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5th grade student performance on Virginia Standards of Learning computer/technology assessment: An analysis of variables

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5TH GRADE STUDENT PERFORMANCE ON VIRGINIA STANDARDS OF LEARNING COMPUTER/TECHNOLOGY ASSESSMENT: AN ANALYSIS OF VARIABLES

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> To laugh often and much, to win the respect of intelligent people and the affection of children, to earn the appreciation of honest critics and endure the betrayal of false friends, to appreciate beauty, to find the best in others, to leave the world a bit better, whether be a healthy child, or garden patch … to know that even one life has breathe easier because you have lived. This is to have succeeded!
>
> \- Emerson

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5TH GRADE STUDENT PERFORMANCE ON VIRGINIA STANDARDS OF LEARNING COMPUTER/TECHNOLOGY ASSESSMENT: AN ANALYSIS OF VARIABLES

Abstract

Technology impacts students and teachers on a daily basis. This study examined the role that Internet access, the number of computers available for student use in the classroom, and the location of computers in the elementary school setting played in student performance on the Virginia's 5th-grade SOL computer/technology assessment. It also analyzed the degree of emphasis placed on technology integration in the classroom setting by analyzing performance-based teacher evaluation instruments across the state of Virginia in reference to expectations associated with technology integration. This was an attempt to isolate some of the variables that may increase student achievement as shown through Virginia's Computer/Technology Standards of Learning assessment for 5th grade students across the state.

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5TH GRADE STUDENT PERFORMANCE ON VIRGINIA STANDARDS OF LEARNING COMPUTER/TECHNOLOGY ASSESSMENT: AN ANALYSIS OF VARIABLES

Chapter 1: The Problem

Introduction

As educators begin this new millennium with hopes for a brighter future for their students, they also face the challenge of educational reform. Educational reform is not a new endeavor. For years, it has been the focus of local and state legislation. The difference, however, is that this new era of reform is closely tied to the involvement of the federal government. President George W. Bush calls education a national priority and a local responsibility. On January 8, 2002, his educational reform package, No Child Left Behind (NCLB), was signed into law. "This new law represents his education reform plan and contains the most sweeping changes to the Elementary and Secondary Education Act since it was enacted in 1965" (Olsen, 2002, p.1). NCLB contains four basic reform principles: 1) stronger accountability for results, 2) increased flexibility and local control, 3) expanded options for parents, and 4) an emphasis on teaching methods that have been proven to work. The first basic reform principle, stronger accountability for results, is the cornerstone of this inquiry.

Accountability

NCLB has forced educators across the country to re-assess student achievement and to accept accountability for the results. One of the first steps in discussing the issue of accountability is to accurately define the word. "Accountability pertains to the need to provide students with benchmarks for learning, the demands of the public to be able to assess school improvement on the basis of quantifiable results, and the need to make clear what children should be prepared to know and do as they face ever increasing challenges in a competitive marketplace" (Allen, 1994, p.1). The assessment requirements under NCLB hold schools accountable for the achievement of all students (2002). One way to enhance this achievement is through the integration of technology in the educational setting.

Accountability in the area of technology means that teachers must instruct students in the use of technological tools that are available to them. Teachers must also integrate technology into all areas of the curriculum. The acquisition of technological skills as set forth in NCLB, indicates that student academic achievement will improve through the integration and use of technology. "Technology empowers the education reforms of No Child Left Behind by expanding educational opportunities for students, equipping teachers with engaging instructional tools, and enabling parents to become more involved in their child's education" (U.S. Department of Education, 2003, P.1).

Since 1998, Virginia has been holding school districts accountable for students' academic achievement through statewide testing. These assessments are based on the objectives set forth in The Virginia Standards of Learning (SOL) and include testing students in grades K-12 in the areas of English, Mathematics, History / Social Studies, Science, and Computer/Technology. In order to maximize opportunities for student acquisition of the necessary skills for academic success, computer/technology skills are imperative. As Secretary of Education, Ron Paige insisted, “We must focus on how we use technology to get results” (U. S. Department of Education, 2003, p.1). Technology skills are the foundation for integration-literacy, which is the ability to use technology combined with a variety of teaching and learning strategies to enhance students’ learning. As a result, students will gain the skills necessary to gather information from multiple sources, select relevant material, and organize this material so that they will be able to make informed decisions.

Most states and school districts, recognizing the responsibility to prepare students to work and live in a technological society, have adopted standards for technology integration in the educational setting. In 1999 the Office of Technology Assessment (OTA) conducted a survey in which 43 states reported that they required or recommended integrating computers or information technology into the curriculum. Of those 43 states, 19 required high school seniors to demonstrate computer competency before graduating (Anderson & Ronnkvist, 1999). Educators across the nation realize that the ability to use technology is an indispensable skill that students need to master. "Those unable to use . . . [technology] face a lifetime of menial work" according to the Secretary's Commission on Achieving Necessary Skills (U.S. Department of Labor, 1991).

Technology Skills

In Virginia students are assessed as to their mastery of computer/technology skills at grades 3, 5, and 8. As developed through the SOL, there are a number of skills that students should acquire by the end of the 5th-grade. These skills and/or objectives are as follows:

C/T5.1 The student will demonstrate a basic understanding of computer theory including bits, bytes, and binary logic.

C/T5.2 The student will develop basic technology skills.

- Develop a basic technology vocabulary that includes cursor, software, memory, disk drive, hard drive, and CD-ROM.
- Select and use technology appropriate to tasks.
- Develop basic keyboarding skills.
- Operate peripheral devices.
- Apply technologies to strategies for problem solving and critical thinking.

C/T5.3 The student will process, store, retrieve, and transmit electronic information.

- Use search strategies to retrieve electronic information using databases, CD-ROMs, videodiscs, and telecommunications.

- Use electronic encyclopedias, almanacs, indexes, and catalogs.
- Use local and wide-area networks and modem-delivered services to access information from electronic databases.
- Describe advantages and disadvantages of various computer processing, storage, retrieval, and transmission techniques.

C/T5.4 The student will communicate through application software.

- Create a 1-2 page document using word processing skills, writing process steps, and publishing programs.
- Use simple computer graphics and integrate graphics into word-processed documents.
- Create simple databases and spreadsheets to manage information and create reports.
- Use local and worldwide network communication systems.

Virginia Department of Education, 2002

These objectives quantify the skills for which each student is to be held accountable and the skills students must demonstrate to show proficiency in the use of technology. It is ironic that the students' proficiency in the area of computer/technology is measured by a test that does not require the students to actually use a computer.

In order for students to demonstrate proficiency in these various areas, teachers must model technology integration in the curriculum so that students can better understand the vital role technology can play in learning enhancement. Virginia's new Enhancing Education Through Technology Program (Ed Tech) emphasizes the importance of not just increasing technology capacity within schools, but integrating it with the curriculum (Virginia Department of Education, 2002).

Teacher Proficiency

In order for students to demonstrate proficiency, school districts must first have teachers who are proficient in the area of technology integration. The question is whether or not teachers in the state of Virginia are proficient in technology integration. Over the past several years, The Virginia Department of Education (VDOE) has tasked each individual school district in Virginia with creating a way to assess teachers' technology proficiency and provide training for those needing support. The standards, set forth in 8 VAC 20-25-30, are an important first step for the state of Virginia in setting precedence as to the importance of technology integration in the classroom. The standards are as follows:

A. Instructional personnel shall be able to demonstrate effective use of a computer system and utilize computer software.

B. Instructional personnel shall be able to apply knowledge of terms associated with educational computing and technology.

C. Instructional personnel shall be able to apply computer productivity tools for professional use.

D. Instructional personnel shall be able to use electronic technologies to access and exchange information.

E. Instructional personnel shall be able to identify, locate, evaluate, and use appropriate instructional hardware and software to support Virginia's Standards of Learning and other instructional objectives.

F. Instructional personnel shall be able to use educational technologies for data collection, information management, problem solving, decision-making, communication, and presentation within the curriculum.

G. Instructional personnel shall be able to plan and implement lessons and strategies that integrate technology to meet the diverse needs of learners in a variety of educational settings.

H. Instructional personnel shall demonstrate knowledge of ethical and legal issues relating to the use of technology.
(Code of Virginia, 1998, p.2)

"Teachers are the main gatekeepers in allowing educational innovations to diffuse into the classrooms" (Collis, Knezek, Lai, Miyashota, Pelgrum, Plomp, & Sakamoto, 1996, p.31). The integration of technology into the curriculum is one such educational innovation. However, as "gatekeepers", teachers must first understand technology integration and how it may be used to enhance learning and student achievement. "Many teachers who initially believe that technology integration is more trouble than it is worth are willing to use it in their classes if they see a benefit in it for their students" (Byrom, 1997, p.3). As Collis et al. (1996) contended, the classroom teacher directly impacts "the eventual success or lack of success of any computers-in-education initiative" (p.22). Studies indicate improvements in student passing rate on tests that are closely related to material covered in computer-assisted instructional packages (Kulik & Kulik, 1991). These packages include the use of computers in the classroom to enhance instruction and make the learning process more relevant for the students. Thus, it is important that districts clarify teacher and student expectations in reference to technology.

Thus far, the VDOE has stipulated that teachers must show proficiency in the eight technology standards to receive licensure. Subsequently, in 1999 the Virginia General Assembly amended Section 22.1-298 of the Code of Virginia to read as follows: "On and after July 1, 2003, persons seeking initial licensure or license renewal as teachers must demonstrate proficiency in the use of educational technology for instruction" (p. 42).

Meaningful technology integration means using technology in teaching strategies in order to enhance instruction. Although teachers may demonstrate technology skills, they may lack the knowledge for meaningful curricular integration of these skills across content areas (Fatemi, 1999). According to the CEO Forum on Education and Technology (1997), fewer than 3 % of America's schools are effectively integrating technology into classroom practices. Furthermore, 12% of schools that have and use technology are not devoting adequate resources and time for integrating technology into the curriculum and/or for professional development. Another 26 % of our nation's schools that have and use computers still consider them "either an add-on activity or are simply technological versions of the workbook approaches that are already prevalent in the nation's classrooms" (Hadley & Sheingold, 1993, p. 265).

Hativa and Lesgold (1996) argued that almost three decades after the computer was first introduced in schools, "it has not brought about a wide spread revolution in methods of teaching or in school structure and organization" (p. 134). Additionally, another study by Parks and Pisapia (1994) concluded that even as millions of dollars are being spent to ensure every classroom is multimedia-equipped and Internet-connected, only 5% of the K-12 teaching force is estimated to effectively integrate technology into every day practice.

Since technology integration has been shown to improve academic achievement, it is imperative that teachers integrate technology into the curriculum. Students will then have the skills needed to tackle the technological demands of the 21st century. Technology enhances learning, and as such, it is not enough to have a computer and Internet access in every classroom. Technology must be integrated, becoming an intricate part of the curriculum. Like any other educational tool, the value of technology comes from its use, not from merely having access to it.

Statistics have shown that the percentage of students who reported using a computer at school at least once a week has risen from 1984 – 1996 (NCLB, 2001). This increase could mean that teachers are integrating technology into instructional strategies in the classroom setting. One way to substantiate technology integration in the curriculum is through performance-based teacher evaluations. These instruments reflect the division's expectations for instructional personnel and send clear messages to staff as to the priorities of the division. Thus, the level of technology integration into the curriculum can be quantitatively addressed. Analyzing what districts across the state are holding teachers accountable is a way to verify the expectations for technology integration.

The conceptual framework shown in Figure 1 represents the basis of this study. The three outer squares represent the variables that may affect student achievement. In this case, student achievement is indicated by 5th-grade passing rate on the SOL computer/technology assessment. This study will analyze these variables: 1) the location of computers in schools, 2) the number of computers available for student use in the classroom, and 3) required Internet access in the educational setting in relationship to student achievement. This study will also analyze performance-based teacher evaluation instruments used to gauge teacher effectiveness across Virginia in reference to technology integration. The researcher will be making the assumption that teachers are proficient in the area of computer/technology as indicated by districts in Virginia (see Figure 1).

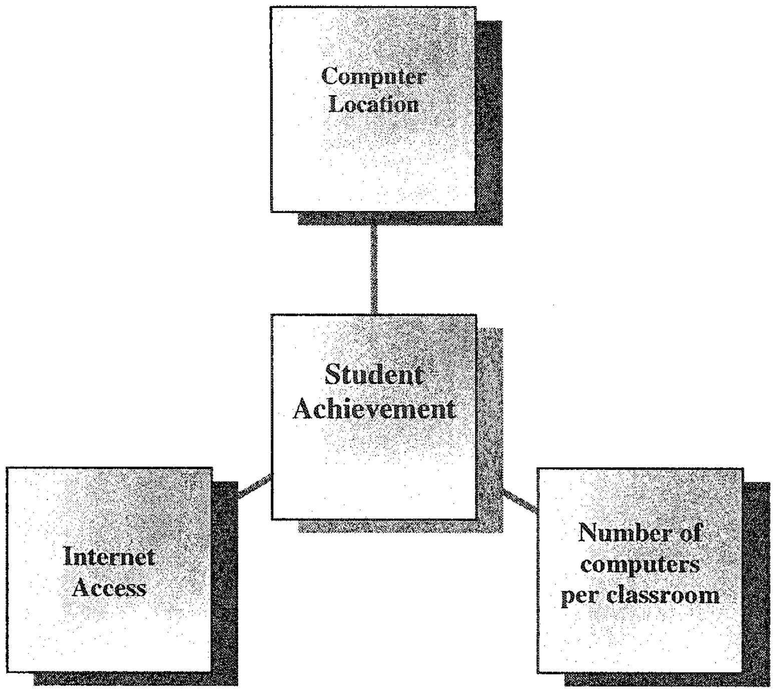

Figure 1. Variables of Impact

Statement of the Problem

The purpose of this study is to: (a) analyze the components of performance –based teacher evaluations that lead to technology integration (b) determine the impact of the number of computers per classroom, and computer location on SOL computer/technology passing rate for 5th-grade students, and (c) explore the relationship between Internet access and 5th-grade student achievement on the Computer/Technology Standards of Learning Assessment.

Research Questions

1. What is the relationship between Internet access and student performance on Virginia's 5th-grade computer/technology SOL assessment?
2. What is the relationship between the number of computers available for student use in the classroom and performance on the 5th - grade computer/technology SOL assessment?
3. What is the relationship between the number of computers (outside the classroom) in the school setting and student performance on the 5th - grade computer/technology SOL assessment?
4. To what degree is technology integration reflected in the assessment instruments used to evaluate teachers?

Significance of the Study

One significant aspect of this study is that by holding teachers and students accountable for proficiency in the area of computer/technology, there may be some variables that impact student achievement over which educators have control. Another significant aspect of holding teachers accountable for computer/technology integration in the curriculum is that performance-based teacher evaluation instruments emphasize technology integration in the curriculum. Also, Internet access, the location of computers, and the number of classroom computers available for student use may significantly impact 5th-grade student performance on statewide SOL computer/technology assessments.

Definition of Key Terms

Achievement- Student performance on the 5th-grade computer/technology SOL assessment (individual school percentage score).

Accountability- For the purposes of this study, accountability is defined as demonstrating success in the area of computer/technology integration to a third party.

Assessment- Individual SOL test given at various grade levels to measure student mastery of objectives.

Computer Location- The actual location of a computer in the educational setting, (i.e. classroom, library, technology lab, etc.).

Enhancing Education Through Technology (EETT or Ed Tech)- Established through NCLB Title II, Part D, consolidates the Technology Literacy Challenge Program and the Technology Innovative Challenge Grant Program into a single state formula grant program.

Internet Access- the ability for students to access the internet

No Child Left Behind (NCLB)- Educational reform designed to improve student achievement.

Performance-based evaluations- Evaluation instruments used in each district to assess the performance of teachers in reference to technology integration and instruction.

Standards of Learning (SOL)- Virginia's objectives for learning grades k-12.

Student Performance- Percentage passing rate based on a school's overall mastery of SOL objectives.

Technology integration- The use of technology to enhance instructional strategies across all subject areas in the education of students from grades k-5.

Technology proficiency- Technology proficiency refers to the eight technology performance standards that teachers are required to demonstrate for licensure in the state of Virginia.

Delimitations

1. The analysis of performance-based evaluation instruments will be limited to Virginia school districts.
2. Achievement passing rate will be limited to the 2002, 5th-grade SOL computer/technology performance in Virginia elementary schools.

Limits of the Study

1. The timing of this study may have coincided with state requirements for school districts to revise performance-based evaluation instruments to comply with accreditation requirements; thus, some documents included in this study may have been under revision at the time the data were requested.
2. Question four of this study emphasized the degrees of technology integration referenced in performance-based assessments used to evaluate teachers across the state. Careful effort was made to assure that the categories created reflected the constructs that were analyzed.

Major Assumptions

1. Virginia schoolteachers are proficient in the area of computer/ technology by July 2003 (licensure condition).

2. Document analysis of performance expectations in reference to computer/technology integration in the classroom describes expected behaviors for teachers.
3. Teachers strive to demonstrate the behaviors framed within their division's performance-based evaluation instrument.

Chapter 2: Literature Review

Introduction

In an effort to improve student achievement through the use of technology in the educational setting, Title II, part D of No Child Left Behind (NCLB), Enhancing Education Through Technology, emphasizes improving student academic achievement, assisting students in becoming technologically literate, and ensuring that teachers can successfully integrate technology into their curriculum (2002). The Virginia Department of Education is in the process of distributing nearly five million dollars in federal grants to train educators in the area of advanced technology applications to improve instruction and raise student achievement (Ed Tech, 2002).

The foundation of this review of literature is based on the belief that teachers are the key to technology integration in the classroom and must be held accountable. However, many variables related to computer/technology integration may also have a strong impact on student achievement. These variables include the location of computers in the schools, the number of computers available for student use in the classroom, the availability of Internet access, and the degree to which teachers are held accountable for technology integration as evidenced by teacher performance-based evaluations. Subsequently, the issues that are relevant to student achievement in acquiring computer/technology skills, which will be discussed in this review, include 1) technology integration, 2) technology implementation, and 3) technology leading to educational reform.

Technology Integration

The need. According to the Bureau of Labor Statistics for the 21st century, 70% of the jobs available in the workforce will in some way be related to technology. Workers will need to be able to effectively use technology to access information, evaluate the information for its worth, creatively implement the information, and be flexible enough to change their work product as the information changes. Of these jobs, 90% will go unfilled if students do not become proficient in basic technological skills (McKenzie, W., 2000).

The National Study of School Evaluation (1996) took a strong stand stating that information technology should be considered as important as reading, writing, and arithmetic. The authors even go as far as to call information technology "the 'forth R' in today's educational system" (p.5). Thus, in itself, effective technology integration is a vital element to include in the curriculum for students from kindergarten through high school graduation.

Technology also plays a vital role in students' success or failure after graduation. Therefore, schools must offer high quality, technology-rich curricula in order to create “technology literate graduates … prepared to meet the challenges and expectations of the information-age society” (p.5).

Many states have jumped on the technology bandwagon, realizing the need for technology integration in education. Virginia has been no exception. The adoption of Standards of Learning for students in reference to computer/technology skills was only the beginning of the effort to make Virginia’s students more computer literate. Teachers must also show proficiency in the eight technology standards set forth by the Virginia Department of Education.

In addition to the challenge of technology proficiency, teachers are confronted with many other technological challenges. For example, a teacher in a typical classroom with several computers for student use deals with an abundance of technology related issues if she/he chooses to integrate technology into the curriculum. As teachers attempt to integrate technology into teaching strategies, troubleshooting, server problems, and computer "freezes," can be overwhelming, especially when attempting to instruct a class of eager students.

Increased pressure from the state for students to perform well on Standards of Learning assessments in core areas such as mathematics, language arts, science, and social studies is also taking precedence over technology integration in many classrooms. Educators have problems looking at technology as a means to increase student achievement.

Consequently, teachers may look at the time it takes for students to create a PowerPoint presentation in social studies as a "waste of time and trouble" as compared to more traditional styles of teaching. It is difficult for many educators to view technology as anything more than just an "add-on," taking up time and energy that could be spent teaching the basic objectives. However, "Few innovations have effects as large as those of computer tutorials … [and] software classified as drill-and-practice significantly improved achievement test passing rate" (Valdez, Foertsch, Anderson, Hawkes, Raack, 2000, p.2).

However, teachers must know more than basic technology skills in order the successfully integrate technology to support curricular goals. "Restructuring with technology involves a shift to learner-centered instruction, cooperative learning opportunities for students, collaborative efforts for teachers, and a de-emphasis on the traditional school/class time constraints" (Cradler, 1992, p.10). Hadley and Sheingold (1993) contended that technology actually allows teachers to decrease time lecturing, increase differentiation of student-centered work, and present more abstract concepts to students. Consequently, when educators choose to make technology an integral part of their classrooms, the possibilities of redefining how they provide opportunities for students to learn increase tremendously (Cradler, 1992). The focal point in the effort to integrate technology into the curriculum is the teacher. As also stated in performance-based evaluations, the teacher is responsible for implementing technology into the curriculum without losing sight of the learning process.

As classrooms across America are being transformed with the implementation of new technologies, there is a shift in teachers' educational philosophy. Teachers become more willing to experiment as their confidence builds. Thus, education becomes more student-focused, and educators establish more collaborative working relations with their peers (Dwyer, Ringstaff, & Sandholtz, 1991).

A new pedagogy, supported by a set of widespread classroom practices, is emerging that encourages individual and small group investigation of student-generated questions. The teacher becomes a consultant, guide, and facilitator as students seek answers and develop skills. As a mechanism toward accomplishing these tasks, technology becomes a most important aspect. Educators must foster these educational experiences in which "students develop a deep, broad, and creative understanding of culture, community, economics, and international politics, past and present, and acquire the social skills to work across differences and distances" (Riel, 1994, p.42). This can be accomplished by providing an assortment of technological tools to acquire information that will in turn allow students the opportunity to express themselves and to experience a higher level of success. "These same experiences provide the skills that will enable students to live productive lives in the global, digital, information-based future they all face" (Dwyer, 1994, p. 35).

An understanding. Technology integration in the classroom setting takes on many meanings and perspectives. Tools commonly used in the classroom such as the blackboard or overhead projector require little or no training. Thinking of computers in this same way misleads educators by implying that computer technology belongs in the same category. When viewed in this manner, teachers continue to implement traditional, subject-based, teacher-directed instructional plans where the computer environment remains peripheral, an 'ad-on' in space and time. If computers are viewed as tools requiring little or no training, teachers will continue using traditional teaching strategies, leaving technology integration as a gap in students' education. Integration must be based on the assumption that computers should be an integral part of the learning process at all levels (Lockard, Abrams & Many, 1994), that is, technology should be an integral part of the curriculum. Although " a number of studies have associated the infusion of technology with general movement by teachers toward more empowering practice" (Saye, 1997, p.7), Becker (1991) found that technology was not being used as a self-directed exploration of higher-order problems, but rather as a tool for drill and practice, and tutorial application. Although students have benefited from this type of application, drills and tutorials can lead to misunderstanding technology integration in the classroom setting. Most definitions of technology integration assume that the mode of student learning with technology is at a higher cognitive level than the conveyance of facts and theories. Along these same lines, Dockstader (1999) stated that technology integration should include using computers efficiently and effectively in all disciplines in order to give students the opportunity to learn "to apply computer skills in meaningful ways, incorporating technology in a manner that enhances student learning, and organizing the goals of curriculum and technology into a coordinated, harmonious, whole" (p. 73-74).

Ideally, educational technology is an integral component of day-to-day instruction. When integrated correctly, educational technology ceases to be seen as a separate entity. Both teachers and students can use it to gain or produce new information, to communicate, and to encourage creativity in the classroom setting. Thus, technology integration includes not only the tools, but also the scientific method, communication skills, and theory in its application (Becker, 1999). Garry (2001) did an outstanding job at summarizing the most current ideas in answering the question: What is technology integration?

> Technology integration is about learning. It is about teaching students to use data and information to think critically, solve problems, and

> evaluate. It is doing things that would otherwise be impossible, and collaborating with people all over the world. We need to move from automating – putting the technology on top of what we already do – into a world where we are informating (using technology to do things that we wouldn't be able to do), which will lead to empowerment. (p.1)

Consequently, technology integration remains one of the perplexing issues educators must address if students and teachers are to reap the benefits of technology in education.

Technology Implementation

Diffusion Theory. Educators have been wrestling with technology integration models for the past decade. To explain the process of adapting innovations such as computers and new teaching strategies, Rogers developed his diffusion of innovation theory. Rogers (1995) defined diffusion as "the process by which an innovation is communicated through certain channels overtime among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas" (p.5). According to Rogers, there are "five elements of diffusion: relative advantage, observability, compatibility, complexity, and trailability. The more of these elements present in any particular innovation, the more likely it will be adopted" (Dias, 1999, p.4).

Diffusion starts when an individual moves from knowledge about the innovation to forming an attitude, whether positive or negative, towards the innovation. This leads to the decision to adopt or reject the implementation of the new idea and finally, to confirm the decision. Along the way individuals seek information to increase certainty about the innovation. At the knowledge stage, there is great interest in innovation-evaluation information, with the most valued sources being individuals who have had actual experience with the new innovation. This model suggests that teachers who use technology are the best source of information for teachers who have yet to adopt it (Byrom, 1997).

When considering whether to include technology integration into their curriculum, educators have several questions. First, many teachers will ask whether or not the effort of using technology is worth the work. Providing these teachers with technology models through structured, on-site observations of teachers who routinely integrate technology into the curriculum answers this question. "Demonstrations by peers, mentors, or seasoned practitioners can illustrate effective ways to use technology to teach existing and expanded content" (Ertmer, 1999, p. 54). Second, if the teachers and students can see a higher quality of work produced by using technology, they will be more likely to adopt technology. Research reveals that students develop an "increasing proficiency in accessing, evaluating, and communicating information" (Cradler, 2000, p.2) when using technology.

Third, many teachers experience frustration with technology because they have had little experience combining technology with new teaching methods. Fourth, teachers question the complexity of technology integration. Finally, after they "experience successfully integrating technology into a lesson, teachers are excited about trying more lessons using technology" (Dias, 1999). These elements must be understood if teachers are to successfully adopt technology and integrate it into the curriculum to enhance student achievement.

Constructivism. Another key aspect of technology integration, beyond Rogers' theory of diffusion, is the concept of constructivism. According to The Institute for Learning Technologies at Columbia University, the constructivist agenda is described as being primarily motivated by "a recognition that most, if not all, knowledge domains are complex and ill-structured in a number of ways that require a mastery and experience with a broad range of cases that reflect the complexity and diversity of the field" (1994, p.7). Constructivists tend to feel that learning requires a significant degree of hands-on, practical experience with the application of principles, and that the learning process operates through acculturation. (Cradler, 2000). How does this relate to technology integration? McKenzie (2000) has coined the word "techno-constructivist" to explain the powerful positive effects technology integration can have on both teachers and students. Techno-constructivists, more than anything else, are willing to allow their students to completely immerse themselves in technology.

Traditional instruction is based on a theory of learning that suggests students will learn concepts, facts, and understandings by direct instruction. Ideally, the students will absorb the content of their teacher's explanations and/or understand by reading explanations from a text and answering related questions. Skills are mastered through some guided and repetitive practice of each skill in a sequential and highly prescribed manner. This teaching is done largely independent of complex applications in which those skills could play a major role.

In contrast, Constructivist instruction is based on a theory of learning that suggests that as understanding arises, the learner is given the time to relate new ideas and explanations to his or her own prior beliefs. An outcome of that assertion is that the capacity to learn skills comes from experience in working with concrete problems that provide experience in deciding how and when to call upon each of a diverse set of skills.

Interestingly enough, there are some indications that teachers, who use technology will, given enough time, evolve into constructivist teachers (Dwyer, Ringstaff, & Sandholtz, 1991; Fisher, Dwyer, & Yocam, 1996;

Hadley & Sheingold, 1993). The use of technology tends to prompt teachers to become more student-centered in their approaches to teaching and planning, and eventually this use of technology will homogenize into a constructivist approach (Dexter, Anderson, & Becker, 1999).

On the other hand, a number of researchers disagree with this viewpoint, suggesting that the traditional teachers do not just evolve into constructivists because a new innovation is at their fingertips. (Hativa & Lesgold, 1996; Miler & Olsen, 1994). "Pedagogical beliefs go deeper than technological capability and accessibility; beliefs define how teachers teach both with and without technology. Teachers' changing beliefs is neither quickly nor easily accomplished" (Ertmer, Gopalakrishnan, & Ross, 2001, p.4). Nonetheless, it will take time for teachers to understand the connection between technology integration and student achievement. Therefore, it is essential that teachers be held accountable for technology integration to improve instruction and student achievement.

Educational Technology and Reform

Accountability. The concept of accountability is a dominant theme in the field of educational reform today. The question is how do teachers define accountability and articulate its impact on student achievement. Scriven (1994) stated "accountability obliges you to be able to demonstrate your success to third parties-not merely to your own satisfaction" (p.159). The third party in this case is not only local school districts and state departments of education, with the implementation of NCLB, it is also the federal government. President Bush sees accountability as a way of addressing educational problems. In a recent press release, President Bush stated that one of the reasons he is so insistent on accountability is because it is a way to correct problems within the educational system (Olson, 2002). Accountability is a key factor in correcting problems, which in essence affects student achievement across the nation.

Popularity of Educational Accountability. The popularity of publicly judging the success or failure of schools based on test passing rate is a relatively new form of educational accountability in the United States. Statistics relative to school performance have existed since the late 19th century, but were only used by educators to monitor the progress of students. The annual release of average Scholastic Aptitude Test (SAT) passing rate in the late 1970s prepared the ground politically for the National Commission on Education Excellence's claim of declining school effectiveness (1983). Thus, judging public schooling by test passing rate fostered the assumption that schooling is a monolithic entity that succeeds or fails as a single body. This misconception tends to hide the wide variations in schooling, particularly differences between poor and wealthy schools across the nation (Kozol, 1991).

The recent use of minimum competency tests also emerged in the late 1970s as a response to alleged lowered standards of public schools (Bracey, 1996). Consequently, the rationale of using testing to make students and teachers accountable was born. By demanding higher test passing rate, it was assumed that students and teachers would rise to meet these expectations (Ravitch, 1995). Therefore, educational standards would increase and students would, statistically speaking, achieve at a higher level. On a theoretical level, this idea sounds plausible. The problem, however, is defining accountability, its relationship to student achievement, and the variables associated with this concept.

Types of Accountability. With this in mind, the next logical question to ask would be what types of accountability measures are being used to demonstrate success in the educational setting. There are at least five types of accountability mechanisms that may exist independently, or along side each other, in schools across the nation according to Darling-Hammond (1992): Political, Legal, Bureaucratic, Professional, and Market. Three of these mechanisms are increasingly relevant to this discussion of accountability and its future in the realm of public education: Bureaucratic, Professional, and Market.

In the past, schools have relied mainly on bureaucratic mechanisms for achieving accountability. Bureaucratic accountability is the attempt to find one best system in which all students will be educated. Administrators are given policies and are expected to translate these policies into procedures for teachers to follow in educating students. The strength in bureaucratic accountability rests in its attempt to ensure a standardized and equal education for all students. However, this system does not hold teachers accountable for meeting the individual needs of their students. The teachers can only be held accountable for following the procedure set forth by the administration.

Professional accountability seeks to ensure that teachers will be highly qualified in their areas of expertise. Unlike bureaucratic accountability, which focuses on standardization and uniformity, professional accountability allows educators to make their own decisions about how to meet the educational needs of their students. This system must pay particular attention to the policies governing the preparation, selection, certification, and evaluation of all staff members, and most importantly, student achievement.

The third type of accountability, market accountability, is based on quasi-market mechanisms. Magnet schools and other choice plans are examples of this category. Because the students or consumers choose the schools, the schools are held accountable in two ways. First, the schools are expected to work harder in providing services that parents and students want. Second, problems in under subscribed schools are revealed, which policymakers can then address. Several complications such as how schools are chosen, what information should be circulated such that students and parents can make good, informed decisions, and how all students can be guaranteed access to quality schools, surface when discussing market accountability.

In reviewing the three types of accountability measures described here, it is important to note that there is no single form of accountability that can sufficiently address the needs of all students. For example, in school choice plans, if the most desirable school in the district is full, students and parents are left looking for alternative education. If mechanisms are not in place to improve the existing schools in the district, choice in itself will not improve education. Thus, a combination of mechanisms for accountability must be in place to ensure student achievement and reform. NCLB takes into consideration several accountability mechanisms in establishing criteria to ensure that educators meet the needs of students across the nation.

According to NCLB, an "accountable" education system involves several critical steps. First, states must create their own standards. The standards must be developed and implemented immediately for math and reading. Standards for science must be in place by the 2005-06 school year. Second, once standards are in place, students must be evaluated as to their progress towards mastery of the standards. Third, each state, school district, and school is expected to make progress towards meeting state goals. This progress is to be shown through state assessments. Fourth, school and district performance will be publicly reported in district and state report cards. Finally, if a district or school continually fails to make progress toward the standards, they will be held accountable (Olson, 2002). Thus, several factors come into play in creating a system which is focused on accountability that ultimately impacts the academic success of all students.

Reform Measures

Federal Reform Measures. Over the next several years, state and local policies and procedures will undergo massive changes in order to meet the new federal requirements set forth in NCLB. However, "The agencies responsible for generating and conducting accountability reviews should be at least quasi-independent of the government in order to preserve the integrity of the system," as Bryk, Sebring, Kerbow, Rolls, and Easton (1998, p.303) recommended, and as it is implemented in Ontario with the recently established Education Quality and Accountability Office (Fullen, 1996, p.57).

One of the most controversial areas of the new reform effort emphasizes the word *accountability* and its relationship to testing. Recent polls suggested that the idea of national testing is popular (Rose, Gallup, and Elam, 1997). Even those who oppose nationalized curriculum and testing agree that testing should exist as long as it is organized on a state and local level (Diegmueller and Lawton, 1996; Lawton, 1997). However, many educators have continued to note the problems of high-stakes testing (Madaus, 1991; Mcgill-Franzen and Allington, 1993; Neill, 1996; Noble and Smith, 1994; Shepard, 1991; Smith, 1994; Smith and Rottenberg, 1991). High stakes testing at any level creates pressure on both students and teachers and may be counterproductive to reform efforts. If these pressures become too overwhelming, the results can create fragmentation. "Fragmentation occurs when the pressures – and even the opportunities- for reform work at cross-purposes or seem disjointed and incoherent" (Stronge, 1996, p.2).

Even though the federal government is more involved in the education of students across the nation than ever before, the common use of assessments to gauge school effectiveness, owes its existence to the national debate over education in the twentieth century and the continuation of local decision-making (Dorn, 1998). In order to clarify this debate on levels of accountability, Secretary of Education Rod Paige stated that the purpose of NCLB, "for both assessments and accountability, is to build on high-quality accountability systems that states already have in place, not to require every state to start from scratch" (Olson, 2002, p.1). This is an attempt to put both state and local educators at ease, and thus reduce the feelings of fragmentation.

State Reform Measures. States have responded to the demands of the federal government in reference to NCLB in a plethora of ways. Unfortunately, many states have not fully complied with core requirements of the 1994 version of the Elementary and Secondary Education Act, especially those related to standards and testing, even though the final deadlines are now passinged (Robelen, 2002). For those states that are in compliance, the implementation of accountability measures set forth in the NCLB is not such a daunting task. In Virginia, goals and objectives have been created and implemented in all districts. Standardized testing is well underway on several levels K-12. Furthermore, the State Board of Education has set benchmarks for districts across the state.

Local Reform Measures. At the local level, "annual tests are too infrequent for appropriate guidance of instruction or evaluation of teaching, while they are too frequent to measure broader changes in schools" (Dorn, 1998, p.16). Ultimately, the "accountability purpose reflects the need to determine the competence of teachers in order to ensure that services delivered are safe and effective" (Stronge, 1996, p. 4). This can only be addressed successfully at the local level in educational systems across the nation.

At the local level, performance-based teacher evaluation instruments are used. The two most frequently cited purposes of personnel evaluation are accountability and performance improvement (Stronge, 1996). The data administrators collect and analyze should help teachers understand and improve instructional processes, which should ultimately lead to higher student achievement. (Fullen, 1996). Principals agree that standards have helped focus teachers and the general public on student achievement. These standards have also created common goals in which to discuss the skills and knowledge that students should acquire in school. (DeBois, 2001). However, accountability shifts at the local level, to focus not only on the areas to be tested but also on areas that will help students be successful in life. Making decisions about school performance based only on the results of standardized tests does not begin to explain what is actually happening on a day-to-day basis in the classroom. For example, students can show great achievement in areas of behavior, attitude, and social skills that can never be measured by standardized tests. One principal of an urban alternative school stated, " I care about helping my students acquire all of the knowledge and skills they'll need to pursue further education and get decent jobs" (Debois, 2001, p.4). He continued to state "While many of my kids haven't been successful in regular schools or on standardized tests, they are still an extraordinary group of young people who can contribute to the well-being of our society" (p.4). Thus accountability takes on a different perspective at the local level.

Holding Schools Accountable. In most testing systems, central office personnel at the state and local levels are responsible for the general logistics of testing, compiling results, and reporting results. These results are then officially made available to boards of education, central office personnel, school based administrators, teachers, students, and the general public (Dorn, 1998). Ideally, when these results are handed down, the key educators at the school level immediately start the process of comparing the results to the previous year, realigning the curriculum, and refocusing on specific instructional strategies to improve areas of weakness. But, the aims of accountability may not include other issues relevant to education and holding schools accountable. The direction of curriculum or the broader purposes of education in a changing world (Darling-Hammond, 1995) are concerns that are not readily answered by reviewing test passing rate. Nevertheless, research conducted at the National Center for Educational Accountability strongly suggests that "accountability can be a comprehensive, constructive, and meaningful, thereby bridging the gap between state accountability systems and teacher autonomy" (Reeves, 2002, p.2).

Conclusion

Over the last decade, most educators have tried a "hit-or-miss" approach to technology integration in the curriculum with an emphasis on student achievement. "Restructuring with technology involves a shift to learner-centered, cooperative learning opportunities for students and collaborative efforts for teachers, and a de-emphasis on the traditional school/class time constraints" (Cradler, 1992, p.2). But, traditions in education are slow to change. An except from a speech delivered by Terrel H. Bell in 1977, the first U.S. Secretary of Education, is remarkably appropriate even today.

> The education system is having a slow and difficult time adopting technological advances, which could multiply the efficiency of instruction. Much of the task of storing and retrieving information and presenting it to students will be done by the computer … We must somehow learn to persuade the decision makers to shake up and change our approach to teaching and learning. The potential of technology must be used to provide a nation a more effective and productive education enterprise. American education is wobbling down an electronic avenue in an oxcart! (as sited in Cradler & Bridgforth, 2003, p.2)

Technology integration can shift instruction from teacher-directed to learner-centered. From fact telling to teacher-student collaboration, from the accumulation of factual knowledge to the transformation of facts, from memorization to inquiry and invention, from the use of standardized tests to relevant portfolio and performance-based assessments, the implementation of technology can make a difference (Cradler, 1992).

Information about stages of adoption, has received much attention through the Apple Sponsored research project called Apple Classrooms of Tomorrow (ACOT). This research has given educators a better understanding as to how teachers perceive computers and integrate them in the classroom setting. This information has also been a valuable tool in planning for training teachers who are having problems with technology implementation. Integrating technology in the curriculum is a difficult and arduous process for many. Teachers do not automatically understand how to use computers in their classroom without first receiving training for themselves and then identifying clear goals and objectives for its implementation. Rogers' theory of diffusion has also been a valuable asset in understanding how new innovations diffuse within organizations. As with any new innovation, the fear of something new is a barrier in itself and one that must be understood and addressed if technology integration is to occur with successful results.

Businesses today are expecting graduates to know more than how to read and write well. It is expected that students will graduate with a basic knowledge and understanding of technology and its application in the real world. The more technology/computer integration the students are exposed to, the easier it will be for them to apply these skills at their future place of employment. Fortunately, the state of Virginia has seen the need for technology integration as a valuable component for students and teachers. Funding for technology is at an all time high as schools around the state take advantage of the available grants. With this funding, comes the expectation of technology integration in all disciplines. This expectation is more clearly addressed in the eight technology standards in which teachers must show proficiency before receiving licensure.

The most important variable, which is the key to student achievement and enhancing curriculum through technology, is the teacher. Teachers must feel comfortable enough to implement technology into the curriculum in a fashion that enhances the learning process. Computers were not meant to be an additional burden to teachers. Technology should be allowing teachers more time to do what they were hired to do; educate students. Schools must provide students with the opportunity to combine the best of traditional learning with the unprecedented opportunities technology offers in the educational setting (CEO Forum, 1997). Furthermore, with such a strong emphasis from the state and federal government on accountability for results, it is important to remember that to be successful in today's world and tomorrow's work place, students must have a solid understanding of how technology will impact every aspect of their lives.

Accountability is not without conflict or controversy, however "One dominant assumption of accountability systems is that the goals of education are agreed upon and we need only to establish a system to measure whether schools and students meet those goals" (Dorn, 1998, p.11). Accountability for results should encourage deeper discussion of educational problems and the variables which impact student success, such as the number of computers available in the classroom for student use, the location of computers in the educational setting, and the availability of Internet access for students. Performance-based teacher evaluation should also reflect the need for integrating technology in the curriculum and hold teachers accountable for such integration. Student achievement should be the starting point of educational reform, not an occasion for political opportunism or crude comparison based on the judging of school success using high stakes testing as the sole source of indication. Accountability should also connect student performance and technology integration to classroom practice. Representation of student performance by passing rate without the context, removes classroom practices from the discussion of educational reform. According to Sanders (1999), "the single biggest factor affecting academic growth of any population of youngsters is the effectiveness of the individual classroom teacher" (p.1). For example, "fifth graders who had three years of teachers who were deemed very ineffective averages 54 to 60 percentile points lower than students who had a series of highly effective teachers" (Olson, 1997, p.1). In the overall picture of educational reform, "accountability must be the unifying theme that draws strategy, rewards, recognition, and personnel evaluations together" (Reeves, 2002, p. 1). Subsequently, technology serves as the catalyst for this reform.

Chapter 3: Methodology

Introduction

In examining computer/technology integration in elementary schools, there were four purposes for this study. First, this study was designed to determine if there was a relationship between Internet access and 5th-grade students' performance on Virginia's computer/technology SOL assessment. Second, this study was designed to explore the relationship between the number of computers available for student use in the classroom and student performance on Virginia's computer/technology SOL assessment. Next, this study was designed to ascertain the relationship between computer location in the educational setting and student performance on the SOL computer/ technology assessment. Finally, this study was designed to analyze the degree to which technology integration was reflected in performance-based teacher evaluations across Virginia.

Research Questions

The four central questions that the researcher addressed are as follows:

1. What is the relationship between Internet access and student performance on 5th-grade computer/technology SOL assessment?
2. What is the relationship between the number of computers in the classroom available for student use at the elementary school, and student performance on the 5th-grade computer/technology SOL assessment?

3. What is the relationship between the location of computers in the school setting and student performance on the 5th-grade computer/technology SOL assessment?
4. To what degree is technology integration reflected in the evaluation instruments used to evaluate teachers?

Target Population

The target population for this study was a simple random sampling of 100 elementary schools in the state of Virginia. The dependent variable in this study was 5th-grade students' passing rate on the SOL computer/technology assessment. Independent variables included the number of computers available for student use in the classroom, the location of other computers, and student access to the Internet.

Data Analysis Matrix

Data analysis occurred in three phases. Phases I and II required the development of a survey in which principals reported whether or not schools have Internet access, if students were required to access the Internet, how many computers were available in the classroom for student use, and the locations (outside the classroom) of computers in their buildings. Phase I required a basic correlation design. Phase II required a multiple regression analysis to determine if the location of computers in the elementary schools predicted success on the 5th-grade student passing rate on the computer/technology SOL state assessment. Phase III consisted of a content analysis of performance-based teachers evaluations across the state. This required the development of coding categories, which were used to sort themes that appeared in the performance-based teacher evaluation instruments as they related to the use and implementation of technology. These themes were drawn from the evaluation instruments, the *Guidelines for Uniform Performance Standards* (2000) for teachers, and the literature review and reflected emergent categories related to technology integration (see Table 1).

Table 1: Data Analysis Matrix

Phases of research	**Research Question**	**Methodology**	**Data collection**	**Analysis**
Phase I	Question #1 What is the relationship between Internet access and student performance on computer/technology SOL assessment?	Development of questionnaire, comparison with SOL passing rate	Questionnaire: sent to Principal. 5th grade SOL passing rate for 2001-2002 from VADOE.	Correlation

	Question #2 What is the relationship between the number of computers in the classroom available for student use, and students performance on the computer/technology SOL assessment?	Development of questionnaire, comparison with SOL passing rate	Questionnaire: sent to Principal. 5th grade SOL passing rate for 2001-2002 from VADOE.	Correlation
Phase II	Question #3 What is the relationship between the location (outside the classroom) of computers in the school setting and student performance on the computer/technology SOL assessment?	Development of questionnaire, comparison with SOL passing rate	Questionnaire: sent to Principal. 5th grade SOL passing rate for 2001-2002 from VADOE.	Multiple Regression Analysis
Phase III	Question #4 To what degree is technology integration reflected in the evaluation instruments used to evaluate teachers?	Content analysis of instruments	Performance-based teacher observations - copies from all districts received from educator working with instruments for another research project	Content Analysis

Procedures

The variables associated with technology integration in the educational setting vary tremendously. In an attempt to isolate several variables that may impact student achievement, this study used both quantitative and qualitative methodologies. In an attempt to gain insight into factors or variables that may effect academic achievement, relationship studies were used. Such studies, according to Gay (1996) have been successful in explaining complex variables and identifying the variables, which can then be excluded from further study.

Phase I of this study involved sending a survey to 100 elementary school principals across the state asking the following questions:

1. Does your elementary school have Internet access readily available to students for instructional purposes?

2. Are 5th-grade students required to access the Internet to complete assignments?

3. What is the total student population in your school?

4. How many computers are available for student use in each of the following locations:

   - Classroom ____
   - Library ____
   - Technology lab ________
   - Other (please specify) ________________________

In order to generate a random sample of the 1164 elementary schools in Virginia, the researcher used a table of random numbers. The desired sample size was 100 elementary schools. Each of the elementary schools was assigned a number ranging from 0000 to 1164. The researcher then selected an arbitrary number from the table of random numbers, looked at the appropriate number of digits representative of the population, and matched that number to the corresponding elementary school. That school was then assigned to the sample. This technique was repeated until the sample size of 100 was obtained.

Surveys were sent to the principal of each school by way of email and regular mail. The principal at each selected school was sent the survey via email three times. The first email request was sent with a subject line that read, "Fellow Administrator, I need your help". The second request was then sent to those principals who had not yet responded with a subject line that read "I need your input". Furthermore, the third request, again sent to principals who had not yet responded, read, "The College of William and Mary". Principals who did not respond to the email request were subsequently sent the survey via regular mail. The mailed survey included a self-addressed stamped envelope.

In addition, the researcher collected the 2002 5th-grade students' SOL assessment passing rate that corresponded to the 100 randomly selected elementary schools across the state. The researcher obtained these passing rates from the Virginia Department of Education's web site. These passing rate that represented the dependent variable in this study, were then correlated with the independent variables represented in the survey questions. The results were used to indicate any correlation between Internet access and 5th-grade passing rate on the SOL computer/technology assessment. The results were also used to detect any correlation between the number of computers in the classroom available for student use, and 5th-grade passing rate on the SOL computer/technology assessment.

In Phase II, a multiple regression analysis (using data collected from the survey) was used to predict whether or not computer location (outside the classroom) within the elementary school building impacted SOL passing rate. For this analysis, the researcher also specified the order in which the variables were checked to determine the correlation and the magnitude of the relationship.

Finally, Phase III included the use of content analysis methodology to determine to what degree technology integration was reflected in the performance-based evaluation instruments used to assess teachers in Virginia. The evaluation instruments were requested from a researcher who analyzed the instruments for a previous study. Results from that study were not relevant to this study and therefore will not be addressed.

The use of content analysis as a form of quantitative and qualitative study is well documented. Content analysis is an objective, systematic, quantitative method of analysis used to describe the examination of documents for research purposes (Gall, Borg, & Gall, 1996; Berelson, 1971).

However, when looking at text from a qualitative perspective, the researcher looks for meanings in the text itself (Gall et al, 1996).

The application of content analysis for this part of the proposed study included the following steps that will be subsequently described: (a) identification of a target population, (b) determination of a coding unit, (c) determination of categories, (d) analysis of emergent categories, if any, (e) calculating frequencies, (f) considering issues of reliability, (g) considering issues of validity, (h) statements referencing limitations of analysis, (i) insuring ethical safeguards and considerations.

Determination of Coding Unit

According to Weber (1990), one of the most important determinations in a content analysis is defining the basic unit of text to be classified. Following are descriptions of the four coding options:

1. Words: Words are well-defined recording units, which are easily classified by computers and a reliable option to use as a recording unit.
2. Word Sense: Semantic units that can be counted as if they were words.
3. Sentences: Sentences are an appropriate recording unit when the investigator is interested in words or phrases that occur closely together.

4. Theme: Because the boundary of a theme describes a single idea, themes are useful recording units.

   (Weber, 1990; U. S. General Accounting Office, 1996)

Theme was the coding unit for the purposes of this study. The performance-based evaluation instruments, by design, incorporated key ideas regarding expectations for teachers in regards to technology integration.

Determination of Categories

The most important aspect of the content analysis was the coding of the content of a document into categories (Gall, et al., 1996). General categories can be derived from the research question itself, but must be translated into explicit indicators for purposes of the analysis (Berelson, 1971). There were two basic decisions the researcher made when developing categories: 1) are the categories mutually exclusive, and 2) how broad or narrow are the categories.

This study identified categories that reflected the integration of technology in the instructional setting. Other uses of technology in the educational setting, as referenced in analyzing the performance-based teacher evaluations, were also categorized.

Coding Emergent Categories

In this study, emergent categories were defined as those categories with high frequency counts of words from an analysis of specific goals and objectives and were listed in the documents being analyzed. Text coding was also used to ensure clarity of category definitions. After developing the coding categories, the researcher enlisted a second person to apply sample text to the coding categories to discover any problems inherent in the coding scheme. The primary researcher coded a sample of 10 evaluations then a second person did the same in order to detect any problems in the coding scheme. This coding process consisted of four steps: 1) selection of a second coder familiar with teacher evaluations, 2) training this person in the coding process, 3) test coding a small sample with 80 % consistency between coders, 4) if 80% consistency is not obtained resume with 10 additional samples until 80% accuracy is acquired. Consistency was obtained and additional samples to acquire 80% consistency were not needed.

Calculating Frequencies

Calculating frequencies is a common method of data collection used in content analysis (Weber, 1990). According to Weber, the higher the frequency count, the higher the concern in that category. In this study, the researcher calculated counts for all categories that emerged from the document analysis.

Reliability of Methodology

The extent to which any research design consistently represents variations in real phenomena is its reliability (Krippendorf, 1980). When designing a content analysis, there are three types of reliability to consider: 1) stability, 2) reproducibility, and 3) accuracy. Out of these three types of reliability, accuracy is the strongest form of reliability and refers to the extent to which the categorization of text actually corresponds to a standard or norm (Krippendorf; Weber, 1990). In this study, coding categories corresponded directly to the standards established by the state of Virginia in the *Guidelines for Standards in Performance-based Evaluations* (2000).

Validity of Methodology

The term validity, according to Weber (1990), is used to define the correspondence between two sets of items, and is also used to reference the generalizability of references, results, and theory. Validation assures that the research findings can be taken seriously as a basis for making decisions and developing theory.

Semantic validity requires that the words defined by a single coding unit have similar connotations as measured by different people (Weber, 1990). Semantical validity requires the researcher to describe the terms of the scientific process. Thus, by having more that one researcher test code data to determine the similarity of classification of coders, semantical validity can be established. This prevents the categories from confounding the data (Gareis, 1996). For this portion of the study, the researcher and an additional coder conduced the test coding.

Ethical Safeguards

The researcher used content analysis and surveys for this study which are inherently unobtrusive forms of research. The importance of ethical safeguards can not be overstated; however, because of the unobtrusive nature of this study, they are of less of a concern.

Chapter 4: Results

Introduction

The primary purpose of this study was to examine technology/computer integration in elementary schools and several variables relating to technology that may increase student achievement. The following questions were investigated.

1. What is the relationship between Internet access and student performance on 5th-grade computer/technology SOL assessment?
2. What is the relationship between the number of computers in the classroom available for student use at the elementary school, and student performance on the 5th-grade computer/technology SOL assessment?
3. What is the relationship between the number of computers in the school setting (outside the classroom) and student performance on the 5th-grade computer/technology SOL assessment?
4. To what degree is technology integration reflected in the evaluation instruments used to evaluate teachers?

Results of the Data Collection

The emailed surveys and follow-up regular survey mailings resulted in responses from 60 of the 100 principals contacted, yielding a 60% overall response rate for the study. Table 2 indicates the total survey response rate. School principals responded by emailing survey responses or sending responses via the self-addressed stamped envelope included in the regular mailings. Out of the 60 responses, three schools were pre-k-2 schools, 19 schools were pre-k-5 schools, eight schools were k-6 schools, two schools were k-7 schools, and one school was a 3-5 school.

The schools also varied in size. The principals of eight schools reported their population to be less than 200. Another 15 principals stated that their school population ranged from 200 to 400. The largest grouping of schools according to size included 22 schools which ranged from 400 to 600 students. Another 12 schools included a population of 600 to 800 students. Finally, two principals reported a population of over 800 students.

Table 2: Total Survey Response Rate

Survey Responses			
Email	Regular Mail	Other	Total
35	24	1	60

In addition, a total of 106 performance-based teacher evaluation instruments received from another researcher, Dr. Charles Maranzano, at the College of William and Mary were analyzed. This was a convenience sample from June of 2002. Nine of the divisions indicated that they were revising their evaluation instruments.

Correlation Analysis of Internet Access

Research question 1: What is the relationship between Internet access and student performance on 5th-grade computer/technology SOL assessment?

In analyzing the relationship between Internet access and Student performance of the 5th-grade computer/technology SOL assessment, all responses indicated that the students did have access to the Internet. Therefore, an analysis could not be made. However, in probing further it was noted that responses varied on whether or not Internet access was required of 5th-grade students. Principals from 39 schools in the study did require the 5th-grade students to access the Internet at some time during instruction. On the other hand, 15 principals did not require their 5th-grade students to access the Internet. Furthermore, for three principals, 5th-grade students were not a part of their total population making the question not applicable.

In analyzing the relationship between required Internet access and 5^{th} grade student performance of the computer/technology SOL assessment, there was a negative correlation of .096 that was not significant ($p > .05$) (see Table 3).

Table 3: Pearson Correlation of Required Internet Access and SOL Passing rate

Correlations between students' passing rate and required Internet access

		PASSING RATE	REQUIRED
PASSING RATE	Pearson Correlation	1	-.096
	Sig. (2-tailed)	.	.494
	N	56	56

Correlation Analysis of Computer Availability

Research Question 2: What is the relationship between the number of computers available for student use in the classroom, and student performance on the 5th-grade computer/technology SOL assessment?

In analyzing the relationship between the number of computers available for student use in the classroom and student performance on the 5th-grade computer/technology SOL assessment results were not significant. As table 4 indicates, the mean for the SOL passing rate on the computer/technology assessments was 86.68 with a standard deviation of 11.48. The mean for the number of computers in the classroom setting available for student use was 3.46 with a standard deviation of 1.69.

Table 4: Descriptive Statistics of Passing Rate

	Mean	Std. Deviation	N
Passing rate	86.6759	11.48335	56
Classroom Computers	3.46	1.685	56

As table 5 indicates, the number of computers available for student use in the classroom was not correlated with the students achievement passing rate of the 5th-grade computer/technology assessment (Pearson Correlation = .188, $p > .05$).

Table 5: Correlation of Computers per Classroom and Passing Rate

		PASSING RATE	CLASSROOM
Passing rate	Pearson Correlation	1	.188
	Sig. (2-tailed)	.	.165
	N	56	56

Multiple Regression Analysis of Numbers

Research Question 3: What is the relationship between the number of computers in the school setting (outside the classroom) and student performance on the 5th-grade computer/technology SOL assessment?

In analyzing the relationship between the number of computers in the school setting and student performance on the 5th-grade computer/technology assessment several clarifications need to be made. In looking at places in the school setting (outside the classroom) where computers were located, the majority of the principals responding to the survey indicated that they had computers in the library and a technology lab available for student access. Furthermore, 19 of the principals surveyed confirmed having computers available for student use in other locations as well.

A multiple regression analysis was used to analyze the relationship between these numbers and student performance on the 5th-grade computer/technology SOL assessment. The mean for the students' SOL computer/technology passing rate was 87.25 with a standard deviation of 11.16. The mean for the number of computers available for student use in location 1, which indicated the library, was 8.09 with a standard deviation of 5.2. The mean for the number of computers available for student use in location 2, which indicated the technology lab, was 26.9, with a standard deviation of 11.4. Finally, the mean for the number of computers available for student use in location 3, which indicated any area other than the library or technology lab, was 12.9 with a standard deviation of 22.1. Refer to table 6.

Table 6: Descriptive Statistics of Location

	Mean	Std. Deviation	N
PASSING RATE	87.2472	11.16433	54
Library	8.09	5.210	54
Tech lab	26.93	11.402	54
Location Other	12.91	22.140	54

The multiple regression analysis using location 1 (library), location 2 (technology lab), and location other, as predictor variables for success on the 5th-grade computer/technology SOL assessment showed no significance ($p > .05$) (see Table 7).

Table 7: Multiple Regression Model Summary

Model	R	R Square	F Change	df1	df2	Sig. F Change
1	.241	.058	1.632	2	53	.205

a Predictors: (Constant), CLASSROO, STUDTECH

Table 8: Summary of Regression Analysis for Variables Predicting Student Passing Rate

Variable	B	Std. Error	Beta	t	Sig.
Library	.23	.30	.11	.74	.46
Tech Lab	7.95E-02	.14	.08	.58	.57
Location other	-2.71E-02	.07	-.05	-.38	.71

a Dependent Variable: PASSING RATE

Content Analysis of Performance-Based Evaluation Instruments

Research Question 4: To what degree is technology integration reflected in the evaluation instruments used to evaluate teachers?

In 1999 Virginia's General Assembly approved the Educational Accountability and Quality Enhancement Act. This Act mandated that each school division modify its evaluation process for teachers, administrators, and superintendents. Subsequently, The Virginia Department of Education (2000) published and distributed *Guidelines for Uniform Performance Standards and Evaluation Criteria for Teachers, Administrators, and Superintendents*. The teacher evaluation criteria included five areas: Planning and Assessment, Instruction, Safety and Learning Environment, Communication and Community Relations, and Professionalism. These five categories were utilized to determine the extent to which language pertaining to technology integration was used to describe the expectations of instructional personnel.

The basic unit of text for this content analysis was theme. The themes analyzed described a single idea consisting of the teacher as an agent of action (subject), the expected behavior (verb), and the target behavior (object). The five categories analyzed consisted of the teacher's expected behavior in the areas of (a) planning and assessment, (b) instruction, (c) safety and learning environment, (d) communication and community relations, and (e) professionalism.

The number of technology descriptions according to each of the five categories is found in table 9. The percentages of technology descriptions referenced in the performance-based evaluation instruments analyzed in this study are also listed. The first column in table 9 lists the five categories analyzed for question four. Column two represents the number of technology descriptions found in each category. In column three a percentage is given for each category. The percentage is based on the number of descriptions found when conducting the analysis divided by the total number of instruments in the sample (N = 106). Column four is a reflection of column three; however, the total number of descriptions is divided by the number of instruments that contained technology references (N=60). The final column reflects a percentage that is based on the number of descriptions divided by the number of schools that responded to the survey.

Table 9: Frequency Analysis of Categories Contained in Division Evaluation Instruments

Categories	Number of Technology Descriptions	Percentage: Descriptions Instruments	Percentage: Technology Descriptions	Percentage: Sample Schools
Planning and Assessment	7	6.6%	11.7%	8.6%
Instruction	47	44.3%	78.3%	61.4%
Safety and Learning Environment	2	1.9%	3.3%	3.3%
Communication and Community Relations	1	0.9%	1.7%	1.7%
Professionalism	13	12.3%	21.7%	18.6%

Category 1: Language that described the teacher's role in planning and assessment. Evaluation instruments from seven school divisions contained language that related to the teacher's use of technology during planning and assessment. Analysis of the language contained within the descriptions in reference to technology revealed teacher responsibilities according to the following themes:

- Integrates the use of appropriate learning tools, e.g. chalkboard, overhead projector, *computers*, calculators.

- Uses available *technological* materials and resources to engage students in varied experiences.
- Uses effective audiovisual/*technology* services.
- Utilizes *technology.*
- Uses electronic *technologies* to access and exchange information with focus on identifying, location and evaluating appropriate *hardware and software* to support Virginia's SOL and other instructional objectives.
- Uses educational *technologies* for data collection, information management, problem solving, decision making, communication, and presentation within the curriculum.
- Demonstrates knowledge of ethical and legal issues relating to the use of *technology.*
- Stays up to date with techniques and subject matter in field – issues and trends regarding exceptional students and in *technology.*

Primary expectations for the teacher included the effective use of technology. School divisions also expect teachers to demonstrate use of technology in order to gather data to better assess their students, and demonstrate knowledge of issues pertaining to technology.

Category 2: Language that described technology expectations during instruction. Language related to technology expectation during instruction represented 78.3% of the technology descriptions analyzed. Out of these 47 descriptions, five were repeated in the instruments analyzed. Thus, the analysis described below gives the frequency and percentages of each unique description. Analysis of the text contained within the descriptions of teacher expectations in the area of instruction revealed the following themes:

Table10: Themes/Technology Expectations-Instruction

Sub-categories	Frequency	Percentage
Utilization	20	48%
Demonstration	5	12%
Integration	6	14%
Other	11	26%

- Utilization:
  - Utilizes available *technological* materials and resources effectively.
  - Provides variety of activities utilizing *technology*
  - Uses comprehensive materials, *technology*, and resources that promote the development of critical thinking, problem solving, and performance skills.
  - Uses appropriate *technology*, instructional aids, and materials effectively.
  - Uses appropriate instructional *technology* equipment and resources to enhance instruction.
  - Uses appropriate instructional *technology-based* resources to support *Technology* SOL and other instructional objectives
  - Utilizes available *technological* materials and resources effectively to engage students in varied learning experiences
  - Uses *technology*, when appropriate to enhance and improve instruction.
  - Use of *technology*
  - Uses human, materials and *technological* resources to support the instructional program
  - Utilizes *technology* in the classroom consistent with the SOL and the resources available in the building
  - Utilizes computers and *technology* to enhance instruction.

- Makes optimum use of available *technology* and manipulatives in the classroom.
- Uses appropriate *technology*
- Uses *electronic technologies* to access and exchange information
- Identifies, locates, evaluates, and uses appropriates instructional *technology-based* resources (hardware and software) to support
- Uses a variety of teaching aids and appropriate *technologies*
- Effectively uses varied materials, including appropriate literature, current resources, audiovisuals, demonstration, and available *technology*
- Uses educational *technologie*s for data collection, information management, communications, and presentations within the curriculum
- Uses *technology* to facilitate teaching and learning

- Demonstration:
  - Demonstrates proficiency in the use of instructional technology
  - Demonstrates knowledge of Virginia *technology* SOL
  - Demonstrates competence in the *Technology Standards for Instructional Personnel*
  - Demonstrates competence in *technology* standards
  - Demonstrates proficiency in the use of instructional *technology*

- Integration:
  - Integrates *technology* into instruction and into the curriculum
  - Integrates cross-curricular components; e. g. language arts, mathematics, career education, life skills, and *technology.*
  - Integrates available *technology* into daily curricular activities
  - Integrates *technology* such as laser disc, graphing calculators, and LCD panel in content lessons
  - Integrates available *technology* into daily curricular activities
  - Employs a moderate repertoire of strategies appropriate for student understanding (*technology* integration is visible)

- Other:
    - Provides opportunities for hands-on *use of technology*
    - Provides opportunities for guided practice and hands-on *technology application.*
    - Teaches to modality performances and uses available *technology.*
    - Incorporates the use of *technology* as appropriate
    - Engages students in *technological* learning experiences
    - Presents lessons incorporating the students use of *technology*
    - Provides opportunities for students to utilize *technology*
    - Incorporates and encourages use of *technology*
    - Delivers curriculum to students through a variety of methods, tools, and resources including *technology* and *web-based* information sites as well as print materials
    - Applies *productivity tools* for professional use
    - Standards of Learning and other instructional objectives
    - Plans and implements lessons and strategies that integrate *technology* to meet the diverse needs of learners in a variety of educational settings.

Language taken directly out of the *Guidelines for Uniform Performance Standards* (2000), was used by a number of divisions. Seventeen divisions stated, "The teacher uses comprehensive materials, technology, and resources that promote the development of critical thinking, problem solving, and performance skills" (p. 27). Five divisions incorporated "The teacher provides opportunities for guided practice and hands-on technology application" (p. 27) into their evaluation instrument. Four divisions stated, "The teacher utilizes available technological materials and resources effectively to engage students in varied learning experiences" (p.27). Another seven divisions quoted "The teacher demonstrated competence in the Technology Standards for Instructional Personnel" (p.27).

Direct reference to technology integration was noted in the teacher evaluation instruments of eight counties.

Category 3: Language that pertained to the role of technology in the safety and learning environment. Language relating technology to the safety and learning environment was found in two evaluation instruments. Analysis of the language contained the following themes:

- Effectively uses chalk board, bulletin board, audiovisual equipment, available *technology* or supplemental teaching aids
- Utilizes *technology* in the learning environment

The descriptions refer to the learning environment and the use of technology to support such environment. Safety in relation to technology was not addressed in any of the instruments analyzed.

Category 4: Language that related technology to communication and community relations. Language that related technology to communication and community relations was found in one evaluation instrument. An analysis of the language revealed the following theme:

- Utilizes available technology for instructional purposes

This one description related to technology was found under the heading of Communication and Community Relations: Interacting within Educational

Environment in the division's evaluation instrument. The other two descriptions listed under this heading referenced interaction with the community.

Category 5: Language related to technology and its role in division expectations for teachers' professionalism. Language relating technology and professionalism was noted in 13 evaluation instruments. The themes relating to technology in the area of professionalism are as follows:

- Demonstrates competency in knowledge, use, and instructional *technology* application
- Incorporates computer *technology* and its instructional applications into the curriculum where appropriate
- Provides a good role model and demonstrates competence in the *Technology Standards for Instructional Personnel*
- Meets *Technology Standards for Instructional Personnel*
- Keeps current with research and *technology in education*
- Utilizes *technology*
- Demonstrates knowledge of *technology*
- Maintains accurate *electronic grade book* which can be easily interpreted
- Uses available *technology* efficiently
- Continues to develop personal *technology* skills out lined in the NCPS *Technology Standards for Instructional Personnel*
- Maintains a high level of personal knowledge regarding new developments and techniques including *technology*, in the field of professional specialization
- Models professional, moral, and ethical standards as well as personal integrity in all interactions by maintaining a high level of personal knowledge regarding new developments and techniques including *technology* in the field of professional specialization
- Masters state *technology standards by* spring of 2001 or within three years of employment

The bulk of the language contained within the evaluation instruments regarding technology and professionalism focused on two areas: Utilization of technology and meeting Technology Standards for Instructional Personnel. Teacher responsibilities in reference to technology in the area of professionalism also included the teacher as a role model in the use of technology. One evaluation instrument referenced the use of an electronic grade book as an expectation.

Chapter 5: Conclusions

Introduction

Technology is an integral part of education. Considering the pervasiveness of computers and technology in today's society, it would be difficult for educators to justify not integrating technology into their efforts. But the variables associated with technology integration in the instructional setting are complex. To try to better understand this complexity, this study will help educators determine if the number of computers in the classroom setting available for student use, the availability of Internet access, the location of computers outside the classroom setting, and performance-based teacher evaluations have any impact on student achievement.

Research Question 1

Summary. Having access to the Internet in the educational setting is an important factor when integrating technology into the curriculum. According to Virginia's SOL for computer/technology objectives, 5th-grade students should be able to process, store, retrieve, and transmit information. This includes the ability to search for information using databases, CD-ROMS, videodiscs, and the web. Students should also be able to describe the advantages and disadvantages of various computer processing, storage, retrieval, and transmission techniques.

Research question one addressed the relationship between Internet access and student performance on the 5th-grade SOL assessment for computer/technology. All the principals responding indicated that students in their buildings did have access to the Internet, which is imperative because without access, the students would have no way to demonstrate mastery of Computer/Technology objective 5.3. However, the principals did differ on whether or not Internet access was required of their 5th-grade students.

Noting the varied responses, an analysis of the relationship between required Internet use and 5th-grade student performance on the SOL computer/technology assessment was conducted. The result was not significant.

Research Question 2

Summary. Having computers in the classroom is no longer a luxury; it is an essential because students and teachers are expected to demonstrate proficiency in the use of computers/technology. In order to demonstrate proficiency, it has become a necessity to have computers available for student use in the classroom setting. Computer/technology objective 5.4 states that "the student will communicate through application software" (VDOE). Thus, students must create documents using word processing, integrate computer graphics into documents, and create simple databases and spreadsheets by the end of their 5th-grade year.

According to the principals surveyed, 99% of their classrooms have computers available for student use. The number of computers in the classroom setting across the state ranged from one to ten. The average number of computers in the classroom was 3.46. However, in analyzing the relationship between the number of computers available for student use in the classroom and 5th-grade computer/technology SOL passing rate, there was no significance.

Research Question 3

Summary. Where to place computers outside the classroom setting has always been an interesting topic of discussion among educators. Computers outside the classroom are commonly found in the library and in technology labs. This creates areas within the building where an entire class can work on an assignment requiring computer access at one time. According to the principals responding to this survey, they all had a varying number of computers available for student use in the library and technology lab. However, 19 principals also reported having computers in other locations in there building.

Multiple regression analysis was used to try and predict whether of not the locations of computers in the school setting (outside the classroom) would predict achievement of the 5th-grade SOL computer/technology assessment. The analysis was conducted on availability of computers in the library, technology lab, and other areas. The analysis indicated no predictive value.

Research Question 4

Summary. The content analysis revealed that the performance-based teacher evaluation instruments reflected technology integration to varying degrees. Evaluation instruments can have powerful symbolic value because they embody the values and expectations of the public in regards to the function of instructional personnel in the division. The criteria in those instruments are used to judge the effectiveness of the teacher, to help focus on instructional effectiveness, and to improve overall job performance. According to the Guidelines for Uniform Performance Standards (2000), reference to the use of technology appears in two of the five major categories of evaluation criteria. The five major categories are: Planning and Assessment, Instruction, Safety and Environment, Communication and Community Relations, and Professionalism. References to technology are found under the categories of Instruction and Professionalism.

Instruction. Under the category of Instruction, performance indicators stress, "the teacher uses comprehensive materials, technology, and resources that promote the development of critical thinking, problem solving, and performance skills" (2000, p.13). In analyzing the evaluation instruments used in Virginia, 44.3% of the 106 instruments obtained referenced technology under the category of instruction. Thus, over half of the divisions in Virginia do not stress the use of technology during instruction in their performance-based evaluation instruments. If technology is not a component of the instrument in reference to instruction, how can teachers be held accountable for technology integration?

Professionalism. The second category that references technology as a performance indicator is in the area of Professionalism. The Guidelines for Uniform Performance Standards states, "the teacher maintains a high level of personal knowledge regarding new developments and techniques, including technology, in the field of professional specialization" (2000. p.31). In reference to technology in this category, 12.3% of the instruments analyzed contained language specific to technology.

Furthermore, in regard to the evaluation instruments and their date of development or revision, it is interesting to note that the number of instruments revised after 1999 increased as did the number of technology descriptions in those documents (see Table 10).

Table 11: Evaluation Instrument Dates

Year of development or revision	Number of evaluation instruments	Number of technology descriptions
1973	1	0
1988	2	2
1990	1	0
1991	1	0
1992	1	0
1994	1	1
1995	3	3
1996	3	2
1997	3	4
1998	9	6
1999	8	4
2000	17	12
2001	28	21
2002	4	2

Conclusion. The variables that this study explored in reference to computer/technology integration in the education setting were 1) Internet access, 2) the number of computers available for student use in the classroom setting, 3) the location of computers outside the classroom setting, and performance-based teacher evaluation instruments referencing technology.

Overall, the variables of interest in this study seem to have no direct relationship with the 5th-grade student SOL computer/technology assessment passing rate. Thus, Internet access, computers in the classroom, and computers in other locations in the educational setting are not the variables significantly contributing to student success on the computer/technology SOL assessment.

However, the lack of language relating technology to instruction in the performance-based teacher evaluations is cause for concern. As the literature points out, in addition to enhancing teaching and learning, technology offers support for activities commonly associated with school accountability and management, such as teacher and program evaluation, student assessment, and data-based decision making to support school improvement efforts. Performance-based teacher evaluation instruments have been recognized as fundamental for implementing standards-based instruction by groups such as the National Research Council and The National Council of Teachers of Mathematics (Pellegrino, Baxter, & Glaser, 2000). If the teachers of Virginia are not held accountable for technology integration through performance-based evaluation systems, then expecting the students to demonstrate proficiency in the area of technology is questionable.

Implications

Even though the results of this study did not show any significant findings in relating 5th-grade students' SOL computer/technology passing rate to the location of computers in the schools, the number of computers in the classroom, or the requirement of Internet access, it is important to note that the average SOL assessment passing rate for the sample analyzed in this study was 86.68%. This would seem to indicate that there are other variables that are contributing to the successful student acquisition of the necessary computer/technology skills.

The SOL assessment used to assess students' proficiency in the area of computer/technology is a paper and pencil assessment. The following Spring 2002 released test items are an example of the types of multiple choice questions students face when taking the SOL test.

In the area of Basic Understanding of Computer Technology, students were asked

1) The basic language of computers, made up of ones and zeros, is called the –

A automatic language

B binary language

C hardware language

D high level language

2) Where can you find commands to save your document?

A File

B Edit

C Format

D Tools

In the area of Basic Operational Skills, students were asked the following questions:

1) Trisha needs to take pictures of the basketball team to place in tomorrow's school newspaper. The fastest way to do this would be to use a –

A drawing paper

B scanner

C digital camera

D 35mm camera

2) Tai was allowed to use a free graphics site o the Internet at school. Which device does he need to use to take a graphic from this site and glue it to his Science poster?

A Keyboard

B Monitor

C Printer

D Scanner

Virginia Department of Education, 2002

The students are not required to use a computer to actually take the test and have done well according to the passing rates analyzed in this study. Does this test actually reflect the proficiency level of 5th grade students? This is a difficult question to accurately answer given the SOL computer/technology testing format.

Considering the lack of language referencing the integration of technology found in the content analysis of the performance-based teacher evaluation instruments across the state of Virginia, the students are performing remarkably well. Thus, the implication from the content analysis of the evaluation instruments used in Virginia is that if accountability measures pertaining to technology integration were reflected in the evaluation instruments, then it stands to reason that the mean score would increase.

Recommendations

This study revealed that of the 106 performance-based evaluation instruments analyzed 56 % did not reflect the need for technology in any of the five teacher evaluation criteria areas listed in the guidelines set forth by the state of Virginia. Divisions must articulate and support a clear vision for the use and integration of educational technologies before technology can be effectively integrated into teaching and learning. One component of having a clear vision is to be able to assess results and insist on accountability for those results. If technology integration is not important enough to include in the performance-based evaluation instrument used to assess teachers' instructional proficiency, a very clear message is conveyed. Evaluation instruments communicate powerful messages to teachers regarding school divisions' expectations for instruction. Teachers will strive to meet these expectations when they are articulated. Thus, it would be prudent for school divisions to better align their evaluation instruments with the State's Uniform Guidelines for Performance Standards in order to address the need for technology integration in the educational setting.

Future Research

This study demonstrated that the location of computers in the educational setting, the numbers of computers available for student access, and required Internet access only accounted for a small portion of the variance in the passing rate on the 5th-grade computer/technology assessment. Thus, the majority of the variables that contribute to student achievement on the 5th-grade SOL computer/technology assessment are still unaccounted for according to this study.

According to Dugger, Delany, Meade, and Nichols (2003) there are six components of educational programs that affect student learning: 1) content, 2) curricular, 3) instruction, 4) learning environment, 5) student assessment, and 6) professional development. The integration of technology into these areas is vital if students are to successfully acquire the skills necessary to be considered technologically literate individuals. Moving in the direction of technology integration would give educators more of an indication as to what is needed to ensure that students are graduating with the skills needed to be successful, contributing members of society.

Future studies exploring the areas mentioned above and their relationship to technology integration would clarify the direction educators need to go in order to increase student achievement. The opportunity to acquire technology literacy through the educational process should be afforded to every student and educators need to understand the complexities of making this a reality.

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Appendixes

Appendix A: Principal Survey

Dear Principal:

I am a doctorial candidate at The College of William & Mary, and a middle school administrator working on my dissertation. I need your help! In trying to isolate some of the variables related to technology integration that may have an impact on student achievement. The following questions have arisen. Please provide the following information in reference to your elementary school.

5. Does your elementary school have Internet access readily available to students for instructional purposes?

6. Are 5th grade students required to access the internet to complete assignments?

7. What is the total student population in your school?

8. How many computers are available for student use in each of the following locations:

   - Classroom ____
   - Library ____
   - Technology lab ________
   - Other (please specify) ________________________

Thank you in advance for supplying me with this information. It will be valuable in identifying factors that may impact the enhancement of teaching strategies and student achievement through technology! If you would like a copy of the results of this study, please let me know.

Sincerely,

Ms. Nancy M. Buchanan
Assistant Principal
Peasley Middle School

Dr. Michael F. DiPaola
The College of William & Mary

Appendix B: Virginia Technology Standards

8 VAC 20-25-10 et seq.

TECHNOLOGY STANDARDS FOR INSTRUCTIONAL PERSONNEL

Statutory Authority: § 22.1-16 of the *Code of Virginia*

Effective Date: March 4, 1998

8 VAC 20-25-10. Definitions.

The following words and terms, when used in this regulation, shall have the following meaning unless the context clearly indicates otherwise:

Demonstrated proficiency means a demonstrated level of competence of the technology standards as determined by school administrators.

Electronic technologies means electronic devices and systems to access and exchange information.

Instructional personnel means all school personnel required to hold a license issued by the Virginia Board of Education for instructional purposes.

Productivity tools means computer software tools to enhance student learning and job performance.

8 VAC 20-25-20. Administration of technology standards.

A. School divisions and institutions of higher education shall incorporate the technology standards for instructional personnel into their division-wide technology plans and approved teacher education programs, respectively, by December 1998.

B.School divisions and institutions of higher education shall develop implementation plans for pre-service and in-service training for instructional personnel. The implementation plan shall provide the requirements for demonstrated proficiency of the technology standards.

C.Waivers shall be considered on a case-by-case basis of the 18-hour professional studies cap placed on teacher preparation programs for institutions requesting additional instruction in educational technology.

D.School divisions shall ensure that newly-hired instructional personnel from out of state demonstrate proficiency in the technology standards during the three-year probation period of employment.

Technology Standards for Instructional Personnel (8 VAC 20-25-10)

E.Course work in technology shall satisfy the content requirement for licensure renewal for license holders who do not have a master's degree.

F.School divisions shall incorporate the technology standards into their local technology plans and develop strategies to implement the standards by December 1998.

G.Institutions of higher education shall incorporate technology standards in their approved program requirements and assess students' demonstrated proficiency of the standards by December 1998.

8 VAC 20-25-30. Technology standards.

A.Instructional personnel shall be able to demonstrate effective use of a computer system and utilize computer software.

B.Instructional personnel shall be able to apply knowledge of terms associated with educational computing and technology.

C. Instructional personnel shall be able to apply computer productivity tools for professional use.

D.Instructional personnel shall be able to use electronic technologies to access and exchange information.

E.Instructional personnel shall be able to identify, locate, evaluate, and use appropriate instructional hardware and software to support Virginia's Standards of Learning and other instructional objectives.

F. Instructional personnel shall be able to use educational technologies for data collection, information management, problem solving, decision making, communication, and presentation within the curriculum.

G. Instructional personnel shall be able to plan and implement lessons and strategies that integrate technology to meet the diverse needs of learners in a variety of educational settings.

H. Instructional personnel shall demonstrate knowledge of ethical and legal issues relating to the use of technology.