content standards were presented in draft form by the lead school divisions to Virginia’s Superintendent of Public Instruction, Dr. William C. Boshier, Jr. The first draft of the standards was received by the Virginia Board of Education at its January 1995 board meeting, and a period of public review and public comment followed (Virginia Department of Education, n.d.pac3). Less opposition was heard to the proposed mathematics and science standards than to

the proposed English and history standards. With the English standards, for example, questions were raised about the level of emphasis on phonics. Regarding the history standards, questions were raised about content that was and was not included and whether the standards were too factual and not conducive to higher-level thinking skills (Hess, 2003).

In June 1995, the Virginia Board of Education officially adopted the revised Virginia Standards of Learning (SOL) as the academic content standards for every child enrolled in a Virginia public school. The SOL specified the instructional content for grades kindergarten through 12 in the four core areas of English, mathematics, science, and history. Computer technology standards were included to ensure students were computer literate prior to entering high school (Virginia Department of Education, n.d.pac1).

After the adoption of the SOL, the work of fully implementing the revised standards began in earnest. Teachers needed to be trained, curricula needed to be aligned, and instructional pacing needed to be considered. Training opportunities were organized for teachers; instructional resource fairs were held to provide information and share aligned resources; and work sessions were held to assist school staff with understanding and interpreting the SOL. Funding was needed to support these efforts, and the state provided millions of dollars for instructional materials, teacher training, and student remediation and instruction (Virginia Department of Education, n.d.pac3).

Not all school leaders, teachers, and parents were in favor of the changes, and many were unsure whether the extensive changes would be permanent. The non-supporters believed that the SOL represented another educational initiative that would fail, and that in time the changes would not be necessary. Despite various opposition to the SOL, Virginia proceeded with its plans for comprehensive educational reform. The first element, raising student achievement standards,

was now in place. The development of the SOL provided a common set of minimum learning standards for all classrooms in Virginia, and this was critical as the state's education leaders prepared to press forward with the second element of reform: measuring student achievement and progress (Virginia Department of Education, n.d.pac3).

Virginia develops and implements assessments to measure student achievement. The second element in Virginia's educational reform was to develop and implement a set of statewide tests for measuring student progress toward learning the newly adopted content standards. The tests would be referred to as the Standards of Learning tests, or the SOL tests. The work to build these new assessments would begin at the same time, academic year 1995-1996, that classroom instruction specifically aligned to the SOL was initiated (Virginia Department of Education, n.d.pac4).

In its April 1996 meeting, the Virginia Board of Education adopted a resolution about Virginia's statewide assessment program. Through its resolution, the Board formalized its intent to enter into a competitive bid process to select a contractor to develop and implement the statewide SOL testing program (1996, April). Key elements of the Board's resolution concerning the SOL tests are represented in Table 2.

In anticipation of identifying an assessment contractor, the Virginia Department of Education (1996d) began the work of establishing Content Review Committees to "assure that the assessments accurately reflect the SOLs" (p. 2). School division superintendents were asked to nominate distinguished educators from their school divisions who were content area experts or experienced in instructional settings with special populations such as students with disabilities or students with limited English proficiency (Virginia Department of Education, 1996d). These

Table 2

Details From the Virginia Board of Education Resolution on Assessment

A Request for Proposals (RFP) will be issued to develop, administer, score, and report results of statewide standardized tests, the Standards of Learning tests.

Purpose of assessments:

1. To measure students' achievement in acquiring and applying the knowledge and academic skills defined in the English, Mathematics, Science, History, and Computer Technology Standards of Learning.
2. To measure students' skills in analyzing, reasoning, synthesizing information, making comparisons, and drawing inferences.

Grade levels and subjects:

Grade 3 Standards of Learning (SOL) tests:

Include grades K-3 English, Mathematics, Science, and History SOLs with particular emphasis on reading skills and reading comprehension.

Grade 5 SOL tests:

Include grades 4 and 5 English, Mathematics, Science, and Computer Technology SOLs, as well as History SOLs through Virginia Studies.

Grade 8 SOL tests:

Include grades 6, 7, and 8 English, Mathematics, Science, and Computer Technology SOLs, as well as History SOLs for U.S. History and Civics and Economics.

Grade 11 SOL tests:

Include content within disciplines:

Mathematics -- Algebra I and Geometry SOLs

Science -- Earth Science and Biology SOLs

History -- World History and World Geography SOLs

English -- grades 9, 10, and 11 English SOLs

Test format:

1. Primarily machine-scored or multiple-choice items which provide broad coverage of content as well as reliable and valid results. A writing sample may be included.
2. Different forms of the test will be developed so that a different test may be used for each test administration.

Test scores:

Will be reported at the student, school, school division, and state levels.

Note. Adapted from Virginia Board of Education. (1996, April). *Resolution on Assessment*. [Document]. (Available from Virginia Department of Education, Division of Policy & Communications, Office of Board Relations, 101 N. 14th St, Richmond, VA 23219).

educators completed Content Review Committee Applications and were entered into the pool of potential candidates to serve on one of five committees, or one each for (a) English, (b) mathematics, (c) science, (d) history, and (e) technology. The committees would be convened throughout the test development process with the responsibility of providing input and recommendations on (a) test item specifications, (b) test blueprints, (c) test items, and (d) test forms (Virginia Department of Education, 1996d).

The Virginia Department of Education completed the state procurement process, and on October 10, 1996, the Virginia Board of Education officially awarded a contract to Harcourt Brace Educational Measurement (HBEM) to conduct all components of the new SOL assessment program (Virginia Department of Education, 1996c). Kick-off meetings were held immediately so the SOL test development processes could get begin. Test blueprints and test specifications were drafted, and staff from the Department trained the contractor's item writers on the scope of the Virginia SOL content. The item writers were responsible for developing the first drafts of the SOL test items that would be administered to students during the first field test scheduled for April and May of 1997 (Virginia Department of Education, 1996c).

Once test materials were completed that required input and review from teachers and content specialists, the Content Review Committees were convened to begin their work of reviewing and providing feedback on these materials that included documents such as test blueprints and test items. All test items were reviewed by the committees prior to being administered to students. School division superintendents were notified that the field test would be occurring and that additional details would follow regarding the participation of their schools. The Virginia Department of Education developed the standardized test administration procedures that would be followed and worked with the contractor to develop the necessary SOL test

administration manuals. Decisions were made about test booklet formats, answer documents, and the type of data that would be collected with the initial field test. Training had to be provided to school division staff in (a) how to handle the secure test materials, (b) how to administer the tests to students, and (c) how to return all test materials once the administration of the field test was completed (Virginia Department of Education, 1996c).

Following the field test administration, Content Review Committees were convened to review the resulting data and determine, based on the test data, which test items performed as expected and should be kept. These test items would be added to the SOL test item bank and would be available for use on operational test forms, or test forms administered to students and scored, beginning in the spring of the following year. This process of Content Review Committees reviewing test items, test item data, and test forms became a standard part of Virginia's annual SOL test development process. Two years, or the life-cycle of an SOL test item, are required to (a) create, (b) review, (c) edit, (d) field test, (e) re-review, and (f) finalize an SOL test item to be placed on an operational SOL test form (Virginia Department of Education, n.d.pac4).

With test items written and field tested, and operational test forms constructed, the first SOL test administration took place in 1998 in reading, writing, mathematics, science, history, and computer technology at grades 3, 5, 8, and in certain high school courses. The new SOL tests, except for a portion of the English writing tests, were all multiple-choice, and they were administered to students with a paper test booklet, an optical scan answer document, and a #2 pencil (Virginia Department of Education, n.d.pac4).

The SOL were developed and implemented under the leadership of Governor George Allen's administration. Virginia's educational reform efforts were continued by Governor James

Gilmore when he was inaugurated as Virginia's 68th governor in January of 1998. Governor Gilmore's administration maintained Governor Allen's focus on improving student achievement and, while continuing support for the first two elements of Virginia's educational reform movement, Governor Gilmore's administration pressed to incorporate the third major reform element, an accountability program for Virginia's public education system (Virginia Department of Education, n.d.pac5).

Virginia Develops and Adopts an Accountability Program. With classroom instruction and educational resources continuing to be adjusted to more closely align with the SOL and the SOL tests being developed and administered on an annual basis, the pieces now were in place to begin to measure the academic performance of Virginia's students. The third element of the statewide reform, a new level of accountability based on the SOL and the SOL assessments, would be introduced.

The accountability was two-fold in that school divisions would be held accountable for specific levels of student performance while, at the same time, individual students would be required to pass a minimum number of SOL tests during high school to earn a high school diploma (Virginia Department of Education, n.d.pac5). This accountability would be phased-in to allow school divisions and students the opportunity to adapt to the new requirements. The graduating class of 2004 would represent the first students required to pass SOL tests to earn a high school diploma. Virginia's educational reform was progressing from standardizing the academic content taught in Virginia's classrooms to now requiring thousands of students to be tested annually to assess their levels of achievement in learning Virginia's required academic content (Virginia Department of Education, n.d.pac4).

Considering the national milestones described earlier, Virginia was developing and implementing its educational reform at the same time President Clinton was urging the adoption of high national academic standards and specific grade level tests to ensure the achievement of those standards. Virginia's educational reform was well underway when President George W. Bush introduced the federal *No Child Left Behind Act of 2001* requiring all state education agencies to implement an assessment system aligned to its state standards (2001).

Virginia's emphasis on technology. During the mid-1990s when Virginia was instituting its standards-based educational reform, personal computers and Internet connectivity as instructional tools were in their early developmental stages. The number of computers in a school was limited, and Internet connectivity often was available only in school libraries and perhaps a few classrooms equipped with an analog phone line and a personal computer with a modem.

Dial-up Internet service was purchased by users who initially paid by the minute to be connected to the Internet to send email or post text to electronic bulletin boards. As the World Wide Web (Web) was developed, Internet content transitioned from plain text into text that was rich with graphics and images. Everything about the Web was increasing -- the volume of content, the variety of content, the demand for access, and the need for faster access. Analog phone lines and dial-up service could no longer meet the demands of individual users or the public schools. Computer technology was improving quickly, and an infrastructure of faster and more efficient digital connectivity was developing globally (VA House Doc No. 85, 2000).

Leaders in the Commonwealth were realizing the opportunities available to students through improved technology in Virginia's classrooms. As a result, statewide funding for technology equipment in local school divisions was provided by the Virginia General Assembly

in 1996 in the form of a technology grant program. As published in a memo from Dr. William Boshier, Virginia's Superintendent of Public Instruction in 1996, the purposes of the program were "(1) networking, retrofitting, and upgrad[ing] of existing school buildings, (2) [providing] network-ready multimedia microcomputers for classrooms, and (3) [providing] network-ready microcomputers for student use" (VDOE, 1996a).

The amount of each school division's grant was determined by the number of schools within the school division each fall. An award of \$53,000 was provided to each school division with an additional \$26,300 for each school with a fall membership, or number of students enrolled in the fall. In 1996, this resulted in a statewide grant of approximately \$55 million provided to Virginia school divisions for use on eligible technology expenditures (VDOE, 1996b). This technology funding was appropriated in the Commonwealth's budget in 1996 and was projected to continue with potential for future re-appropriations.

Virginia's education leaders recognized that to successfully integrate technology into public education, it would take more than simply funding the equipment. In 1994, as part of the state's six-year educational technology plan, leaders acknowledged that "infrastructure and equipment alone are not sufficient to infuse technology into instruction. Teachers must be trained, support services provided, equipment maintained, and an on-going evaluation established" (VDOE, 1994, p. 4). Virginia supported technology training efforts through programs such as the Telecommunications Act of 1996, the Technology Literacy Challenge Fund, and Goals 2000 (VDOE, 1998). In 1995, specific computer technology standards for 3rd, 5th, and 8th grade students were included as part of the Virginia Standards of Learning. In 1998, Technology Standards for Instructional Personnel (TSIP) were approved by the Virginia Board

of Education and later enacted into law by the Virginia General Assembly as part of the state's teacher licensure requirements (VDOE, 2001c).

Virginia school divisions were required to develop and maintain a comprehensive local technology plan that would describe the current status of their technology as well as outline their goals and objectives and their strategic plans for achieving them. Each version of Virginia's state educational technology plan served as a guidance document to which school divisions could align their local efforts (VDOE, 2003). "In the early 1990s, through the collaborative efforts of the General Assembly, the Board of Education, the Department of Education, and schools, Virginia was recognized as a national leader in instructional technology" (VDOE, 1995, p 7).

Technology and state assessments. Virginia's educational reform efforts had gained some forward momentum but still had a wide base of opponents by the late 1990s when the SOL assessment program was fully operational. Some teachers, parents, and instructional leaders believed that standards-based instruction and the concept of accountability were part of an educational movement that would eventually go away. As more students experienced taking the SOL tests and the graduating class of 2004 entered high school, the focus shifted to preparing students to pass the SOL tests. Summary SOL test results for school divisions and schools were being published by the Virginia Department of Education and made available in the form of school report cards. A new concern was surfacing about how much time was passing between the test administration date and the date when score reports were provided to school divisions. Given the increased attention to test results and potential consequences associated with passing or failing the tests, many school administrators, teachers, parents, and students were impatient with 3- to 4-week delays for the results of multiple-choice SOL tests to be reported (DeMary, 2010; Virginia Department of Education, n.d.pac6).

Virginia's state education leaders realized that the ability to continue moving forward with school reform was being hindered by the time needed to receive test results. To maintain any momentum, options to expedite the return of high-stakes SOL test results had to be considered. Testing students earlier in the school year to allow more time to process and score tests was not an option. Concerns already were circulating among school divisions about having to administer the SOL End-of-Course tests prior to the true end of a course or end of the students' instruction. Options that reduced test processing time were needed rather than options that reduced instructional time.

The procedures required of school personnel when handling secure SOL test materials required significant attention to detail and thorough documentation and accounting to ensure the test materials remained secure and accounted for. The procedures were often tedious and were always time consuming. Preparing and properly distributing SOL test materials within the school division prior to the test administration took days and even weeks in larger school divisions.

Once the paper-and-pencil SOL tests were administered to students, many of the detailed steps in the handling process would begin again but in reverse. Verifying the accuracy of the student data and ensuring all enrolled students were accounted for were additional steps that had to be completed as part of the work to return paper SOL test materials to the contractor for processing.

Virginia's education leaders believed substantial amounts of time could be saved if it were possible to reduce or eliminate the processes related to physically compiling answer documents, preparing them for shipping, and delivering them across the country to the scoring contractor's headquarters. Fairfax County Public Schools, the largest school division in Virginia,

had to maintain a warehouse accessible by freight carriers to receive, and eventually re-ship, the pallets of SOL test materials needed for all of the schools in their division.

After the tests were administered, the materials had to be secured, counted, repackaged, and transported back to each school division office to be picked up by freight carriers in each of the 132 school divisions. Shipped via overnight carrier, the shipments of Virginia's completed SOL tests would start to arrive at the contractor's processing facilities, and a largely manual process of opening the materials and preparing them for processing would begin. The answer documents were unboxed by a technician in the opening area and loaded onto carts so they could be logged in, assigned processing numbers, tracked, and prepared for entry into a climate-controlled area where all documents remained for a minimum 8-hour acclimatization period prior to scanning (see Figure 1).



Figure 1. A photograph of answer documents stacked on a cart waiting for acclimatization. After being opened, the answer documents are stacked on carts and tracked as they are moved into a climate controlled area for appropriate acclimatization and then to processing for scanning. Pearson, State Assessments. (n.d.). Reprinted with permission.

Each stack of answer documents included a scannable cover sheet, or header sheet, that was hand-coded by a technician with details about the specific documents in each stack on the

cart. Details included such specifics as (a) the cart number, (b) the originating location of the answer documents, (c) the specific school district name and code, (d) the school name and code, (e) the date received, (f) how many answer documents were in each stack, and (g) where on the cart the stack was located.

The acclimatization process occurred to ensure the answer documents had moisture content within an allowable range prior to scanning. Technicians inserted electronic moisture probes randomly into the stacks of documents to measure the relative humidity of the paper. Moisture was shown to cause answer documents to expand or contract such that the gridded responses could not be read accurately if the moisture content were outside an accepted range. To ensure accuracy, some documents required extended periods of acclimatization prior to being scanned (K. S. Carson, personal communication, March, 2010).

During peak processing times, the number of answer documents in a test processing facility at any one time could reach into the millions of documents. The number of carts and number of staff needed to accommodate the handling and tracking of this magnitude of documents increased accordingly (see Figure 2).

The test data files generated by the document scanning process were scored and then used to produce the various types of score reports for the particular assessment. Virginia's SOL score reports were printed, compiled, and packaged for shipping back to school divisions. School personnel opened the reports and, depending on the specific report type, filed them in student academic records, mailed them home to parents, or provided them to teachers and instructional



Figure 2. A photo of answer document carts waiting for processing at a high volume period. The volume of paper answer documents to be tracked, processed, scored, and reported included documents from multiple states and multiple assessment types during peak testing times in the spring. Hundreds of document carts spanned the floor space in a processing warehouse at a large scoring facility. Pearson, State Assessments. (n.d.). Reprinted with permission.

leaders for review. Compact discs (CDs) of individual student-level data were produced and packaged individually for each school in Virginia and delivered to the appropriate school division.

The overall scoring and reporting process was time consuming and labor intensive in its current form. The Department of Education began exploring alternate ways to score SOL tests that could result in schools and teachers receiving student score reports and test data more quickly. Alternatives such as local scanning and scoring conducted by school division staff or regionally based scanning and scoring conducted by Virginia Department of Education staff at specific locations across the state were among the options discussed as solutions. Logistics, cost,

and questions of scoring integrity were among the concerns with the solutions being discussed (Canada, 2010; DeMary, 2010; Neugent, 2010).

Simultaneously, Virginia was making strides in its efforts to introduce technology and the Internet into the state's public education system. The Telecommunications Act of 1996 (1996) was into the implementation stages. It was a reasonable next step for education leaders and technology leaders to consider the potential of using the Internet as a tool for delivering and scoring Virginia's SOL tests more efficiently.

In a similar timeframe, the Governor of the Commonwealth, Honorable James S. Gilmore III, issued an Executive Order (# 51, July 23, 1999) calling for all Executive Branch agencies and institutions to establish policies and procedures for implementing the recommendations put forth by the Governor's Commission on Information Technology. The Commission had published a December 1998 report, "Toward a Comprehensive Internet Policy for the Commonwealth of Virginia," where it recognized the potential of the Internet as an effective tool for providing government services to the citizens and businesses of Virginia. "No sector of the Commonwealth's citizens should be left without access to this important resource" (1998, p, 9). Through his Executive Order, Governor Gilmore directed agencies and institutions to actively proceed with utilizing the Internet as a tool in delivering services to all Virginians.

A feasibility study of computer-based testing was commissioned by the Department in 1999. Steven L. Wise, a professor at James Madison University at that time, was contacted to begin work on defining what potentially could be gained in Virginia through implementing computer-based testing and what costs and risks would be associated (Wise, 1999).

Aligned with the Executive Order and the directive for state government to maximize the use of the Internet to provide improved services to the citizens of the Commonwealth, the

Governor proposed the statewide technology initiative as part of his budget proposal to the Virginia General Assembly. After changes to the proposed funding plan, the Initiative received approval by the 2000 Virginia General Assembly, and funds were appropriated for the Virginia Department of Education to implement Virginia's Web-based Standards of Learning Technology Initiative (Virginia HB 29, 2000; Virginia SB 29, 2000).

Chapter 2

Virginia's Web-based Standards of Learning Technology Initiative

Three Goals of the Web-based Standards of Learning Technology Initiative

In Informational Superintendents Memo #113 dated June 2, 2000, then acting Superintendent of Public Instruction Dr. JoLynne DeMary outlined to school division superintendents the purpose of the Web-based Standards of Learning Technology Initiative that was passed as part of the 2000 Virginia General Assembly (VDOE, 2000c):

The intent of this initiative is to use Web-enabled systems to improve Standards of Learning instructional, remedial, and testing capabilities of high schools.

Funding for this program is targeted to reach three general goals in each high school. These goals are: providing student access to computers with a ratio of one computer for every five students, creating Internet-ready local area network capability in every school, and assuring adequate high speed, high bandwidth capability for instructional, remedial, and testing needs. (p.1)

State leaders, including Virginia's Governor, members of the Virginia General Assembly, and members of the Virginia Board of Education, were committed to proceeding with the Web-based Standards of Learning Technology Initiative, and Dr. DeMary used this memo as a formal notification to school divisions that implementation from the state level was beginning.

Standards of Learning Technology Initiative Funding

While the goals of the Initiative were established early and remained unchanged throughout the 2000 Virginia General Assembly, the topic of how the Initiative would be funded generated much discussion and went through the greatest change. Initially, the Governor proposed that the legislation be funded through a combination of general fund dollars

appropriated in the state budget and proceeds from the Virginia Literary Fund (VDPB, 1999).

The Virginia Literary Fund is a--

permanent and perpetual school fund that began in 1810 and was later established in the Constitution of Virginia. Revenues to the Literary Fund are derived primarily from criminal fines, fees, and forfeitures, unclaimed and escheated property, and repayments of prior Literary Fund loans. The most recent addition to the sources of Literary Fund revenues has been the transfers from unclaimed lottery winnings (VDOE, 2007, p. 1).

The Governor's funding plan included a general fund appropriation of "\$4,203,220 for contractual services and demonstrations" in year one of the Initiative, or fiscal year 2001, and a second year, or fiscal year 2002, general fund appropriation of "\$12,370,382 for onsite computer service support as well as central office guidance and assistance" (VDPB, 1999, p. 2). In this context, central office guidance and assistance referred to what would be provided to school divisions by the Virginia Department of Education.

The Governor's proposed funding plan required \$41.2 million from the Literary Fund to be distributed to local school divisions in fiscal year 2001 to fund technology infrastructure and equipment. As proposed in fiscal year 2002, \$43.6 million from the Literary Fund would be distributed to local school divisions to continue to support the procurement of infrastructure, hardware, and software. The Governor's funding proposal referenced a third year, extending beyond the biennium budget, in which an additional \$43.6 million from the Literary Fund would be distributed for continued hardware and software purchases needed to implement the Initiative (VDPB, 1999).

The proposal included that the allocation of Literary Fund dollars to local school divisions would be “based on the needs of each school division and would be distributed based on a set amount per high school (70 percent of the allocation) and on a per pupil basis (30 percent of the allocation)” (VDPB, 1999, p. 2). Once a high school met the three goals of the infrastructure criteria (five to one student to computer ratio, Internet-ready local area network capability, and high speed, high bandwidth Internet access for instructional, remedial, and testing needs), then “the school would no longer receive the set amount (the 70 percent of the allocation) and any remaining dollars would revert back to the Literary Fund” (VDPB, 1999, p. 2).

Use of Literary Fund dollars generated significant discussion that eventually resulted in modifications to the funding plan for the Initiative. Rather than distributing dollars from the Literary Fund to localities to develop their technology infrastructure, it was decided that 5-year equipment notes, or bonds, would be issued by the Virginia Public School Authority (VPSA) to raise funds that would be issued as grants to reimburse school divisions for their infrastructure expenditures. The Literary Fund would instead pay the annual debt service on these 5-year notes. The debt service payment for the technology grants issued in 2000 for the Web-based SOL Technology Initiative was approximately \$15.7 million in the first year, \$15.6 million in the second year, and continued similarly through the life of the 5-year equipment notes (VDOE, 2000d). This model better protected the balance of the Literary Fund and more closely matched previous Virginia educational technology initiatives where funds were provided to localities for the reimbursement of equipment purchases.

Under this revised and final funding plan, each school division would receive state funding equivalent to \$50,000 for the division and \$26,000 per school each year that equipment notes were issued. The final plan called for the VPSA equipment notes to be issued each year

beginning in 2000 through 2004, with the associated debt service payments to be funded by Virginia's Literary Fund (VDOE, 2000d).

The proceeds from the issuance and sale of the VPSA equipment notes were used to reimburse school divisions for eligible expenditures on technology equipment and improvements needed to implement the Initiative. In addition to the school divisions' funds, the final budget for the Web-based Standards of Learning Technology Initiative provided funding to the Virginia Department of Education to implement the Initiative. This new addition to the administrative budget, or central office budget, included approximately \$3.8 million in fiscal year 2001 and \$2.4 million in fiscal year 2002 from the general fund. These dollar amounts were estimated by the Virginia Department of Education and the Virginia Department of Planning and Budget to cover the Department's anticipated expenses associated with implementing the new Initiative (see Figure 3).

School Divisions' Intent to Participate

The technology funding made available to school divisions as a result of the Initiative was of great interest to school divisions across the state. To receive any funds, however, the Virginia Department of Education required that a school division's superintendent first commit to participating and meeting the minimum requirements of the Initiative. These details were described in Informational Superintendents Memo #113 and in an attached document named the "Division Intent to Participate Statement" (VDOE, 2000c). Any school division opting to

Funding Provided to Administer the Standards of Learning Technology Initiative (Central Office Budget)		
Purpose	FY 2001	FY 2002
a) On-site software development, testing, and validation costs.	\$312,000	\$312,000
b) Test center software development, testing, and validation costs	\$1,248,000	\$0
c) Software license fees	\$1,500,000	\$1,500,000
d) Software for the central office	\$10,000	\$10,000
e) Test center costs	\$36,230	\$36,230
f) On-site support	\$450,000	\$0
g) Manuals	\$45,000	\$45,000
h) Training	\$67,500	\$67,500
i) Scoring, equating, and other vendor costs	\$50,000	\$50,000
j) Personal services (covers two additional positions in FY01 and four additional positions in FY02)	\$124,490	\$407,412
Total	\$3,843,220	\$2,428,142

Figure 3. Annual funding appropriated by the 2000 Virginia General Assembly for the Web-based Standards of Learning Technology Initiative. Estimated costs were developed by the Virginia Department of Education and the Virginia Department of Planning and Budget. The costs shown in the anticipated line items above would be incurred by the Virginia Department of Education (VDOE, 2000d).

participate in the Initiative and receive the associated funds had to return the document, signed by the division superintendent, as a first step to indicate the school division's willingness to meet certain minimum requirements (see Figure 4).

Division submission of the "Intent to Participate" statement indicates that the superintendent supports the goals of the Initiative, is willing to commit division time, resources and personnel to achieving success of the program, understands the obligation to use funds provided to meet the goals and objectives of the

Initiative, and will direct staff to submit project plan status reports according to guidelines and timeframes to be established by the DOE. (VDOE, 2000c, p. 1)

While the introduction of the Initiative generated much mixed discussion among school divisions, 100% of school division superintendents returned the signed documents indicating their divisions would participate. Some superintendents were encouraged by the potential of the Initiative while others considered the decision to participate more as a necessary step to receive any state technology funding that they had come to depend on within their local school budgets (DeMary, 2010; Neugent, 2010). Receipt of additional funding, as is often the case in the initiation of change in education (Fullan, 2001, 2007), was a critical factor affecting school divisions' willingness to participate (DeMary, 2010; Neugent, 2010).

By agreeing to the requirements to participate in the Initiative, local superintendents ensured their school divisions would receive a share of the state funding equivalent to \$26,000 per school and a fixed amount of \$50,000 in each year of the biennium (Virginia HB 29, 2000; Virginia SB 29, 2000; VDOE, 2000e). In addition to receiving the state funds, each participating school division was required to commit a minimum level of local funds toward implementing the Initiative. The local funds had to be equivalent to 20% of the state-provided funds, and then at

Web-Based Standards of Learning Technology Initiative

Division "Intent to Participate" Statement

As Superintendent of Schools for the _____ Public School System, I confirm that our division supports the goals and objectives of the Web-Based Standards of Learning Technology Initiative and that I, my administrative team, and our teachers are willing to augment state funding by committing necessary division time, resources, and personnel required to achieve success in the program. I also understand the obligation to use funds provided to meet the goals and objectives of this initiative. I will direct my staff to work with the Department of Education on implementation issues and to submit requested status reports in a timely manner.

Additionally, I understand that participation in funding provided for this initiative will require submission of a "Plan for the Use of Funds" by November 1, 2000. By signing this statement, I certify that, as minimum requirements, my division will:

- Commit to be capable of administering Web-enabled Standards of Learning tests in each of our high schools by May 1, 2003;
- Appropriate the 20 percent local match, 25 percent of which will be used for technology training;
- Provide the Department of Education with a detailed review of any Standards of Learning software application that is purchased;
- Use E-Rate funding to meet the connectivity goals of the initiative;
- Submit to the Department of Education an analysis of each high school's technological capacity to meet the goals of the program;
- Use funds provided to create the technological capacity if the capacity at each high school is not deemed sufficient to meet initiative goals;
- Prepare each high school to meet instructional, remedial, and testing goals prior to using funding for achieving the same goals for middle and elementary schools; and
- Submit project plan status reports according to guidelines and timeframes to be established by the Department of Education.

Division Superintendent

Date

This signed statement should be sent by August 1, 2000 to:
Lan Neugent, Assistant Superintendent for Technology, Virginia Department of Education, P.O. Box 2120,
Richmond, Virginia 23218-2120

Figure 4. The Web-based Standards of Learning Technology Initiative Division "Intent to Participate" Statement. This document was signed by each school division superintendent and returned to the Virginia Department of Education to indicate a commitment by the division to meet certain minimum requirements related to the Initiative (VDOE, 2000c).

least 25% of that required local funding had to be used for training teachers on technology (see Figure 5).

**Standards of Learning Web-based Technology Initiative Annual Funding:
A Sample Participating School Division**

Organization	Funding
School Division A	\$ 50,000.00
Elementary School 1	\$ 26,000.00
Elementary School 2	\$ 26,000.00
Middle School 1	\$ 26,000.00
High School 1	\$ 26,000.00
Total State Funds	\$ 154,000.00
<i>Required 20% Local Match *</i>	\$ 30,800.00
Total State and Local Funds	\$ 184,800.00
<i>* Minimum 25% of the 20% local match to be expended on technology training for teachers</i>	\$ 7,700.00

Figure 5. An annual funding scenario for a sample participating school division. This funding scenario is based on a sample school division with two elementary schools, one middle school, and one high school (Virginia HB 29, 2000; Virginia SB 29, 2000).

Another element of the Intent to Participate document was that the superintendents would direct their staffs to “submit project plan status reports according to guidelines and timeframes to be established by the Department of Education” (VDOE, 2000c, p. 1). While this requirement was presented in one short statement in the Intent to Participate, the impetus behind this requirement was significant. State government in Virginia, including the Department of Technology Planning, had come under fire for initiating large, expensive technology projects that resulted in failure and substantial loss of state funds (DeMary, 2010; JLARC, 2003; Neugent, 2010). In November 2000, the Joint Legislative Audit and Review Commission (JLARC, 2003), the oversight agency of the Virginia General Assembly, directed its staff to conduct a review of recent technology projects initiated and procured by Virginia state agencies. From its review of

15 state technology projects, JLARC staff identified that Virginia “wasted at least \$75 million on failed efforts” and “experienced another \$28 million in cost overruns” (JLARC, 2002, p. 10).

As a result of previously failed technology projects, additional oversight was being implemented for any state technology project with a budget exceeding \$1M. The use of formal project management requirements as put forth by the Project Management Institute (PMI) was expected of any state agency with a technology project meeting the minimum budgetary threshold of \$1M. Such initiatives would be strictly monitored by Virginia’s newly formed E-Government Office (Canada, 2010; DeMary, 2010; Neugent, 2010). The Virginia Department of Education presented an argument against additional oversight by Virginia’s Executive Branch. The Department stated that the Web-based Standards of Learning Technology Initiative was an education initiative rather than a technology initiative, and the agency had not experienced failed initiatives previously. The decision was clear from Governor Gilmore’s cabinet staff that the initiative was a state technology project in excess of \$1M, and it would be monitored as such (Canada, 2010; DeMary, 2010; Neugent, 2010).

While planning and implementing a large-scale initiative with Virginia school divisions was not a new challenge for the Department, the agency did not have any staff who held the Project Management Professional (PMP) certification. To ensure appropriate project management terminology and concepts were incorporated throughout the Initiative as required, it was necessary for the Department to contract with a private company that could provide consultation and expertise in the area of formal project management (Canada, 2010; DeMary, 2010; Neugent, 2010).

Nominations for High School Demonstration Projects

While Department of Education staff started to address the need for project management expertise, they also continued their work on implementing the Web-based SOL Technology Initiative. On August 25, 2000, local school superintendents were invited through a Superintendent's Memorandum to nominate one high school in their division to participate in future demonstration projects for the Web-based SOL Technology Initiative (VDOE, 2000f). The purpose of the demonstration projects, as stated in the memorandum, was "to demonstrate the viability of delivering Web-based SOL tests at the high school level" (VDOE, 2000f, p.1).

Schools selected for the demonstration projects would administer simulated SOL tests to students during a designated time and with technology that would be installed by selected vendors as part of the Initiative. The Department indicated that school division technology personnel needed to be available to support the demonstration and to meet with Web-based SOL Technology Initiative teams on a regular basis by teleconference or in person prior to the date of the actual demonstration. School divisions were also informed that grants may be awarded to selected schools to assist with costs associated with personnel, software, or equipment related to the demonstration projects (VDOE, 2000f). A total of 57 high schools were nominated by local superintendents to participate in the demonstration projects for the Initiative (VDOE, 2001b).

The Plan for the Use of Funds

The Department's next steps deliberately reflected an emphasis on project management standards. Staff designed an electronic document, the Plan for the Use of Funds, for use by all school divisions. The basis of the document was introduced to school divisions in Informational Superintendents Memo #113 and was described as--

incorporating formal project planning and a risk management perspective format that will be complementary to the DOE's master plan for this initiative. The guidelines, expectations, success measures and format of these *Plans for the Use of Funds* will be determined by the DOE with the assistance of the Department of Technology Planning (DTP) of the Secretary of Technology's office and will be distributed by a superintendent's memo prior to July 1, 2000. (p. 1)

The Department indicated updates to these plans would be collected from school divisions later in the Initiative as required by the Secretary of Technology (Canada, 2010; DeMary, 2010; Neugent, 2010).

The *Plan for the Use of Funds* (Figure 6) was developed by Department staff as a Microsoft Excel workbook consisting of four individual worksheets entitled (a) Contact, (b) Division Monthly Progress, (c) School Monthly Progress, and (d) Financial (VDOE, 2001f). A copy of the Excel workbook was downloaded from the Internet by each school division and saved locally on a workstation for use.

To begin using the *Plan for the Use of Funds* workbook, individuals first selected their school division name from a drop-down list shown on the opening worksheet. The workbook was embedded with Microsoft Visual Basic programming that would, based on the school division selected, automatically populate the four individual worksheets in the

* Only schools with fall membership enrollments in one or more grades between grades 3 and 12 were considered eligible to receive Web-based SOL Technology Initiative funds because these schools were responsible for administering SOL tests to their enrolled students. School divisions could opt to have other schools participate in the Initiative; however, state funds would not be provided for the Initiative to any school without fall membership enrollments.

workbook. Data populated into each division's workbook automatically included elements such as the names of individual schools eligible to participate in the Initiative*, the amount of funding

the division would receive from the state, and the amount of local matching funds the division was responsible to provide.

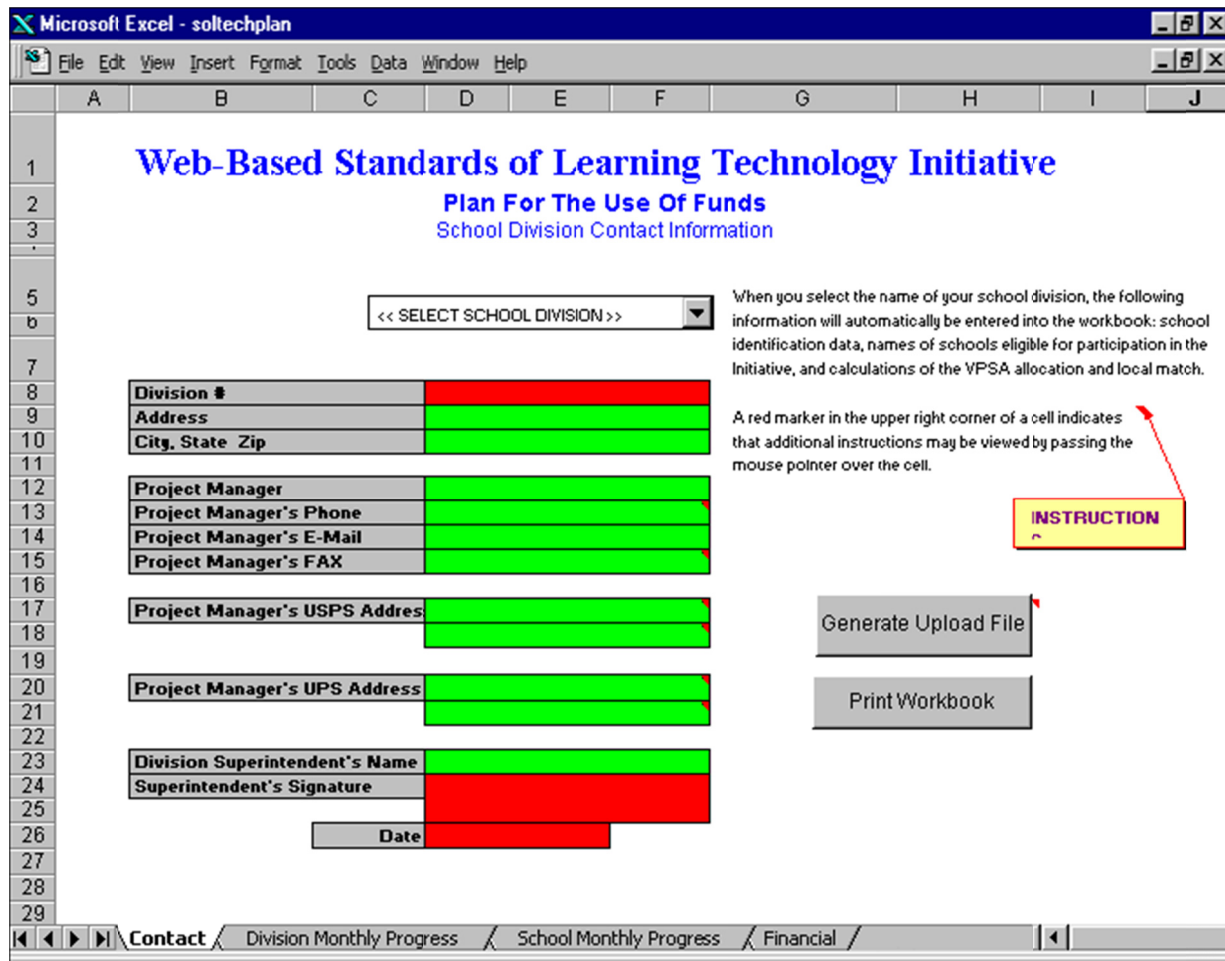


Figure 6. The *Plan for the Use of Funds* resource from a Microsoft Excel workbook with four individual targeted worksheets. School divisions downloaded a copy of the workbook and, upon saving and opening the file, the “Contact” worksheet displayed as the opening page. Selecting the school division name in the drop-down list resulted in a set of embedded Microsoft Visual Basic macros running and automatically populating certain fields throughout the workbook with data specific to the selected school division (VDOE, 2001f).

The second worksheet in the *Plan for the Use of Funds* workbook was the Division Monthly Progress worksheet (see Figure 7). Based on formal project management concepts, the worksheet included four specific phases: (a) awareness, (b) planning, (c) implementation, and (d) monitoring. Specific tasks to be completed were detailed within each phase, and school

divisions were to enter an estimated completion date, the percentage completed to date, and eventually, the actual completion date for each task.

Web-Based Standards of Learning Technology Initiative				
Division Monthly Progress				
<p>Purpose: To provide the Department of Education information regarding the status of specific tasks in the school division implementation of the Web-based Standards of Learning Technology Initiative.</p> <p>Use: To generate statewide project status reports submitted to the Superintendent of Public Instruction and to the Governor's Chief of Staff and to identify school divisions that may need assistance with the completion of project tasks.</p> <p>Expectation: That the Monthly Progress Report indicate an estimated date of completion of each task and reflect an increase in the percentage of completion of those tasks throughout the phases of the project. Some tasks may not reflect an increase until the latter phases of the project.</p>				
Task Description		Est. Comp. Date	Current % Comp.	Actual Completion Date
<i>Sign and submit an "Intent to Participate" certificate to DOE by 8/1/2000</i>		08-01-00	100%	
<i>Complete and submit Preliminary "Plans for Use of Funds" to DOE by 11-1-00</i>		11-01-00	0%	
<i>Complete and submit Revised "Plans for Use of Funds" to DOE (Spring 2001)</i>		05-15-01	0%	
Awareness	Select project manager		0%	
	Organize team members		0%	
	Define and document goals and objectives within your division		0%	
	Define and clarify expectations of project results		0%	
	Identify and document impact of project on division		0%	
	Communicate project to stakeholders		0%	
Planning	Define and sequence tasks and activities		0%	
	Define resources necessary to complete tasks		0%	
	Identify all barriers to successful completion of each task		0%	
	Identify methods to overcome barriers		0%	
	Develop a plan for administering the online assessment		0%	
	Conduct a capacity assessment of each high school		0%	
	Determine needs for Internet access for online assessment		0%	
Identify additional hardware and infrastructure needs		0%		
Implementation	Acquire local matching funds		0%	
	Submit application for E-Rate funds		0%	
	Procure and install an Internet-ready local area network in each high school		0%	
	Provide Internet access to all students in each high school		0%	
	Conduct Personnel Training		0%	
<i>Report readiness to submit initial remediation and instructional software evaluation</i>			0%	
Monitoring	Test hardware and connectivity (LAN and Internet)		0%	
	Test online assessment and report results to DOE		0%	
<i>Submit Project Review to DOE</i>			0%	

Figure 7. The Division Monthly Progress worksheet in the “Plan for the Use of Funds” workbook. It included a minimum set of tasks to be completed by the school division in each of the four phases with an area to track details regarding the status and completion of each task (VDOE, 2001f).

The tasks in the *Plan for the Use of Funds* workbook were identified by Department staff as a minimum set of steps that each school division would have to complete to be prepared to administer online tests successfully. The tasks were ordered sequentially in each phase, and the school division's first task after the division superintendent submitted the signed "Intent to Participate" statement was to identify a project manager to serve as a leader and point of contact in the division for the Initiative. Reflecting Virginia's emphasis on technology throughout the Initiative, the individual identified as the project manager was often the director of technology for the school division or an individual in a leadership position who was responsible for overseeing technology. The job responsibilities of the individual assigned to the project manager role, however, varied widely by division. While a full-time technology position could have been added to serve as the project manager of the Initiative, in most school divisions, the project manager responsibilities were added to an already existing full-time position. Especially in small divisions, the individual identified as the project manager already had a broad range of existing duties in the division such as technology and assessment together. In some cases, those duties included technology, assessment, and such additional duties as instruction, transportation, or facilities management. When it was time to organize the team and hold a planning meeting, it was recommended, light-heartedly, to those project managers with assigned responsibilities in at least technology and assessment, that they schedule a lunch with themselves and have a friendly conversation with themselves to work through the details of what needed to occur to get the Initiative started in their division. Department staff recognized and acknowledged that the Initiative resulted in added responsibilities for existing staff in many school divisions statewide.

In addition to tracking the progress of tasks in the school division and in each eligible school, the project managers were to use the *Plan for the Use of Funds* workbook to track

financial data associated with the Initiative. The fourth worksheet in the document, labeled *Financial* (see Figure 8), included an area to track the school division's budgeted expenditures and actual expenditures in six different categories throughout the first two fiscal years of the

Web-Based Standards of Learning Technology Initiative Financial

VPSA Grant Award Total = \$180,000.00; \$36,000.00 matching funds required.

FY 2001		BUDGETED EXPENDITURES					ACTUAL EXPENDITURES					Budget less Actual
Expenditure Type	Planned expenditures	VPSA funds	20% local matching funds	E-rate funds	Other Local Funds	Totals	VPSA funds	20% local matching funds	E-rate funds	Other Local Funds	Totals	
Hardware						0					0	0
Instructional Software						0					0	0
LAN Capability						0					0	0
Internet Access						0					0	0
Other Uses of Funds						0					0	0
Teacher Training						0					0	0
Total Budget/Actual	0	0	0	0	0	0	0	0	0	0	0	0
Remaining Available Funds		180,000	36,000			216,000	180,000	36,000			216,000	

FY 2002		BUDGETED EXPENDITURES					ACTUAL EXPENDITURES					Budget less Actual
Expenditure Type	Planned expenditures	VPSA funds	20% local matching funds	E-rate funds	Other Local Funds	Totals	VPSA funds	20% local matching funds	E-rate funds	Other Local Funds	Totals	
Hardware						0					0	0
Instructional Software						0					0	0
LAN Capability						0					0	0
Internet Access						0					0	0
Other Uses of Funds						0					0	0
Teacher Training						0					0	0
Total Budget/Actual	0	0	0	0	0	0	0	0	0	0	0	0
Remaining Available Funds		180,000	36,000			216,000	180,000	36,000			216,000	

Figure 8. The Virginia Department of Education designed the Financial worksheet as a tool for each school division. Divisions were to report budgeted and actual expenditures and funding sources during fiscal years 2001 and 2002. The sample data shown are for a school division with five eligible schools. The \$180,000 annual total in VPSA funds is based on \$50,000 for the division and \$26,000 per eligible school. The 20% local annual match to be provided in this sample is \$36,000 (VDOE, 2001f).

Initiative, fiscal year (FY) 2001 and FY 2002. When the project managers selected their school division in the drop-down menu on the opening page of the *Plan for the Use of Funds*, the *Financial* worksheet was populated with that school division's financial data for the Initiative.

Each Virginia school division was to use the spreadsheet as a tracking tool for specific tasks to be completed and for the financial resources committed to the Initiative. As described to school divisions in Informational Superintendents Memo #113 published on September 22, 2000:

The tasks included in the workbook, as well as the order in which they are presented, generally conform to standard project management activities and expectations for an initiative of this scope and duration. We hope you find the workbook useful in this regard and encourage you to develop your own detailed plans to meet local objectives and project management needs. (VDOE, 2000c, p. 1).

The Virginia Department of Education would rely on the same document as a data collection tool. During the development of the workbook, Microsoft Visual Basic macros were embedded in the spreadsheet to facilitate data collection from the local project managers. By clicking the "Generate Upload File" button on the opening page, the project managers would automatically generate a formatted data file containing their latest progress data. The prepared file was automatically exported and saved to the local computer where the project manager would then submit the file via email attachment to the Virginia Department of Education.

An expanded view of a portion of the *Financial* worksheet (see Figure 9) includes descriptions of the types of expenditures school divisions were directed to record in the *Plan for the Use of Funds*.

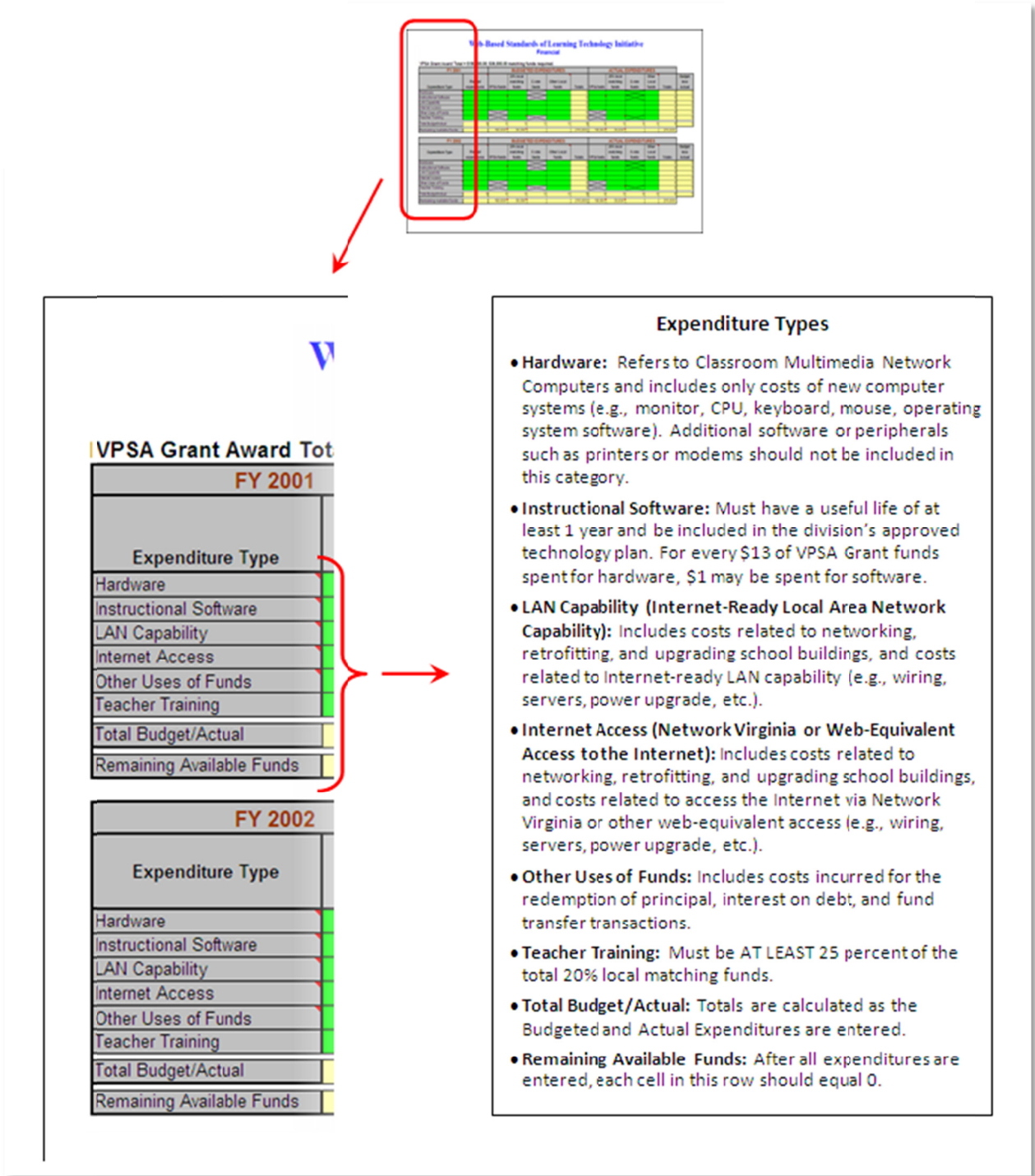


Figure 9. Expenditure types documented in the *Plan for the Use of Funds* workbook. This expanded view of page 1 of the *Financial* worksheet includes a description of the types of expenditures the Virginia Department of Education directed school divisions to record during FY 2001 and FY 2002 (VDOE, 2001f).

Due to the Initiative being declared a state technology project rather than solely an education initiative, the Virginia Department of Education's use of formal project management concepts continued to be monitored by Governor Gilmore's E-Government office (Canada, 2010; DeMary, 2010; Neugent, 2010). As a result, the training* for school divisions regarding

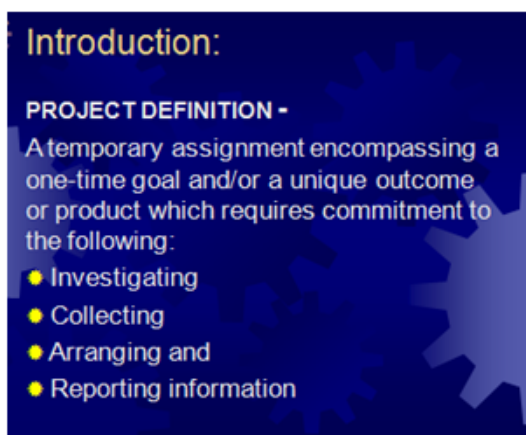
the *Plan for the Use of Funds* included not only the requirements and how to use the workbook, but also project management specifics such as the definition of a project and the components of a successful project. An additional consultant was utilized by the Virginia Department of Education to ensure appropriate project management terminology and concepts were incorporated in the training materials for the *Plan for the Use of Funds*. This session was the first presentation delivered to school divisions regarding the Initiative as well as the first work product to be viewed by the E-Government

* The 2-hour training for the *Plan for the Use of Funds* was held on October 11, 2000, and was the first presentation to school divisions regarding the Web-based SOL Technology Initiative. The purpose of the session was to "provide an overview of the technology initiative, assist school division project managers in developing their local plans and answer questions relating to the initiative" (VDOE, 2000g, p. 1). The session was delivered to school divisions via satellite broadcast over the Virginia Satellite Education Network, GE2 at 85 degrees west on channel 6. Viewers could call the Department with questions that would be written down and handed to the presenter during the broadcast.

A Web-based presentation, or a Webinar with audio and video transmitted via the Internet, was not an option at that time; a satellite broadcast was the best technology available to the Department of Education for delivering a presentation, ironically, about the Web-based SOL Technology Initiative. VHS copies of the presentation could be ordered after the broadcast was completed.

office and members of the Governor's staff (Canada, 2010; DeMary, 2010; Neugent, 2010).

Figures 10 and 11 are excerpts from the training presentation on the *Plan for the Use of Funds* developed by a contracted project management consultant and presented by the Virginia Department of Education. The five presentation slides and the scripted text are excerpts from the presentation and represent the level of specificity regarding project management concepts that were required as part of the oversight by Virginia's E-Government Office.



The intent of this training exercise is to familiarize each of you with some basic project information as well as the details behind this initiative.

Before getting into the initiative details, let's review some basics:

- A project is a temporary assignment encompassing a one-time goal and/or a unique outcome or product. Time must be committed to investigating, collecting, arranging, and reporting information outside the range of usual activities.
- A project has a defined start and end date, interim goals, and is defined by specific and measurable objectives or tasks.

The two components that lead to a successful project are **definition** and **control**. Without either of these, you will be unlikely to achieve (or even know) the final result, within the budget, and within the deadline.

Figure 10. Training slides one through three for the presentation on the *Plan for the Use of Funds*. The presentation was developed by a project management consultant and presented to school divisions by the Virginia Department of Education. The slides (in blue boxes) are shown as presented, and the narrative text (in white boxes) was spoken by the Department staff member (VDOE, 20001f).

Definition

- Purpose
- Tasks
- Schedule
- Budget

The first component, **Definition**, requires you to be able to answer the following questions:

Purpose. What is the expectation? Why is the project being undertaken, and what conclusions or answers should it produce?

Tasks. How can a large project be broken down into a series of short-term progress steps? Remember, although a big project may be overwhelming, smaller portions can be methodically attached and completed according to schedule.

Schedule. What is the final deadline? And with that deadline in mind, how can a series of smaller tasks be arranged, maintained, and scheduled? Proper scheduling of tasks on a week-to-week basis is the key to meeting a long-term deadline.

Budget. How much should the project cost? Have a clear understanding of budget constraints.

Control

- Team
- Coordination
- Monitoring/Tracking
- Action
- Completion

The second component, **Control**, requires you to know and understand the following:

Team. As a project manager, you will need to gather the necessary team. You may have to borrow resources, outsource some or all of the team, or use all or part of your own staff. But you can't build the team until you know the purpose, schedule, and budget for the project.

Coordination. By its very nature, a project demands consistent management and as project manager, you must be responsible for coordinating the efforts of everyone on the team.

Monitoring/Tracking. Your schedule and budget will succeed only if you are able to spot emerging problems and correct them; delegating work to others or creating a control system isn't enough. You also need to track the indicators that tell you whether the project is on schedule and within budget and if the purpose is being achieved at each step along the way.

Action. If you find that problems are developing, you will need to take action to correct them. If your team is falling behind schedule, you must accelerate the pace of work. If they're exceeding budget, costs and expenses must be brought under control and further variances eliminated or reduced. This is possible only if you can follow up on discovered problems before they get out of hand.

Completion. Even if a project is well-managed and kept on schedule for 99% of the time period, if that last step isn't taken, the deadline won't be met. Even well-run projects sometimes prove difficult to close out. That final report, the last conclusion, and the commitment to paper often prove to be the hardest parts of the entire project.

Figure 11. Training slides four and five for the presentation on the *Plan for the Use of Funds*. The training presentation on the *Plan for the Use of Funds* was developed by a project management consultant and presented to school divisions by the Virginia Department of Education. Presentation slides 4 and 5 (in blue boxes) are shown as presented, and the narrative text (in white boxes) was spoken by the Department staff member (VDOE, 2001f).

A timeline (see Figure 12) for school divisions to submit their *Plan for the Use of Funds* to the Virginia Department of Education was developed and communicated by the Department. To prepare a submission, the project manager used the “Generate Upload File” button and emailed the resulting data file to the designated contact. The Virginia Department of Education compiled the school division submissions and used the data to prepare status reports for the Governor, the Secretary of Education, the Secretary of Technology, and members of the General Assembly (VDOE, 2000g).

Date	Activity
November 1, 2000	Preliminary Plan for the Use of Funds
February 15, 2001	Submit first progress report covering November 1 through January 31
March 15, 2001	Begin submitting monthly progress reports with each progress report covering the 1 st through the end of the preceding month.
May 15, 2001	Submit updated Plan for the Use of Funds
May 15, 2002	Submit updated Plan for the Use of Funds (financial worksheet will not be changed).

Figure 12. A timeline for the *Plan for the Use of Funds* workbook. The Virginia Department of Education published a timeline that each school division was to use when reporting progress on the Initiative via the *Plan for the Use of Funds* workbook. (VDOE, 2001f).

The High School Capacity Survey

While developing the *Plan for the Use of Funds*, the Virginia Department of Education was designing another electronic document to be used by school divisions, also in Microsoft Excel, called the *High School Capacity Survey*. In contrast to the *Plan for the Use of Funds*, the *High School Capacity Survey* would be completed and submitted only once, and it was solely

technical in nature. School divisions were asked to have their division technology coordinator complete the survey to provide details regarding “the school division's Internet connection, each high school’s Internet connection, each high school's Local Area Network, and the number and location of ‘Internet Connected and Capable’ computers in each school” (VDOE, 2000h, p. 1).

Data collected via the *High School Capacity Survey* were used by the Virginia Department of Education to establish a baseline of the technological capacity of Virginia’s high schools and to gain a better understanding of each school division’s technological readiness to participate in the Initiative. These details were used as part of the procurement process in which the Virginia Department of Education solicited proposals for securely delivering high-stakes tests online beginning in Virginia’s high schools (Canada, 2010; Neugent, 2010, VDOE, 2000f).

Web-based SOL Technology Initiative Project Plan

A formal document, the *Web-based Standards of Learning Technology Initiative Project Plan*, was being developed while the three external documents previously described, the (a) *Intent to Participate*, (b) *Plan for the Use of Funds*, and (c) *High School Capacity Survey*, were being completed and distributed to school divisions.

The project plan for the Initiative (see Figure 13) was considered a required project deliverable from the Virginia Department of Education to the E-Government

office. The formalized project plan had to be developed and written in accordance with industry

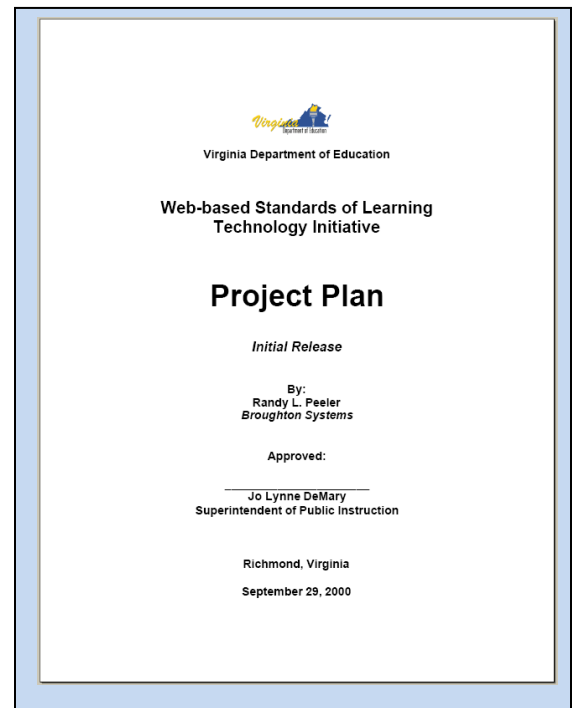


Figure 13. The initial release of the project plan for the Initiative. The plan was approved on September 29, 2000, by Dr. Jo Lynne DeMary, Virginia’s Superintendent of Public Instruction (VDOE, 2000a).

standards as established by the Project Management Institute. The project plan, as stated in the forward of the document, “is intended to present both general and detailed project information and shall be used to manage and control project execution” (VDOE, 2000a, p. 2).

The initial version of the project plan was compiled by the project management consultant after extensive collaboration with Department of Education staff in August and September 2000. Collaboratively, they established the work to be performed, the expected deliverables, the project milestones, and the various timelines to completion. The project plan, once approved, would become the basis for all project monitoring, status reports, and evaluations by the E-Government Office and Executive Branch Offices, including the Governor’s Office. The project plan had to be approved by the agency head, the Virginia Superintendent of Public Instruction, and maintained as a formal, versioned document, according to industry standards, for the duration of the Web-based SOL Technology Initiative (Canada, 2010; DeMary, 2010; Neugent, 2010). The first release of the formal project plan was approved and published as version 1.0 on September 29, 2000 (VDOE, 2000a).

Organizational Hierarchy for the Web-based Standards of Learning Technology Initiative

The Department of Education developed an organizational hierarchy for the Initiative (see Figure 14) that was documented in version 1.0 of the *Web-based Standards of Learning Technology Initiative Project Plan*. The graphic used to depict the organizational hierarchy included representations of the various groups and offices that had a role in the Initiative, and by using different line types and line weights in the graphic, the types of reporting relationships between the various entities were shown.

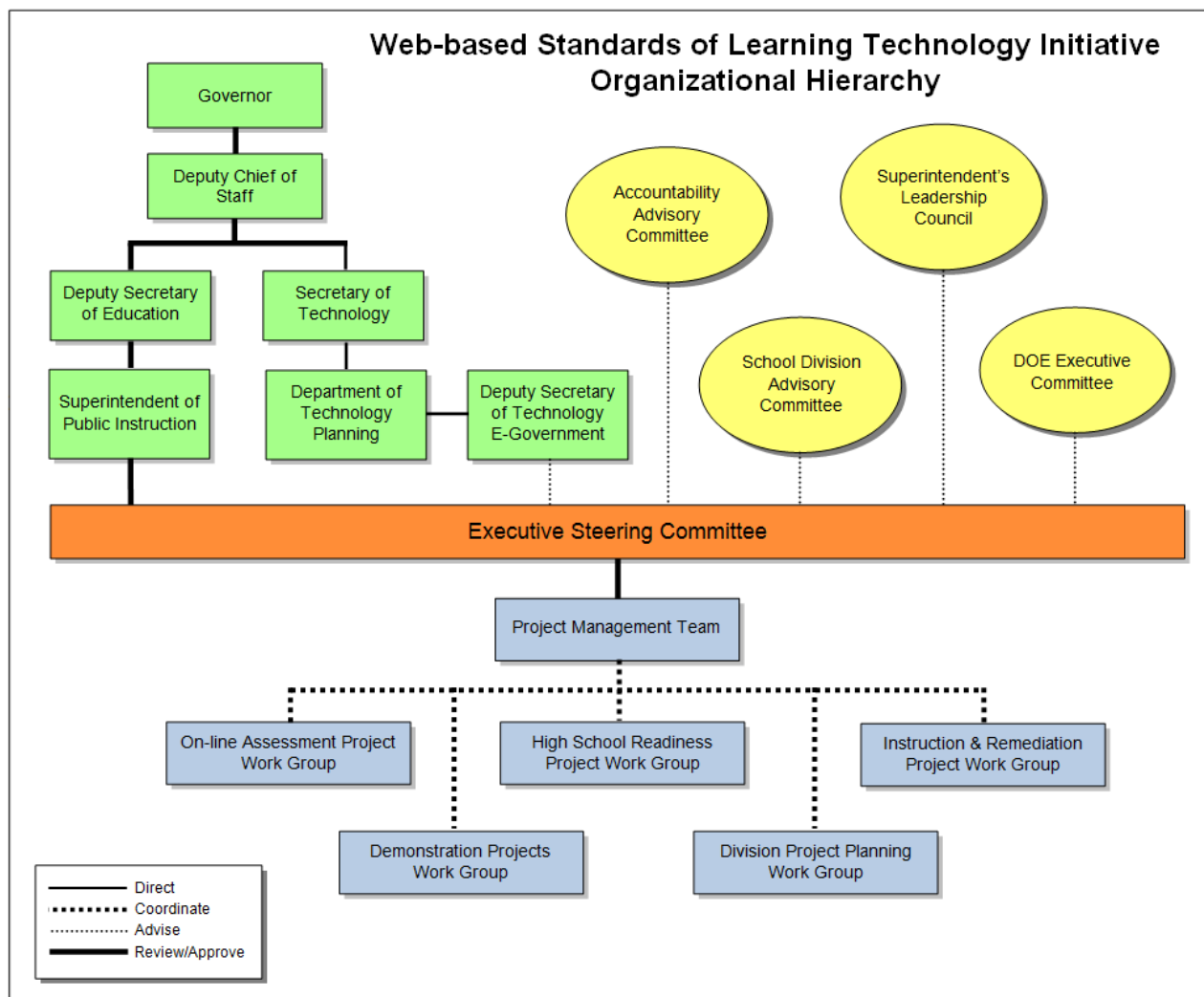


Figure 14. The organizational hierarchy for the Initiative. The hierarchy was documented in the *Web-based SOL Technology Initiative Project Plan* (VDOE, 2000a).

The Executive Steering Committee, shown in orange in Figure 14, served as the main decision-making body throughout the Initiative. The committee consisted of individuals in the following positions, all from within the Department of Education with the exception of two positions as noted:

- Superintendent of Public Instruction
- Internal Deputy Superintendent
- Assistant Superintendent for Assessment and Reporting

- Assistant Superintendent for Technology
- Assistant Superintendent for Instruction
- Assistant Superintendent for Finance
- Assistant Superintendent for the Governor’s Best Practice Centers
- Director of Management Information Systems
- Associate Director of Test Development
- Manager of External Technology Services
- Manager of Online Assessment [Associate Director of Web-based Assessments]
- External Services Technology Project Advisor (private contractor)
- E-Government Consultant (from the E-Government Office)

The External Services Technology Project Advisor was a certified Project Management Professional (PMP) contracted by the Department of Education to ensure project management principles were utilized throughout the planning and execution of the Initiative. The E-Government Consultant from Virginia’s E-Government Office monitored the status of the Initiative and served in an advisory role while keeping the E-Government Office and Executive Branch informed regarding the progress and status of the Initiative.

The Executive Steering Committee reported on the Initiative to the Superintendent of Public Instruction, the Secretary of Education, the Secretary of Technology, the Deputy Chief of Staff, and the Governor’s Office (VDOE, 2000a). Given the significance of the Initiative to the Department of Education, however, the Superintendent of Public Instruction, Dr. JoLynne DeMary, actively participated in all meetings of the committee. The group met regularly each month and held additional meetings as needed.

A Project Management Team, shown in Figure 14 in blue, was implemented to manage the day-to-day work of the Initiative being conducted by five Project Work Groups, also shown in blue in Figure 14. Members of the Project Management Team, some of whom served on the Executive Steering Committee, included individuals in the following positions:

- Assistant Superintendent for Assessment and Reporting
- Assistant Superintendent for Technology
- Director of Management Information Systems
- Director of Secondary Education
- Manager of External Technology Services
- Manager of Online Assessment [Associate Director of Web-based Assessments]
- Public Relations Manager
- Director of Instructional Media and Training
- Director of Teleproduction Services
- Assessment/Technology Consultant (private contractor)
- External Services Technology Project Advisor (private contractor)
- E-Government Consultant (from the E-Government Office)

The Project Management Team reported directly to the Executive Steering Committee and met regularly each week. Reflective of the heavy focus on technology in the early phases of the Initiative, key leaders within the Project Management Team included the Assistant Superintendent for Technology, the Director of Management Information Systems, the Manager of External Technology Services, and the Associate Director of Web-based Assessments (Canada, 2010; Neugent, 2010).

The Project Management Team guided the work of the five Project Work Groups that were formed to divide the requirements of the Initiative into smaller, manageable areas of responsibility. Each work group had a defined scope of work that included specific tasks and deliverables to be completed successfully and on time to ensure completion of the overall Initiative. A chairperson or two co-chairpersons were assigned to lead each work group with at least three to four Department of Education staff assigned as regular working members in each group. Given the staffing levels at the Department, some staff members were assigned to work with multiple Project Work Groups. The chairpersons of the five Project Work Groups

interacted regularly and reported weekly to the Project Management Team. The responsibilities of each Project Work Group are defined in Figure 15.

Project Work Group	Defined Responsibilities
Online Assessment Project Work Group	Develop a request for proposals resulting in a solution that enables Virginia school divisions to securely administer high-stakes SOL tests electronically, receive score reports promptly, and maintain the integrity of the assessment program. Technical requirements and capacity projections must be clearly defined as part of the solution.
Demonstrations Project Work Group	Develop requirements and supervise all preparations and implementation of Demonstration Projects at various statewide locations. Ensure locations are distributed equitably among vendors and represent various computing platforms, ranges of school profiles and demographics, and various technology profiles and capacities. Ensure evaluations of Demonstration Projects are conducted by stakeholders and are documented and summarized.
High School Readiness Project Work Group	Analyze the level of technical capacity in schools to include types of computers, network infrastructure, and Internet connectivity. Develop technical specifications required of schools to successfully implement the Initiative. Develop guidelines for use by school divisions in installing or upgrading network infrastructure and Internet connectivity.
Local Education Agency (LEA) Planning Project Work Group	Develop a set of resources for use by school divisions and schools to assist with planning and monitoring Initiative progress, planning and monitoring expenditures, and preparing for site certification. Provide information, training, and support to schools and school divisions throughout the Initiative.
Instruction and Remediation Software Project Work Group	Develop a method for school divisions to evaluate instructional and remedial software and submit the evaluations so information is available to all school divisions.

Figure 15. The defined responsibilities of each Project Work Group. Each definition included a specific scope of work with tasks and deliverables required to be completed successfully and on time to ensure the completion of the overall Web-based SOL Technology Initiative (VDOE, 2000a).

While some dependencies existed among each of the work groups based on their assigned responsibilities, none of the work groups were idle waiting for tasks first to be completed by one of the other groups. The Program Management Team developed the *Intent to Participate* document for school divisions to review and sign. The LEA Planning Project Work Group was responsible for developing the *Plan for the Use of Funds* and the training session that was delivered via satellite broadcast to the school divisions. The High School Readiness Project Work Group was designing the *High School Capacity Survey* and preparing to evaluate and analyze the data that would be received. The Demonstrations Project Work Group was soliciting letters of interest from school divisions with a desire to participate in the first attempts at administering online tests to students.

While these work groups were interacting with school divisions regarding the various tasks necessary to get the Initiative underway, the Online Assessment Project Work Group was working internally to develop a request for proposals (RFP) for the Initiative. The RFP needed to convey the vision and goals of the Web-based SOL Technology Initiative while also establishing a set of clear, measurable requirements to which potential offerors could develop a response that could be evaluated fairly.

By the time the project plan was documented and officially approved on September 29, 2000, members of the Executive Steering Committee and the Project Management Team had been through multiple rounds, formally and informally, of brainstorming, projecting, planning and estimating. The groundwork for the Initiative had been set in place legislatively and financially, and the Initiative had the support and attention of the Executive Branch and the Governor's Office. The details of the Web-based SOL Technology Initiative were not widely

known within school divisions yet, but discussions of possibly administering SOL tests on student computers were starting to occur.

Chapter 3

A Demonstration of Web-based Testing in Virginia

Given the anticipated complexity of transitioning Virginia's high-stakes assessment program to a Web-based program with thousands of students completing tests online, the Department of Education opted to begin with what eventually became known as the Demonstration Phase. The Demonstration Phase was planned with a primary goal of showing that SOL tests could be delivered online successfully and securely to Virginia students. Beyond demonstrating that online testing was possible, however, the Department needed to gain a greater understanding of the challenges associated with such a transition. In 2000, it was difficult to find any state that had experience administering high-stakes assessments online in their public schools (Canada, 2010; Neugent, 2010). Some high-stakes exams for industry certifications and professional licensure were being administered via computer, but these tests were administered in commercial testing centers or other controlled environments. The computers in these cases existed solely for test-taking purposes and often were connected to small local area networks or dedicated circuits where exposure to external traffic or the commodity Internet was not physically possible.

The Department had begun to anticipate some obvious challenges related to testing school-aged children online using school-based computers, but no online implementation of large-scale, high-stakes testing had occurred elsewhere that could serve as a model or example for Virginia to observe. As a result, the Department planned the Demonstration Phase such that selected vendors would have to prepare and administer various SOL tests online in a small number of demographically and geographically diverse high schools throughout Virginia. The online SOL tests that the vendors were to administer in the Demonstration Phase were released

SOL tests, or non-secure SOL tests that were available publicly. The tests contained previously administered SOL test items that would be administered online to students under secure SOL test conditions in each school, although students would not receive official score reports for their work. Instead, the Demonstration Phase would allow for Department staff and a number of Virginia students, teachers, and administrators to have the opportunity to experience one or more online test delivery solutions in their schools. Their feedback would be valuable in the effort to identify one or more solutions that could support the statewide online delivery of Virginia's SOL assessments.

Demonstration Phase Request for Proposals

To identify potential vendors with the interest and expertise necessary to participate in the Demonstration Phase, the Department developed a request for proposals seeking a vendor or a partnership of vendors to propose a turnkey solution for administering SOL tests online. The proposed solution needed to include (a) secure test delivery software, (b) training and support for the software, (c) conversion of previously released SOL items into an online test format, (d) reporting of online test results, and (e) provision of any associated infrastructure and equipment needed to demonstrate online delivery of the SOL tests (Canada, 2010; DeMary, 2010; Neugent, 2010; VDOE, 2000b). For the successful offerors selected to advance to the Demonstration Phase, their proposed solutions would eventually have to be fully implemented and evaluated at certain Virginia high schools selected by the Department.

The request for proposals was developed such that all potential offerors would respond in an electronic template to a set of minimum testing requirements and minimum technical requirements (VDOE, 2000b). Identifying those requirements to be included in the request for proposals was a collaborative effort by two groups of staff at the Department of Education who

were not accustomed to sharing and depending on one another's expertise. The assessment staff and technology staff at the Department, prior to this Initiative, had little interaction regarding the details of their work and their programs. Sharing information and knowledge between the two groups began during the development of the request for proposals, and that change became even more critical as work on the Web-based SOL Technology Initiative continued (Canada, 2010; Neugent, 2010).

The testing and technical requirements that were included in the final request for proposals are presented in Figure 16 (VDOE, 2000b). The testing requirements were designed such that offerors would use existing SOL test items, from the publicly released SOL tests, and create an online test form that would be administered to students through a secure, electronic format rather than a traditional paper-and-pencil test booklet. The technical requirements were developed so that offerors would detail the types of technology needed in schools to support their proposed testing solution. A successful solution would have to be capable of delivering, scoring, and reporting Virginia's statewide assessments online while maintaining the security of test content and the confidentiality of student data.

Testing Requirements – Section #1	Item #	Page Reference
Test Security	1.1	14-15
Presentation of Tests and Test-related Information and Materials	1.2	15-16
Interface with the Existing Assessment Contractor	1.3	16
Data Management — Student Demographic Data	1.4	16-17
Scoring and Reporting	1.5	17-18
Training and Support	1.6	18
System Safeguards	1.7	19
Comparability	1.8	19
System Use of Assessment Results	1.9	19-20
Technical Requirements – Section #2	Item #	Page Reference
User Interface (non-proprietary) and Workstation Hardware	2.1	22
User Training and Documentation	2.2	22-23
Security Model	2.3	24
Connectivity Requirements – Located within Offeror Demonstration Test Center During the Demonstration Period	2.4	24-25
Server Requirements	2.5	25
Database Platform, Processing and Administration	2.6	25-26
Product Support (for User Hardware, Software and Connectivity)	2.7	26
Service Levels, Technical Monitoring and Reliability Targets	2.8	26-27
Project Management	2.9	27
General Product Information	2.10	27-28
Single Vendor and/or Partnership Information	2.11	28
School Building Hardware Requirements	2.12	29
Offeror Pricing Information	2.13	46

Figure 16. The testing and technical requirements in the request for proposals. These were the two main areas to be addressed by potential offerors (VDOE, 2000b).

All requirements in the request for proposals were further categorized by type, either mandatory or optional, and by the level of overall importance in the evaluation of the proposals - high, medium, or low (see Figure 17). The expectation was clearly stated in the request for proposals that “Not meeting or addressing a mandatory requirement may be grounds for elimination during the evaluation process” (VDOE, 2000b).

Type	Description
<i>Mandatory</i>	<i>The turnkey solution(s) must provide the defined functionality or response</i>
<i>Optional</i>	<i>The turnkey solution(s) may but need not provide the defined functionality or response</i>

Importance	Description
<i>High</i>	<i>The importance or value of this feature or functionality, as a discriminator in the evaluation, is high</i>
<i>Medium</i>	<i>The importance or value of this feature or functionality, as a discriminator in the evaluation, is medium</i>
<i>Low</i>	<i>The importance or value of this feature or functionality, as a discriminator in the evaluation, is low</i>

Figure 17. A description of the type and importance of the requirements. All requirements in the proposal were categorized by the type of requirement and the level of overall importance in the evaluation of the proposals (VDOE, 2000b).

Figure 18 is an example of a set of requirements as formatted and listed in the request for proposals. The type and overall importance of each requirement were detailed in this manner throughout the document (VDOE, 2000b). Overall, 28 assessment requirements were

Requirement	Response	Importance
(1.1.1) Verification of student identity	<i>Mandatory</i>	<i>High</i>
(1.1.2) Control for the following: <ul style="list-style-type: none"> ▪ (1.1.2.a) Printing all or part of the tests while in the process of the on-line administration ▪ (1.1.2.b) Visiting web sites to find answers to the questions ▪ (1.1.2.c) E-mailing of all or part of the test to anyone ▪ (1.1.2.d) Cutting and pasting of all or part of the test to another application ▪ (1.1.2.e) Use of other desktop applications during test administration ▪ (1.1.2.f) Confidentiality regarding test access and access to student information before, during and after testing 	<i>Mandatory</i>	<i>High</i>

Figure 18. The first testing requirements listed in the request for proposals addressed test security. Requirements 1.1.1 and 1.1.2 are examples of requirements that were categorized as “Mandatory” and with a “High” level of overall importance (VDOE, 2000b).

included and all categorized with an importance level of high. Sixty-three technical requirements were detailed that included 33 of high importance, 24 of medium importance, and 6 of low importance. Separate from the required elements, the request for proposals included 11 optional features in assessment and 10 optional features pertaining to technology (VDOE, 2000b).

As part of the technical requirements, the Department required offerors to respond to how their solution would be implemented to administer online tests successfully in four different fictitious high schools (VDOE, 2000b). The profiles of the fictitious high schools were created to mirror the range of existing high schools in Virginia at that time and were detailed for the offerors within the request for proposals. By requiring a response to the four scenarios, the Department expected to gain details of how offerors' solutions would address differences among Virginia's high schools while maintaining the similarity among the proposals needed for evaluation purposes (Canada, 2010; VDOE, 2000b).

The first high school profile in the request for proposals is shown in Figure 19. It was presented as a newly constructed high school where infrastructure components had not yet been purchased. The offerors had to complete a detailed inventory, including costs, of any equipment to be purchased to implement their solution based on the description of High School #1 (VDOE, 2000b).

The additional three fictitious high school profiles were included to represent the range of physical architecture and technologies installed in existing high schools in Virginia along with the range of student enrollments and quantities of tests administered (see Figures 20, 21, and 22). The expectations in responding to these school profiles were similar to what offerors had to

provide for High School #1 except that offerors were to detail how their solutions would be integrated with the existing technology and whether any additional equipment was needed to implement their solution given the existing technology and infrastructure described in each profile (VDOE, 2000b).

Template 1 – New High School #1 Inventory Form

Testing Metrics Projected for the Average New High School

Benchmark Metrics	New High School – Average
# of Students to be Tested	1200 Students – Grades 9-12
# of Tests per Student	Variable
# of Test Windows	Three per Year
# of Tests in Recent Spring Test Window	4000
# of Test Forms per Content Area	12 tests; Two Forms per Test
Physical Architecture	Offeror Completes Template Below

The above table represents the average test metrics anticipated in any of the new high schools to be built in Virginia over the next five years. Offeror's should use these metrics to undertake the sizing of hardware and other equipment required for High School #1. Again, Offeror should treat High School #1 as if it has just been built with current connectivity protocols, but has not yet purchased any of the infrastructure components necessary to participate in the demonstration project.

Figure 19. The first sample high school in the request for proposals. This was a newly constructed high school where network infrastructure components had not been purchased. Offerors were required to complete an inventory of all new equipment necessary to support their solution (VDOE, 2000b).

Template 2 – High School #2

Testing Metrics

Benchmark Metrics	High School #2 — Small
# of Students to be Tested	250 Students – Grades 9-12
# of Tests per Student	Variable
# of Test Windows	Three per Year
# of Tests in Recent Spring Test Window	600
# of Test Forms per Content Area	12 tests; Two Forms per Test
Physical Architecture	See Below

High School #2 obtains Internet services via the district WAN. The district has a full T-1 ATM circuit to Net Work Virginia located in the central office. Thirteen schools in the district are connected to the central office by 256K Frame Relay circuits. The high school has three computer labs with seven Internet-capable computers in each lab. There are two network drops per room and an average of one Internet-capable computer in each of 31 classrooms. All computers have a shared 10mb/s connection to the school LAN. The 75-year-old building is wired with Category 5 cable. There is one NT 4.0 file server in the Library/Media center. The librarian spends about 25 percent of her time on technology support.

Figure 20. The second sample high school in the request for proposals (VDOE, 2000b).

Template 3 – High School #3

Testing Metrics

Benchmark Metrics	High School #3 — Medium
# of Students to be Tested	926 – Grades 9-12
# of Tests per Student	Variable
# of Test Windows	Three per Year
# of Tests in Recent Spring Test Window	1850
# of Test Forms per Content Area	12 tests; Two Forms per Test
Physical Architecture	See Below

High School #3 obtains Internet service via a T-1 circuit at the Central Office. Service is provided by A&B Telephone, a Tier 3 ISP. Although the committed information rate on this circuit is 1.544 Mb/s, only 720K/s is realized. Service is not good and downtime is frequent. Three other schools share this circuit. They are connected to the central office via 2-way microwave links at 10Mb/s (upstream and downstream). All of the school district's NetWare 4.11 file servers are located in the Central Office. High school #2 has 3 computer labs, with 17 Internet computers in each. The 45 classrooms have one Internet computer each. This is a campus school, built in 1998. Buildings are wired 5 drops per room with Category 5 cable. There are fiber uplinks between buildings. There are four computer support staff in the district who serve the Central office and the schools.

Figure 21. The third sample high school in the request for proposals (VDOE, 2000b).

Template 4 – High School #4

Testing Metrics

Benchmark Metrics	High School #4 — Large
# of Students to be Tested	2009 – Grades 9-12
# of Tests per Student	Variable
# of Test Windows	Three per Year
# of Tests in Recent Spring Test Window	3500
# of Test Forms per Content Area	12 tests; Two Forms per Test
Physical Architecture	See Below

High school #4 obtains Internet service via the district WAN. The district has a DS-3 ATM circuit to a Tier 1 ISP. Each of the 37 schools in the district has a full T-1 to the Central Office. There are 2 NT 4.0 servers in the school, one for administration and one for instruction. The LAN backbone is 100 percent switched and approximately half of the workstations are switched. There are 12 computer labs in High school #4 with 12 Internet computers per lab. Each of the 93 classrooms has one Internet computer. The 27-year old building was wired with Category 5 cable in 1997. There are five network drops per room. This school has a full time computer support person.

Figure 22. The fourth sample high school in the request for proposals (VDOE, 2000b).

On Friday, October 12, 2000, the request for proposals entitled *Demonstrating Success: A Statewide Web-based Standards of Learning Technology and Online Testing Initiative* was published in various newspapers, on the Department Web site, and in the Virginia Business Opportunities listing. Offerors' proposals were due back to the Department in Richmond, Virginia, no later than 3:00 p.m. on Monday, November 13, 2000 (VDOE, 2000b).

Finalizing the request for proposals and posting it publicly was a critical milestone of the Web-based SOL Technology Initiative. The Superintendent of Public Instruction notified the Governor's Office and the E-Government Office, and she used the posting as an opportunity to communicate the progress of the Initiative to all Virginia school superintendents (see Figure 23).

To: School Division Superintendents
From: Jo Lynne DeMary
Subject: Release of the Web-based Standards of Learning Technology Initiative Request for Proposals

As part of the implementation of the state-wide Web-enabled Standards of Learning (SOL) Technology Initiative, the Department of Education is pleased to announce that the Request for Proposals (RFP) for the on-line testing portion of the Technology Initiative is being released to the public on Friday October 13, 2000. The intent of this RFP is to invite vendors or groups of vendors to submit proposals for an on-line testing solution that will be implemented at various demonstration sites in early 2001. The proposed solution should also be scaleable to include state-wide on-line testing for all public high schools by 2003.

The RFP and all related documents will be available on the DOE Web site at: <http://www.pen.k12.va.us/VDOE/Technology/soltech/soltech.html>. Completed RFP's are due back to the DOE by November 13, 2000 at which time the review of all submissions will begin. Vendors should refer to the DOE Web site for specific requirements for submitting a proposal.

For questions concerning the SOL Technology Initiative, please contact Ms. Cam Harris, assistant superintendent for assessment and reporting or Mr. Lan Neugent, assistant superintendent for technology.

Figure 23. An email notification from the Superintendent of Public Instruction to local school division superintendents. The email announced the public posting of the Request for Proposals for the Initiative and reminded schools of the proposed timeline for online SOL testing (October 12, 2000).

The next step of the state procurement process, as detailed in the request for proposals, was to hold a mandatory pre-proposal conference (VDOE, 2000b). This was held in Richmond, Virginia, on October 24, 2000.

Due to the importance of all Offerors having a clear understanding of the scope of the work and requirements for this solicitation, attendance at this conference will be a prerequisite for submitting a proposal. Proposals will only be accepted from those offerors who are present at this pre-proposal conference. Attendance at the conference will be evidenced by the representative's signature on the attendance roster. No one will be admitted after 9:00 a.m. DST. (VDOE, 2000b, p. 62)

In addition to asking questions at the pre-proposal conference, potential offerors could submit written questions to the Department. All questions and the responses by the Department would be provided via email to all pre-proposal conference attendees. The deadline for submitting questions and the overall schedule for the procurement were included in the request for proposals (see Figure 24).

Event	Day	Due Date *
RFP Published / Mailed to Offerors	Friday	October 13, 2000
Mandatory Pre-Proposal Conference	Tuesday	October 24, 2000
Deadline for Submission of Written Questions to RFP	Thursday	October 26, 2000
Electronic Mail Response to Written Questions Regarding the RFP (Issue Addenda, as necessary)	Friday	October 27, 2000
Proposals Due 3:00pm EST	Monday	November 13, 2000
Notice of <i>Intent to Award</i> Posted	Monday	December 4, 2000

** VDOE reserves the right to revise the above schedule.*

Figure 24. The procurement schedule was presented in the request for proposals. All potential offerors were required to attend the pre-proposal conference and provide required documents on or before the dates shown to remain eligible for consideration (VDOE, 2000b).

Ninety-four different questions were received by the Department from potential offerors. The volume of questions caused a delay in providing responses, but on November 3, 2000, the Department provided a complete set of responses via email to all potential offerors (VDOE, 2000b).

A total of 11 proposals were submitted to the Department by the deadline on November 13, 2000 (see Figure 25). Some vendors worked together and developed a collaborative response to the request for proposals, while others planned to complete all work from within their own companies.

Companies Responding to the Virginia Web-based Standards of Learning Technology Initiative Request for Proposals	
1. ACTS Corporation	7. I-mind, Inc.
2. BTG, Incorporated	8. KPMG Consulting, Inc.
3. CSSG, Incorporated	9. NCS Pearson, Inc.
4. CyberEd Corporation	10. River Deep, Inc.
5. Edmin.com	11. Vantage Learning, Inc.
6. EduTest.com	

Figure 25. Eleven companies responded to Virginia’s Web-based Standards of Learning Technology Initiative request for proposals. Proposals were due on November 13, 2000 (VDOE, 2000b).

Evaluation Criteria and Evaluation Process

The evaluation criteria (see Figure 26) were published within the request for proposals document and consisted of 1,000 possible points distributed among six different categories (VDOE, 2000b). The first category was “Scope of Work” and included the offeror’s (a) comprehension of the Initiative, (b) ability to understand the technical and assessment environments within K-12 public education in Virginia, and (c) ability to demonstrate a “realistic and achievable project plan and timeline” (p. 60).

Criteria	Point Value
Scope of Work (Sections 1, 2 and 3) <ul style="list-style-type: none"> ▪ Comprehension of nature and scope of work involved ▪ Provided evidence of a sound understanding of Virginia’s education reform program ▪ Completeness and soundness of proposal ▪ Feasibility of the proposal to be implemented statewide ▪ Technical merit of methodology, procedures, and techniques Project Management <ul style="list-style-type: none"> ▪ Showed realistic and achievable project plan and timeline ▪ Evidence of knowledge of assessment program and interface requirements with the existing test contractor 	350
Pricing (Section 4) <ul style="list-style-type: none"> ▪ Mandatory Pricing Table; One-Time Investment and Statewide ▪ Optional Pricing Table; One-Time Investment and Statewide ▪ Relationship of Offeror’s Bid to the Lowest Proposal Price Received¹ (300 points) ▪ Value-Added Solution 	300
¹ Cost evaluations and scoring will be made using the Mandatory Pricing Requirements of the Proposal. The proposal with the lowest total cost will be awarded 300 points. All other cost proposals deemed to be acceptable will receive a prorated score calculated using the following formula: $L/R \times 300 \text{ points} = Z$ (L = The total cost of the proposal with the lowest total cost in the Mandatory Requirements section; R = The total cost of the Offeror’s proposal being scored; and, Z = The total number of points awarded to the Offeror’s cost proposal.)	
Qualifications of the Offeror for Providing: (Sections 5 and 6) <ul style="list-style-type: none"> ▪ Ability to meet the terms of the RFP ▪ Ability to meet General Requirements and Special Terms and Conditions ▪ Quality of deliverables 	100
Quality of Assigned Personnel <ul style="list-style-type: none"> ▪ Related company and individual experience ▪ Professional qualifications/technical competencies ▪ Commitment of sufficient personnel to the project ▪ Reference from other clients for whom the Offeror has provided similar services 	100
Ability to Collaborate on Testing, Scoring and Reporting Services <ul style="list-style-type: none"> ▪ Ability to work with Test Contractor, Harcourt Educational Management ▪ Evidence of quality control procedures ▪ Inclusion of required elements ▪ Efficiency in providing reports 	100
Participation of Small, Women-Owned, and Minority-Owned Businesses	50
TOTAL	1000

Figure 26. The evaluation criteria were published in the request for proposals. A total of 1,000 possible points was distributed among six categories. The numbers of points awarded for pricing, 300 points, and participation of small, women-owned, and minority-owned businesses, 50 points, were calculated rather than assigned by the seven-member evaluation committee (VDOE, 2000b).

The cost of each proposed solution was assigned up to 300 possible points. The proposal with the lowest cost would be awarded the maximum 300 points, and the remaining proposals would receive a prorated score based on the following formula:

$$\frac{\text{Total Price of Lowest Priced Cost Proposal}}{\text{Total Price of Cost Proposal Being Scored}} \times 300 \text{ points} = \text{Points Awarded for Cost}$$

Because the point totals awarded for cost were calculated rather than assigned by each of the evaluation committee members, the cost proposals from each of the offerors were not shared with the evaluation committee initially. Rather, the procurement office at the Department reviewed the cost proposals and assigned the point value to be awarded to each offeror's solution and provided this information near the end of the committee's work (VDOE, 2000b).

The remaining three evaluation categories addressed each offeror's ability to (a) implement the proposed solution successfully and with a high level of quality, (b) assign sufficient staff to the project with professional qualities and technical expertise necessary to complete the implementation statewide, (c) collaborate with the existing Virginia assessment contractor, and (d) demonstrate quality control procedures that would ensure the accuracy of online test forms and score reports for all students during a statewide test administration (VDOE, 2000b).

A seven-member evaluation committee was formed consisting of assessment, instruction, and technology professionals with experience in Virginia school divisions or statewide and national organizations. Copies of the 11 proposals were packaged and distributed to the committee members who were tasked with following a prescribed process (see Figure 27) and eventually identifying one or more offerors to be awarded a contract to proceed to the Demonstration Phase of the Initiative.

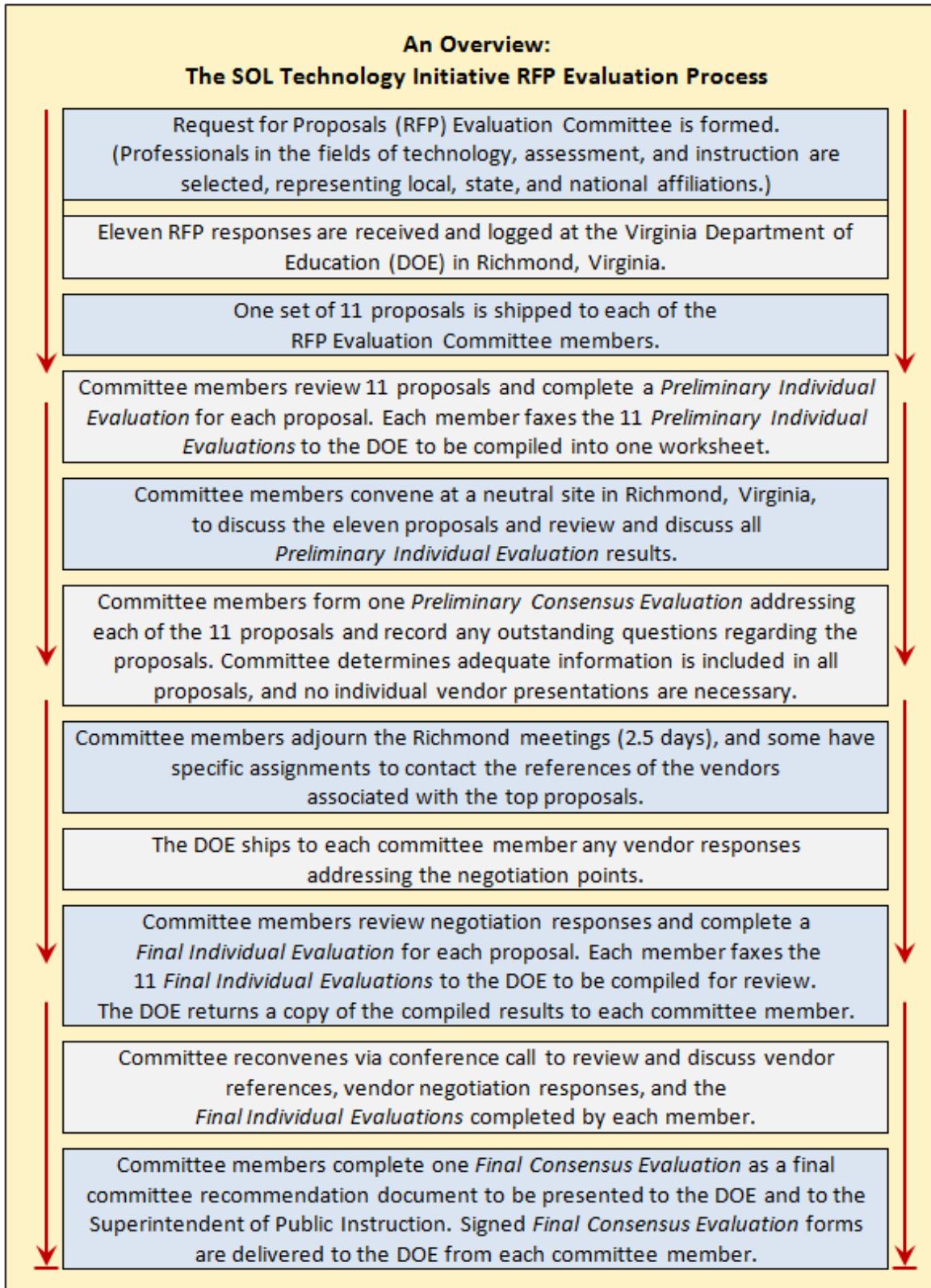


Figure 27. The evaluation process prescribed for the evaluation committee. The process followed to select the final vendor(s) to proceed to the next phase of implementation (VDOE, 2000b).

Upon receiving their set of 11 proposals, the committee members worked independently to review each proposal and complete a score sheet. No interactions among the committee members were allowed regarding the proposals or their scores during that time. The 11 score sheets were submitted to the Department by each committee member prior to the group convening to continue the evaluation process. In total, two rounds of individual evaluations were completed and each of those was followed by a round of consensus evaluations where committee members could discuss the proposals and their individual evaluations as part of reaching an agreement on a total score for each offeror's solution (Canada, 2010; DeMary, 2010; Neugent, 2010; VDOE, 2000b).

Three Successful Proposals

The evaluation committee convened in Richmond, Virginia, for two and a half consecutive days to discuss the proposals and their independent evaluations. They completed an initial consensus evaluation and identified questions they had for any of the offerors. This was followed by a number of conference calls to discuss vendor responses to questions and results of vendor reference checks (VDOE, 2000b). The committee's final consensus was that proceeding with three specific vendors who best met the requirements of the Initiative would give Virginia the greatest opportunity for a successful Demonstration Phase. On December 4, 2000, after brief discussions among members of the Web-based SOL Technology Initiative, the Department accepted the recommendations of the evaluation committee and published a public notice of its intent to award contracts to the following three vendors: BTG, Inc., NCS Pearson, Inc, and Vantage Learning, Inc (VDOE, 2000b).

Virginia Schools as Demonstration Sites

While the Department was developing the request for proposals and completing the state procurement process, a parallel effort was being conducted to establish which schools would serve as demonstration sites, or the locations where one or more successful vendors would implement their online testing solution. On August 25, 2000, Virginia's Superintendent of Public Instruction extended an invitation to all Virginia school divisions to nominate one high school to participate in the online delivery of simulated SOL tests to "demonstrate the viability of delivering Web-based SOL tests at the high school level" (VDOE, 2000f, p. 1). The selection criteria detailed within the invitation were (a) enrollment, (b) geographic location, (c) resources available to assist with the demonstration, and (d) number of SOL tests administered. The requirements were to prepare for and conduct simulated Web-based tests with high school students early in 2001. This included having the school available for a site survey, equipment installations, and system configurations after school hours and possibly during winter break in December 2000. Appropriate school personnel would have to commit to attending regular meetings, in person and via teleconference, with Web-based SOL Technology Initiative teams and vendors. The invitation to school divisions referenced that selected schools may receive grant funds to help offset costs associated with "personnel, software, and equipment needed to implement the demonstration projects" (p. 1). Letters of interest were to be submitted to the Department by October 6, 2000.

Fifty-seven of 132 school divisions responded by submitting a letter nominating one of their high schools to take part in this initial step toward online testing in Virginia. All 57 school divisions agreed to provide staff and student participants, as well as any additional support needed to conduct a demonstration of online SOL testing if their high school were selected as a

demonstration site (Canada, 2010; DeMary, 2010; Neugent, 2010; VDOE, 2000b). While the potential to receive grant funds existed and was communicated, no amount of funds was promised until well after the selection process was finished and the selected schools had accepted the offer to participate.

To ensure a fair selection of demonstration sites, the Department formed an independent selection committee to assist in the site selection process. Committee members were chosen who possessed knowledge of technology and had no connections with any of the nominated high schools or their school divisions. The Department developed a rating system for the committee members to use in ranking each nominated high school based on factors such as geographic location, level of technical capacity, and enrollment size.

To best mirror the challenges of a statewide implementation of online SOL testing, a broad geographic representation among the demonstration sites was desired. The Department determined that a minimum of one high school from each of the eight Superintendent's Regions should be included. Second, the Department wanted to utilize a set of schools ranging in size and technical capacity. The number of students enrolled in each high school, the number of SOL tests administered annually, and the existing technical capacity within the school and the division were other factors considered during the selection (Canada, 2010; Neugent, 2010; VDOE, 2000h).

Back in October, 2000, a *High School Capacity Survey* had been conducted by the Department to collect details about the technical infrastructure and capacity of Virginia's high schools. The results of that survey were used as a primary source of technical information during the selection of the demonstration sites.

Nine high schools representing nine different school divisions were identified from the 57 nominations (see Figure 28). To ensure that each vendor worked with three different high school environments, the identified high schools represented small-, medium-, and large-sized high schools that varied with low, medium, and high technical capacities. The number of SOL tests annually administered in each high school also varied. Telephone calls were made to the principals of the nine identified high schools to confirm their knowledge and interest in the SOL Technology Initiative as well as their commitment to serving as a demonstration site. The calls to the identified schools were successful, and on December 18, 2000, the Department posted a press release to announce the nine high schools selected as demonstration sites (VDOE, 2001h).

The three vendors with contracts to proceed into the demonstration phase received an email containing a list of the three high schools they were assigned and details of each high school that included (a) the school name, address, and Web site; (b) numbers and types of SOL tests administered in the previous school year, 1999-2000; (c) number of students enrolled, (d) testing schedule and school calendar for spring 2001, and (e) the school technology profiles (see Figure 29) from the *High School Capacity Survey* that were used by the selection committee when evaluating the demonstration sites. The testing schedule and school calendars for each of the sites were important as the vendors were required to work closely with their assigned high schools to ensure scheduling conflicts did not occur (VDOE, 2001h).

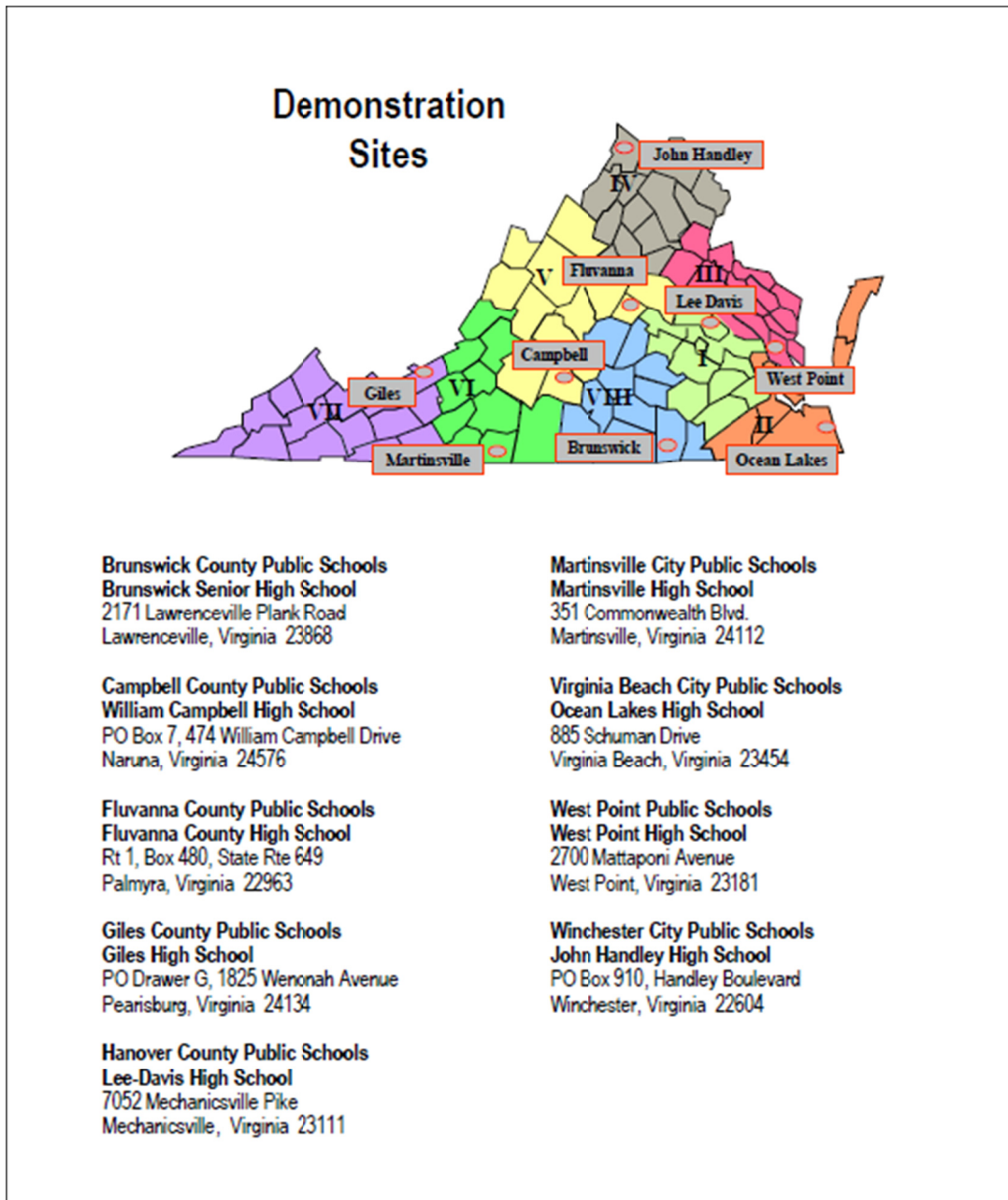


Figure 28. The nine high schools selected as demonstration sites. The schools represented nine school divisions among the eight Superintendent’s Regions in Virginia and represented a range of enrollment size and technical capacity. Each vendor was assigned three high schools where they would implement and demonstrate their online testing solution (VDOE, 2001b).

Technology Data for Two Different High Schools Serving as Demonstration Sites

		School A			School B		
1	Describe the school's Internet connection	Connected: T1 or Greater			Connected: T1 or Greater		
		Upstream		Downstream			
	School Internet Circuit Data Rates	> 1,544 megabits/sec		> 1,544 megabits/sec		1,544 megabits/sec (T1)	
2	School's registered Domain Name	www.k12.va.us		k12.va.us			
	Is Thin-Client Technology in use in this school	<input type="radio"/> Yes <input checked="" type="radio"/> No		<input type="radio"/> Yes <input checked="" type="radio"/> No			
3	Can workstations on this school LAN access secured sites?	<input type="radio"/> Yes <input checked="" type="radio"/> No		<input checked="" type="radio"/> Yes <input type="radio"/> No			
4	Can personnel in all instructional areas in this school initiate 2-way voice communication with the school office?	<input checked="" type="radio"/> Yes <input type="radio"/> No		<input checked="" type="radio"/> Yes <input type="radio"/> No			
5	How many classrooms in this school have phones?	0		0			
	Is Ethernet used on this school LAN?	<input checked="" type="radio"/> Yes <input type="radio"/> No		<input checked="" type="radio"/> Yes <input type="radio"/> No			
	Is Token Ring used on this school LAN?	<input type="radio"/> Yes <input checked="" type="radio"/> No		<input type="radio"/> Yes <input checked="" type="radio"/> No			
6	What is the LAN data rate to the desktop in instructional areas?	All Internet Computers on this LAN communicate at 100 mps			Most Internet Computers on this LAN communicate at 10 mps.		
7	FTE Positions	1.25			0.50		
8	Please specify this school's kwh demand as a % of capacity.	< 80 % of installed capacity			< 80 % of installed capacity		
9	What percent of the computers are using switched technology?	50-99 percent of the computers are switched			None of the computers are switched		
		Classrooms	Computer Labs	Library/Media Centers	Classrooms	Computer Labs	Library/Media Centers
	Total Number of each type of room in the school	97	13	1	29	3	1
	Total Number of Internet Computers in each room type	108	251	21	19	48	7
	Total Number of Network Drops in each room type	159	244	21	145	90	13
		H.320	H.321	H.323	H.320	H.321	H.323
	#r of locations with 2-way digital videoconferencing capability	0	1	1	0	0	0

- 1 The Internet connections in the demonstration (demo) sites ranged from 512 kilobits/sec upward to 1.544 megabits/sec, a T1 line, and higher. The Internet Circuit Data Rates varied within the same range for both upstream (upload) and downstream (download) data flow.
- 2 Some demo sites had registered Domain Names and school Web sites. Others had no presence on the Internet at the time.
- 3 Network configurations varied among demo sites as some allowed access to secure Web sites while other schools blocked such Web sites. To administer online tests, the three different online testing solutions required access to secure, https Web sites.
- 4 The ability to initiate 2-way conversation was considered significant in the event of technical issues occurring in a classroom during online testing.
- 5 The ability to make an out-going phone call from the classroom/lab was considered significant in the event communication with a help desk or other external troubleshooting resource was needed while being at the computer.
- 6 The rate of data flow to each computer depended on the network infrastructure but was usually 10 megabits/sec or 100 megabits/sec.
- 7 The number of full time positions (Full Time Equivalent, or FTE) dedicated to supporting technology in a school was often less than or equal to 1.0 FTE.
- 8 The electric power available was critical as schools started to increase the amount of computers and network components in each school.
- 9 Computers connected to Ethernet switches (switched) were more efficient and preferred over non-switched computers or computers connected to hubs.

Figure 29. The technology profiles for two demonstrations sites are shown with annotations (VDOE, 2001h).

Preparing for the Demonstration

After the three vendors were notified on December 4, 2000, of being selected to proceed into the Demonstration Phase, each began work immediately to prepare the test items that would be administered to students online. The items the Department provided were released multiple-choice SOL test items that were previously administered to students in a two-column format in a paper test booklet. Each vendor was required to deliver the test items securely on a computer, allow students to navigate among the test items as was possible in a paper test booklet, collect and score student responses, and produce online score reports based on the student responses (Canada, 2010; Neugent, 2010; VDOE, 2001h).

Each of the three solutions showed one question at a time on the screen and required students to select an answer by clicking one of the answer options with a mouse. Two solutions enabled students to use their keyboard to type the letter of their selected answer as an alternative to using the mouse. All three solutions provided students with some form of navigation backward and forward through the test items as well as the ability to skip questions and return to them later. Two solutions allowed students to select individual questions to be marked as needing review. In both of those solutions, a student could easily identify marked items at any point during the test and return to them directly. Two solutions tracked for the student which test items were answered and those that were left blank.

Test items from four specific End-of-Course SOL tests were required to be presented online by each vendor. This included released test items from the Earth Science, Geometry, English: Reading and Literature, and Chemistry SOL tests. The Department selected these specific tests because of the unique requirements of each content area. The Earth Science SOL test required a calculator be provided to students throughout the test, and certain test items

required more extensive graphics and tables to be displayed clearly online. The Geometry SOL test required the ability to complete geometric constructions with online tools such as a compass, a straight-edge, and a pencil. To determine a correct answer, students had to bisect a given angle or construct a perpendicular bisector for a specific line segment. The Geometry SOL test also included a formula sheet that was to be offered online. The English: Reading and Literature SOL test was a passage-based test that required each vendor's solution to display the reading passages and, while continuing to provide access to the passage, begin presenting a series of test questions about the passage for students to answer. The fourth required test to be presented was the Chemistry SOL test. It included items with chemical formulas and equations and required that students have online access to an approved periodic table of the elements. All End-of-Course science and math tests allowed students to use a graphing calculator so this was included among the requirements the vendor solutions needed to present (Canada, 2010; Neugent, 2010; VDOE, 2001h).

While the three vendors worked to develop their online version of the SOL tests, they also worked closely with Department and school division staff to complete the high school site evaluations, install any additional equipment or upgrades, plan staff and student training, and schedule the demonstration of students testing online. Three weekly conference calls were held throughout the demonstration phase where a vendor, Department staff, and staff from the vendor's three assigned demonstration sites would participate. These weekly calls were to be planned and led by the specific vendor with an agenda provided in advance and meeting minutes to be provided afterward to all participants. The weekly calls enabled regular communications to occur among all involved while minimizing statewide travel as much as possible. The calls also gave Department and school division staff an opportunity to experience the type of project

management and leadership each vendor would provide if selected to implement a statewide roll-out of online testing (Canada, 2010; Neugent, 2010; VDOE, 2001h).

Training for school staff and students. Beginning in mid-February, 2001, vendors began providing on-site training in the use of their testing software at the nine demonstration sites. Teachers and administrators participated in training that was provided in formats ranging from hands-on training to online tutorials to printed documentation. Different information was presented depending on the roles of those being trained. Division directors of testing, school test coordinators, and some building administrators received detailed training on how to schedule tests, assign students to specific test administrations, and manage the students' demographic data in the online systems. Technology staff learned of the hardware and software requirements and any specific configurations or software installations that were necessary for the solution being implemented in their high school. SOL test examiners and proctors received training in how to administer the online tests to students and how to respond to student questions regarding the online test delivery software. Some schools asked their assigned vendor to provide a basic overview of the online testing environment to parents, community members, and school board members (Canada, 2010; Neugent, 2010; VDOE, 2001h).

The vendors were required to provide training for students on how to use the online testing software. The high school students participating in the demonstration needed to know how to access the online test, indicate their answers on the computer, and navigate throughout the test. Prior to starting the test, they needed to be aware of any online tools that were provided and how to use them. As part of a secure test environment, assistance could not be provided once the test was being administered. At some schools, students were trained with an online tutorial that they completed just before taking the online test. At other locations, students were

trained in a group session prior to the actual test day (Canada, 2010; Neugent, 2010; VDOE, 2001h).

Test scheduling and administration. Each vendor provided a Web-based management system where student data were entered, tests were scheduled, and score reports would be accessed once the students' tests were scored. While the three vendors' systems varied considerably, all three were accessed using either Internet Explorer or Netscape Navigator, the two leading Web browser applications at the time. Having a Web-based management system was an advantage frequently cited by school test coordinators and administrators. It allowed them to complete some of their preparation for testing (e.g., entering and updating student data, scheduling students for tests) from home over the Internet rather than staying late at school to complete the many test-related tasks necessary for paper-and-pencil testing. One of the tasks to prepare for paper-and-pencil testing that school personnel were pleased to avoid was preparing color-coded bins containing student rosters, specific quantities of secure test booklets, student answer documents, and other test materials such as extra #2 pencils, erasers, and scratch paper (Canada, 2010; Neugent, 2010; VDOE, 2001h).

Another well-received online administrative feature was the ability to upload student data into the Web-based management systems using a standard, pre-defined data file that could be exported from most student information systems. Schools were familiar with preparing a data file for purchasing pre-identification labels prior to paper-and-pencil SOL testing so the labels could be received and affixed to SOL answer documents. Purchasing these labels meant avoiding the tedium of hand-coding student names on each answer document. This different upload process for online testing, however, was more comprehensive as it included data about the students in addition to their names. It eliminated the need to hand-code any student

information, and the data were easily updated. The inability to update student data was a point of frustration with the pre-identification labels school divisions regularly purchased for paper-and-pencil SOL testing (Canada, 2010; Neugent, 2010; VDOE, 2001h).

The three vendors' solutions each provided some degree of test administration control or the ability to limit when test content could be accessed and by whom. One solution required an administrator to "start" and "stop" student tests from a computer logged into the administrative system at the time of the test. Another solution restricted the hours during which individual logins could occur, while another required student input of a daily security key that was randomly generated every 24 hours and available only to test administrators. To successfully login to begin testing, one solution required that students enter their full name and birthday accurately. Another solution had school test coordinators prepare student test tickets that included each student's username and unique password required to log into a test. The student test tickets were generated and printed prior to the test and provided to the test examiner in a sealed envelope along with a roster of students taking that test. In all three solutions, if a new student joined the class and had not been pre-registered for the test, an administrator with appropriate access could manually enter the student's information into the system to complete the registration immediately and enable the student to test that day with the class (VDOE, 2001h).

Technical specifications. From the time the Web-based Standards of Learning Technology Initiative was signed into legislation by the 2000 General Assembly, school divisions frequently asked about technology requirements and when they would receive more details about what would be required in their schools. They asked about types of network infrastructure, types and quantities of computers, and the amount of bandwidth that would be

needed to administer SOL tests online successfully. Some school divisions wanted to begin spending the VPSA grant funds for new, upgraded equipment and infrastructure, but without knowing what the final online testing solution or solutions would require, the Department encouraged school divisions to first focus on the basic needs of their facilities such as electrical power and up-to-date network infrastructure.

Once the evaluation committee finished its work and selected three solutions to proceed into the Demonstration Phase, the Department completed an in-depth review of the technical specifications for these solutions. The goal of the review was to identify common elements among the three solutions as well as industry best practices that could be shared with school divisions to begin to give them some details about what may be needed. The Department realized, however, that until the Demonstration Phase was completed, any technical guidance provided to school divisions needed to be general and clearly indicated as preliminary (Canada, 2010; Neugent, 2010; VDOE, 2001h).

Two new documents were published by the Department for school divisions as a result of the technical review of the three online testing solutions. The first document, entitled *Preliminary Architectural Guidelines for High School Readiness*, included a brief introductory section with details of the Initiative where the Department indicated “these guidelines should be followed when planning for the installation or upgrade of facilities, network infrastructure, or computer platforms to ensure financial resources are used efficiently and in compliance with the project’s technical requirements” (VDOE, 2001a, p. 1). Throughout the document and in all communications about the document, the Department indicated the guidelines should be considered preliminary, and “these guidelines are not to be interpreted as statewide standards” (VDOE, 2001a, p. 3).

The main portion of the guidelines contained general recommendations for school divisions in four areas: (a) facilities, (b) local area networks, (c) wide area networks, and (d) computing or workstation platforms (2001). In addition to providing recommendations in these areas, the Department encouraged school divisions to prioritize any purchases and upgrades.

The Virginia Department of Education suggests, initially, focusing on upgrading facilities and the local area network (LAN). Priority should be given to facilities for two reasons. First, providing adequate facilities is critical to the success of any networking infrastructure, and second, additional time is needed for the results of the demonstration projects to be incorporated into the guidelines.

Wide area networking (WAN) and procuring workstations would then be addressed in subsequent phases as those requirements are defined. (VDOE, 2001a, p. 4)

The second document, *Designing and Optimizing Ethernet Networks* (2001), was published by the Department simultaneously and as a supplement to the guidelines. It was compiled by Department technology staff and consisted of industry best practices that school divisions should be implementing or at least striving to implement. An excerpt from *Designing and Optimizing Ethernet Networks* (see Figure 30) is shown as an example of the types of information provided. Both documents were shared with school divisions via Informational Superintendent's Memo No. 8, dated January 19, 2001 (VDOE, 2001i).

Several general rules should be kept in mind as Virginia school divisions invest in the various network infrastructure components.

- Network infrastructures are constantly evolving. Therefore, networks must be modular to accommodate these changes. In addition, where possible, new technology components should be able to work within the current technical infrastructure and to grow with future computing demands.
- In moving forward, schools should consider networking technology that has been in use six to twelve months. Availability and support are far more important than having the absolute latest technology.
- Although both Ethernet and Token Ring networks are deployed in schools across the commonwealth, the predominant networking technology is Ethernet. This document focuses on guidelines for Ethernet networking. All new infrastructures should be Ethernet-based, not Token Ring.
- The key to network design is in understanding networking standards. Use a few standards, and use them across the entire network if possible. Optimizing the network starts by building the simplest network that will meet your needs; reaching consensus about network standards at the outset will save time and other resources.

Guidelines will be provided for the following areas:

- Local Area Networks
- Wide Area Networks
- Computing / Workstation Platforms
- Infrastructure Management

These guidelines are not to be interpreted as statewide standards.

Figure 30. An excerpt from the *Designing and Optimizing Ethernet Networks* guidance document. This document was prepared by the Department to be a resource to school divisions as they installed new networks or upgraded existing networks (VDOE, 2001i).

Test and data security. The security of test content and student data before, during, and after testing was another critical issue considered and evaluated throughout the Demonstration Phase. The SOL tests were high-stakes tests that would soon be included as part of Virginia’s high school graduation requirements so the integrity of the testing environment was one aspect that came up quickly in any discussion of online test security. In many school computer labs that would be used for testing, the ease with which students could view the monitors of other students was problematic. Usually, the options for rearranging computers in these labs were quite limited due to the type of desks and the locations of power outlets and network jacks. The computers

were often intentionally close to one another either to maximize space in the lab, or in some cases, encourage collaboration during instruction. Clearly, most school divisions would need to take steps to ensure that students were not able to see one another's monitors and test items while taking the same test. Demonstration sites that used laptop computers for administering online tests had the most flexibility as the laptops were easily positioned in ways that kept students from having a clear view of other computers. In situations where it was not feasible to adjust the arrangement of computers, some schools placed cardboard dividers between student workstations. Others taped heavy card stock, such as file folders, to the both sides of the monitors during the test to limit visibility (VDOE, 2001h).

Another solution successfully implemented during the Demonstration Phase was to use flexibility in scheduling students and proctoring tests so that not all students in a lab were taking the same test. Without the need to track different test booklets and answer documents for each test being administered, the schools participating in the Demonstration came up with the solution of having students who were seated within close range of one another take different content area tests (VDOE, 2001h).

Security of the test content was addressed in varying ways by the three vendors' systems. At no time during the Demonstration Phase was test content hosted or physically stored on hard drives in computers and servers within a school or school division. Each of the vendors participating in the Demonstration Phase stored the test content on a secured server at a data hosting location as required in the request for proposals. The Department felt strongly that it did not have the resources or personnel needed to maintain the levels of security, throughput, and redundancy that statewide online SOL testing would require. Rather, SOL test content would be

maintained in one or more professional data hosting facilities on secured servers that could be scaled to meet the needs of statewide online testing.

As required by the test and data security requirements, all test content and student data transmitted over the Internet were to be encrypted throughout the transmissions. Each vendor solution needed to include some form of technology that would prevent unauthorized users from being able to intercept network transmissions and readily view secure test items or confidential student data (VDOE, 2001h).

Securing the desktop of the workstation during the testing window was mandatory and, as expected, presented a challenge for all three vendors. As stated clearly in the request for proposals, students should not have been able to open other applications (e.g., email, word processors, instant messaging) or view other Internet sites while taking an online SOL test (VDOE, 2001h).

During the Demonstration Phase, students were told they could actively challenge the desktop security of the online testing system they were using. In each of the solutions, desktop security was compromised by students to some degree. In two of the solutions, students were able to easily visit other web sites while taking the test. One vendor's online testing solution allowed the use of certain keystroke combinations to open other applications, toggle between them, and then copy and paste actual screen shots of the test items into a document that was shared via email with classmates. Using the Internet, students were able to check the answers they were sharing with one another. One student took a screen shot of a test item and emailed it to the Virginia Department of Education staff member who was at the school that morning observing the students taking the online demonstration test (VDOE, 2001h). As part of the demonstration testing, students could document any concerns or questions they had about the

online testing system they were using and specific test item numbers. One student logged her concern (see Figure 31) that while on any item number in the test she could share the test content via email for others in class to use (VDOE, 2001h, p.1 in Student Logs Demo 2001).

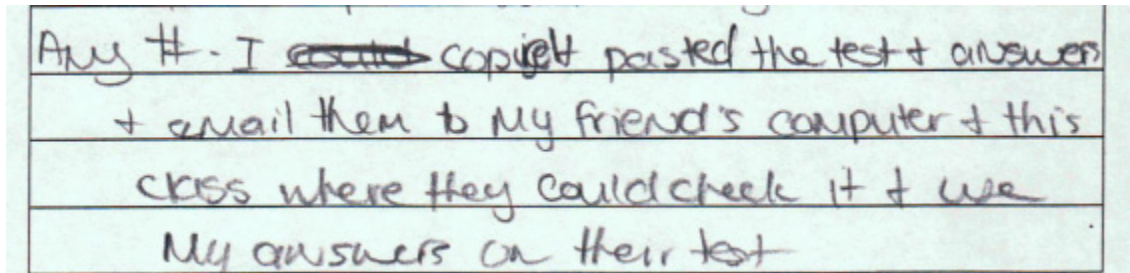


Figure 31. A sample from a student log during the Demonstration Phase. Students participating in the Demonstration Phase were provided with a log where they could make notes of any problems they encountered while taking the online test. Students were asked to also provide any suggestions regarding the overall online test (VDOE, 2001h, p.1 in Student Logs Demo 2001).

The online testing system that provided the greatest amount of security during the Demonstration Phase used a Java-based application to deliver the secure test content to students. This Java-based application was designed to be compatible with a Windows-based or Mac-based computer and to function as a standard Internet browser to the end user. When working properly, it included integrated security that locked down the desktop of the student's computer and prevented access to other applications or other Internet sites while the student was accessing the secure test content. Even this solution was compromised by a student during the Demonstration Phase; however, the vendor was able to identify and correct the issue promptly. It was determined a human error occurred during the test publishing process that allowed the gap in security. That particular security issue was corrected before any other tests were administered the next day (VDOE, 2001h).

School division demonstration funds. School divisions with a high school that participated in the Demonstration Phase received a one-time grant award (see Figure 32) to

purchase equipment and supplies needed to prepare for the Demonstration Phase and the administration of online SOL tests.

Demonstration Site Financial Award Breakdown			
Division	Equipment Award Total	Soft Award Total	Award Total
Brunswick	\$179,335	\$11,200	\$190,535
Campbell	\$174,524	\$10,536	\$185,060
Fluvanna	\$202,279	\$13,900	\$216,179
Martinsville	\$172,854	\$10,300	\$183,154
Winchester	\$172,838	\$10,000	\$182,838
West Point	\$204,885	\$14,329	\$219,214
Virginia Beach	\$209,808	\$13,900	\$223,708
Giles	\$202,514	\$13,900	\$216,414
Hanover	\$180,964	\$10,600	\$191,564
Totals	\$1,700,000	\$108,664	\$1,808,664

Figure 32. A list of participating school divisions with details of the demonstration site financial grant award. School divisions with a high school participating in the Demonstration Phase received a one-time grant award from the state for purchasing equipment and supplies needed to prepare for the Demonstration Phase and the administration of online SOL tests. The Soft Award total represented funds that could be spent on training, stipends, and other consumable or one-time costs (VDOE, 2001h).

Third-party evaluation. The request for proposals included a provision for an independent third-party review of the proposed solutions being presented in the Demonstration Phase. The Department contracted with a technology consulting firm, Trilogy Consulting of Richmond, Virginia, to conduct a review of the solutions presented by BTG, Inc. (BTG), NCS Pearson, Inc. (NCS), and Vantage Learning, Inc. (Vantage). The scope of the independent review included conducting user tests of the three solutions, reviewing all vendor documentation, confirming whether the requirements in the request for proposals were met, and verifying the accuracy of the response to the request for proposals with the provided product. Two individuals

from the technology consulting firm were provided online access to each vendor's test management system and online testing interface. This access enabled them to use and fully test each solution from their offices using a Windows-based computer (PC) and a Macintosh-based computer (Mac). During the month of March, 2001, the consultants traveled to three demonstration sites so they could observe the administrative training delivered by each vendor and interact with each vendor's technology personnel responsible for implementing the solution. At the direction of the Department, the consultants did not observe or interact with students; however, they did review all comments submitted by students and teachers after the completion of the demonstration tests at each location (Trilogy Consulting, 2001).

After testing each solution and reviewing all documentation, the consultants compiled a set of follow-up questions that each vendor was asked to respond to by April 6, 2001. The sets of questions were developed individually for each vendor and were based on that vendor's responses to the request for proposals and the online solution that was implemented. Most questions were about the server-side environment of each solution so the consultants could obtain the technical details needed to assess each solution's scalability for statewide online testing. Scalability and test security were among the requirements the Department directed the consultants to evaluate during their independent review (Trilogy Consulting, 2001).

Near the end of the Demonstration Phase, the consultants and Department staff conducted a half-day review session with each vendor's team. The review sessions were structured as an opportunity to gather final information and feedback from the vendor teams prior to conducting the overall evaluation of each solution. The vendors were given the opportunity to provide details of any modifications they made to their solutions during the Demonstration Phase and discuss any issues they experienced as part of the testing period.

A technical report was produced by Trilogy Consulting for the Department where the consultants presented the results of their testing and a summary of their findings. The report included side-by-side comparisons of the three solutions, the number and types of requirements met by each solution, and summaries of other details such as vendor readiness, observed risks, and on-going risks of the Initiative (Trilogy Consulting, 2001).

Final evaluations and vendor selection. The Department was depending on the results of the Demonstration Phase to be useful and informative to its implementation of the Web-based SOL Technology Initiative. A primary goal of the Demonstration Phase was to gather details to inform the decision of which solution or solutions would provide the greatest potential for a successful statewide implementation of online SOL testing. In addition to that, however, the Department needed to maximize the information gained about all aspects of administering high-stakes SOL tests online.

Plans were made to collect as much feedback as possible from the various participants throughout the Demonstration Phase and at its conclusion. The project managers, usually technology contacts identified in each of the nine participating school divisions, were provided with a large three-ring binder containing pre-formatted log sheets for tracking all communications, expenditures, and activities associated with the Demonstration Phase. Meeting minutes and notes were captured from all of the conference calls and on-site meetings that occurred among the school divisions and their assigned vendors.

After the online testing occurred at the demonstration sites, the school administrators and staff involved in the Demonstration Phase at each high school were asked to complete a *Vendor Evaluation Form* (see Figure 33) or a formatted spreadsheet where they could offer comments and numeric ratings of how well the solution at their school met the requirements put forth in the

Web-based SOL Technology Initiative Vendor Evaluation Form

DIRECTIONS:

The following rating sheet includes the various criteria (located in light blue cells) upon which the 3 vendor solutions are being evaluated. Using a scale of 1 to 10 (with 1-low and 10-high), please rank the vendor's level of performance toward meeting these criteria during the demonstration testing at your high school. Click in the cell to enter a numeric ranking between 1 and 10. For any criteria that you did not observe or are unable to evaluate, please enter NA (Not Applicable). A number of text boxes have been provided throughout the ranking sheet in which you can (optionally) enter any additional notes or comments.

High School: <please complete>

Test Security

The SOL tests at the high school level are high stakes tests. Students must pass certain required numbers of SOL tests in order to be awarded various diplomas under Virginia's Standards of Accreditation. Given the high stakes nature of these tests, attention to the security of the tests is essential.

Requirement	Rating 1(low) to 10 (high)
Application incorporated effective verification of student identity	
Effectiveness of the solution to control for the following:	X
Printing all or part of the tests while in the process of the on-line administration	
Visiting web sites to find answers to the questions	
E-mailing of all or part of the test to anyone	
Cutting and pasting of all or part of the test to another application	
Use of other desktop applications during test administration	
Confidentiality regarding test access and access to student information before, during and after testing	
Notes:	
Total	0

This first page of the Vendor Evaluation Form addressed the topic of Test Security. Thirteen topics were included in the evaluation form, and the specific requirements listed under each topic were derived from the request for proposals for Virginia's Web-based SOL Technology Initiative.

Figure 33. An excerpt from the *Vendor Evaluation Form*. The school administrators and staff involved in the Demonstration Phase at each high school were asked to provide comments and numeric ratings of how well the solution at their school met each of the requirements in the request for proposals. An excerpt from the formatted spreadsheet is shown (VDOE, 2001h).

request for proposals. The specific areas that the school administrators and staff were asked to evaluate were extensive and included the following 13 topics from the original request for proposals:

- Test Security (see Figure 33)
- Presentation of Tests and Test-related Materials
- Data Management – Student Demographic Data
- Scoring and Reporting
- Training and Support
- User Interface (non-proprietary) and Workstation Hardware
- User Training and Documentation
- Security Model
- Connectivity Requirements
- Database Processing and Administration
- Product Support
- Project Management
- Miscellaneous

The participants returned their completed spreadsheets to a designated email address at the Department. The return rate of the evaluations and the volume and quality of comments provided were encouraging to the Department’s Project Management Team. Nine evaluations (three from each high school) were returned for one vendor’s solution. Thirteen evaluations were returned for each of the other two solutions from their three assigned high schools (VDOE, 2001h).

Test examiners and proctors who administered the online tests to students were asked to submit feedback to the Department regarding their experiences and observations during the administration of the online demonstration tests. Students who participated in the online tests were provided with a paper comment sheet to record any feedback while they were taking the

test, and at the end of the test, they were presented with a brief series of online questions regarding their experience (VDOE, 2001h).

All data from the demonstration sites were due to the Department no later than April 23, 2001. The data were compiled by vendor and prepared for use during the final evaluation of the Demonstration Phase and the three vendor solutions. The data also would be used in planning the next steps for the statewide implementation of online SOL testing (VDOE, 2001h).

An outstanding question from the Demonstration Phase that needed to be answered was whether Virginia would benefit from continuing a relationship with more than one of the three vendors to implement online SOL testing statewide. When the Department was crafting the request for proposals, it was unclear how much the proposed solutions may differ in the types of technologies employed and the types of local and state resources needed to implement online testing. It seemed possible from a technology perspective that having more than one type of solution available might be beneficial if the solutions addressed different needs among the schools and school divisions in the state.

After reviewing the three successful proposals and observing the online testing activities at the nine demonstration sites, members of the Department's Program Management Team agreed that the final three proposed solutions had enough conceptual and technical similarities that no distinct advantage would be gained for local school divisions or the Department by supporting more than one solution. The Program Management Team, during one of its regular weekly meetings, concluded that opting to continue with more than one of the proposed solutions would likely introduce more risk than benefit to the Initiative. The minutes from that April 4, 2001, meeting (see Figure 34) included details of the decision by the Program Management

2. *Clarify the need and feasibility of retaining more than one vendor to proceed after the Demonstration Phase.*
- It is recommended that no more than one vendor be selected to continue with this project for the following reasons:
 - Multiple technologies would be difficult to manage in a state-wide implementation and would provide no foreseeable benefit to school divisions or the state.
 - Multiple presentations of assessment instruments introduce significant risk for standardized, high-stakes testing.
 - The existing budget does not provide sufficient funds for more than one vendor. Additional funding would have to be pursued.

Figure 34. A section of text from Program Management Team Meeting Minutes, April 4, 2001. The Department's Program Management Team concluded at its April 4, 2001, meeting, as shown in the minutes, that it would recommend identifying only one vendor to proceed with the statewide rollout of online SOL testing (PMT Minutes, April 4, 2001 in VDOE, 2001h).

Team (PMT Minutes, April 4, 2001 in VDOE, 2001h). Trilogy Consulting reached a similar conclusion through its independent third-party review of the three vendor solutions (Trilogy Consulting, 2001).

After obtaining the independent technical review of the three vendor solutions and collecting all data from the nine participating high schools at the conclusion of the Demonstration Phase in late April, 2001, the Department was prepared to conduct the final evaluation of the three vendor solutions. The Department's goal for the final evaluation was to identify one vendor whose online testing solution could be recommended to the Executive Steering Committee as the best solution for pursuing a successful statewide implementation of online SOL testing (VDOE, 2001h).

The Department developed and implemented a plan for a structured evaluation process (see Figure 35) that would ensure input from a variety of stakeholders. The data collection conducted throughout and after the Demonstration Phase served as the initial step of the evaluation process. All data were available and included as part of a scheduled Demonstration

Debriefing that took place in Richmond, Virginia, on Friday, April 27, 2001 (VDOE, 2001h).

The debriefing allowed for school personnel representing the nine demonstration sites to convene face-to-face for the first time since conducting online testing in their schools.

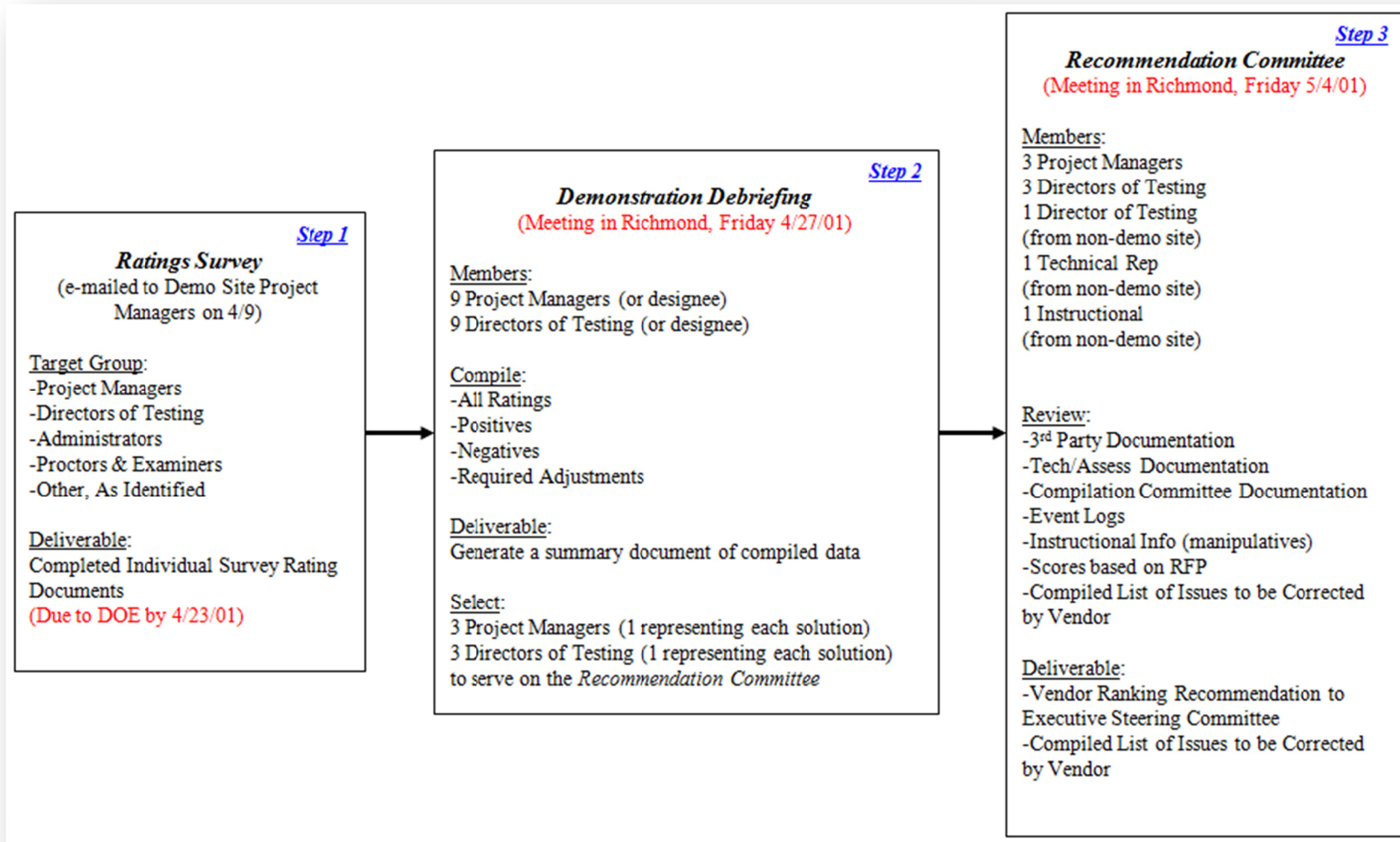


Figure 35. Vendor Recommendation Process for the Web-based SOL Technology Initiative. The Department developed and utilized a plan that would ensure input from a variety of stakeholders when identifying the best solution to recommend to the Executive Steering Committee for pursuing a successful statewide implementation of online SOL testing (VDOE, 2001h).

The Demonstration Debriefing opened with all participants meeting together briefly before being divided into three groups, by vendor, so the detailed work of discussing their assigned vendor's solution could begin. Each group included representatives from the three school divisions that used the same vendor's solution, and their task was to compare and summarize their experiences with the online testing system and their vendor's resources, training, and overall project management (VDOE, 2001h).

Each group was provided with a compilation of the data collected about their assigned vendor. This included the numeric rankings and comments provided by school personnel in the *Vendor Evaluation Forms* as well as the feedback from the student and test examiners and proctors. Individuals brought their own notes and documentation, and the nine project managers returned their 3-ring binder of details and documentation. While the dynamics of each group varied, they were able to collaborate and effectively capture the important details and experiences from the Demonstration Phase. Department of Education staff members were present to assist with meeting logistics, but otherwise, they only observed the discussions and interactions regarding the vendor solution being discussed in each meeting. No vendor representatives were present during the Demonstration Debriefing (VDOE, 2001h).

The groups returned to the larger group in the afternoon to make a brief presentation summarizing their vendor's solution and their experiences. They were asked to include positive attributes, challenges, any changes they would recommend, and any details regarding the online testing experience of students and staff which they considered beneficial to record. Participants were engaged in the small group discussions and remained attentive throughout the afternoon presentations as this was the first opportunity to hear from their peers about the two vendor solutions that they had not experienced (VDOE, 2001h).

Highlights of the information offered by the groups and discussed among the participants are detailed in the following text:

Test security. Each vendor addressed the topic of test security on student workstations differently during online testing. One vendor provided no desktop security during the Demonstration Phase and indicated it was the responsibility of the examiners and proctors to ensure students were only accessing the test while on the computer. Another vendor, sensing a need to add test security, implemented a shareware custom web-browser near the end of the demonstration period. When launched, the custom browser would open the online testing web site in kiosk-mode where students could not close or minimize the window or open a new window. Examiners commented that the custom web browser helped to control student access, but it created classroom management issues. A password had to be entered at every workstation to close the custom browser before another student could test or use the computer for instruction once testing was finished. School personnel indicated the browser's password was the same for all workstations in the school so if it were shared, even inadvertently, it could compromise the test administration. The third vendor developed a Java-based application that limited student access to other functions and software during testing. The application successfully locked down workstations except in one situation where a student found a security gap that resulted from human error during the test publishing process. In addition to students gaining access to the Internet during testing, the transmission and temporary storage of secure test content was a concern along with students potentially accessing their tests without permission before or after online testing (VDOE, 2001h).

Presentation of tests and test-related materials. The four released, multiple-choice SOL tests and their associated test manipulatives (e.g., formula sheets, graphing calculator, compass)

were presented online with varying degrees of success. All vendors presented one test item per screen. Two vendors struggled with formatting issues such as font size inconsistencies, poor graphics quality, and excessive scrolling. Two vendors presented their versions of an online compass tool as required for use with the Geometry SOL test. Both received similar student feedback that the tool was difficult to use, did not work consistently, and could not be locked or set to ensure arcs with an equal radius could be drawn. The third vendor did not provide an online compass until the final day of demonstration testing. Two of three vendors provided an online graphing calculator, but students commented that they would prefer to have their own hand-held calculator as they do during paper-and-pencil testing because they were not familiar with the button labels and locations on the online version they experienced (VDOE, 2001h).

Data management – student demographic data. All participants were pleased to avoid hand-coding or gridding student demographic information on paper answer documents. Some participants commented that student data would likely be more accurate because it was being exported directly from a student information system. One vendor experienced difficulty after its technical staff conducted software and data maintenance on the test administration system overnight, and a high school's student data were inadvertently purged. The high school's demonstration testing could not occur as rescheduled because the data had to be reloaded prior to student testing (VDOE, 2001h).

Scoring and reporting. Two of the online testing solutions were developed to score the students' tests immediately upon completion. School administrators with appropriate authority to access student score reports could view them within minutes of students completing their tests. Participants working with these two vendors were pleased with the rapid return of test results, but they requested that the variety of reports be expanded. The third vendor arranged for a

subcontractor to conduct its scoring and reporting work throughout the Demonstration Phase. Ironically, the company hired as a subcontractor was one of the other companies also competing in Virginia during the Demonstration Phase. The subcontracted vendor failed to provide any score reports for the vendor prior to the end of the Demonstration Phase (VDOE, 2001h).

Training and support. Each vendor was required to provide training to the staff and to the students in their assigned schools and to provide technical support. The staff training was intended to familiarize adults with how to schedule, setup, and administer online tests, while the training for students was to familiarize them with how to access and navigate throughout the test, use the online tools, and complete their online test for scoring. The feedback from school staff regarding the effectiveness of the training varied even among staff attending the same training session. Those more familiar with using web-based applications were satisfied with hearing overall concepts of how the system worked, receiving limited directions with a checklist of tasks, and then being given the opportunity to practice in the system. Some staff wanted step-by-step directions provided in a classroom setting, and others requested a written user's guide so they could read the information before logging into the system to complete the tasks. To train students, the vendors developed tutorials that the students would use prior to taking an online test. The tutorials were recorded presentations for students to watch on their computers prior to testing that demonstrated using the testing software and online tools. None of the tutorials had students interacting with the software or tools directly. School staff commented that while the students seemed comfortable navigating and marking responses in the online test, they were not provided with opportunities to practice with the online tools prior to taking the test. Some students documented in their written feedback that watching the training tutorial, if it worked on their computer, was boring and long (VDOE, 2001h).

For technical support, each vendor provided varying amounts of on-site support along with telephone and email support for school staff throughout the Demonstration Phase. The effectiveness and timeliness of support varied among the three vendors, and school staff readily offered examples and feedback regarding positive and negative experiences in receiving technical support from their assigned vendor.

Connectivity requirements. All three vendors emphasized the importance of having a reliable, high-speed Internet connection available at their assigned demonstration sites. As part of the Demonstration Phase, however, the Department deliberately assigned each vendor three schools with varying levels of technical capacity, including various Internet speeds, to observe how each solution would perform in different environments. One vendor's solution required each student workstation to communicate with a server via the Internet each time the student navigated to another test item throughout the administration of the online test. For example, after a student successfully logged into an online test, the first test question was downloaded and presented on the workstation. Once the student answered that item or navigated to another test item, the workstation communicated with the server again to download the next item. This process was repeated at each student workstation throughout the length of the test, and resulted in bandwidth demand that was inconsistent and unpredictable. Comments and feedback resulting from the Demonstration Phase referenced delays between test items where students waited multiple seconds and sometimes minutes before the next test item was presented (VDOE, 2001h).

The two other vendors utilized an approach where all items on the test, rather than only the first item, were downloaded to the student workstation upon successful login by the student. One solution did not allow students to begin the test until all test content was downloaded and

available on the workstation. This resulted in delays, sometimes for many minutes, occurring from the time students logged into the test until they could begin viewing and responding to test items (VDOE, 2001h).

The other solution also was designed so the test content began to download to the student workstation upon a successful student login; however, it varied in that the student did not have to wait for the download to finish prior to starting the test. Instead, once the first five to seven test items were successfully downloaded and available in workstation memory, the test delivery software allowed the student to begin viewing and responding to questions. Meanwhile, the remaining test items continued to download in bundles of five items at a time in the background and transparently to the student. If a bundle of test items did not download successfully, the test delivery software on the student workstation would send another request for the items to the server. Throughout the Demonstration Phase, this design resulted in the fewest delays and disruptions for students and the greatest resilience to network latency issues (Trilogy Consulting, 2001; VDOE, 2001h).

Recommendation committee. The presentations by each group assigned to a vendor solution were completed that afternoon with Department staff recording notes and collecting all project documentation produced by the participating schools. From the presentations and subsequent discussion, Department staff were able to develop a preliminary list of findings or specifics that needed to be considered in making the determination of which vendor solution would be identified as the best option to proceed with into the implementation of the Web-based SOL Technology Initiative.

The final step that afternoon was to identify representatives to serve on the Recommendation Committee to complete the evaluation of the Demonstration Phase and finalize

a ranking of vendors that would be presented to the Web-based Standards of Learning Executive Steering Committee. As shown in Figure 35 (see page 92), the Recommendation Committee would consist of school division representatives from each vendor group and school division staff who did not participate in the Demonstration Phase.

The Recommendation Committee met on May 4, 2001, and worked throughout the day to produce the final deliverables for the Executive Steering Committee. Through the review of documented feedback and the discussions at the Demonstration Debriefing, it became evident that the high schools assigned to BTG and Vantage had experienced different levels of success than those assigned to NCS Pearson. When issues arose with the NCS Pearson solution or with the technology in their assigned high schools, the NCS Pearson team was identified as the most responsive and most resourceful vendor among the three (VDOE, 2001h).

Based on the evidence available to them, the Recommendation Committee was decisive in identifying the NCS Pearson solution as the option that provided the best opportunity for Virginia to successfully implement online SOL testing. The committee detailed positive attributes both about the solution and the NCS Pearson Program Management Team. The committee members provided suggestions of changes and features they believed NCS Pearson needed to implement to improve its online testing system for Virginia, and they offered recommendations and feedback for the Department to consider as the planning and implementation of the Initiative continued (VDOE, 2001h).

On May 9, 2001, the Executive Steering Committee of the Web-based SOL Technology Initiative met to review the findings of the Demonstration Phase and the final vendor rankings and comments offered by the Recommendation Committee. The Executive Steering Committee finalized a decision to proceed with a 5-year contract renewal with NCS Pearson that would span

the period of July 1, 2001 through June 30, 2006. The overall scope of that contract renewal included implementing an online test delivery system that would enable all Virginia high schools and school divisions to administer the required Standards of Learning tests to their students online via the Internet (Trilogy Consulting, 2001; VDOE, 2001h).

Extending this contract with NCS Pearson was a significant milestone of the Web-based SOL Technology Initiative. The details were shared with the Governor's office prior to being announced to the school divisions and general public.

Chapter 4

Implementing Operational Web-based Testing in Virginia

With a contract renewal in place with one vendor and a wealth of information gained from the Demonstration Phase, the path was cleared for Virginia to shift from the competitive proof-of-concept model to a more focused, single-vendor implementation of operational* Web-based (online) Standards of Learning (SOL) testing. The Demonstration Phase was an opportunity to work with each vendor, but because it included an ongoing procurement effort with a contract renewal awarded at the conclusion, the level of open communication and collaboration between the Virginia Department of Education (Department) and each vendor was limited to avoid any biases or appearances of preferential treatment toward any particular vendor or solution.

* In this context, operational testing refers to test administrations where students completed a full-length, secure SOL test that was constructed according to the SOL Test Blueprint for the specific test. The test attempts resulted in official scores and score reports for the student in the Virginia Assessment Program.

From Demonstration to Operational Testing

After finalizing a contract renewal with NCS Pearson (Pearson) and identifying the company as the sole vendor directly involved with Virginia's Web-based SOL Technology Initiative, a different relationship between the Department and Pearson began to develop from what was experienced during the Demonstration Phase. The interactions shifted from a closed, procurement-based perspective to one where the Pearson Program Management Team and the Department's Project Management Team could communicate more openly. It was now appropriate and necessary to talk about what went well, what challenges existed, and what needed to be accomplished as part of a highly visible, statewide technology initiative that was also expected to have a lasting impact on Virginia's statewide assessment program.

The Department's Project Management Team shared the details and experiences that were gained during the Demonstration Phase with the Pearson staff. This included the feedback about the Pearson system as well as what was learned from the other two vendors' demonstration sites. Six of nine high schools, or three high schools assigned to BTG and three high schools assigned to Vantage, were able to conduct online testing but experienced varying levels of difficulty with administering online tests during the Demonstration Phase. While successes were experienced in these high schools and valuable lessons were learned, the six schools each experienced challenges with online testing that were due to local technology, their assigned vendor solution, or both (Trilogy Consulting, 2001; VDOE, 2001h).

As a result of the experiences at these six schools, an early task shared by Pearson and the Department was to work quickly in those schools to identify potential problems and plan appropriate actions in response. Any local technology issues needed to be resolved, but collaborating with these schools to ensure the staff and students had positive experiences as a result of the Demonstration Phase was equally important. Having the school communities of all nine demonstration sites able to report positive online testing experiences after the Demonstration Phase would be beneficial to the participating school divisions and would provide the opportunity for positive communications about the status of the Web-based SOL Technology Initiative (Canada, 2010; DeMary, 2010; Neugent, 2010).

Pearson staff reviewed the school and division infrastructure details and made site visits to the other six high schools as they had done with the three they were assigned initially. The site reviews and preparations were completed with no significant changes necessary to implement the Pearson solution. A single day of online testing at all nine locations was scheduled to occur in spring 2001. This would demonstrate whether Pearson could implement

their online testing solution quickly at six additional locations and then support simultaneous online testing at the nine locations. Pearson staff were deployed at the nine different high schools across the state and communicated via cell phone and email throughout what turned out to be an uneventful but successful day. The students completed the online demonstration tests and returned to their classes.

The problems that the six high schools experienced with their assigned vendors during the initial demonstration testing were resolved in this second round of demonstration testing when they used the Pearson solution. The bandwidth demand at the time of testing was more manageable and students were able to successfully log in to their tests. The desktop security remained in place and could not be circumvented by the students. The Division Directors of Testing in these six locations were able to begin experiencing the details and successes that they heard described during the Demonstration Debriefing in Richmond, Virginia earlier that spring (VDOE, 2001h).

Conducting this second round of demonstration testing successfully at all nine locations resulted in an added level of confidence for the Department, the nine participating schools, and their school divisions. Testing simultaneously at nine high schools was a small accomplishment when compared to the next goal of having all Virginia high schools testing online in 2003, but it provided a positive closure to the Demonstration Phase and momentum to move to the next phase. The Department completed its formal status report indicating a successful close-out to the Demonstration Phase, and the focus shifted from demonstrating that online SOL testing was possible to planning and preparing for the first operational implementation of online SOL testing (VDOE, 2001h).

Collaboration of Assessment and Technology Staff

The Web-based SOL Technology Initiative was categorized as a technology initiative from the beginning. Establishing a baseline of technology that included hardware and high-speed Internet connectivity in the schools was viewed as critical to the success of implementing Web-based instructional resources and statewide online SOL testing. The Web-based SOL Technology Initiative, despite no mention of assessment in the name, was expected to have far-reaching implications for Virginia's statewide assessment program as well as the level of technology available for student use in the public schools.

From a planning and implementation perspective, the Division of Technology and the Division of Assessment and Reporting had limited experience working closely as partners, but for the Web-based SOL Technology Initiative, it was critical to have collaboration between the two groups (Canada, 2010, DeMary, 2010, Loving-Ryder, 2015; Neugent, 2010). With this project, when a decision or a change was made in one area, the likelihood was strong that it would have an impact on the other. It would occur eventually if not immediately, indirectly if not directly, and sometimes without warning*.

The Department's technology leaders were experienced and knowledgeable in information technology areas such as (a) hardware, (b) software, (c) software

* During the Demonstration Phase, at one of the more rural demonstration sites, the vendor brought in approximately 50 wireless laptops in two mobile carts to be used by students to complete the demonstration test. The vendor staff needed the full day to prepare the laptops and used the library media center as a staging area. The decision was made to plug the new laptops into power strips overnight so they would be fully charged by morning for students to use for testing.

When the custodial staff arrived to open the building early the next morning, they were puzzled by the cold temperatures they were experiencing in the academic area of the building – the area near the library media center. The temperatures dropped overnight and when the heating system turned on, there was not enough power for the building to supply the heating system and the 50 laptops that were charging. The circuit breakers tripped; the laptops were not charged, and the building was not heated. Testing was canceled that morning and could not occur until the laptops were ready (VDOE, 2001h).

development, (d) networking, (e) data management, and (f) educational technology. They were familiar with and guided by the professional information technology standards current at that time such as the *TIA/EIA-568-A Commercial Building Telecommunications Cabling Standard* from the Telecommunications Industry Association and Electronics Industry Alliance (TIA/EIA, 2001), and the *IEEE Computer Technology Standards* from the Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA, 2001).

Similarly, the Department's assessment leaders were experienced and knowledgeable in educational measurement areas such as (a) psychometrics, (b) standards and assessments, (c) item and test development, (d) test administration, (e) assessment scoring and reporting, and (f) assessment data. They were familiar with and guided by the professional assessment standards current at that time such as the *Standards for Educational and Psychological Testing* from the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education (AERA, APA, NCME, 1999).

The Department's Project Management Team included representatives from the Division of Assessment and Reporting and the Division of Technology. Two of those individuals, one from each division, were responsible for leading the day-to-day operations of the Initiative. The Manager of External Technology Services and the Associate Director of Web-based Assessments were the two Department staff that guided the Demonstration Phase and, going forward, would be interacting daily with the Pearson Program Manager assigned to the Virginia contract.

The next goal of the Department and Pearson was to ensure that operational online SOL testing was available in all of Virginia's high schools by 2003. The Department had an existing contract with Harcourt Educational Measurement (Harcourt) that provided for annual SOL test

development and paper-and-pencil SOL test administrations. It would be the responsibility of the Department to manage both contractors, Harcourt and Pearson, to accomplish the necessary steps to have the 11 End-of-Course (EOC) SOL assessments* available as online tests by 2003. It was the responsibility of each of the 132 school divisions, with guidance from the Department, to have the approximately 400 high schools statewide be capable of conducting online SOL testing by 2003 (Virginia HB29, 2000; Virginia SB 29, 2000; VDOE, 2001h).

* Eleven End-of-Course SOL tests would be the first tests offered online to enable a more prompt delivery of test scores:

- Algebra I
- Geometry
- Algebra II
- English: Reading, Literature & Research
- Earth Science
- Biology
- Chemistry
- Virginia and United States History
- World History I
- World History II
- World Geography

The English: Writing test continued to be administered only in paper, at that time, due to the student short-paper component where students wrote to a prompt as part of the test (VDOE, 2001h).

Phased Implementation

From the time the Initiative was developed, the expectation was that high schools would be the first schools to administer operational online SOL tests. High schools were used for the demonstration sites, and EOC released tests were used for the demonstration test content. Knowing that online testing would begin in the high schools, some of the next steps were to make decisions about who would test online and which tests would be available.

The Department was not requiring any school division to participate after the Demonstration Phase. Instead, school divisions were given the flexibility to develop their own plans for how they would transition to online SOL testing. School divisions had the best knowledge of their technology, their facilities, and which students and school staff adapted to change more readily.

After developing demonstration tests from the released versions of EOC SOL Earth Science; English: Reading, Literature, and Research; Geometry; and Chemistry tests, Pearson and the Department had a better sense of what was required to convert these subject area test items and how the students reacted to experiencing each of these content areas online. The first operational test administration would be in fall 2001, and the EOC tests offered online would be the EOC SOL Algebra I; English: Reading, Literature, and Research; and Earth Science tests. The Geometry SOL test was administered during the Demonstration Phase rather than the Algebra I SOL test, but the Department decided not to administer the Geometry test online initially due to concerns that students were unfamiliar with the online compass needed for completing geometric constructions. The Algebra I SOL test did not introduce any new online tools for students so was chosen to replace the Geometry SOL test for the initial fall 2001 test administration. The four identified EOC tests also were among the test names more frequently administered during the fall test administration.

The Department's decision to transition only a small number of tests to the online mode in a single administration was aligned with its overall strategy of using a phased implementation approach. By limiting the amount of change occurring simultaneously, all groups were better positioned to experience success.

No minimum or maximum limits were set regarding the number of online SOL tests a school division could administer during an online test administration. The entire division, a school, a classroom, or a smaller number of students could be the starting point for operational online testing in a school division. The requirement to test students remained, but this allowed the divisions to choose what mode to use when both paper and online tests were available. Fifteen divisions participated in the first administration, and as the quick return of test scores and

details of the experience with online testing were shared among educators, the number of participating divisions (see Figure A.41 in Appendix A) increased annually through spring 2005 when all 132 school divisions were administering some number of SOL tests online.

Assessment Considerations

Through the completion of the Demonstration Phase, the focus of the Web-based SOL Technology Initiative had been more toward technology and infrastructure and whether Virginia's public school divisions would have the level of equipment and technical expertise necessary to support the administration of SOL tests online. Based on the successes experienced during the Demonstration Phase, it seemed feasible that school divisions across Virginia could, with the projected level of funding, support the administration of SOL tests online at the high schools and then into their middle and elementary schools.

Quickly, the scope of the Initiative proceeded, as expected, to include a greater assessment perspective. The next steps involved considering what had to occur to transition a high-stakes state assessment program from its initial paper-and-pencil format to a comparable online test where students were being assessed with the same test items only via a computer rather than in the traditional two-column paper-and-pencil test booklets in use at the time.

This question was being considered at the same time, in summer 2001, that the sitting Assistant Superintendent for the Division of Assessment and Reporting was retiring and a newly appointed assistant superintendent was being identified. Staff turnover in key leadership positions was a standing risk from a project management perspective given the scope and visibility of the Initiative. The Department, however, selected an experienced assessment leader from within the agency to be named as the next Assistant Superintendent for the Division of Assessment and Reporting, and any risk to the Initiative was resolved and no time was lost.

Comparability of online testing and paper-and-pencil testing. The Division of Assessment and Reporting continued to work through what had to occur to begin the transition to operational online SOL testing. The question of comparability between paper-and-pencil tests and online tests was a concern given the high-stakes nature of the assessments. The question of comparability between paper and online assessments that were otherwise identical was well documented, and it was an issue of greater concern when the test results from the two modes, online and paper, would be used interchangeably (APA, 1986; AERA, APA, NCME, 1999, Standard 4.10). As a result, the Department and Pearson would partner to conduct comparability studies for each of the End-of-Course SOL tests when it was transitioned to the online format (Loving-Ryder, 2015; VDOE, 2001h).

The comparability studies were developed using a common-person design where each student was administered two equivalent forms of the same test. School divisions with a desire to administer online SOL tests were invited to participate in the comparability study that would occur in fall 2001 during the operational SOL test administration. A total of 2,090 students from 15 different school divisions participated with most students taking one of the three tests included in the study: SOL Algebra I, Earth Science, and English: Reading, Literature, and Research. A total of 93 students were scheduled during the fall test administration to complete two of the three assessments included in the study, such as SOL Algebra I and Earth Science. All students first completed an operational paper-and-pencil test, so no students' results would be at risk due to the study. For their second test attempt, the students were randomly assigned to take either an equivalent test form in the online mode or the paper-and-pencil mode. To address student motivation, all participating students were informed that regardless of the mode of their

second test attempt, either paper or online, that they would receive the higher of their scores between the two test attempts (Fitzpatrick & Triscari, 2005, Loving-Ryder, 2015).

Different psychometric analyses were applied to the test results collected during the comparability study, and the results indicated that the online and paper-and-pencil tests were generally comparable on the Algebra I and Earth Science tests; the differences were small and not significant. The results of the English: Reading, Literature, and Research test indicated that a mode effect, although small, could be present for students taking this test. The results were similar to what was documented in the research literature, suggesting that at that time completing a passage-based reading test on a computer could result in the test being slightly more difficult than if completed on paper (Fitzpatrick & Triscari, 2005).

Based on the results of the comparability study and consultation with nationally-recognized measurement experts, the Department opted to proceed with the conservative approach that online tests would be post-equated separately from the paper-and-pencil tests to eliminate any concern for mode effect among students completing the SOL tests online. Proceeding this way would result in additional work or duplication of effort for the Department, but it provided a considerable level of confidence regarding the integrity of the transition to online SOL testing (DeMary, 2010; Loving-Ryder, 2015).

Transitioning test content from paper to online tests. The contract renewal awarded to Pearson after the Demonstration Phase was, as planned, solely for online test delivery and the associated scoring and reporting of the online tests. The SOL test content would continue to be developed under the Department's existing contract with Harcourt, and then once the test items and test forms were finalized, the content would be handed off to Pearson in a mutually agreed upon format. From a technology perspective, it seemed that a compatible file format should be

attainable and a method of secure file transfer between the two contractors could be arranged. Both of those elements were possible, but the overall hand-off of test content became more complex as the details were discussed and finalized among the three organizations.

Timing was critical. Pearson needed the final test content as soon as possible so their work of preparing the content for online delivery and scoring could begin. Handing-off SOL test content before it was through its final stages of review and approval at Harcourt and at the Department, however, would introduce significant risk to the accuracy of the items. The volume of test items and test forms compounded the challenge of tracking changes and maintaining version control for each test item and composed test form. A late edit to a paper-and-pencil test item may be overlooked in the online conversion process if that test content were handed to Pearson before it was considered completely final.

Adding to the complexity, Pearson staff needed to revise the paper-and-pencil test items received from Harcourt so they could be properly displayed with one item per screen instead of the two-column format used by Harcourt for printed pages of test booklets. Some of the text needed to be revised due to the online delivery mode. Directional terms were particularly problematic. In a paper test, the stem of the test item may have included directional terms such as, "...in the graph above," but after being formatted for display as an online test item with minimized scrolling, the online version of the stem for the same item may have read, "...in the graph below..." Especially in a high-stakes, standardized test environment, it was critical to have the test directions be relevant and test items display properly and accurately in the paper-and-pencil and online test forms.

Because test items had the potential to change, either intentionally or in error, during the conversion process, the online forms needed to be reviewed in the online test delivery software

prior to being administered to students. This review and approval of online test forms was conducted first at Pearson and then replicated by Department staff as a standard quality control check. The additional time requirement was extensive for each test form being transitioned for online test delivery; the following steps had to be completed prior to the test form being administered operationally: (a) convert test items to the online format, (b) compose the online test forms, (c) review the online test forms, (d) make needed corrections and re-review the content to approve the form, and (e) confirm the scoring information for each online test item and complete form. When a test was administered online, EOC Algebra I for example, it resulted in 22 versions of those tests being converted as described. Once those steps were completed, two of the forms then were read professionally to record and produce audio versions of the online forms for use by students requiring an audio accommodation. As part of the quality control check, the audio forms and their recordings, went through the same final review process at Pearson and at the Department.

Test administration and test delivery systems. The solution that Pearson implemented during the Demonstration Phase with their three assigned high schools consisted of two systems that school divisions interacted with throughout the demonstration testing. The eMeasurement System (eMeasurement) was a Web-based application that was accessed only by authorized school personnel, and it was used for scheduling and managing the test administration and accessing score reports after the tests were scored. TestNav was the software used by students when taking an online test. Both systems required access to the Internet and a computer that met the minimum technical requirements set forth in the *Architectural Guidelines for High School Readiness* (VDOE, 2001a).

Using a Web-based system such as eMeasurement to enter student data, schedule and setup test sessions, print student test tickets, and see which classrooms of students were testing during the day were all new experiences for a Division Director of Testing (DDOT). This required learning to use the new application, but also transitioning from a solely paper-based management style to one of working with data, student records, and test schedules online. While some tasks became more efficient in the online environment, that did not result in less overall work to be accomplished by school personnel involved in administering the SOL tests. Instead, once a school division decided to start the transition to administering SOL tests online, it resulted in a net increase in the amount of work required for a test administration. The division and school personnel responsible for administering SOL tests were required to be well-versed in both the traditional paper-and-pencil testing environment and a new online environment. For the first time, technology personnel were needed in the divisions and schools to prepare for and support SOL testing.

In preparing to use any Web-based management system where multiple people will be granted some level of user access to the system, a top-level account for the organization with the ability to create and manage those new user accounts must first be assigned. Following the hierarchy of roles and responsibilities from the paper-and-pencil testing environment, the Department determined it would be the DDOT who would continue to serve as the single point of contact with the Department. The DDOT would be responsible for creating and managing new eMeasurement user accounts for individuals in the school division who would be administering online SOL tests. Since eMeasurement was the system that housed all the secure online test content, the role of managing eMeasurement user accounts was compared to how a DDOT manages access to the location where secure paper-and-pencil test content and

confidential student data are in the school division (VDOE, 2001g). It was a responsibility that the Department and the school divisions assigned cautiously. Figure 38 is an excerpt from an early DDOT testing manual for an online SOL test administration.

4.6 Pass Secure Authority to Appropriate Staff

It is your responsibility to determine what additional staff at your division or at your schools will need access to the Administrative features of eMeasurement Services. You will assign various responsibilities and accesses to the system as you enter the names and pertinent information in the Security component of eMeasurement Services. The least amount of access needed by a user to complete his/her work should be provided. Access in eMeasurement Services does provide access to secure test content and confidential student data. For more information regarding assigning these responsibilities see the eMeasurement Services User's Guide.

Figure 36. An excerpt regarding security from the *Testing Manual for the Division Director of Testing*. The responsibility of the DDOT to assign secure administrative user accounts in the eMeasurement System to division and school staff are referenced in this excerpt (VDOE, 2001g).

Changes to the test delivery software. As a result of feedback gained during the Demonstration Phase, Pearson agreed to make some enhancements to their online test delivery software or TestNav. Students indicated that some of the test-taking strategies they used during paper-and-pencil tests were not available in TestNav. Specifically, the students mentioned the multiple-choice test-taking strategy of “slash the trash” where they would visually eliminate an option by marking through it once they no longer considered it as a possible response to the test question. Some students asked if it were possible to be provided with an online pencil that they could mark through the answer options on the screen (VDOE, 2001h).

Pearson software developers responded by creating a new tool in the TestNav software called the item-choice eliminator tool. By clicking this tool on the TestNav tool bar, the student could then click on the multiple-choice response to be eliminated. The tool would present a bold red *X* over the option the student selected for elimination (see Figure 37). As a check, if the student selected an answer to the test question but then marked that same response with the item-

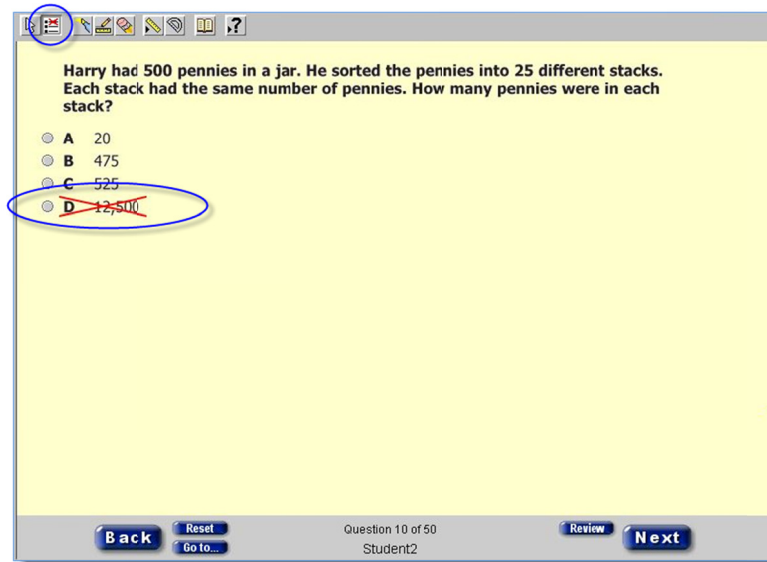


Figure 37. A sample test item shown with the item-choice eliminator tool being used. The item is also an example of the off-white background* the students asked for as a result of the Demonstration Phase (VDOE, 2001h)

choice eliminator tool, the TestNav software would present a dialogue box on the screen notifying the student that an option was being eliminated that has been selected as the answer. The student then needed to respond whether to change the response or keep it as the selected answer.

A second request that students included in their feedback had to do with the appearance of the test items in the TestNav software.

Repeatedly and from multiple locations, students asked if the white background of the test items could be changed. The comments indicated it was too white or too bright to view for the length of time that they would be taking the test.

Pearson responded by preparing the online SOL test items with an off-white background*.

* In 2008, the Department began to receive questions from school divisions regarding the off-white background used in the online SOL test. Students were indicating they did not like the off-white background. After discussion and comparisons, the Department had Pearson revert the background of the online test items to white. This change received positive feedback from school divisions and students.

A possible explanation for the desired change was that the quality of computer monitors and video hardware has vastly increased since 2001 at the time of the Demonstration Phase. The improvements have reduced the amount of flashes visible to the human eye, thus reducing the eye strain likely experienced by students during the Demonstration Phase. (K. S. Carson, W. C. Ostler, personal communication, March 9, 2015).

Pearson and the Department considered another topic of discussion among students and teachers that resulted from the Demonstration Phase. For the SOL Algebra I test, students are allowed to use an approved graphing calculator provided that the memory of the calculator is cleared and only approved applications, or apps, are loaded on the calculator. During the Demonstration Phase, the vendors were required to provide an online graphing calculator in their online test delivery solution. Because the online software was to include the graphing calculator, students were not permitted to use their own hand-held calculator during the demonstration testing.

Pearson's TestNav software included a fully functional online graphing calculator among the online tools presented; however, students stated clearly to the test examiners and in their comments that they did not like the calculator that was offered. The students commented that many of the labels on the buttons were not the same as what they were used to seeing and, when labels were the same, the location of the buttons was very different. Students commented frequently that they needed to be able to use their own graphing calculator during an online SOL test. The Department responded by implementing the same calculator guidelines for online SOL testing that were in place for paper-and-pencil SOL testing. The calculator must be on the approved list, have a cleared memory, and be clear of unapproved apps at the time of testing. This policy has remained the same through the duration of the SOL assessment program (VDOE, 2015).

Technology Considerations

Architectural guidelines and high school readiness. In January 2001 prior to the Demonstration Phase, the Department published the *Preliminary Architectural Guidelines* to offer guidance to school divisions but with the understanding that the outcome of the

Demonstration Phase could result in changes to the guidelines. Many school divisions were anxious to begin spending their state-provided technology funds, but it was too early in the Demonstration Phase for the Department to be certain of what the schools would need to successfully implement online SOL testing.

The Demonstration Phase confirmed that the *Preliminary Architectural Guidelines* that the Department provided were reasonably accurate and effective. The Department made minor revisions to the document to ensure it included at least the minimum technical specifications necessary to utilize the Pearson online testing solution. The Department finalized this version as the *Architectural Guidelines for High School Readiness* and published it in a July 13, 2001, Superintendent's Memo (VDOE, 2001d). Simultaneously in that memo, the Department published a *High School Readiness Certification Process* that school divisions were required to complete for each high school prior to administering operational online SOL tests (VDOE, 2001d).

The *High School Readiness Certification* consisted of three stages (see Figure 38). It was not required to certify all high schools at the same time, but before any high school could administer SOL tests online, that school had to be certified through Stage 2. The Stage 3 certification, eventually to be called the 96-hour Checklist, was a checklist of technology and assessment tasks to be completed in each school no sooner than 96-hours, or four school days, prior to the start of online SOL testing.

As the Initiative continued and school divisions were completing the certification of their high schools, requests began to be received about certifying middle schools. A school division could not begin to use the state-provided technology funds for its middle schools until all high schools in the division had completed the Stage 1 and Stage 2 Certifications. In turn, a school

division could not begin to use state funds to upgrade equipment and infrastructure in its elementary schools until all middle schools in the division had completed the Stage 1 and 2 Certifications (VDOE, 2001e).

HIGH SCHOOL READINESS CERTIFICATION

STAGES OF CERTIFICATION

Stage 1 Certification included a checklist of minimum requirements and recommended elements, or best practices, as identified in the *Architectural Guidelines for High School Readiness*. This was a self-certification process that required multiple signatures from within the division upon submission to the Virginia Department of Education.

Stage 2 Certification was initially a technical certification where school divisions had to run a provided software application, called "Load Test," that could be configured to produce an amount of network traffic at the school similar to the number of students that would be tested concurrently at the school. Another option was to administer an online training test concurrently to the same number of students expected to complete online SOL tests concurrently at the school.

Stage 1: Preliminary Self-Certification (attached checklist)
 School divisions certify that they are ready to meet the goals of the Standards of Learning (SOL) Technology Initiative by affirming that they have completed the **Required Elements** of the checklist. Upon submission of the checklist, school divisions are free to seek reimbursement from 2001 funds for expenditures made in middle schools. School divisions that choose to self-certify are still responsible for all expenditures to ensure that high schools meet Stage 2 certification.

Stage 2: Technical Certification
 School divisions will successfully complete a technical certification program that tests the capacity of the high school and division network. Upon completion, school divisions are free to seek reimbursement from 2002 funds for expenditures made in middle schools. School divisions that are unsuccessful in achieving technical certification should plan to use 2002 funds to purchase the required technology until they successfully complete the program. Achieving technical certification may require that school divisions implement one or more of the **Best Practices** in the *Architectural Guidelines*. Technical Certification procedures will be made available in Fall, 2001.

Alternative to Stages 1 and 2:
 School divisions may contract directly with NCS Pearson at a "state contract" price to obtain readiness certification. Contract pricing will vary according to the number of schools assessed. School divisions may use state Technology Support Personnel funds for this purpose. For those school divisions that choose this alternative, NCS Pearson will provide a pass/fail report that includes recommendations for improving the high school infrastructure. School divisions that achieve a "pass" may seek reimbursement from 2001 and 2002 funds for middle school expenditures. More information on this Alternative will be provided by Fall, 2001.

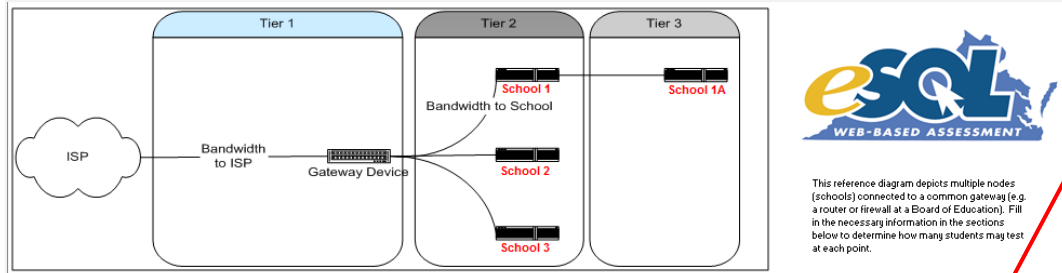
Stage 3: Preparedness Checklist
 School divisions will complete a preparedness checklist that ensures stability of the high school and division network not more than 96 hours prior to each online testing administration. The Preparedness Checklist will be available in Fall, 2001.

NOTES:
 All Stages of certification must be completed prior to high school online test administration.

Figure 38. The cover page of the High School Readiness Certification worksheet. The three stages of high school readiness certification are described (VDOE, 2001e).

The High School Readiness Certification was eventually expanded to become the School Readiness Certification as school divisions were ready to certify schools other than their high

schools (VDOE, 2004). The concept of the three stages remained the same, but the Stage 2 certification process was revised to include use of a bandwidth estimator worksheet instead of expecting school divisions to simultaneously load test their schools' networks. The bandwidth estimator worksheet, developed by Pearson with input from the Department, was a functioning spreadsheet (see Figure 39) that would calculate the projected bandwidth demand on the school and division networks based on multiple factors entered by the school division and knowledge of the file sizes associated with the online SOL tests. Data entered into the bandwidth estimator by the school divisions included quantities such as (a) number of tests administered concurrently at each school and at the division, (b) amount of bandwidth leased each school or network location and the overall school divisions, (c) peak bandwidth utilization throughout the division, (d) and overall network design. The Department opted to have school divisions use the bandwidth estimator worksheet when it became clear that school divisions did not have the resources necessary to adequately load test their local area and wide area networks. Except in the largest of school divisions where it was difficult to represent all schools and network nodes in the single spreadsheet, the bandwidth estimator was a tool for school divisions to use when planning for online SOL testing as well as for certifying the readiness of the schools.



This reference diagram depicts multiple nodes (schools) connected to a common gateway (e.g. a router or firewall at a Board of Education). Fill in the necessary information in the sections below to determine how many students may test at each point.

Section A - Gateway to ISP

Leased Bandwidth to ISP (kbps)	Peak Utilization of Connection to ISP (%)	Peak Utilization of Connection to ISP (kbps)	Effective Available Bandwidth (kbps)	Bandwidth Required for Child Nodes (kbps)	Combined Number of Students Contributing to Load For All Schools
1543	65.00%	1002.95	540.05	200	100
					Maximum # Students Concurrently Testing
					270

Proctor Caching is implemented at the gateway level:

A potential message indicating the **school division** is remaining within the capability of its network:

Maximum # Students Concurrently Testing	270
Bandwidth limitations will accommodate total demand from testing.	

OR

A potential message indicating the **school division** is exceeding the capability of its network:

Maximum # Students Concurrently Testing	270
Total demand for testing exceeds available leased bandwidth.	

Section B - Schools Connected at Gateway

School	Downstream School	Proctor Caching Implemented at Node	Number of Students Testing Simultaneously for this School	Total Number of Actual Students Testing Simultaneously Through this Node	Bandwidth to Gateway (kbps)	Peak Utilization of Connection to Gateway (%)	Peak Utilization of Connection to Gateway (kbps)	Effective Available Bandwidth (kbps)	Bandwidth Required at Node	Status Message
School 1	-	<input checked="" type="checkbox"/>	50	100	1544	65.00%	1003.6	540.4	200	This school is within bandwidth limitations.
1	School 1A	<input type="checkbox"/>	50	-	512	50.00%	256	256	100	This school is within bandwidth limitations.
School 2	-	<input type="checkbox"/>	-	-	-	-	-	-	-	-
2	-	<input type="checkbox"/>	-	-	-	-	-	-	-	-
School 3	-	<input type="checkbox"/>	-	-	-	-	-	-	-	-
3	-	<input type="checkbox"/>	-	-	-	-	-	-	-	-

A potential message indicating this **school** is within the capability of each of the two network segments:

This school is within bandwidth limitations.
This school is within bandwidth limitations.

OR

A potential message indicating the **school** is exceeding the capability of its two network segments:

Exceeds available bandwidth for this school.
Exceeds available bandwidth for this school.

Figure 39. The Stage 2 Bandwidth Estimator Worksheet shown on the left with sample output messages on the right. As more divisions needed to complete Stage 2 Certification for multiple high schools, the “Load Test” software became unwieldy. A worksheet was created to mathematically model bandwidth utilization based on network design, throughput, SOL test file size, and number of students testing online concurrently. Possible messages are described in the figure (VDOE, 2001e).

Proctor caching. In each fall and spring test administration, the Department and Pearson added more tests to the list of SOL tests that were available to be administered online. By 2003, all EOC tests except for the SOL English: Writing test could be administered online, and by 2006 the full range of non-writing SOL tests were available for school divisions to administer online. This was ahead of the spring 2009 target date when all elementary school, middle school, and EOC non-writing SOL tests were scheduled to be available to school divisions. As additional tests were added, many high schools were beginning to maximize the amount of bandwidth available to them and were beginning to contend with network performance issues.

Pearson and Department staff began to receive more calls from school divisions as the frequency of the problem was increasing in all areas of the state. As a result of site visits to two of the affected high schools, Pearson staff returned to their offices and engineered a caching solution that was specific to the TestNav software and the encrypted test content that was being transmitted from the host server to the student workstations across Virginia. The software, called Proctor Caching software, followed industry standard caching practices but was built into the Pearson software and provided at no cost to school divisions. By installing the Proctor Caching software on a dedicated workstation or a proxy server located on the school network, the SOL test content was able to be securely downloaded and saved to that computer where it was then available locally to student workstations. The addition of proctor caching in school divisions resolved numerous testing issues that were all traced back to performance-related problems. The introduction of proctor caching to the online SOL testing process was instrumental in supporting the volume of testing that was needed in schools that were struggling with having maximized the throughput of the networks due to new demands on the available bandwidth.

The Department and Pearson partnered in the work to deploy the new software and quickly train school divisions on how to configure and implement proctor caching at their schools. The Department prepared training presentations (see Figure 40) while Pearson

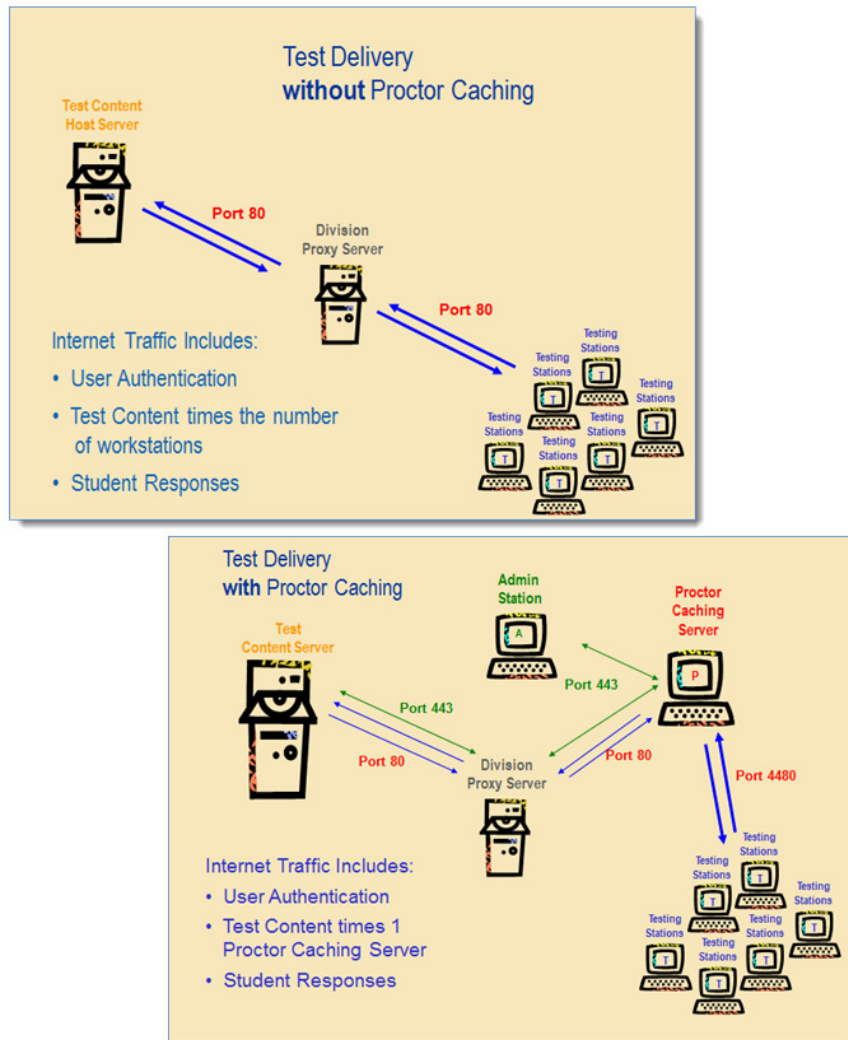


Figure 40. Training slides to be used with school divisions regarding Proctor Caching.

completed the development and deployment of the new software. The concepts of proctor caching and benefits of using the technology were presented at training sessions, state technology conferences, assessment meetings, and to members of the Web-based SOL Technology Initiative Steering Committee.

Early warning system. The Early Warning System associated with TestNav was another development that came when school divisions were struggling with performance-based issues. Situations were occurring where student responses were not being communicated successfully to the Pearson server and students were left with what appeared to be unfinished tests. These situations did not occur regularly, but given the direct impact on students, the Department and Pearson were anxious to resolve the issue. The problem occurred when an event caused the student workstation to no longer be able to transmit student responses out to the Internet and to the Pearson servers where they were recorded and eventually scored. The event could be something like a hardware failure on a local workstation that affected one student, or it could be something with a greater impact such as construction workers near a school inadvertently cutting fiber optic cables responsible for carrying the school network traffic to the Internet. In that situation, all students testing at the time were impacted.

The challenge was to retrieve, from the memory of the computer, the answers the student had entered at the workstation before it became unresponsive. If the responses could be retrieved, it could very likely prevent a student from having to retake the entire test at a later date. As initially required by the Department, however, the TestNav software did not allow printing, screen captures, or any other type of information recording due to test security concerns. Similarly, test items and student responses were only stored in the memory of the workstations; these data were not written to the local disk drive. To retrieve student responses from the memory of workstations that were no longer communicating with the Internet, TestNav needed to be revised.

Pearson developed the Early Warning System (EWS), an addition to TestNav that would provide an early indication that connectivity was a problem and student responses were not being

saved. When the initial versions of the EWS were triggered due to a loss of connectivity, the EWS would result in TestNav presenting a display on the student's monitor that listed all of the student's responses and whether they had been saved at the Pearson servers and recorded in the database. If the workstation could still connect to a printer, that list could be printed; otherwise, a student may be asked by the test examiner to write the answers down on paper so they could be entered later once connectivity was restored. Students could often continue testing because the workstation had the test items available in memory and would save the student responses in memory, but no responses would be saved outside of the workstation. These first iterations of the EWS prevented students from having to be retested when events occurred during online testing such as fiber optic cables being cut near a school.

Pearson continued to refine the EWS concept to the level that students no longer needed to be warned that a connectivity problem was occurring. Instead, the system was revised such that two alternate save locations could be configured prior to the start of testing. Once a student responded to a question, the response would be sent to each of the alternate save locations and then also transmitted to the Pearson server. If the transfer to the Pearson server could not occur, the responses would remain in the two save locations. TestNav would periodically attempt to regain its connection out to the Pearson server, but if that were not possible, the student's answers were available in the designated save locations. Upon connectivity being restored (e.g., the fiber optic cable being repaired), the student's answers could be uploaded from the save location to the Pearson servers for scoring.

Chapter 5

Implementing Web-based Standards of Learning Testing: Lessons Learned

The Virginia Department of Education (Department) provided its first annual report on the Web-based Standards of Learning (SOL) Technology Initiative (Initiative) to the Governor and the General Assembly on September 1, 2000. The last report on the Initiative was filed on the same day in September, 2009, but the effects of the Initiative can be observed in schools across Virginia currently in the 2014-2015 school year. Computer hardware, software, and high-speed Internet connections are available in Virginia's schools at levels that could not have been realized without the continued financial support of the General Assembly. The targeted investments continue to support school divisions' efforts to maintain the technology readiness needed to support instruction, remediation, and assessment in Virginia's public schools. With the approval of the General Assembly, the Virginia Public School Authority conducted the fourteenth sale, or Series XIV, of technology equipment notes in May, 2014 (Virginia Department of Education, 2014).

Virginia's implementation of the Web-based Standards of Learning Technology Initiative, from 2000-2009, resulted in a wide range of scenarios and experiences. The lessons learned through the implementation are represented from the perspective of the participant-observer researcher in the subsequent sections and pages of this chapter. A summary is provided in Figure 41.

Readiness

At the start of the Initiative, the term readiness was most often used in describing the status of a school's infrastructure and technology. The *High School Readiness Certification* and

Readiness
Using a School Readiness Certification helped ensure levels of technology, planning, and communication existed in the schools prior to attempting online testing.
Readiness applied to multiple aspects of technology and assessment.
Readiness was a shared responsibility (state, division, and contractor).
The Demonstration Phase provided a safe opportunity to explore readiness among the groups.
Technology
Monitoring hardware and software changes in the technology industry was critical to maintaining readiness in the schools. This was a short-term and long-term task.
Technical expertise that could be mobilized when needed was important.
Having multiple resources of technical expertise (at the state, division, and contractor) was critical to verifying information.
Technology was a continuing operating cost rather than a one-time investment.
The types and deployment of technology often varied based on factors such as school priorities, instructional priorities, grade levels, and course offerings.
An assessment issue occurring during testing usually led to a technology issue that had to be considered.
Having desktop security on workstations prior to the start of online testing reduced the likelihood of technical issues. Having a standardized workstation image saved time in identifying the cause of technology problems.
Assessment
Virginia benefitted from having an established assessment program that was transitioned to online delivery in phases (high schools first and gradual introduction of tests)
Virginia benefitted from allowing school divisions to establish their own timeline for transitioning to online testing.
The changes associated with online testing affected all aspects of the assessment program; the impact was not limited to test administration and test administration staff.
Maintaining paper-and-pencil tests and online tests multiplied the time for review and quality checks in advance of test administrations.
School division staff, school staff, and parents demanded multiple examples of online test items to allow students to experience navigating in an online test, using online test tools, and reviewing and responding to test items.
The level of real-time support needed by school divisions from the state during testing windows increased as the volume of online tests administered increased.
A technology issue occurring during online testing usually led to an assessment issue that had to be considered.
Leadership & Oversight
Virginia benefitted from a unified message about online testing from the Governor's office, the General Assembly, the Virginia Department of Education, school division superintendents, and school leaders.
Decisions needed to be made quickly during online testing. Having points of contact and a set of priorities established in advance was critical.
Project Management
Implementing a formal project management structure was beneficial throughout the early stages of the Initiative.
Assessing and managing the levels of risk were necessary steps in the successful implementation.
Partnerships and Communication
Developing new partnerships and establishing new lines of communication were necessary steps.
Having a reliable method for communicating quickly and accurately to multiple school divisions simultaneously was critical.
Having a reliable method for communicating quickly and accurately within organizations (within the VDOE, within the schools, within the division, etc.) was critical.

Figure 41. A summary of the lessons learned through the implementation of the Web-based SOL Technology Initiative.

subsequent *School Readiness Certification* helped to ensure a minimum level of technology existed in the schools prior to attempting to deliver online SOL tests.

Readiness also was relevant to factors associated with assessment such as test development and test administration. Effort was invested in ensuring test items that displayed well in paper-and-pencil tests were just as effective when transitioned to a computer screen. Items developed and finalized for two-column, portrait-oriented paper test booklets needed work to be displayed appropriately and accurately on a one-item-per-screen, landscape-oriented computer monitor. The extensive reviews of test items and test forms by content specialists needed to occur for online test items just as it did for the multiple iterations of paper-and-pencil test items and forms developed each year. Directional terms such as above and below that were relevant in the paper-and-pencil test items often were no longer accurate when test items were formatted for online test delivery. Graphics or art work that had been optimized for high-volume printing had to be reworked to a new format that was effective and efficient for online display. Once any part of a test item was revised, the review process for that test item would begin again. Adapting test development processes that were honed for efficient paper-and-pencil test development so they applied equally well to online test development was a lengthy process. It was compounded by the need to maintain high-quality paper-and-pencil tests at the same time online tests were beginning to be implemented.

Just as test items were being adapted to an online test environment, standardized test procedures had to be revised for online test administration. Test directions for students to “mark their answer documents” or “close their test booklets when finished testing” were no longer appropriate for students taking the online version of the tests.

As a simple example of how readiness was a shared responsibility among the state, the school divisions, and the contractor: The staff at the Virginia Department of Education needed to adapt and rewrite the paper-and-pencil test administration procedures, the contractor needed to prepare and produce the test manuals with the new procedures, and school divisions had to prepare and train staff to implement the new procedures with students. What seemed like a short, easy task became that much more challenging when added to the overall implementation schedule and the volume of other outstanding tasks to be completed prior to developing, administering, scoring, and reporting high-stakes tests to students via the Internet.

Technology

A general lesson learned regarding technology associated with high-stakes online testing was that the Department could not over communicate the details of technical requirements to its school divisions. Also, providing preliminary information about upcoming changes, and indicating that details may change going forward, was at least better than providing no details at all. One role of the *School Readiness Certification* was to serve as a communication tool – it communicated the expectations and requirements, at three different stages, that needed to be achieved within the school and the school division to successfully administer online SOL tests.

The technology resources available to school divisions varied from location to location and even from year to year when staff turnover occurred or personnel budgets were affected. Any technology tools the Department or contractor could provide that did not require extensive expertise or costs were beneficial and appreciated by school divisions with limited resources.

The proctor caching solution was an example of offering all school divisions a no-cost solution that was manageable and effective at minimizing bandwidth demand during online testing. Some school divisions may not have used the no- or low-cost solution (e.g., Proctor

Caching software) offered by the state or contractor because they had invested in solutions of their own (e.g., caching devices for their wide area and local area networks), but the needs of many school divisions demanded that level of support.

Assessment

Virginia benefitted from having an established assessment program that it transitioned to an online assessment program in phases. School divisions were allowed the flexibility to determine when they were ready to administer SOL tests online. A division could opt to administer online tests in one school while maintaining the paper-and-pencil administration in other schools.

The phased implementation allowed school divisions to regulate the amount of change they experienced and when it would occur. From the Demonstration Phase, it was clear that transitioning to online testing in a school was more than a technology decision. In addition to the infrastructure needs, each school had to consider test dates, feasible testing rooms, numbers of computers available, numbers of students to be tested online. They needed to know what procedures had to be followed to prepare for testing, what accommodations could be provided online to students, which adults could serve as online test examiners and proctors, and when could students be trained in how to take an online test. All of that was to be considered prior to the preparation of student data for online test registrations in advance of administering the online tests.

As part of the transition to online testing, school leaders, teachers, and parents demanded multiple examples of online test items to allow students to experience navigating in an online test, using online test tools, and reviewing and responding to online test items. This was experienced again as recently as 2012 and 2013 when Virginia introduced technology-enhanced

items such as hot spot, drag-and-drop, graphing, and fill-in-the blank test items. Written documents, functioning examples of test items, and videos showing the new types of test items, or how to navigate within the test were all requested. After being developed and deployed, these resources were used regularly in the schools and by parents.

Leadership and Oversight

Strong leadership at various organizational levels was present from the beginning of Virginia's Initiative and is considered to have had a positive impact throughout the project. The Initiative had visibility at the highest levels of Virginia government in the Executive Branch, the Legislative Branch, and throughout public education in Virginia. Leaders, including the Governor and the Deputy Chief of Staff, were briefed at regular intervals. They continued to be supportive of the work being accomplished statewide to infuse the schools with technology for use in instruction, remediation, and assessment. As the Department indicated in its September 1, 2000, *Report to the Governor and General Assembly: the Web-based Standards of Learning Technology Initiative* (VDOE, 2000i):

The Superintendent of Public Instruction is committed to project success and heads the major project oversight and steering committee that meets on a monthly basis. She also includes the initiative as a standing item in her regional superintendents meeting[s], leadership team meeting[s], and management team meeting[s]. (p. 1)

JoLynne DeMary, Virginia's Superintendent of Public Instruction throughout the early, formative years of the Initiative, remained aware of the activities of the Initiative and espoused its benefits and most recent accomplishments at any opportunity she had with Virginia General Assembly members, Virginia Board of Education members, local school division

superintendents, and members of the public. Dr. DeMary's understanding of the details of the Initiative was instrumental in her communications about the Initiative outside of the agency. Her knowledge and support of the Initiative served as a unifying and motivating force among the Department's staff members who were responsible for the implementation. When interviewed in 2010 as part of this research, Dr. DeMary repeated a statement that she used often regarding the Demonstration Phase and overall implementation of the Initiative. "Failure was[is] not an option" (DeMary, 2010). This was a statement shared with her by M. Boyd Marcus, Jr., Chief of Staff to Governor James S. Gilmore, III (DeMary 2010).

Dr. DeMary wanted school divisions to accept responsibility and be accountable for moving the Initiative forward, and she communicated this regularly to school superintendents. It was her directive to maintain a list on the Department's Web site with the status of each school division's *High School Readiness Certification* (Canada, 2010; DeMary, 2010; Neugent, 2010).

Leadership at the school division and school levels was an indicator of which divisions would readily adopt the Initiative, use the state-provided funds, and prepare to implement online SOL testing. The leadership of the division superintendent, the division director of testing, and the division director of technology were critical in preparing the school division to work through the challenges associated with implementing online SOL testing. Similarly, the school administrators in each building set the tone for their staff and students related to SOL testing and the transition to administering the tests online (Canada, 2010; DeMary, 2010; Neugent, 2010).

Project Management

Being required to follow formal project management principles throughout all aspects of the Initiative was a new experience for the Department and many local school personnel. With much focus on the Y2K or Year 2000 Initiatives and the concern for currently struggling state

technology initiatives, the Department was subject to an unusual level of scrutiny regarding how it would manage a large technology Initiative such as the Web-based SOL Technology Initiative (Canada, 2010; Dickey, 2010; DeMary, 2010; Neugent, 2010). With a representative from the E-Government office assigned to monitor and serve as an advisor to the project, the Department worked with a contracted certified Project Management Professional (PMP) to develop and implement a formal project management plan and project management structure (VDOE, 2000a).

The Department reported in its 2001 *Report to the Governor and General Assembly: the Web-based Standards of Learning Technology Initiative* (VDOE, 2001j) that:

...the [project] management structure is intended to provide oversight, progress reporting, timely decision-making, feedback from constituencies, weekly and day-to-day project management, and accomplishment of implementation activities.

Divisions have become integral to this structure through establishment of work teams comprised of project managers, administrators, teachers and specialists in technology, assessment and instruction. Division work teams report local progress toward accomplishing the goals of the initiative through submission of “plans for the use of funds,” local project planning efforts, and implementation based upon direction from the DOE. The multi-phased project plan that has been created serves as guidance for implementing this initiative. This plan is continually modified and amplified as needed during the course of the project. (p. 1)

Because the Initiative “stayed green” in the monthly status reports submitted to the E-Government office, the strict oversight put in place gradually lessened as the close of the Gilmore administration approached in late 2001. In June, 2001, the Department ended its contract with the external project manager and took on the role of project management with

internal Department staff. The monthly monitoring remained in place as the Manager of Technology Services continued to submit monthly status and risk reports to offices in the Secretariat of Technology through 2005 when the Department was able to officially close-out the project from the perspective of external oversight.

While the strict oversight added stress to an already complex implementation, the reporting expectations and organizational structure required in the early years of the Initiative did help the Department. It was understood in the agency that Initiative meetings would not be cancelled, deadlines would not be missed, and whatever effort it took to keep the Initiative moving forward successfully needed to occur. The oversight and visibility of the Initiative helped legitimize the project management and reporting requirements placed on school divisions by the Department. School division superintendents along with directors of testing and directors of technology were made aware that the Superintendent of Public Instruction and the Governor's office were interested in the progress and success of the Initiative. The oversight and attention the Initiative was receiving sent a clear message to the stakeholders that it would be implemented successfully.

Partnerships and Communication

The Initiative resulted in many instances of new partnerships and individuals beginning to communicate and collaborate for the first time at the state and local school division levels. This occurred in the Department where, prior to the Initiative, the Division of Technology and the Division of Assessment and Reporting did not have a need to interact to prepare for SOL test administrations or to communicate with one another about how best to support school divisions while the SOL test administrations were occurring. With paper-and-pencil testing, the preparation for testing involved the contractor getting boxes of test materials properly packed

and shipped to the correct schools and school divisions. Conversations between technology staff and assessment staff were not part of the usual routine before, during, or after SOL testing when only paper-and-pencil tests were administered.

With the implementation of online testing, situations occurred where the assessment issues required technology assistance. In the case of an audio accommodation not provided to a student, was that because the audio form was not assigned properly or because a computer lost connectivity? In the case of a brief power failure, did all the computers restart successfully? Were the Ethernet switches in the wiring closet connected to a battery backup or did they need to be checked? Did the wireless routers in the ceiling restart successfully? The laptops switched over to battery power for the few seconds the power was off, but could they reconnect to the wireless network without intervention? Assessment staff and technology staff needed to work together to solve issues that previously were not part of SOL testing.

Communication about online testing was critical in advance of testing. A school and school division Internet connection is a shared resource among students, teachers, and administrators throughout the school division. Was there enough bandwidth to meet existing network demands and support online testing? Input from instructional staff was needed when considering network usage at the time of testing. The Stage 2 certification process was intended to predict the level of network demand, but it required input from technology and assessment staff much before the day of testing.

The Department worked to gain partnerships and opportunities that could prove to be valuable as the Initiative proceeded. The Department polled division technology directors in early 2002 to establish a current list of Internet service providers (ISP) serving Virginia school divisions, and on April 24, 2002, an invitation (see Figure 42) was sent to over 100 ISP contacts

asking for their attendance at an informational session to learn more about the Initiative and their company's role. The invitation went to large companies such as Sprint, Verizon, and Cox Cable, as well as numerous small, local ISPs that provided Internet connectivity to schools in rural areas of Virginia. The high level of response suggested interest among the ISPs, and the post-meeting evaluation indicated the 3-hour session was highly successful. Based on the response to this meeting, a similar session was offered to technology integration companies who offered products and services to school divisions such as hardware, software, installations, upgrades, and maintenance. Presentations at both meetings answered questions and helped promote communication between the Department and the various companies about how best to support the school divisions and the overall Initiative. The Department benefited from these new connections; it was more effective to establish relationships proactively than wait until a problem occurred.

Once online SOL testing was taking place in school divisions, new channels of communication were needed even between the Department and the school divisions. As the number of school divisions administering online SOL tests started to increase, the number of daily phone calls around and during testing time began to increase, both at Pearson and at the Department. The amount of real-time communication needed during testing was unprecedented compared to the Department's experiences with paper-and-pencil testing.

While system-wide performance issues did not occur regularly with the eMeasurement System, or the current version now called PearsonAccess, the Department learned



COMMONWEALTH of VIRGINIA

DEPARTMENT OF EDUCATION

P. O. BOX 2120
Richmond, Virginia 23216-2120

2002-04-24 10:00 AM
2002-04-24 10:00 AM
2002-04-24 10:00 AM
2002-04-24 10:00 AM

April 24, 2002

Dear _____

The Virginia Department of Education and school divisions across the commonwealth are collaborating to implement Virginia's Web-based Standards of Learning (SOL) Technology Initiative. The primary goal of this statewide initiative is to provide school divisions with the capability to use Web-enabled systems to improve SOL instruction, remediation, and assessment. Implementation of the initiative has progressed extremely well and, for the first time, nearly 1,000 high school students completed an online, Web-based version of the Virginia SOL End-of-Course tests last fall.

As an Internet Service Provider (ISP) for K-12 education in Virginia, you are invited to attend an informational meeting hosted by the Virginia Department of Education regarding the Web-based SOL Technology Initiative. The meeting will be held on the morning of May 21, 2002, at the James Monroe Building in Richmond. As indicated on the enclosed meeting agenda, representatives from the Department of Education and NCS Pearson will present information geared toward your company's role in this statewide initiative.

Due to the fact that we consider the services from Virginia's ISPs to be a critical element in the success of this initiative, we strongly encourage you to join us. We suggest that your company have an education account manager as well as a technical representative attend the meeting. We do ask that you please limit your company's attendance to no more than three participants. Please RSVP via e-mail to Jean Gray at jgray@mail.vak12ed.edu by Monday, May 13, 2002, with the names and titles of those planning to attend the meeting.

For any questions regarding the meeting, please feel free to contact Sarah Sushbury, manager of technology services at the Virginia Department of Education, at ssushbury@mail.vak12ed.edu. We look forward to seeing you in your support of this highly visible initiative.

Sincerely,

Lan W. Neugent
Assistant Superintendent for Technology

Please RSVP via e-mail to Jean Gray, Virginia Department of E

Virginia's Web-based Standards of Learning Technology Initiative

Informational Meeting for Virginia Internet Service Providers
James Monroe Building, Richmond, VA ♦ 9:30am to 12:30pm ♦ Tuesday, May 21, 2002

AGENDA

- I. Welcome and Introductions
- II. Overview and Current Status of the SOL Technology Initiative
- III. eMeasurement Services: Technical Requirements of Online Testing
- IV. Partnerships for Successful Statewide Implementation
- V. Questions and Answers
- VI. Closing Remarks

Figure 42. The invitation sent to Internet Service Providers regarding an informational meeting held on May 13, 2002, in Richmond, Virginia.

quickly it did not have enough people to adequately handle the volume of calls if the system became unavailable during testing. The Pearson Help Desk was available for school divisions to contact, but their system struggled with call volumes if a large system-wide issue occurred.

As a more effective way to make a message available to school divisions who were testing at the time of a system issue, the Department developed what was called the Status Page. It was available at a Web address that school divisions could access in the event they were experiencing system issues. It allowed them to confirm whether what they were experiencing was isolated to their division or was a statewide issue. The Status Page (see Figure 42) displayed a message from the Department regarding the current status of the system and the steps to be taken for students currently testing or any students expecting to begin testing that day.

The Department could refresh the message in minutes as the situation changed. The Status Page was an example of a new communication path that was developed, and is still maintained, to meet the need to communicate with multiple groups of people quickly and efficiently.

The contractor-customer relationship between the Pearson Program Team and the Department's staff was another area that evolved as each organization became more experienced during the implementation of online SOL testing. Having real-time communication during the online test administrations was critical.

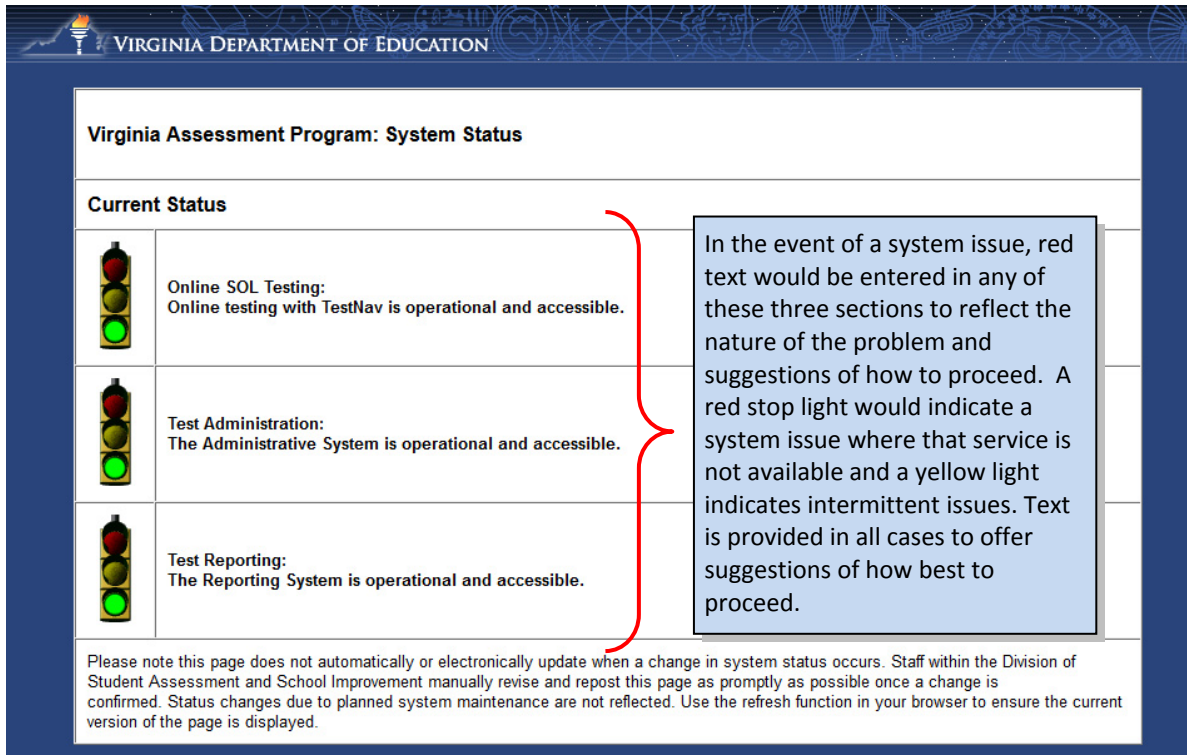


Figure 43. A screen shot of the Status Page used by the Virginia Department of Education. In the event of a system issue, the Department of Education is able to display a message and maintain the message as conditions change by the minute.

When issues occurred, individuals both at the Department and at Pearson needed to communicate quickly about how best to handle the existing situation and then how to proceed after the situation was resolved or at least mitigated. An early example of this occurred as more school divisions were participating in the Initiative and the overall volume of tests administered and scored had increased significantly. Testing volumes usually followed a consistent trend line of gradually increasing, reaching a peak testing volume around 10:00 A.M., and then decreasing through the lunch period with a slight increase occurring again after lunch. From that point, test volumes consistently decreased as the end of the school day approached. While the volume of tests administered was spread over the course of the school day, it was clear that many school administrators were attempting to access SOL score reports around the same time in the

afternoon statewide. Users began reporting system errors and system time-out messages when they logged in to retrieve score reports for the SOL tests administered that day. Calls were received at the Department and Pearson regarding the inability to view student score reports. The questions included whether students' tests had been lost or if the tests could be scored.

Pearson staff worked to identify the problem while Department staff started to prepare a communication to inform school divisions that (a) student tests had not been lost, (b) the issue was with reporting scores only, (c) the issue was being addressed, and (d) additional details would be forthcoming regarding the ability to access score reports. Throughout the implementation of the Initiative, it was more productive to communicate promptly with the school divisions to provide the information that was known and to confirm that their concerns were legitimate and were being addressed.

The solution in this situation involved redesigning how the online SOL score reports were generated and accessed by school divisions. While the solution reduced the variety of reports that could be accessed on the same day that students tested, it was a compromise that resulted in being able to maintain the availability of same-day reporting for all school divisions.

The relationships that were formed through communicating openly and working closely with the division directors of testing have benefitted the Department as other changes were implemented in the SOL assessment program. Since the implementation of the Initiative, the Department implemented technology-enhanced test items in its online tests and began to administer the SOL writing assessment online. New tests were developed to assess newly adopted and more rigorous Standards of Learning in the areas of reading, writing, mathematics, and science. Standard settings were conducted for all of the new SOL tests and new performance levels indicating college and career readiness were established on the EOC Reading, Writing,

and Algebra II tests. Computer adaptive tests are being introduced in phases beginning with grade 6 mathematics tests in 2014-2015. As the Department continues to implement change in its SOL assessment program, the strategies and lessons learned during the implementation of the Web-based Standards of Learning Technology Initiative remain relevant to the state, the school divisions, and the contractor.

A statement that Randy Bennett shared regarding change and innovation at the Race to the Top Assessment Program meeting in Washington, DC, on April 15, 2011, is offered as one more perspective on lessons learned from Virginia's Web-based SOL Technology Initiative (USDOE):

One of the things I think you have [Virginia has] done really well is tend to what I'll call [the] first rule of innovation, which is to plan to fail early, often, small and gracefully. I think the alternative is not very pretty, and there've been very few instances that I know of in which you've [Virginia] had larger visible failures. And I think the reason is because you [Virginia] spent the time upfront doing a lot of small things... (p. 64)

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Appendix A

Context and Research Methods

Context of the Study

The purpose of this study was to investigate, from a participant-observer perspective, how electronic testing was implemented within a statewide high-stakes testing program in Virginia's public education system. First, to prepare for a full discussion of the investigation, a context for the study was presented by reflecting on specific national and state milestones achieved in education and technology in the two decades prior to Virginia's efforts to administer Web-based high-stakes tests. Through this timeline, one will begin to see the events that became the foundation for Virginia's implementation of Web-based testing.

Statement of the Problem

Delivering high-stakes assessments via the Internet to all schools in Virginia was a lofty concept to consider in 1999. Even by 2003, only 12 states and the District of Columbia were implementing some form of electronic testing according to a 2003 *Education Week* survey of state departments of education (Olson, 2003b). Among these 12 states, the extent of their electronic testing implementation varied greatly.

The challenges associated with implementing electronic testing were complex and diverse. They required input from dissimilar areas of expertise making the task of addressing all of them within a single organization, such as a state education agency, all that more difficult. Specifically, the challenges cut across political, financial, organizational, technological, and assessment issues. Addressing these challenges to successfully implement a statewide Web-based testing program is the problem investigated in this study. From a participant-observer perspective, a single state's efforts to implement statewide high-stakes electronic testing were examined. As Manager of External Technology Services, my role was to serve as the project manager for Virginia's implementation of online testing from the early days of the Initiative, and my experiences and observations are the data in this study.

Rationale for the Study

The amount of statewide testing taking place in public education increased with the implementation of *No Child Left Behind* and, more recently, President Barack Obama's proposed plans for public education as described in *A Blueprint for Reform: The Reauthorization of the Elementary and Secondary Education Act* (USDOE, 2010). States must administer grade-level assessments in mathematics and reading and periodic assessments in science. Many states are now at the stage in which Virginia was during the late 1990s. The numbers and types of

statewide assessments being administered have increased while technology has become more prevalent in the schools. A demand exists for a faster turnaround of test scores and more efficient use of the resulting student data.

Having served as the project manager for Virginia's implementation of online testing, I am often contacted by state education agencies looking for background information, guidance, and thoughts that may help them in pursuing similar efforts. I am asked to present Virginia's experiences at national conferences and invited to serve on advisory councils for organizations beginning to consider electronic testing. My experiences indicate that a demand for the information exists and continues.

With the introduction of electronic testing into the high-stakes testing arena, existing research is commonly focused on the equivalency of paper-and-pencil testing with electronic testing. Minimal research is available on what is required to implement electronic testing successfully. Articles exist summarizing the efforts of different states in implementing online testing, but an in-depth analysis of associated success factors does not appear to be available. The authors of an issues brief published by the National Governors Association's Center for Best Practices presented general challenges associated with electronic testing and summarized implementation projects in six different states, but they stopped short of addressing specific successes and failures experienced by state education agencies (National Governors Association's Center for Best Practices, 2002).

As the researcher, my goal is to inform others of Virginia's experiences, including its successes and failures, and to share the lessons learned. The data in Figures A.44 and A.45 represent the implementation of electronic testing in Virginia over time. The Commonwealth is in its 14th year of electronic testing, and the information gained during that time could be useful

to entities involved in implementing electronic testing. In this report, I explore Virginia's implementation of online testing and then frame the results in a manner that may be helpful to state and local education agencies, education leaders, technology leaders, government officials, and assessment contractors as they navigate the complexities of such a project.

In preparation for this study, I developed a body of information regarding assessment and technology topics to assist a reader in understanding the complexities of electronic testing. Additionally, I related Virginia's implementation of electronic testing to Michael Fullan's (2001, 2007) three-phased approach of initiating, implementing, and institutionalizing change in education. These materials are presented in Appendix B.

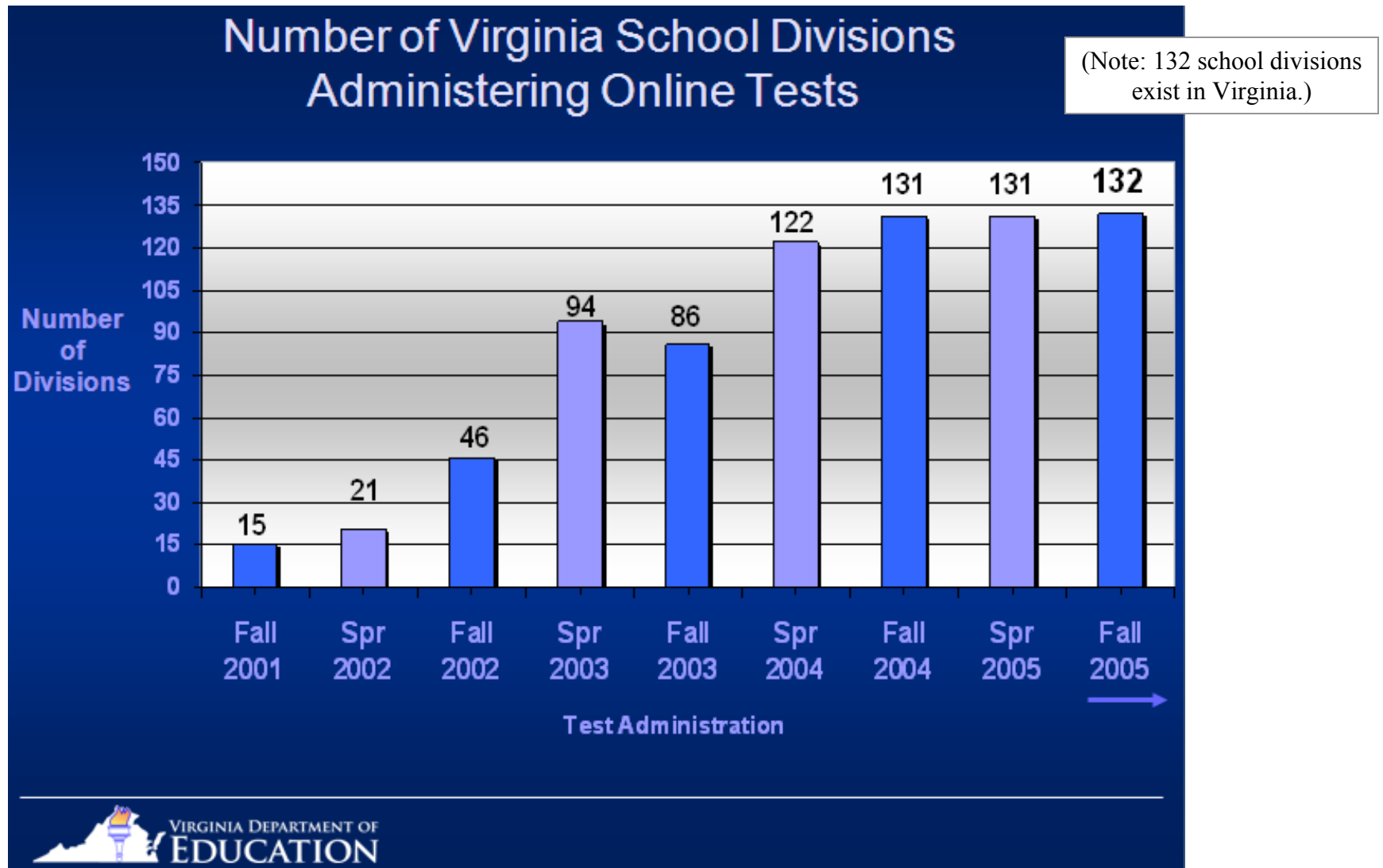


Figure A.44. The number of Virginia school divisions participating in administration of online SOL tests by date of test administration. Participation was optional until spring 2013. All 132 school divisions were participating by the fall 2005 SOL test administration. The number of participating school divisions remained at 132 from fall 2005 forward.

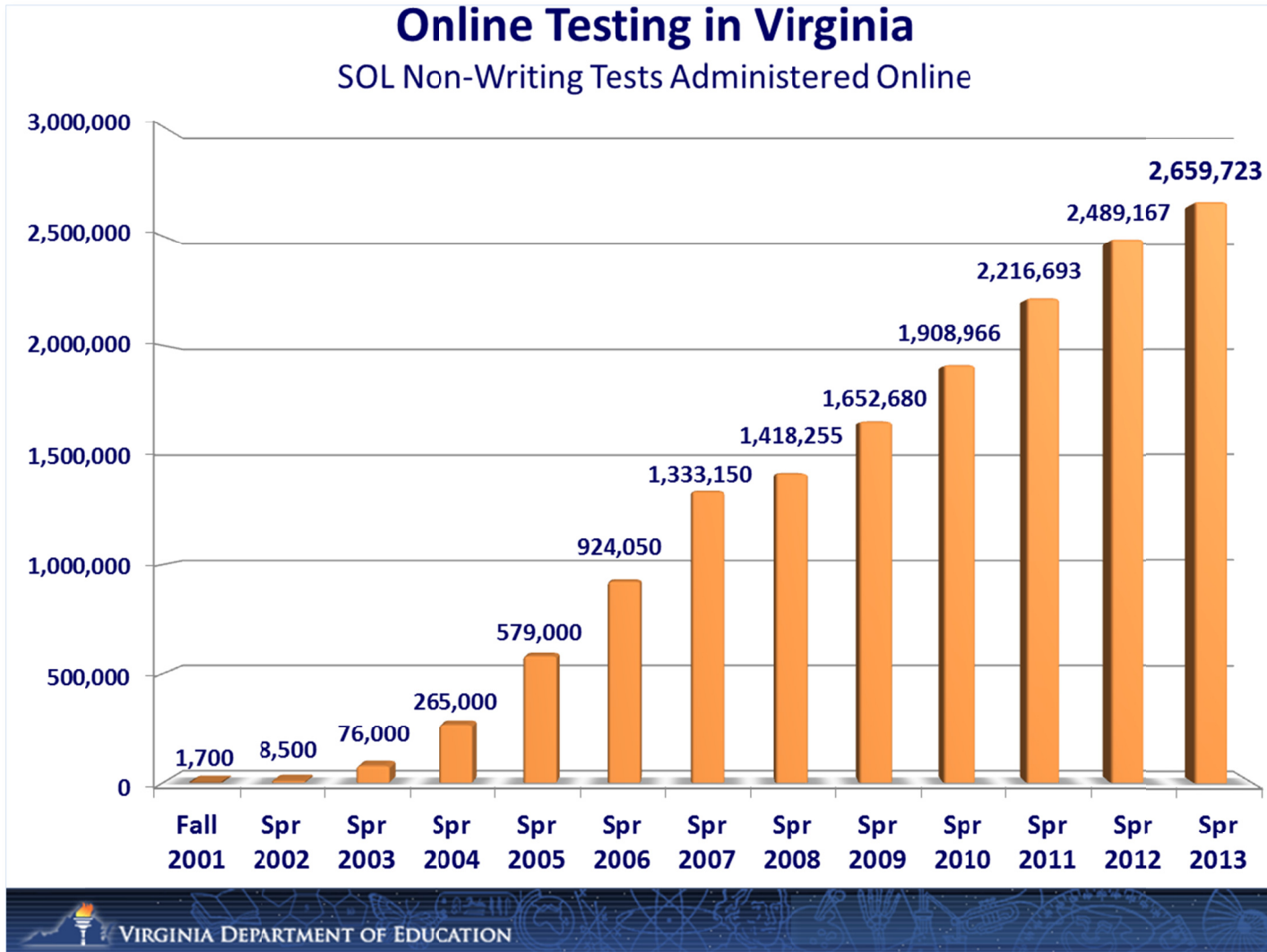


Figure A.45. The number of Virginia SOL tests administered to students online by test administration through spring 2013. The first online SOL test administration occurred in fall 2001. Online testing occurred in the fall and summer test administrations but is not represented in this data.

Methodology

This study was conducted as a participant-observer case study (Bogdan, 1972; Bogdan, 1973; Bogdan & Bilken, 2003; Creswell, 1998; Huberman & Miles, 2002; Jorgensen, 1989; Maykut & Morehouse, 1994; Merriam, 1998; Rossman & Rallis, 2003). Through my role as a project manager, I have been fully immersed in Virginia's implementation of online testing since it was formalized as a project in 2000. My role as a participant-observer researcher fit Jorgensen's (1989) definition of a complete insider.

Participant-observer case study principles were recognized throughout the study, but certain historical case study concepts also were relevant and beneficial during data collection and data analyses. Carr (1963) recognized that two phases of historical research exist but that conducting them independently of one another is unreasonable for any researcher. Data collection and analysis must occur, and establishing and writing findings must occur. These two sets of activities, however, cannot be completed effectively one after the other. I found Carr's emphasis on returning to read the data in the midst of writing to be quite realistic. The thought processes and steps involved in writing did at times provide a different lens for re-reading the documents and artifacts. Without re-reading and reconsidering the materials and the data as part of the writing process, my findings and documentation would likely not be as thorough and rich.

To initiate the study, an emphasis was placed on three main elements as shown in Figure A.46. Within each of the three elements, a common set of six categories was proposed for exploration. The relationships and interactions among the categories were identified and detailed as part of the study. As Merriam (1998) suggested, "Devising categories is largely an intuitive process, but it is also systematic and informed by the study's purpose, the investigator's

Virginia's Web-based Standards of Learning Technology Initiative

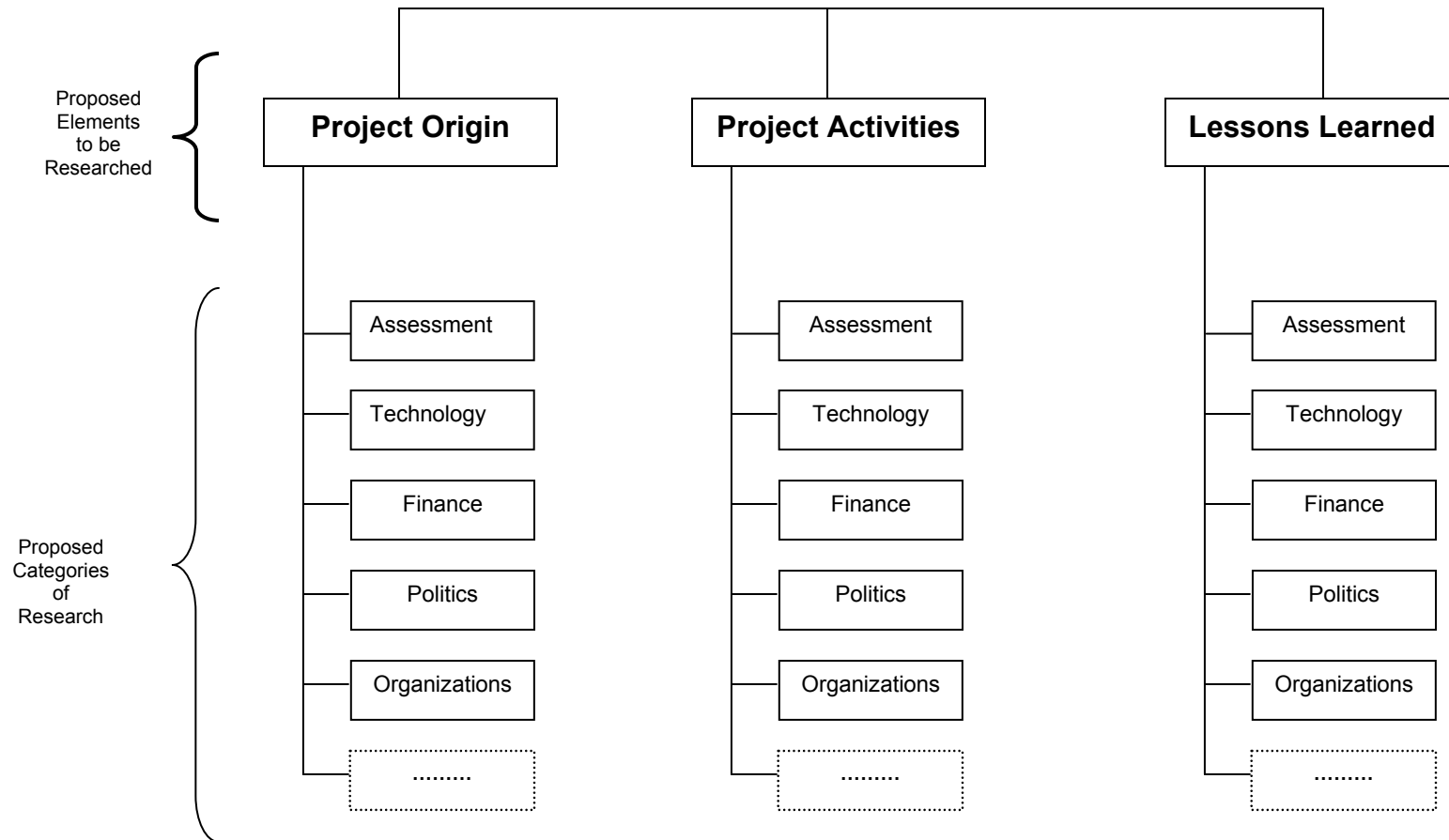


Figure A.46. A diagram of three proposed elements to be researched and potential categories to be explored within each element. Relationships among the categories were identified and defined as part of the study. The dotted rectangles symbolize additional categories that could be identified as research was conducted.

orientation and knowledge, and the meanings made explicit by the participants themselves” (p. 179). The six categories were proposed initially to maximize the breadth of the study and to provide a comprehensive view of the varied elements of a statewide online testing implementation. The sixth category, shown as unnamed, was reserved as a placeholder for one or more categories to be identified during the collection or analysis of data. It was understood by the researcher that the proposed three elements and six categories existed as part of the initial research plan, and that given the inductive nature of qualitative research, the elements and categories could vary as the study progressed.

Data collection. Reviews of existing project documentation served as one method of data collection. The documentation included but was not limited to legislative documents, procurement records, project plans, status reports, risk mitigation reports, meeting agendas, and meeting minutes.

Examples of specific formal documents reviewed were (a) the *Web-based Standards of Learning Technology Initiative Project Plan: Initial Release* (VDOE, 2000a), (b) Governor Gilmore’s Executive Order 51(99) (1999) and Executive Order 65(00) (2000), (c) Virginia Senate Bill 29 (2000) and House Bill 29 (2000), (d) *SOL Technology Initiative Request for Proposals* (VDOE, 2000b), (e) *Architectural Guidelines for High School Readiness* (VDOE, 2001a), (f) *SOL Technology Initiative: Report on the Demonstration Phase* (VDOE, 2001b), and (g) various memos from the Virginia Superintendent of Public Instruction to Virginia school divisions. Many of these documents were available publicly via the World Wide Web while others were accessible at the Virginia Department of Education in Richmond, Virginia. Other less formal documents examined were filed emails and individuals’ meeting and working notes.

Interviews with individuals closely associated with the Virginia initiative served as the other primary source of data for the case study. The initial list of interview participants was determined based on individuals' status as decision-makers and leaders within the organizational structure of the statewide initiative. As participants were interviewed, they were asked for recommendations of others whose input may be beneficial. This sampling method, referred to as snowball or chain sampling, was helpful to confirming the list of participants to be interviewed to capture the varied aspects of the initiative (Merriam, 2009). The participants varied in age and gender, and they represented an inclusive group of professionals who contributed to Virginia's project. The interview participants were:

- Virginia Superintendent of Public Instruction
- Assistant Superintendent for Instruction
- Assistant Superintendent for Finance
- Assistant Superintendent for School Improvement and Student Assessment
- Assistant Superintendent for Technology
- Director of Education Information Management

Given my role in the Virginia initiative, I was familiar with most of the individuals identified as potential candidates to be interviewed. I contacted each candidate individually by email or in person to request his or her contribution to the case study. I provided the (a) description of the case study, (b) rationale for how they had been identified as a candidate for participation, (c) associated expectations, and (d) approved Informed Consent materials. Candidates responded within the same day indicating their willingness to contribute to the study.

Whenever possible, I conducted face-to-face interviews at a location of the participant's choice; however, telephone interviews were needed in some situations due to scheduling or travel constraints. I utilized a digital recording software application installed on my laptop

computer to ensure I was capturing a complete record of the information being shared throughout the interview. For phone interviews or other ad-hoc conversations where a digital recording could not be maintained, I recorded detailed notes in my research journal. Each participant I was able to contact seemed genuinely interested in the study, willing to participate, and willing to receive any follow up questions or additional communication regarding the research.

Questions used during the semi-structured interviews are in Appendix C and were initially developed to align with the categories presented in Figure A.46 of this document. The categories and types of questions initially documented served only as an interview guide while I worked with each participant. Maintaining an open dialogue with the participant during the interview and actively listening to all of their feedback were critical. Familiarity with project documentation and data collected throughout the previous interviews was necessary to guide the interview and maximize the collection of data. Asking questions that facilitated potential triangulation of data among the varied data sources was used to establish credibility and trustworthiness.

Throughout the study, I maintained a research journal that served as a central location for recording additional concepts, noting specific issues to pursue in greater detail, and collecting any observations, reactions, and questions that could be useful throughout the collection and analysis of data. Given the researcher's role as a participant observer, entries in the research journal provided an additional source of data for use in the study.

Data analysis. I utilized holistic qualitative strategies to analyze the collected data in an attempt to fulfill the goal of communicating a rich description of Virginia's online testing implementation. One method of data analysis used was Glaser and Strauss's (1967) constant comparative method with suggested procedural additions from Lincoln and Guba (1985) and

Maykut and Morehouse (1994). As part of this methodology, the artifacts and data were (a) separated into small pieces of information or units of meaning, (b) coded and categorized inductively, and (c) compared within and across categories as the collection and analyses were taking place. The product of this was a set of *propositions* or, as defined by Maykut and Morehouse (1994), “statements of fact inductively derived from a rigorous and systematic analysis of data” (p. 126). I used these derived statements in the late phase of data analysis when I developed and shaped the final narrative of the study.

The analysis began with the process of *unitizing* data where, according to Holsti (1969) “raw data are systematically transformed and aggregated into units which permit precise description of relevant content characteristics” (p. 94). I applied this method first to the project documentation. The goal was to identify the smallest possible units of data from within the artifacts and transcripts that could stand by themselves and be understood as single pieces of information. From Lincoln and Guba (1985), “a unit may be a simple sentence or an extended paragraph, but, in either case, the test of its unitary character is that if any portion of the unit were to be removed, the remainder would be seriously compromised or rendered uninterpretable” (p. 203). Maykut and Morehouse (1994) and Lincoln and Guba (1985) encourage researchers to work from photocopies of data so that units may be physically cut apart and attached to large index cards for later analysis. I used this method in part, but in time, I also adapted the method to a more electronic format where I began to record the units of data with their assigned codes as individual electronic records. Having the data units available electronically facilitated necessary processes such as copying, categorizing, re-categorizing, revising, and comparing the data units. With a mix of hard copy records and electronic records, I marked each of them with an alphanumeric code to indicate the original source of the data unit.

For example, a unit of data originating from the second page of a transcript from an interview with participant number 3 was coded I/3-2. The date when the unit was identified was also noted with the unit in the event that a later review of that particular data source produced additional data units or required some to be retired.

As the data were unitized, the process of inductively categorizing the units could occur. According to Lincoln and Guba (1985):

The essential tasks of categorizing are to bring together into provisional categories those cards that apparently relate to the same content; to devise rules that describe category properties and that can, ultimately, be used to justify the inclusion of each card that remains to be assigned to the category as well as to provide a basis for later tests of replicability; and to render the category internally consistent. (p. 347)

The hard copy records and the electronic records each containing single pieces of data unitized from the various artifacts and data sources were reviewed, categorized, and compared to other data units in the study. A graphic representation of the analysis process is shown in Figure A.47.

Credibility and trustworthiness.

I utilized various strategies for ensuring the credibility and trustworthiness of the study. First, I presented readers with clear detailed information regarding the purpose and methods of the study. Maykut and Morehouse (1994) state:

A detailed description of the research process and outcomes provides readers with a basis for judging the credibility of a study. It allows them to look closely at the sample and the specific procedures for data collection and analysis and will contribute to (or lessen) their level of trust in the reported outcomes. (p. 145-146)

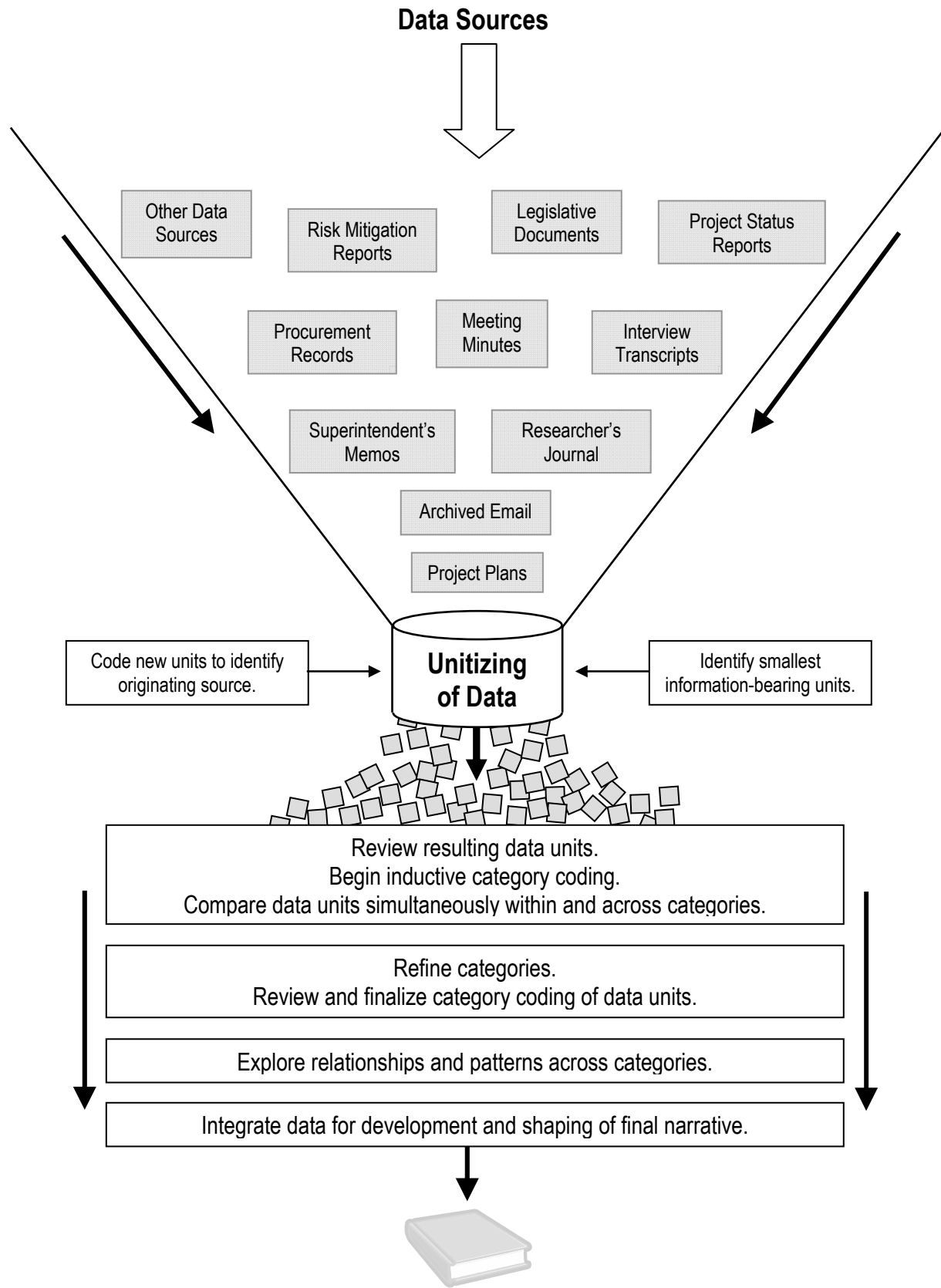


Figure A.47 A graphic overview of the constant comparative data analysis procedures utilized.

To ensure all elements of the Virginia initiative were adequately represented in the results of the study, I utilized multiple sources of data. I conducted interviews with key individuals specifically selected because of their range of backgrounds and their roles and responsibilities throughout the implementation of online testing in Virginia. Relying on these individuals to identify other potential participants, also known as network sampling, resulted in a varied list of candidates to be interviewed. One challenge that existed in being able to contact individuals was the length of time had passed since the beginning of the Initiative in the 1999-2000 school year. As project manager for the Initiative, I had an awareness of the types of documentation created throughout the project, and to check my knowledge, I used the interviews as an opportunity to ask about documentation and confirm the available information.

As part of the interviews, I asked the participants whether they would be willing to review and validate the data that I collected during their interview and, if needed, have additional conversations about the information. All participants were open to continued communications throughout my research and indicated their willingness to review and validate my data collection and my findings.

Presentation of the Findings

The findings are presented as a separate monograph detailing the implementation of Virginia's Web-based Standards of Learning Technology Initiative. The chapters of the monograph are (a) an historical perspective on the Virginia project, Chapter 1; (b) an overview of the Initiative, Chapter 2; (c) the details of Virginia's Demonstration Phase, Chapter 3; (d) a summary of the transition to online SOL testing in Virginia, Chapter 4; and (e) a presentation of the lessons learned, Chapter 5. Appendices are included to present the traditional research materials such as the literature review and description of the methodology.

Appendix B

Background and Literature Review

Electronic Testing: Terminology and Concepts

The concept of electronic testing is complex in that for it to be effective, two exceedingly different fields, technology and assessment, must be fully integrated. In the following sections, I detail the terminology and concepts needed to understand electronic testing from an assessment perspective and a technology perspective. For purposes of clarification, I differentiate between the two perspectives by presenting them separately. The first of the two sections is titled *Assessment Terminology and Concepts* and is presented below.

Types of assessments.

Electronic testing. For the purposes of this paper, electronic testing refers to any type of assessment administered on a computer or computer-like device such as a hand-held computer or personal digital assistant (PDA). Specific types of electronic testing such as computer adaptive testing or online testing will be identified, but the terminology electronic testing will be used globally when no specific type of testing is being referenced.

Norm-referenced and criterion referenced tests. A norm-referenced test (NRT) is a type of test administered to students for the purpose of comparing students to one another or ranking them along a continuum of achievement (Bond, 1996; Bracey, 2000; Jones, Jones, & Hargrove, 2003; National Association of State Boards of Education [NASBE], 2001; Tindal & Haladyna, 2002; Wilde, 2002). Alternatively, a criterion-referenced test (CRT) is administered to students in order to measure how much a student has learned relative to a body of knowledge or set of standards. Unlike the results of an NRT, CRT results should not be used to compare levels of achievement among students (Bond, 1996; Bracey, 2000; Jones, Jones, & Hargrove, 2003;

NASBE, 2001; Tindal & Haladyna, 2002; Wilde, 2002). When comparing CRTs and NRTs, Linda Bond stated, “These two tests differ in their intended purposes, the way in which content is selected, and the scoring process which defines how the test results must be interpreted” (Bond, 1996, ¶ 1).

Both CRTs and NRTs may be administered electronically. A more important decision is not how to administer the test, but rather to determine which test is most appropriate to administer based on what will be interpreted from the test results.

Large-scale assessments. Large-scale describes assessments based on the relative volume of tests administered (Bracey, 2000; Iowa Department of Education [IDOE], 1999; Jones, Jones, & Hargrove, 2003; NASBE, 2001; Tindal & Haladyna, 2002; Wilde, 2002). A widely administered state assessment program such as Virginia’s Standards of Learning (SOL) program is considered large-scale because nearly all students in Virginia take the tests. In a frequently asked questions page on the Iowa Department of Education (1999) website, the following example is posted: “An assessment given to all 3rd graders in a district, even if the number is relatively small, would be considered a large-scale assessment” (Assessment of Student Progress section, ¶ 8). Various large-scale testing programs exist in the 50 states, and these programs will likely continue given the intent of the *No Child Left Behind Act*.

High-stakes and low-stakes tests. High- and low-stakes tests refer to the type of consequences associated with the level of student performance on the test. A test labeled as high-stakes indicates that critical, long-term consequences are decided based on the test scores of the students. Such high-stakes decisions could be grade-level retention or promotion, type of high school diploma awarded, or even high school graduation overall (Bracey, 2000; Jones, Jones, & Hargrove, 2003; NASBE, 2001; Sloan & Kelly, 2003; Tindal & Haladyna, 2002;

Wilde, 2002). In some cases, the effect of high-stakes tests extends beyond individual students and may include individual teachers, a school, or a school division. Virginia's school accreditation status is an example of high-stakes testing extending beyond individual students.

In comparison, a test such as a diagnostic test or practice assessment is a low stakes test. The level of consequences is minimal and not long lasting for the individual or the organization (Bracey, 2000; Jones, Jones, & Hargrove, 2003; NASBE, 2001; Wilde, 2002). Classroom assessments usually are considered low stakes tests.

Types of test items.

Primarily three types of test items are used when writing test questions (Bracey, 2000; NASBE, 2001; Tindal & Haladyna, 2002; Wilde, 2002). These three types of items are used in paper-and-pencil tests as well as in electronic tests.

Selected response items. This item type includes possible answers that the test-takers must evaluate and then select the option they believe is most correct (Bracey, 2000; NASBE, 2001; Tindal & Haladyna, 2002; Wilde, 2002). Multiple-choice questions, true or false questions, and matching questions are the most commonly used selected response items. The selected response format is the most widely used form of large-scale assessment with approximately 85% of states administering statewide multiple-choice assessments to their students (Bond, Braskamp, & Roeber, 1996). However, only five states reported using multiple-choice tests as the sole format of their statewide assessment program (Bond, Braskamp, & Roeber, 1996).

Constructed response items. This item type requires test-takers to formulate their own answer for the question asked. No options are provided. The accepted length of the response may be indicated within the item such as a blank for a single word to complete a sentence, or the

length of the response may be left up to the test-taker such as a short-answer question or an essay question. The test-takers may be limited to a specific number of words or pages, or the test may be administered within a set time where they must complete their response in that allotted time (Bracey, 2000; NASBE, 2001; Tindal & Haladyna, 2002; Wilde, 2002).

This item type is different than a selected response item as the test-takers have little opportunity to succeed by guessing. In addition to knowing the content being tested, the test-takers must have the ability to formulate a written response that addresses a specific question. Constructed response items currently are most often administered in the paper-and-pencil testing format; however, options exist for administering them in an electronic testing environment. Students could be asked to respond to the item from a computer workstation where they would type their answer to the question. This raises issues of equivalency or fairness, as requiring a student to respond at length on a computer could evaluate computer literacy in addition to the student's knowledge of the test content.

Performance-based items. This item type requires test-takers to demonstrate mastery of specific content or skills over time by completing a product such as a portfolio or by conducting an activity such as demonstrating a set of skills (Bracey, 2000; NASBE, 2001; Sloan & Kelly, 2003; Tindal & Haladyna, 2002; Wilde, 2002). Performance-based items are the most complex of the three item types, and they require additional time and expense to develop, administer, and score. Determining the constructs measured by a performance-based item is a more involved process than with selected or constructed response items.

Performance-based items are most common in classroom assessments, although some large-scale assessment programs have used them with varying degrees of success. The selected-response or constructed response items remain more common in large-scale assessment

programs than performance-based items (Bracey, 2000; NASBE, 2001; Jones, Jones, & Hargrove, 2003; Sloan & Kelly, 2003; Tindal & Haladyna, 2002).

Electronic test delivery models. Test delivery models are used to describe how tests are delivered or presented to students. Five electronic testing models are included below, and the main differentiating factor among them is the level of test adaptivity. Test adaptivity is the degree to which the presentation of items in a test changes for the student, based on the student's performance during the test (Dragow, 2002; Folk & Smith, 2002; Patelis, 2000; Wainer, et al., 2000). For example, in a non-adaptive test, the number and difficulty level of the items in a test are determined at the time the test is constructed. This will not change during the test regardless of how the student is performing. In an adaptive test, if a student correctly answers a test item or set of items at a specified difficulty level, then the next item or set of items presented by the test delivery system will have a higher difficulty level. Similarly, if a student cannot answer the items correctly, then the next items presented by the test delivery system will have a lower difficulty level.

One perspective for considering electronic test delivery models is to place the various models on a continuum from no adaptivity to high adaptivity (Patelis, 2000). Descriptions of the five test models and their level of adaptivity are presented in the sections that follow.

Linear test delivery model. On a continuum of adaptivity, the linear model would be depicted to the far left and most closely mirrors a printed, paper-and-pencil test. This model contains no adaptivity; the quantity and order of test items are predetermined and remain the same for all students taking the same form, or version, of the test. Also called fixed-form tests, the linear test model requires fewer adjustments to test construction processes than other testing models when transitioned from a paper-and-pencil test environment to the electronic testing

setting. Linear online tests are developed using the same psychometric methodologies as used for a paper-and-pencil test and require no special preparation or programming other than digitizing the items so they may be displayed on a computer. (Hamilton, Klein, & Loricé, 2000; Patelis, 2000).

Students taking an electronic test delivered linearly should be able to navigate forward and backward through the test, skip items, change answers, and review any items before submitting the test for scoring. The computer hardware and software used for electronic testing in the 1970s and 1980s did not provide this level of functionality for test-takers (Bunderson, Inouye, & Olsen, 1989). The technology needed for test-takers to be able to navigate fully throughout a test before completion only became available to K-12 education in the late 1980s and 1990s with technical advancements in desktop computing such as increased hard disk storage and random access memory (RAM).

In the linear test delivery model, all test-takers see the same items and in exactly the same order. This raises two potential testing problems. The first relates to test security as, depending on the arrangement of computers in the test taking area, students may be able to see other students' computer monitors. If the arrangement of computers cannot be changed to reduce the visibility of students' tests to one another, the testing environment must be carefully monitored. The second problem is item exposure, or the number of times an item is exposed to test-takers (Davey & Nering, 2002; Hambleton, 2002; Parshall, Harmes, & Kromrey, 2000; Wainer, et al., 2000). Item exposure is high in a linear test as all students see the same items each time the test is administered. High item exposure or overuse of an item can be a risk to the validity of a test as a measurement instrument (Davey & Nering, 2002; Hambleton, 2002; Parshall et al., 2000; Wainer, et al., 2000).

Linear-on-the-fly model. The linear-on-the-fly (LOFT) test delivery model is a modified version of the linear test delivery model and would appear one position to the right of linear tests when placed on the five model continuum (Patelis, 2000). It is classified as a non-adaptive electronic delivery model in that the test content does not change based on a test-taker's performance. The model does, however, provide unique test forms to each test-taker. Prior to the start of each test session, the test-taker's form is assembled from a large item bank based on a predetermined set of test and content specifications. Assuming the electronic testing interface allows full navigation of the test, the LOFT delivery model affords the test-taker the same opportunities as the linear model to skip items and review and change answers before submitting the test (Folk & Smith, 2002; Patelis, 2000).

A benefit of the LOFT model over the linear model is the potential for a lower level of item exposure. Because each test-taker's form contains a randomized set of test items, item exposure may be reduced. In addition, the security risk within the testing environment is not as great as the test-takers are not seeing the same items in the same order. A trade-off for reduced item exposure and decreased security risk, however, is the time and expense associated with generating a larger item bank needed for creating different test forms for individual test-takers (Folk & Smith, 2002; Patelis, 2000).

Testlet delivery model. The third model on the five-model continuum of adaptivity is the testlet delivery model. A testlet is a pre-determined number of test items grouped together as a single unit based on item difficulty and content specifications. In the testlet delivery model, the test-taker completes a testlet, and based on the score achieved, the delivery system identifies another testlet and automatically administers it to the individual. This pattern continues until the test delivery system is able to determine the test-taker's level of proficiency to within a certain

level of accuracy (Folk & Smith, 2002; Patelis, 2000). Within each testlet of items, the test-taker has the ability to navigate through the set of items, skip items, and change answers; however, once a testlet of items is submitted for scoring, the test-taker may not retrieve any of those questions or answers (Folk & Smith, 2002; Patelis, 2000).

A benefit of the testlet delivery model is increased test efficiency, as each test-taker may not have to complete an entire test in order to determine a score or proficiency level.

Disadvantages of this model are increased item development time and increased item development costs. Both of these result from the need to produce a test bank large enough to create multiple testlets of varying degrees of difficulty (Folk & Smith, 2002; Patelis, 2000).

Mastery delivery model. Many variations of the mastery delivery model exist, but all function with the primary goal of categorizing test-takers into groups of mastery and non-mastery. A test-taker continues answering items until the test delivery system is able to determine whether the individual should pass or fail (Folk & Smith, 2002; Patelis, 2000).

One variation of the mastery model utilizes testlets rather than individual items. The testlets are administered and based on the test-taker's performance, another testlet is administered or an outcome of pass (mastery) or fail (non-mastery) is determined. The length of the test depends on how many test items or testlets the delivery system must administer before being able to determine an outcome for the test-taker to within a specified degree of accuracy (Folk & Smith, 2002; Patelis, 2000).

Computer adaptive delivery model. The fifth test model considered to be at the far right of the adaptivity continuum is the computer adaptive test delivery model (CAT). This model is the most adaptive model of the five as it adapts the test based on every item administered to the test-taker. By using the detailed item specifications of the question just answered by the test-

taker and whether answered correctly or incorrectly, the test delivery engine then selects the next test item to deliver. This process continues with items identified and presented to the test-taker until an accurate test score can be determined by the test delivery system. Once an accurate test score can be determined or in the case of a fixed-length form, the required number of items is completed, the delivery system will end the test (Bunderson et al., 1989; Folk & Smith, 2002; Patelis, 2000; Wainer, et al., 2000).

While the CAT is the most complex of the delivery models, the complexity of the model should not be recognizable to the test-taker. A quality CAT system running on adequate infrastructure should not leave the test-takers waiting at their computer workstations for the presentation of the next item. The main difference test-takers should experience when taking a CAT is their inability to browse and review items or change responses to their previously answered questions. Another noticeable difference of a variable-length CAT is that neither the test administrator nor the test-taker will know how many items must be answered to complete a test. It will vary depending on the test-takers performance on specific items.

“The basic notion of an adaptive test is to mimic automatically what a good examiner would do” (Wainer, et al., 2000, p. 10). In simple terms, a CAT consists of an item of mid-range difficulty being asked first. If the test-taker’s response is correct, a more difficult item follows. Conversely, if the test-taker answers the mid-range item incorrectly, a less difficult item follows. Test items continue to be selected and asked based on the test-taker’s performance until the test delivery system is able to establish the level of each test-taker’s knowledge to within a pre-determined level of accuracy (Bunderson et al., 1989; Folk & Smith, 2002; Wainer, et al., 2000).

The current CAT delivery model is based on a type of psychometric theory called item response theory (IRT) where specific parameters of each test item are considered along with the

test-takers ability to answer the test items correctly. IRT represents a mathematical description of what happens when an individual test-taker attempts to answer a specific test item. “This [IRT] is the theoretical glue that holds a CAT together” (Wainer, et al., 2000, p. 13).

Because of the complexity of IRT, specific methodologies of (a) item construction, (b) item pre-testing, (c) item screening, (d) item pool calibration, and (e) item scoring exist for the CAT delivery model that are not found in other test delivery models. In the case of a variable-length CAT, each item is more critical than in other models because a test-taker may see only a small number of items. “If an item is flawed, its impact [on a variable-length CAT] on the estimate of the examinee’s proficiency is doubled” (Wainer, et al., 2000, p. 13).

A frequently mentioned benefit of this test delivery model is the increased efficiency of testing. In a variable-length CAT, the time needed for test-takers to obtain an accurate score usually is reduced because only the minimum number of items needed to establish a test-taker’s score is administered. Also, since the difficulty of items presented adapts to the test-taker’s performance, the test-takers are challenged and more likely to remain productive because they receive items specifically identified for them by the CAT delivery system. This individualized nature of each test item administered is said to provide a more accurate measurement of a student’s abilities than that afforded by a traditional linear test where test-takers usually answer the easier questions and guess at the more difficult items (Bunderson et al., 1989; Folk & Smith, 2002; Wainer, et al., 2000).

Technology: Terminology and Concepts

“The role of information technology in virtually every type of educational enterprise is growing rapidly. Educational assessment is no exception” (Hamilton et al., 2000, p 7).

Electronic testing currently is most prevalent in high-stakes admissions exams and professional

licensing exams, but the K-12 market for electronic testing clearly is developing. “The high speed and large storage capacities of today’s computers, coupled with their rapidly shrinking costs, make computerized testing a promising alternative to traditional paper-and-pencil measures” (Hamilton et al., 2000, p 7-8).

In the previous section, *Assessment Terminology and Concepts*, I presented information important to understanding electronic testing from an assessment perspective. In this section, I present similar foundational information about electronic testing but from the perspective of technology.

Stand-alone and client-server computing. A stand-alone computer is not connected to other computers either directly or via a network, and therefore, cannot communicate with other computers to send or receive information. Stand-alone computers were used for electronic testing in the 1970s with the main benefit being the automated scoring of tests (Bunderson et al., 1989). In regards to the other steps of test administration such as making copies of tests, distributing tests, and filing test results, use of the stand-alone computer for testing did little to reduce the required administrative time. It simply transferred that work from the paper environment to the electronic environment. A test administrator still needed to copy the test to a diskette and load the test onto each of the stand-alone computers. Once the test-takers completed the test, the computer scored the test automatically, but the test administrator needed to retrieve each student’s test file and test score from the individual computers.

Instead of using stand-alone computers, most current electronic testing takes advantage of communication capabilities available in a networked environment such as with client-server computing (see Figure B.48). A network consists of two or more computers connected together, and in a client-server network environment, the client is the computer with which the end user

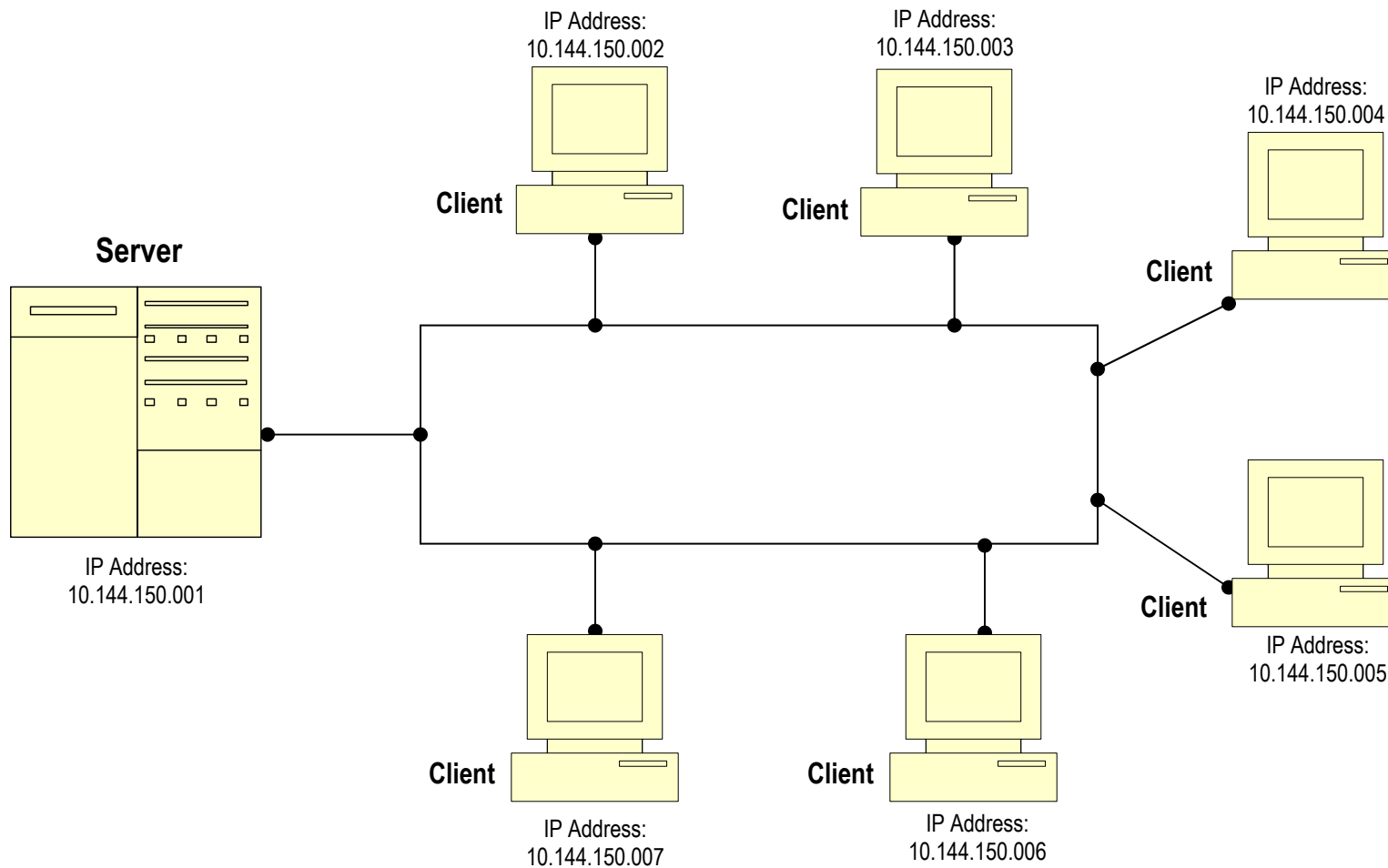


Figure B.48. A simplified client-server computing environment. Each computer has a unique numeric IP address. The test content is stored on the server until a student successfully logs in to a test on a client workstation. At that time, test questions are transmitted from the server to the client via the network. Student answers are transferred from each client back to the server.

interacts and the server is the computer that communicates or “serves” information to the client. The server is usually a more powerful computer than a client workstation because it must be capable of communicating information to multiple clients simultaneously while also processing and storing information. All computers on an industry-standard network, whether functioning as clients or servers, have a unique label called an Internet Protocol (IP) address that uniquely identifies them and allows communications to be directed only to the desired locations. When a client workstation initiates communication with a server, the server is able to reply to the appropriate client workstation because it addresses the reply only to the IP address of the computer that initiated the communication.

Use of a client-server computing environment for electronic testing greatly reduces the manual data transfers that were required for electronic testing when using stand-alone computers. A software application written for electronic testing utilizes the communication available in a client-server environment to manage a number of processes. These processes include: (a) storing test items on the server, (b) allowing access only to authenticated users (c) distributing test items to individual client workstations, (d) retrieving students’ responses from client workstations, (d) scoring students’ responses, and (e) reporting students’ results back to client workstations. Although simplified, these are the main processes involved in conducting electronic testing in a client-server environment.

Infrastructure, LANs, and WANs.

To support a client-server environment in a K-12 school, the school division must install network infrastructure. This consists of cabling and electronics needed to connect the computers in a school on a network. If an existing network infrastructure has been installed since the mid-1990s, most likely, it will consist of multi-strand, multi-mode fiber optic cable for connecting

longer distances in a school and unshielded twisted pair (UTP) copper cable for connecting distances under 100m. Many schools are installing wireless networking components, but some often still install a cabled backbone for the base of their infrastructure.

To connect the cables and complete the network infrastructure, certain electronics are needed in order to direct network traffic through the cables. The electronics mainly consist of routers and switches, although some networks may have other equipment in place. Once the cabling and electronics have been installed and configured and all network devices such as computers, servers, and printers have unique IP addresses assigned, everything can be connected to the infrastructure and begin communicating across the network.

Because a network within a school is relatively small and contained within the school building, it is called a local area network (LAN). In a school division, each school likely has their own LAN connected and operational within the building. School divisions have realized the benefits of having network services not only in their schools but shared among their schools. By installing additional network infrastructure to connect the schools' LANs to one another, a school division forms a wide area network (WAN) that allows network communication among the schools. A WAN, or wide area network, consists of any number of LANs, or local area networks, that are connected and able to communicate with one another.

School divisions commonly lease Internet connectivity from local Internet Service Providers (ISPs) and have the service connected to a central location within their division such as a school board office or one specific school. The Internet connectivity is then shared outward from that central location over the school division's WAN to each school's LAN.

When conducting electronic testing via the Internet, well-maintained LANs and WANs are critical to successfully administering the tests. Any break in communication, also called a

network interruption or a network outage, could potentially disrupt or halt the testing process. Electronic testing software varies by product as to how tolerant the software is to network interruptions.

Network bandwidth. Network bandwidth is a measure of the amount of data that can be transferred over a network in a given period and is usually expressed in bits per second (bps). A standard modem connected to a telephone line is able to transmit approximately 56,000 bits per second, or 56 Kbps, whereas a connection to the Internet leased by a small school may be capable of transmitting approximately 1.54 million bits per second, or 1.54 megabits per second (1.54 Mbps). The amount of bandwidth utilized by schools varies because of the different activities schools support that require bandwidth. Schools using the Internet for sending email and accessing Web pages, for example, do not require as much bandwidth as schools conducting regularly scheduled distance learning courses over the Internet along with their usual email and Web usage. As more data intensive activities occur in a school, more bandwidth is needed.

Network bandwidth is a finite resource that must be shared among all users on a network. Many network users are unaware of bandwidth and only notice it when there is not enough to meet the demand. The amount available will fluctuate throughout the day depending on the number of users on the network and the types of activities the users are attempting. When available bandwidth is low, end users may comment that the network seems “slow today” as they wait longer at their computers for Web pages to load, files to download, or email attachments to arrive. School divisions often find their bandwidth utilization peaks during lunches when students and teachers have more time to sit at networked computers to check email or access the Internet.

Although bandwidth is a finite resource on a network, it is possible to successfully manage bandwidth so it is shared based on priority rather than on the usual first-come, first-served pattern of bandwidth use. This is critical when conducting electronic testing, especially in low bandwidth environments. If the electronic testing software must compete for bandwidth while students are testing, the results could include (a) delays in test items appearing on the screen, (b) total failure of test item transmissions, and (c) partial or total loss of student test responses. Depending on the testing software's tolerance for network problems, any of these situations could threaten the validity of the testing environment.

Network databases. Electronic testing requires the use of network databases, or large collections of data organized systematically and accessible via secure network connections. The database must be capable of receiving data, storing data, and reporting data back out via a network. The data collected in a high-stakes testing program can be extensive and usually includes student demographic data as well as data that are specific to the student's test attempt. For example, in Virginia's high-stakes SOL testing program, test administrators collect over 40 fields of data for each student taking a test.

The electronic testing system generates data that must be managed in the testing database in addition to whatever student records are provided initially. Other data being managed include but are not limited to (a) access control information such as usernames, passwords, and levels of access, (b) test administration schedules, (c) test items and item statistics, (c) test forms and form specifications, (d) individual student responses, and (e) individual student scores and score reports.

Some electronic testing systems have the ability to collect raw data such as the number of times a student (a) changed an answer, (b) reviewed an item, or (c) accessed a manipulative such

as an online calculator or online ruler during the test. The length of time spent completing the test or viewing individual items is collectable data. In constructed-response or performance-based assessments, an electronic testing system could store data on what Web sites were visited during the test, what applications were used to develop the response, and in what order the response was created (Luecht & Clauser, 2002). The electronic testing system must work in tandem with its associated databases so that data are transferred in an accepted and retrievable format.

Issues Related to Implementing Electronic Testing

Various stories and journal articles have been published about the efforts of different states to implement electronic testing. According to a 2003 *Education Week* survey of state departments of education, 12 states and the District of Columbia were implementing some form of electronic testing (see Table B.3). Five of these states report they intend to meet, at least

Table B.3.

States Implementing Electronic Testing in the 2002-2003 Academic Year

States	Grades in which electronic tests are administered	Test designed to meet the requirements of <i>No Child Left Behind</i>	All districts and/or schools required to participate in electronic testing	Test administered via the Internet	Test administered as a computer adaptive test
Arkansas	8 - 12		x	x	
Delaware	5, 6, 8, 9			x	
District of Columbia	2				x
Idaho	2 - 10	x		x	x
Indiana	8 - 12			x	
Kansas	7	x		x	
Kentucky	4, 5, 7, 8, 10 - 12			x	
Maryland	6 -12			x	x

Table B.3 (continued).

States Implementing Electronic Testing in the 2002-2003 Academic Year

States	Grades in which electronic tests are administered	Test designed to meet the requirements of <i>No Child Left Behind</i>	All districts and/or schools required to participate in electronic testing	Test administered via the Internet	Test administered as a computer adaptive test
North Carolina	3 - 8, 10		x ^a	x ^a	x ^a
Oregon	3 - 12	x		x	
South Dakota	2 - 12			x	x
Utah	3 - 12	x		x	
Virginia	9 - 12	x		x	

Note. Adapted under Fair Use from “Legal Twists, Digital Turns” by L. Olson, 2003, Education Week, 22(35), p. 12-13.

^aVaries by test.

partially, the requirements of *No Child Left Behind* with their implementation of electronic testing.

Not all implementation efforts have progressed smoothly. In 2003, the Georgia Department of Education reported that approximately 270 actual test questions were posted mistakenly on a public section of their Internet site for students, parents, and teachers. Because of this, the state was forced to suspend their spring online testing at various grades levels (Olson, 2003a).

South Dakota was dealing with two specific hurdles when they decided to halt their online testing in spring 2003. The state was intending to implement the Dakota Assessment of Content Standards (DACS) as a computer adaptive test (CAT). The first problem for South Dakota was their CAT format did not comply with the *No Child Left Behind* requirement of testing students at their official grade level. Given the adaptive nature of the testing model, students eventually would be presented with questions above or below their grade level (Borja, 2003).

In addition to the compliance questions raised by their electronic test, technical issues plagued South Dakota's implementation. One South Dakota school district's Director of Assessment and Technology and Information Services claimed the test had both content and technical problems. "The DACS was a fiasco from day one" (Homan in Borja, 2003, Fiasco from Day One section, ¶ 7). When speaking of the suspension of the DACS, the Director of Education Services for the South Dakota Education Department, Wade Pogany, said he was aware of the complaints about system performance. Pogany stated, "We're moving in that direction to go online, but we want to make sure all of the issues – bandwidth, speed, connectivity – are resolved" (Pogany in Borja, 2003, Fiasco from Day One section, ¶ 4).

Advocates of electronic testing argue that technology will assist states in complying with increased testing requirements while also providing “cheaper and more efficient test delivery, a quicker turnaround of scores, and the ability to analyze and report the test data in new ways” (Olson, 2003b, p. 12). Benefits of utilizing electronic testing over a more traditional paper-and-pencil format include (a) reducing the amount of time needed by most students to complete their tests (Bennett, 2002b; Bugbee, 1996; Bunderson et al., 1989; Hamilton et al., 2000; Wise and Plake, 1989), (b) the potential to provide teachers with more information about student performance (Bennett, 2002b; Bugbee, 1996; Hamilton et al., 2000; Wise and Plake, 1989), and (c) providing nearly instantaneous test results to whomever has authority to access the information (Bennett, 202a, 2002b; Bugbee, 1996; Hamilton et al., 2000; Wise and Plake, 1989). The following sections detail some of the issues that may accompany efforts to achieve those cited benefits.

Equivalency of Electronic Testing

With electronic testing becoming more widely available, more instructors and organizations are considering the adaptation of traditional paper-and-pencil tests to electronic tests (Bennett, 2002a, 2002b; Bugbee, 1996; Mason, Patry, & Bernstein, 2001; Wise & Wise, 1987). Because of this, many researchers started to question the equivalence of scores attained in one test medium as compared to the other. Currently, the majority of research about electronic testing appears to focus on this question of equivalence or comparability of the two testing formats. The National Board on Educational Testing and Public Policy included the use of technology in assessment as one of its five priorities in its 2000 national research agenda. The organization advocated further investigations of online testing as compared to paper-and-pencil

testing based on (a) subject, (b) type of test, (c) testing algorithms, and (d) student characteristics (Clarke, Madaus, Pedulla & Shore, 2000).

In 1988, the College Board and the Educational Testing Service (ETS) commissioned Mazzeo and Harvey to conduct a review of studies comparing electronic testing and paper-and-pencil testing. The authors of the thirty-seven studies examined by Mazzeo and Harvey (1988) considered different types of tests such as (a) free-response tests, (b) personality tests, (c) aptitude tests, (d) achievement tests, (e) coding skills tests, (f) graphics tests, and (g) multiple-page item tests and whether administering them electronically or in the paper-and-pencil format affected student scores. Mazzeo and Harvey concluded from their review that the type of test being administered electronically made a difference in whether the scores could be considered equivalent. They found scores on personality inventories varied when administered in a paper-and-pencil format versus an electronic format, and tests with excessive graphics or reading passages may be more difficult for test-takers as an electronic test. In the studies reviewed by Mazzeo and Harvey that examined untimed achievement tests, the scores on the paper-and-pencil versions often were higher than the scores on the electronic versions. The score differences, however, were very small and resulted in no statistically significant difference in the overall mean scores.

Bunderson et al. (1989) conducted a similar review following the work by Mazzeo and Harvey. They found mixed results among studies of equivalence between the two different test types. Nine of the studies they reviewed included lower mean scores among students completing the electronic test versus those completing the paper-and-pencil test, and in three studies, higher mean scores were recorded for those students completing the electronic version of the test. In 11 studies, no significant differences were found in the mean scores attained on the electronic or the

paper-and-pencil versions of the tests. Mead and Drasgow (1993) conducted a meta-analysis of 28 comparability studies where they concluded that the equivalence or comparability of electronic testing and paper-and-pencil testing should not be taken for granted.

In the following statement, Hamilton et al. (2000) reflect the inconclusiveness of the research and demonstrate the complexity of the equivalence question by suggesting that variables other than the medium of the test (whether it is electronic or paper-and-pencil) could affect the outcome.

Additional research is also needed [when using electronic testing] to examine differences in medium effects on tests in different subjects as well as for different examinee groups. This research is especially important in contexts in which there is a need to compare the results from the two approaches [electronic and paper-and-pencil] to testing. (p. 20).

Hamilton et al. imply that a single, one-size-fits-all answer does not exist for whether electronic and paper-and-pencil tests are equivalent. Other variables could include, but are not limited to the subject being tested (math, science, English, etc.) or characteristics of the test-takers (age, computer experience, computer anxiety, test anxiety, etc.).

Existing research is not conclusive as to whether identical test questions administered electronically and in paper-and-pencil may be considered comparable. If administering standardized tests electronically when the test scores will be compared to paper-and-pencil versions of the same test, the common recommendation among researchers is to equate the tests (Bugbee, 1996; Bunderson et al., 1989; Hamilton et al., 2000; Mazzeo & Harvey, 1988; Mead & Drasgow, 1993; Wise & Plake, 1989; Yoes, 2000). Equating is a mathematical process used to adjust for any potential differences in test difficulty between two or more versions of the same

test (Camara, 2002; Wainer et al., 2002). Utilizing an equating process is especially important when administering electronic tests in a high-stakes testing environment where the test scores are compared with paper-and-pencil scores and then used to determine serious consequences such as grade retention and promotion or high school graduation.

Electronic Testing Environment

Teachers and administrators who have not experienced electronic testing often ask how the testing environment differs. Except for the anticipated differences such as students sitting at computers and test administrators not distributing printed test booklets and answer documents, the environment depends largely on the functionality of the electronic testing software and the requirements and policies of the assessment program.

Testing software. From a 2001 report published by the Pew Foundation, 94% of teenagers surveyed stated they use the Internet to conduct school research. Seventy eight percent said they believe the Internet helps them with schoolwork (Pew Research Center for People and the Press, 2001). Given this data, it seems that developing testing software that utilizes the same skills as those needed to browse the Internet would be reasonable. In fact, many electronic testing companies are using a browser-like format for the appearance of their electronic testing software. The applications are graphical in nature and resemble the look of an industry standard Web browser such as Internet Explorer.

The type of electronic test delivery model being used affects what functionality the testing software must have. If the electronic test is based on the linear test delivery model or the LOFT model then students need the ability to navigate forward and backward through the entire test, review items, skip items, and change their answers before submitting their test for scoring.

If the delivery model used is the testlet model, then students must be able to review questions only within the individual testlet in which they are working at the time.

The CAT delivery model does not require testing software with full navigation. Instead, this software must operate efficiently in order to avoid noticeable delays between the time a test-taker submits an answer and when the next question is displayed. This ability to avoid delays also depends on the network infrastructure and network bandwidth available to the testing software within the physical location of the test administration.

In addition to basic navigation functionality, some electronic testing applications have attempted to mirror more closely the test-taking options available in the paper-and-pencil testing environment. A number of software vendors have incorporated an option for test-takers that is similar to how students can mark items to be reviewed in a paper test booklet. By clicking a check box on the screen with the item, that item will be added to a review list. This list may be recalled by the test-taker at any time, and the testing software displays it automatically at the end of the test.

Much of the attention to electronic testing software focuses on what the student test-takers experience, but the administrative aspect of electronic testing software is equally important to the successful implementation of electronic testing. The administrative software must be user-friendly and efficient for those adults administering electronic tests in K-12 education.

Administrative functions of electronic testing software include (a) loading student data; (b) scheduling tests for individual students; (c) assigning administrative access to other school personnel; (d) granting test access to students; (e) controlling student access to tests; and (f) requesting, viewing, printing, and archiving student test results. Current electronic testing

systems address these functions differently, and some more efficiently than others, but this general functionality must exist within an electronic testing system in order to be considered feasible for administering tests in K-12 education.

Test security. The electronic testing software is the interface through which students take the test, but if well planned, the software can provide one or more layers of test security at the same time. Especially in the high-stakes testing environment, item exposure, or the total number of times an item is used and over what span of time that usage occurs, is a concern (Bennett, 2002a, 2002b; Davey & Nering, 2002; Hambleton, 2002; Parshall et al., 2000; Wainer, et al., 2000). If an item bank is compromised and items become public knowledge, any efforts to systematically control item exposure are futile.

With this in mind, the testing software must be able to protect the physical integrity of the test items. The ability to print, email, transfer, or copy and paste test items from within the testing software must be disabled to ensure the security of test items. Test administration policies and procedures must be considered to prevent secure test items from being shared via photographs or text messaging on mobile devices.

With test items presented on the computer via the testing software, it is critical to know where those images are being stored before the test begins, while the test is being taken, and after the test is completed. Most current electronic testing takes place in a client-server environment where the test content is hosted on a secure server and transferred to the client workstation at the time of the test. The server on which the data are stored must be accessible only by a secure Internet connection such as with an https protocol and a secure socket layer (SSL) connection. A valid user ID and password should be required in order to gain access to the host server. For increased security, any test content or student data being transferred over the Internet should be

encrypted, or secretly coded, and remain encrypted until the testing software on the client workstation is launched and proper authentication is provided to decrypt the data. This is especially important in the case of high-stakes Web-based testing.

Once the test content is transferred to the client workstation and decrypted into legible test items, the items remain vulnerable at least during the time that testing is taking place. The level of vulnerability and risk of item exposure increases if the electronic testing software has no control over the test-takers' access to other software applications such as email or word processing. Especially important is whether the test items are stored on client workstations in their decrypted format and for how long they remain on the workstation after the test is completed. If test items are stored in random access memory (RAM) on the workstation during the test, once the computer is shut down, the items no longer will be available. If, however, the items were recorded to the hard drive of the computer in their decrypted format, those items could be retrieved from the computer at a later time, even if the testing software deleted them, by using readily available data recovery utilities.

Another technical concern regarding test security, especially for high-stakes testing, is the ability to know what software is installed on the computers or computing-devices being used for testing. Electronic testing in K-12 schools is likely conducted on computers that are used for instructional purposes when not used for testing. If ambitious test-takers were to have access to these computers before testing, it is possible to install software that functions as "stealth spyware". This type of software runs undetected in the background of the computer and is able to transmit a real-time image of what is taking place on the screen to another specific computer located on the network. Such software can take screen shots at pre-set intervals and save them as

image files or transmit them to another computer via the network. Awareness and control of the software installed on the workstations to be used for high-stakes testing is critical to test security.

The arrangement of workstations where the electronic testing will occur is critical to test security especially if the test delivery model used is the linear model. Test administrators must minimize the ability of students to view one another's monitors during testing. If wireless laptops are used for testing, rearranging the room to avoid this scenario is possible. In most cases, this is not an option. Potential solutions include administering more than one test subject in the room and staggering test-taker seating such that no two tests in the same subject are administered on adjacent computers. Creative school divisions developed various types of low-cost barriers to place between computers to ensure security such as cardboard cubicles or file folders taped around computer monitors to limit the range of vision. This specific security concern is lessened when a CAT is administered because the students will not receive the same items throughout the test.

A potential problem in electronic testing that also exists in the paper-and-pencil environment is whether the actual identity of the test-taker matches whom they purport to be. In a K-12 school environment, it is helpful when the individual administering the test is able to identify the student test-takers by name. Good testing practices recommend against classroom teachers administering high-stakes tests to their own students, but having other school personnel, who are familiar with the students, administer the tests can be effective.

A feature of most electronic testing software that assists with test security concerns is that a student may be logged into the testing system at only one location. Any attempt to login simultaneously from another location would be denied. Displaying the name of the student on the screen throughout the test is a software feature that can assist test proctors as they supervise

the test administration. The student name appearing on the screen is the student to whom the test is being credited and should be the student sitting at the computer taking the test.

Security of Web-based high-stakes testing is a continuing development. Additional security features must be considered as new threats are discovered, improved security technologies become available, and the demand for security increases due to the high-stakes associated with test scores.

Training for Students, Teachers, and Administrators

Properly training end users is critical to successfully implementing electronic testing in K-12 education. The adults responsible for administering tests have multiple responsibilities beyond testing in their schools and need to be capable of setting up and administering electronic tests efficiently. As part of Virginia's statewide implementation of electronic testing, the state's Department of Education offered hands-on training to the school divisions and a Web-based tutorial for test administrators. The hands-on training was more effective for training school personnel how to (a) load student data, (b) schedule tests for individual students, (c) assign administrative access to other school personnel, (d) grant test access to students, (e) control student access to tests, and (f) access student test results. In addition to these administrative functions, test administrators and proctors must be familiar with the software the test-takers will use so they may assist appropriately if needed.

Students taking an electronic test for the first time may need training in how to navigate through a test using the testing software. The students must know how to record their answers, change their answers, navigate forward and backward as allowed, and submit their test for scoring.

The involvement of the technology staff in schools is vital to the success of electronic testing, but these individuals may be overlooked when training plans are formulated. The electronic testing systems available for use in schools may have different installation and configuration options and may require the presence of specific hardware or software to function properly. Knowledge of how to troubleshoot the electronic testing system is valuable for school and division-level technology staff to receive before testing begins. By ensuring the local technology staff receives training in the technical details of the electronic testing system, a school division reduces the risk of extended testing interruptions caused by technical problems. While receiving training cannot eliminate all risk of technical problems, it does prepare individuals with knowledge and a plan of action for addressing problems when they occur.

Stakeholders of online testing beyond those directly involved in administering and taking electronic tests include individuals such as (a) legislators, (b) policy writers, (c) community members, (d) school board members, and (e) parents. Training or educating these stakeholders in what an electronic testing system can provide and what benefits exist can be crucial to the support and continuation of an electronic testing program.

System Performance Issues

As presented previously, South Dakota's implementation of electronic testing was plagued by system performance issues. "The DACS [Dakota Assessment of Content Standards] was a fiasco from day one" (Homan in Borja, 2003, Fiasco from Day One section, ¶ 7). The technical problems in South Dakota were severe enough that the electronic testing program was suspended.

Issues of system performance vary among electronic testing implementations and can range from students experiencing delays in the presentation of test items on their monitor to a

complete system failure where no data can be transmitted and the data are lost. Factors affecting system performance include (a) the technical infrastructure installed where the testing will occur, (b) the presence of trained, local technical support staffs, (c) the selected Web-based test delivery model, and (d) the selected electronic testing system.

Infrastructure and network bandwidth were defined previously in the section *Technology Terminology and Concepts*. Well-maintained local infrastructure and adequate availability of network bandwidth are vital to successfully implementing electronic testing and avoiding system performance issues. Network congestion due to insufficient network maintenance or an over-allocated network bandwidth will result in varying degrees of system performance issues. Data loss and total system failure are possible if problem persist throughout an electronic testing administration. Local technical support staffs trained in network management and network maintenance are needed prepare for electronic testing. Expenses associated with providing technical support and adequate networks are ideally included in an implementation budget for electronic testing.

While considerable time usually is spent on reviewing the psychometric implications of selecting a particular electronic test delivery model, the technical implications are overlooked and can result in system performance issues costly to the potential success of the program. The more highly adaptive delivery models require greater bandwidth among concurrent testers. Network communication must occur after each item is answered so that the next item may be identified and then delivered to the test-taker's workstation. These communications require network bandwidth for each user while they are testing. In a linear test delivery model where the items and their order of presentation are known in advance, the electronic testing system could

be designed to download the test forms prior to all students beginning their tests. This would reduce the concurrent demand for bandwidth and improve overall system performance.

Another issue related to system performance is the number of computer workstations required to administer tests electronically. Beyond the logistics and finances needed to acquire the computers, the local network infrastructure and bandwidth must be capable of supporting the number of computers used for testing. Additional computers on a network translate to additional communication and data transfers that require bandwidth, network resources, electrical resources, and human resources for technical support. To ensure the required levels of system performance, these needs cannot be overlooked at the local level, and the electronic testing vendors must monitor their system-wide infrastructure to ensure it is capable of handling the concurrent testing volume demanded by the sum of their customers. The vendors have the same concerns as school divisions in terms of bandwidth, network resources, electrical resources, and human resource, but all on a larger scale. They have the added responsibility of ensuring the design of the electronic testing system will support high volumes of concurrent testers.

Costs of Electronic Testing

The cost of electronic testing is higher than its paper-and-pencil counterpart (Bennett, 2002a, 2002b; Hamilton, et al., 2000; Stout, 2002). The initial costs of preparing for a linear electronic test delivery exceed the costs of preparing for a similar linear test delivery in paper-and-pencil (Bennett, 2002a, 2002b; Stout, 2002). Only after the electronic system is established and higher volumes of tests are administered does the cost differential begin to decrease. Eventually, the savings from reduced printing, packaging, shipping, and scoring of paper-and-pencil test materials are realized.

If features of an electronic test delivery system not possible in a paper-and-pencil test, such as test adaptivity, are implemented, the costs are likely much higher. The added costs of electronic testing may result in a more precise measurement of student achievement, a faster return of test scores, and the opportunity to assess new test constructs with more cognitively complex item types (Bennett, 2002a, 2002b; Luecht & Clauser, 2002; Folk & Smith, 2002; Stout, 2002).

When considered in isolation, the financial challenge of implementing electronic testing in K-12 education is staggering. By including any state and local investments in technology infrastructure already being made in the schools, the cost of electronic testing is high, but perhaps more acceptable. In Virginia for example, over a 3-year period, the General Assembly appropriated approximately \$58 million annually for local school divisions to upgrade their technology infrastructure. Because these funds, approximately \$174 million, are benefiting the schools' instructional efforts throughout the academic year in addition to supporting the electronic testing implementation, it is debatable whether this total amount of funds should be attributed to the cost of implementing electronic testing. Regardless of how the funds are categorized, the electronic testing implementation in Virginia required widespread infrastructure upgrades within the schools to be successful.

Applying a Theoretical Change Model to the Implementation of Electronic Testing

Electronic testing is a new concept in K-12 education. That statement alone can generate conversation in a room of educators, as new concepts regularly come and go in K-12 education, requiring time and effort from educators, but often resulting in few benefits or lasting change. It seems no part of education is exempt from changes intended to improve the status quo. Regardless of whether the topic is teaching students, communicating with parents, empowering

teachers, or leading a school, the new concepts and innovations in education exist in large numbers and are available for implementation. “The main problem is not the absence of innovation in schools, but rather the presence of too many disconnected, episodic, fragmented, superficially adorned projects” (Fullan, 2001, p. 21).

How can electronic testing be introduced successfully into schools, when many are already are overburdened with new initiatives and change? In this next section, I present a theoretical model for educational change created by Fullan (2001, 2007), and I investigate the implementation of electronic testing based on this model. Fullan is a prolific author and world-renowned authority on educational change.

Change Theory in Education

Fullan (2001, 2007) refers to educational change as having two main elements: *what* change to implement and *how* that change is implemented. An organization is not as likely to experience successful, sustained change without the full development of each of these. “*What*” change to implement is determined during Phase I of the change process, or *Initiation*. “*How*” to implement the selected change is determined and carried out during Phase II, or *Implementation*. Fullan completes his model of the change process with Phase III, or *Institutionalization*.

Phase I: Initiation. To an untrained observer, the decision to implement something new may appear to be the beginning of the change process. Instead, the decision to implement a change is the conclusion of the first phase of the total change process (Fullan, 2001, 2007). Phase I is referred to by Fullan as *Initiation*, but he offers alternative labels such as *adoption* or *mobilization* that may be used to refer to the same phase. The work done in Phase I includes (a) preliminary recognition of the problem, (b) identification of changes that could solve the problem, (c) the selection of the change that best fits the situation, and (d) the decision to

proceed with Phase II, or Implementation. Many factors can affect *Initiation*, or Phase I of Fullan's (2001, 2007) change process. Ideally, the decision to implement change in education is driven first by the desire to improve the existing situation and second, by educational theory that strongly suggests the selected change indeed will make the situation better. Unfortunately, this is not often the case. As Fullan indicates, *Initiation* may be prompted by factors completely removed from educational theory such as community pressure, changes in leadership, or changes in funding. The list of variables potentially affecting *Initiation* is endless, but Fullan creates eight main factors under which most variables can be categorized. The eight factors are presented in Table B.4 with a description of each. The order of the factors is irrelevant, but whether a factor affects *Initiation* independently or in combination with one or more other factors may be important. Fullan offers, "For example, community pressure combined with a problem-solving orientation will have quite different consequences than community pressure combined with a bureaucratic orientation" (p. 53).

The initiation phase and electronic testing. During the 2002-2003 academic year, 12 states and the District of Columbia administered some form of electronic tests in their public schools (Olson, 2003b). That they implemented some electronic testing indicated that the 13 education agencies completed the Initiation Phase where, for whatever reasons, they made the decision that electronic testing was a change they would implement.

Five of the states indicated the tests they administered electronically were designed to meet the requirements of *No Child Left Behind*. The federal legislation may have been a factor affecting the *Initiation* Phase in these states. Twelve of the states administering electronic tests in

Table B.4.

Factors Affecting Initiation (Phase I) of the Change Process in Education

Factor	Description/Examples
1. Existence and Quality of Innovations	Increased availability and improved quality of innovations can contribute to initiation. Examples include: school reform models (Success for All, High Schools That Work); instructional models (Reading Recovery, Higher Order Thinking Skills, or Interactive Mathematics Program); and Web-based applications (Blackboard, WebCT, Concert).
2. Access to Innovation	Proliferation of professional organizations, consortiums, and partnerships in which information and opportunities for innovations are shared can contribute to initiation.
3. Advocacy from Central and/or School Administration	Interest from one or more administrators who can provide internal authority, support, and access to internal and external resources can affect initiation.

Table B.4 (continued).

Factors Affecting Initiation (Phase I) of the Change Process in Education

Factor	Description/Examples
4. Teacher Advocacy	Successful teacher-implemented change at the classroom level can affect initiation. This factor most often combines with one or more additional factors to implement higher level change.
5. External Change Agents	National and regional education service centers, laboratories, and boards can contribute to initiation. For example: North Central Regional Educational Laboratory, Appalachia Educational Laboratory, Southern Regional Education Board, private consultants, foundations, and business partners.
6. Community Pressure/Support/Apathy	Reaction or lack of reaction from a community can affect initiation. For example: A perceived need for change by community members due to population shifts, overcrowding, work force changes, controversial decisions, unpopular decisions, increased violence, increased crime.

Table B.4 (continued).

Factors Affecting Initiation (Phase I) of the Change Process in Education

Factor	Description/Examples
7. New Policy and/or Funds (Federal, State, Local)	National, state, and local legislation providing funds or new requirements can contribute to initiation. For example: No Child Left Behind, Children’s Internet Protection Act, Virginia Standards of Learning, Virginia Web-based SOL Technology Initiative.
8. Problem-Solving and Bureaucratic Orientations	Addressing problems or meeting bureaucratic needs can affect initiation. For example: Cost-saving measures, increased teacher turnover, or school board elections.

Note. Adapted under Fair Use from *The New Meaning of Educational Change* (3rd ed.) by M. Fullan, 2001, p. 54.

2002-2003 used the Internet as their means of delivery. If schools in these states already had access to high- speed Internet connectivity, that access was perhaps an important factor in their *Initiation* Phase.

The change process is dependent on so many dynamic variables that none of the 13 education agencies administering electronic tests at that time was likely to have experienced the exact same *Initiation* Phase. Their *Initiation* Phases likely were affected by similar factors such as new policy, access to innovation, or advocacy from different groups, but the timing and degree of effect from those factors would have varied. The distinctiveness of this phase across different groups, different locations, and different times is why it can be difficult and quite time consuming. No two *Initiation* Phases will include the same steps.

While it is clear that the *Initiation* Phase can be started from a variety and combination of sources, it is not clear what characteristics lead to a successful *initiation* of change in education (Fullan, 2001, 2007). Can change only be initiated successfully when the majority of stakeholders agree with the change in advance? Having the support of the majority is a benefit, but Fullan describes social systems as having inertia and therefore requiring a high commitment of energy from the change initiators if they hope to overcome the majority's tendency not to change. According to Hatch (2002), if time and money are spent by schools to explore change options and a vote of teachers and staff members follows, the outcome likely will not be the result of informed voters, but rather a measurement of how effective the campaign was to select a particular program. Teachers and school administrators usually do not have the time and funds needed to develop sufficient knowledge of options before making a choice; therefore, they may make uninformed decisions about change.

Phase II: Implementation. In Fullan's (2001, 2007) change model, the Implementation Phase is the next major step in the process, and it consists of putting into action the new concept or the new program. "Implementation is critical for the simple reason that it is the means of accomplishing desired objectives" (Fullan, 2001, p. 70). Regardless of whether the Initiation Phase was conducted carefully or carelessly and which of the eight factors affected it the most, the individuals carrying out the Initiation identified a specific change to be implemented. At this point in the process, either the change will expand to the next level of complexity, or it will simply stop and never be realized. In his change model, Fullan (2001, 2007) identifies nine factors that affect the implementation of change. In the paragraphs that follow, I briefly described the factors presented by Fullan. In Table B.5, I related each of these factors to a question and answer that I experienced during the implementation of electronic testing in Virginia.

The first factor affecting implementation is *need*. Change is more readily accepted if it can be linked to a clear need. If, for example, a change were initiated to solve a problem, then the stakeholders are more likely to accept implementing the change if they understand the problem will be solved and their needs will be met. Communicating the need or needs met by the implementation of change is a good practice and may be necessary to generate buy-in from stakeholders.

The implementation of change is affected by how *clearly* the stakeholders understand the goals and the means for achieving the goals. If the change is explained in broad terms with no explanation and no clarity of how it will be accomplished, the level of frustration and anxiety among the stakeholders rapidly increases. This can negatively influence the change process.

Table B.5

Factors Affecting Implementation (Phase II) of the Change Process in Education

Factor	Related Question	Potential Answer
Need	“Why do we need to administer SOL tests electronically?”	“Receiving a pass/fail report from a paper-and-pencil test administration can take up to 14 days. Test scores of students waiting to graduate are needed back more quickly so we know if they need to be re-tested and in what areas of the test they did not perform well. By administering them electronically, we can give our tests later in the school year and get the scores back in time to help the students who fail.”
Clarity	“How are we going to administer all of our SOL tests in the 2 week test window without having a computer for every student?”	“The length of the SOL test window is flexible, so we can use as many days as needed to administer our SOL tests on computers. We are receiving two new computer labs as part of this project so we will rotate our students through our five computer labs until we are finished. Even by using more days to complete the testing, we still will get our results back sooner. This means we can administer the tests later in the school year.”

Table B.5 (continued).

Factors Affecting Implementation (Phase II) of the Change Process in Education

Factor	Related Question	Potential Answer
Complexity	Do you know how difficult this is going to be, and how many people will have to be involved?	“Yes, implementing electronic testing in our school is going to require a lot of work, but we’re going to have an assessment team and a technology team that will meet separately and then jointly to brainstorm what is needed to make electronic testing possible. A representative of each team will report the ideas and solutions in our next department chair meeting so we can begin to make plans.”
School Board and Community	“What has the school board said about this?”	The school board observed a presentation by DOE staff on how electronic testing is being implemented statewide and what the benefits are to schools. Each of the board members even took a sample test after the presentation and was pleased with what our students would be experiencing. They are interested in knowing how the students respond to taking their tests on computers.”

Table B.5 (continued).

Factors Affecting Implementation (Phase II) of the Change Process in Education

Factor	Related Question	Potential Answer
Principal	“Does the principal support the idea?”	“Yes, the principal is the one who heard about the possibility of conducting electronic testing when he attended a conference in the winter. He will be attending the training on how to use the system and has agreed to allocate time to get the students and teachers trained in using the system before testing begins.”
Teachers	“Do the rest of the teachers agree?”	“Most have expressed an interest in learning more about electronic testing, especially because it means their students can test later in the school year. Many of them have volunteered to serve on the assessment and technology teams that are being formed to prepare for it, and others have asked when they’ll be learning more about what’s involved.”
Government	“Why is the DOE staff involved?”	“The electronic testing is being implemented from the state level because the DOE has the ability to publish the SOL tests electronically and to provide funding for technology infrastructure from the state budget. By having it coordinated from the state level, all students are seeing the same standardized testing environment across the state even though the items are shown on computers.

Note. Adapted under Fair Use from *The New Meaning of Educational Change* (3rd ed.) by M. Fullan, 2001, p. 72.

The *complexity* level of the proposed change will have an effect on its implementation. Change with a high level of complexity requires a more detailed implementation process. Examples of complex change are new projects requiring lengthy, sustained effort by all teachers and students or widespread change encompassing large geographical areas as well as large numbers of participants. Complex change is more difficult to complete and usually carries a greater toll for failure.

High *quality and practicality* of the new concept or the new idea being implemented are critical to successful change implementation. This refers to the *quality* of thought and preparation invested in the change process, along with how *practical* the change is to implement in the given setting. For example, a change implemented solely for political reasons with no consideration for the cost or the consequences is of low quality and low practicality.

These four of the nine factors, or *need, clarity, complexity, and quality and practicality*, relate mainly to the characteristics of the newly implemented idea or concept. The next factors in Fullan's (2001, 2007) change model affecting implementation are related to the social conditions of change and how different groups of people affect change implementation. In the following paragraphs, I briefly described the next four factors, and related each of them to Virginia's implementation of electronic testing in Table B.5.

A *school district* is a common level from which school administrators implement change in education. Often a school district's history of change implementation is a strong indicator of the future success of new change implementation efforts. As Fullan (2001) states,

“The more that teachers or others have had negative experiences with previous implementation attempts in the district or elsewhere, the more cynical or apathetic

they will be about the next change presented, regardless of the merit of the new idea or program” (p. 80-81).

Successful change implementation can lead to more successful change implementation by the momentum generated. Similarly, however, the momentum generated by failed change implementation can lead to more failed implementations.

The *school board and community* have the potential to affect the implementation of change in education. This can occur by a school board hiring specific people or voting to support certain programs. Community members can affect change implementation by voting for candidates or supporting specific budget items. The attitudes of these groups and their willingness to support and cooperate with their schools can affect change implementation sometimes more deeply than providing funds or hiring additional people.

Shifting to the school level, *principals* can have a powerful effect on how well the implementation of change occurs. They often have the ability to legitimate change and to provide support psychologically, academically, and financially. They also have the ability to thwart change efforts. Fullan (2001) comments that few principals, however, receive adequate preparation to serve in the role of continuously managing change.

Teachers, both individually and as a collective group, can affect the implementation of change in a school. Their school’s experience with change implementation can play a role in how they handle new change, but their working relationships with one another in the school are also likely to have an influence on change implementation. Fullan (2001, 2007) lists collegiality, open communication, job satisfaction, support, and trust as key characteristics of teachers’ working relationships that can affect change implementation.

The last factor Fullan (2001, 2007) lists as having an effect on change implementation is government. The demand for educational reform from the federal level is an example of government playing a role in the implementation of change. *No Child Left Behind* included new funding, new initiatives, and new policies, and the potential to shape the implementation of educational change. However, Fullan states, “To the extent that each side is ignorant of the *subjective* world of the other, reform will fail – and the extent is great” (2001, p. 86). Fullan sees the changes implemented by government not as part of a process but instead, as a series of episodic events that government never connects in order to affect change collectively.

Phase III: Institutionalization. Institutionalization, or the continuation of the change that was implemented, is considered a less complex phase than Initiation or Implementation. Fullan acknowledges this is often the case; however, he cautions that Institutionalization must not be overlooked and should be treated as a separate phase where a decision is made to formally adopt the implemented change or to abandon it. *Institutionalizing* a change in a local school division could occur naturally if the idea or program was extremely beneficial and acknowledged as such by a majority of decision makers. If a change was sponsored by federal, state, or corporate funds and at the end of the implementation, the funds are discontinued, then the process of *institutionalizing* that change may be difficult. Fullan (2001, 2007) presented research indicating that initiatives or new programs implemented with temporary funds often do not continue beyond the initial funding period regardless of the strength of the *Implementation* phase. Managers or leaders of change must make a conscious effort to complete the change model by evaluating the implemented change, considering whether it is worth adopting permanently, determining the resources needed to sustain it, and then prioritizing it among all *institutionalized* changes.

Appendix C

Interview Materials

Topics to be Addressed:

- ❑ Background information and professional role of the participant (general and specific to the initiative)
- ❑ Origin of the Initiative (purpose, timing, feasibility, goals)
- ❑ Organizational structure and associated roles (VDOE, Executive Branch, Legislative Branch, localities, contractors)
- ❑ Perceived challenges at the beginning of the Initiative
- ❑ Procurement process
- ❑ Implementation (processes, scaling, training, public relations, etc.)
- ❑ Changes to individuals' roles due to online testing
- ❑ Changes in organizational structure and associated roles as implementation progressed.
- ❑ Barriers to successful implementation
- ❑ Lessons learned
- ❑ Current status of online testing in Virginia
- ❑ Post-interview: review interview transcript (edits, deletions, etc.)

Guiding questions:

- How did the Initiative come about?
- What was your role in implementing the Initiative? Did it change as the implementation advanced?

- What was the organizational structure of the people and groups associated with the Initiative? Who or what organization was overseeing the Initiative? Was it effective? Would you recommend changes to that structure?
- How do you view the relationship between technology and assessment in respect to implementing online testing?
- What did you perceive as the initial risks of transitioning Virginia’s high-stakes testing program to an online delivery system?
- How was funding generated to implement this Initiative? Has it been adequate? Have any changes been made in the original implementation plan that were brought about mainly due to funding issues?
- A “Request for Proposals” was published to solicit vendor participation in the Initiative. What is your recollection of that process?
- What process was used to select the current vendor? What were your main concerns regarding that process – either as it was being planned or as it was being carried out?
- What was the Demonstration Phase, and how was that planned and carried out? Was additional funding needed for that?
- Was the Demonstration Phase successful? From your perspective, what contributed to the success or problems?
- This is the documented criteria against which the vendors were evaluated (provide a copy of the criteria). Do you recall how and why it was developed in this manner, and which items do you believe were most important on this list?
- How was the selection committee chosen?

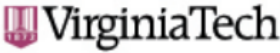
- What was the outcome of the selection process, and what were your reactions to that outcome?
- Has the implementation of online testing changed your job responsibilities (supporting, explaining, defending, managing, etc.)?
- After the vendor was selected, what were the next steps in the implementation? (Did a plan exist for the additional implementation? Was the delivery system fully developed when the contract was signed? Were further software developments needed or allowed? How were the tests put online? How is the process managed – by VDOE, by the vendor, mutually, etc.? How was the implementation scaled? How was training handled?)
- Does the state continue to closely manage the project or does the vendor manage the process of implementing online testing? (Reasoning for this?)
- Are the online tests the same tests as the paper-and-pencil tests?
- Was there concern about using an online test to replace a paper-and-pencil test score – especially given the updated graduation requirement related to passing SOL tests to earn verified credits? (How was this handled within the agency and within school divisions?)
- How was it decided who would participate in online testing (which divisions, which students)?
- Does online testing change the assessment program?
- What role did/do the school division personnel have in the implementation of online testing?
- Have the roles of school division personnel and the VDOE changed due to online testing, and if so, how?

- Did the technology that was needed for online testing already exist in the school divisions, and how was that determined? (What role did the vendor or the DOE or the divisions have? Was there adequate funding for the technology?)
- What types of risks were involved with online testing and what was done to mitigate any risks from the technology perspective? and from the assessment perspective?

Appendix D

Approvals and Certifications

Institutional Review Board Approval Letter

	<p>Office of Research Compliance Institutional Review Board North End Center, Suite 4120, Virginia Tech 300 Turner Street NW Blacksburg, Virginia 24061 540/231-4606 Fax 540/231-0959 email irb@vt.edu website http://www.irb.vt.edu</p>
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MEMORANDUM

DATE: October 30, 2014

TO: David Parks, Sarah Jane Susbury

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)

PROTOCOL TITLE: Virginia's Implementation of Online High Stakes Assessments

IRB NUMBER: 09-549

Effective October 29, 2014, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the Continuing Review request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

<http://www.irb.vt.edu/pages/responsibilities.htm>

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	Expedited, under 45 CFR 46.110 category(ies) 6,7
Protocol Approval Date:	November 16, 2014
Protocol Expiration Date:	November 15, 2015
Continuing Review Due Date*:	November 1, 2015

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Invent the Future

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
An equal opportunity, affirmative action institution

Date*	OSP Number	Sponsor	Grant Comparison Conducted?

* Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.

Fair Use Certifications and Permissions Letter

4/5/2015

VT Fair Use Analysis Results

Draft 09/01/2009

(Questions? Concerns? Contact Gail McMillan, Director of the Digital Library and Archives at Virginia Tech's University Libraries: gailmac@vt.edu)

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Virginia Tech ETD Fair Use Analysis Results

This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.

Name: Sarah J. Susbury

Description of item under review for fair use: Page 54 of Fullan, M. (2001). The new meaning of educational change (3rd ed.). New York: Teachers College Press.

Report generated on: 04-05-2015 at : 17:51:26

Based on the information you provided:

Factor 1

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

Factor 2

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

Based on the information you provided, your use of the copyrighted work weighs: *in favor of fair use*

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VT Fair Use Analysis Results



Draft 09/01/2009

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Virginia Tech ETD Fair Use Analysis Results

This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.

Name: Sarah J. Susbury

Description of item under review for fair use: Page 72 of Fullan, M. (2001). The new meaning of educational change (3rd ed.). New York: Teachers College Press.

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Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

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This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.

Name: Sarah J. Susbury

Description of item under review for fair use: Page 12-13 of Olson, L. (2003, May 8). Legal twists, digital turns. Education Week, 22(35), p. 11-16.

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Factor 3

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

Factor 4

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

Based on the information you provided, your use of the copyrighted work weighs: *in favor of fair use*

4/5/2015

VT Fair Use Analysis Results



April 6, 2015

Kimberly S. Carson
Vice President
State Services
Assessment & Instruction
Pearson
2510 N Dodge St.
Iowa City, IA 52245

Dear Ms. Carson,

This letter is to confirm our recent communication regarding my use of two Pearson color photographs. I am completing a doctoral dissertation at Virginia Polytechnic Institute and State University entitled *Virginia's Implementation of Web-based High-stakes Testing in Public Education*. I am requesting permission to reprint two color photographs that depict blue numbered carts with paper answer documents prepared for processing in a Pearson facility.

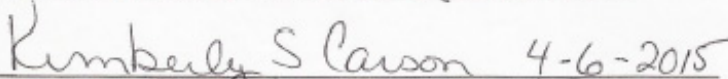
The requested permission extends to any future revisions and editions of my dissertation and to the prospective publication of my dissertation by ProQuest/UMI Company. These rights will in no way restrict republication of the material in any other form by you or by others authorized by you. Your signing of this letter will also confirm that your company owns any and all copyrights to the above-described photographs.

If these arrangements meet with your approval, please sign this letter where indicated below and return it to me at your earliest convenience. Thank you.

Sincerely,


Sarah J. Susbury

PERMISSION GRANTED FOR THE USE REQUESTED ABOVE:


Signed: Kimberly S. Carson Date: 4-6-2015
Vice President
State Services
Pearson