ANALYSIS OF FACTORS THAT INFLUENCE A TEACHER'S USE OF COMPUTER TECHNOLOGY IN THE K-5 CLASSROOM

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(ABSTRACT)

Throughout the last 30 years, there has been a movement to use computer technology in schools to enhance teaching and learning. In recent years, the *No Child Left Behind Act* of 2001 has mandated that states have a long range strategic educational technology plan that describes the many facets of their technology integration efforts (2002). However, at this time research indicates that technology integration in classrooms is still low tech and infrequent (Cuban, 2001; NCES, 2005a). The purpose of this quantitative study was to gain insight into a teacher's use of computer technology with students in K-5 general education public school classrooms across the state of Virginia. Eleven independent variables (e.g., teaching philosophy, professional development, hardware proficiency, software proficiency) and 2 dependent variables (i.e., frequency and application of technology integration) were selected based on a review of literature and input from educators. A questionnaire, designed to measure variables, was field tested for validity and reliability then administrated to teachers. The population of the study was approximately 16,500 K-5 general education public school teachers from the state of Virginia with active e-mail addresses in the Market Data Retrieval (MDR) database. A systematic sample of 1,400 K-5 teachers was selected from the MDR database. Teachers' responses rendered 313 usable questionnaires. Analysis of the data revealed that the majority of independent variables (8), with the exception of 3 independent variables (i.e.,

technical support, student to computer ratio, technology integration support), yielded significant correlations with the dependent variable frequency of technology integration. Whereas, all independent variables (10), with the exception of technical support, yielded significant correlations with the dependent variable application of technology integration. Multiple linear regression analysis was conducted to determine whether the 11 independent variables were significant predictors of variation in the dependent variables (frequency and application of integration). The results of both regression analyses rendered significant models for the prediction of variation in frequency and application of integration (R^2= .16, R^2=.39), respectively. The researcher concluded that the predicted variance (R^2= .16) of regression model 1 was too small to be considered a viable model for the predication of variation in frequency. Whereas, regression model 2 predicted a greater level of variance (R^2=.39), thus it was considered a good predictor of variation in the application of technology integration. Three of the 11 independent variables (i.e., software availability, teaching philosophy, and software proficiency) were among the variables that were significant predictors of variance in the application of technology integration. The strongest predictor was software availability followed by teaching philosophy and software proficiency. Teachers who reported moderate to low variety in the application of technology integration also reported moderate access to software, moderately low software proficiency, and use of instructional practices that were consistent with constructivism.

DEDICATION

This dissertation is dedicated to my family, especially my daughter, Taylor Rogers, niece Imani Williams, and uncle, Norman McCalla. As well as, those family members who have passed on but are with me in spirit, especially my mother, Patricia Rickman and grandmother, Myrtle McCalla. It is difficult to describe in words all that I have gained from each of you that has sustained me on this journey. However, this much I know; each of you has touched me in unique ways. I believe it was something about your strength, compassion, and encouragement that inspirited me to remain focused and vigilant on my path to complete this dissertation.

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CHAPTER I

THE PROBLEM

Context of the Study

The integration of technology with curriculum and pedagogical practices in classrooms has been an area of concern for the education community throughout the last 30 years. Research indicates that even though the use of technology to improve student learning (Mann, Shakeshaft, Becker, & Kottkamp, 1999; Sivin-Kachala & Bialo, 2000; Wenglinsky, 1998) and support pedagogical practices (Ertmer, Addison, Lane, Ross, & Woods, 1999; Hernández-Ramos, 2005; Sandholtz, Ringstaff, & Dwyer, 1997) has produced some positive outcomes, only half of all American teachers use technology for instructional purposes in the classroom (National Center for Education Statistics [NCES], 2000).

The need for research that could be used to enhance the quality of teaching practices that facilitate technology integration has been a prominent issue (NCES, 2000). Policymakers, administrators, teachers, and researchers need empirical research to make informed decisions regarding the use of technology in classrooms (Kulik, 2003; Pelgrum, 2001). The present study was conducted to examine teacher personal and environmental factors that influence technology integration in elementary school classrooms. The theoretical framework emanated from a review of literature regarding variables that influence a teacher's integration of technology in the classroom.

The Role of Technology in Society

"The term technology can be used to mean a very wide variety of things, from computers to pencils" (Ringstaff & Kelley, 2002, p. 2). The use of various forms of technology has been evident in society for thousands of years (Schlechty, 2001);

however, it was not until 1936 that the first computer was created ("The history of computers", 2007). With the invention of the personal computer (PC) in the late 1970s and the graphical user interface (GUI) in 1983 consumers experienced the usefulness and ease of computing in the home and workplace ("The history of computer", 2007).

The goal of education in an information society is to produce an educated citizenry capable of improving the workplace (Pelgrum, 2001). Computer technology is used to promote transformation of "students into productive knowledgeable workers" (Pelgrum, 2001, p. 163). Today, U.S. Department of Labor projections suggest that by the year 2014, three of the ten fastest growing occupations will have their origin in computer science and all ten occupations will rely on the use of computers in one form or another (2005). In 2005, occupations related to the field of computer science were among the three highest paid professions in the nation (U.S. Department of Labor, 2006).

The Impetus for Computer Technology Integration in Education

While some of the earliest forms of educational technologies were storytelling and handwritten manuscripts, today computers are the technical tool of choice (Schlechty, 2001). In the field of education, the use of computer technology as a necessary component of education reform across the nation was largely sparked by the *A Nation at Risk* report. The report indicated that American students lacked basics and higher order thinking skills, as well as the scientific and technology literacy needed to compete in the global economy (National Commission on Excellence in Education, 1983). In the 1980's education reform connected to the use of computer technology in classrooms gained momentum with the support of "a loosely tied national coalition of public officials, corporate executives, vendors, policymakers, and parents" (Cuban, 2001, p. 12). This group advocated for the use of technology in schools to equip students with the skills necessary to compete in the global market place of the 21st century, improve "teaching and learning", and increase "efficiency and productivity" of schools (Cuban, 2001, p.13).

Federal and state legislation and policies have contributed to the use of computer technology in schools. In recent years, the intent of the federal government to merge the use of technology with plans for education reform has been revitalized. The focus has moved beyond the procurement of equipment and Internet access, which were prominent issues of the 1980s. On January 8, 2002, President George W. Bush signed into law the *No Child Left Behind Act* of *2001* (NCLB) (2002). The *Enhancing Education Through Technology Act of 2001* is the portion of the NCLB Act of 2001 devoted to the use of technology to improve student achievement.

The Enhancing Education Through Technology Act of 2001 has three goals. First and foremost, schools are to use technology to improve student achievement. Second, in preparation to cross the digital divide, all students must be technology literate by eighth grade. Finally, technology resources and systems must be integrated with professional and curriculum development to establish research based instructional practices that could be replicated across state and local educational agencies (NCLB, 2002).

In 2003, the state of Virginia published a renewed plan for technology integration in schools. The *Educational Technology Plan for Virginia: 2003-2009* aligns the state's goals for technology integration with requirements set forth in the NCLB Act of 2001 (VDOE, 2003). This plan is designed to "present a vision for the use of technology in schools and classrooms, and it serves as a blueprint for school divisions by identifying the necessary components of an effective technology program" (VDOE, 2003, p. iii).

Integration, professional development and support programs, connectivity, educational application, and accountability are addressed in the plan (VDOE, 2003).

The Educational Return on Technology Expenditures

Early on the widespread and effective use of educational technology was considered simply having enough technology in schools (Culp et al., 2003; Pelgrum, 2001). Consequently, across the country the procurement of computer technology, related equipment (i.e., software, network servers) and services (i.e., computer integration specialists, technicians) in public schools grew tremendously. The number of students to computers with Internet access decreased from a ratio of 12:1 in 1998 to 4.4:1 in 2003 (NCES, 2005b). Improvements in Internet connectivity in schools increased, 100% of schools had Internet access as of 2003 (NCES, 2005b). However, the enormous cost associated with the use of technology in schools continues to escalate. In the last decade alone, the national annual expenditure on computers for K-12 education tripled to five billion dollars annually (WestEd, 2002).

In 2002, Richard Davis, Assistant Treasurer of the Virginia Public School Authority, reported an expenditure of $326 million on technology in schools, since the launch of the state's first technology plan in 1996 (VDOE, 2003). Though the price tag to equip the state's schools for technology integration has been tremendous, the pay off has been substantial. According to Davis "Virginia has made enormous advances in infrastructure, hardware, software, teaching and learning resources, professional development, and administrative applications" (VDOE, 2003, p. v).

It is evident that in recent years, the nation's schools have more computers and related services that support the use of computers technology in classrooms. However, in a report based on controlled and quantitative evaluation studies in the 1980s and 1990s, Kulik (2003) found that evaluation literature is so patchy that it is difficult to determine the impact that computers have had on student outcomes in America's schools. Kulik's (2003) findings indicated, "For most technologies, results are available only at selected grade levels, in selected subjects, and on selected instructional outcomes" (p.60).

Waxman, Connell, and Gray (2002) reported that much of the research (i.e., meta-analysis, studies, reviews) regarding the use of technology in schools has focused on the impact of computer-based instruction (CBI), computer-assisted instruction (CAI), integrated learning systems (ILS), and microcomputer on student outcomes. However, findings of these early studies did not specify the appropriate way to "integrate and use technology in schools and classrooms" (Waxman, Connell, & Gray, 2002, p. 3). In some instances, policy makers and researchers have indicated that there remains a need for empirical research that addresses teaching and learning with technology (Cuban, 2001; NCES, 2002; NCLB, 2000).

Technology Integration and the Business of Schools

The old cliché, the only thing that remains constant is change, is a truism that can still be applied to society today. Phillip Schlechty (2001), founder and CEO of the Center for Leadership in School Reform, suggested that America's schools are microcosms of the larger American society. Additionally, he asserted that the way schools conduct business must change as society changes or schools will become extinct. In the National Technology Education Plan, Ron Paige, the United States Secretary of Education stated, "Education is the only business still debating the usefulness of technology. Schools remain unchanged for the most part, despite numerous reforms and increased investments in computers and networks" (U.S. Department of Education, 2004, p. 22).

Rodney Earle (2002) attributed some of the problems with technology integration in schools to societies' misconceptualization of technology integration. The focus should be on processes related to effective pedagogy that support teaching and learning, rather than on hardware (Earle, 2002, p. 3). "As education changes to reflect new social and educational needs, teaching strategies also change; consequently, strategies change for the integrating technology into teaching and learning" (Roblyer, 2003, p. 52). To support and sustain the incorporation of technological innovations in schools, education organizations must have tools available, a process to access tools, and skilled teachers to use tools effectively. At this time, there are too few skilled teachers and the technology savvy teachers are not able to extend their expertise to enough people; as a result, schools must be restructured (Schlechty, 2001).

Teachers as Gatekeepers to Technology Integration in Schools

The notion that in order to understand a teacher's use of technology in the classroom one must explore a teacher's personal attributes (Marcinkiewicz, 1993) as well as environmental variables (Zhao & Frank, 2003) has been well documented in empirical studies (Hernández-Ramos, 2005; Zhao, Pugh, Sheldon, & Byers, 2002). In recent years, there has been much research of isolated variables (e.g., attitudes, professional development, technical proficiency) to predict the integration of technology in the classroom (Becker & Riel, 2000; Kanaya, Light, & Culp, 2005; Sugar, Crawley, & Fine, 2005; Zhao et al., 2002; Zhao & Frank, 2003). However, some researchers have indicated that it would be more informative to research the influence of sets of variables. Teacher personal attributes and environmental variables should be studied simultaneously, since multiple variables influence a teacher's use of technology in the classroom (Blankenship, 1998; Hernández-Ramos, 2005; Marcinkiewicz; 1993; Vannatta & Fordham, 2004; Zhao et al., 2002).

Statement of the Problem

Researchers have explored the integration of computer technology in classrooms from various perspectives, ranging from student achievement to the impact of technology use on teaching and learning. Even though the venue of researchers has shifted throughout the last three decades, to keep pace with technology innovations and the way technology is used in schools, there remains a need for research that explains a teacher's use of technology in the classroom.

State and local policy makers, educational agencies, school administrators, and teachers across the state of Virginia have developed and implemented plans for technology integration since 1997. Federal guidelines for long range strategic educational technology plans have become increasingly stringent, taking into consideration knowledge gained from the last three decades of research. Consequently, legislators, school board members, administrators, and teachers must have current information about factors that influence a teacher's use of technology to guide the continued investment in equipment and related services used to facilitate computer technology integration in schools.

Purpose of the Study

Every child deserves a quality education and technology is one of the tools that educators could use not only to motivate students to learn, but to present content across curriculum areas in a different way. The various applications of technology can be useful in building skills such as collaboration, communication, and critical thinking that could serve students well in the classroom today and in the workplace tomorrow. The NCLB

Act (2002) requires that technology be used to improve student achievement. Additionally, the NCLB Act (2002) requires that students must be technology literate by grade eight in preparation to cross the digital divide, so educators must use technology in the classroom to this end. In the recent past, researchers said that the use of technology in schools is infrequent and low tech (Cuban, 2001; NCES, 2005a). In order for decision makers to plan for the effective use of technology in schools, it is essential to consider teachers and their use of technology in the classroom. Since teachers do not function in a vacuum, it is also important to consider their environment.

The purpose of the present study was to identify sets of variables that could be used to predict variation in a teacher's use of technology in the K-5 classroom. Research conducted to identify sets of variables as well as the variables selected for investigation in the present study were not unique. In the past, several researchers (Blankenship, 1998; Hernández-Ramos, 2005; Marcinkiewicz, 1993; Vannatta & Fordham, 2004; Zhao et al., 2002) have identified sets of variables thought to be predictors of a teacher's use of technology in the classroom. However, teachers and technology change and advance over time; consequently, there remains a need for continued exploration in this area. The current data and analysis garnered from the present study has been used to provide recommendations that could increase and improve the quality of technology integration in the K-5 classroom.

Research Questions

The literature and research regarding the integration of computer technology with other curriculum areas in schools indicated that the following questions should be addressed to better understand the dilemma of low integration of technology in the K-5 classroom.

1. Which of the following variables are correlated with a teacher's use of technology in the K-5 classroom?
    a. Teaching philosophy
    b. Technical proficiency
    c. Professional development
    d. Technology integration support
    e. Technical support
    f. Access to computers and related hardware
    g. Access to software
2. What sets of variables best predict a teacher's use of computer technology in the K-5 classroom?

Definitions of Constructs

Table 1 includes construct and constitutive definitions for constructs identified in the theoretical framework of the study (see Figure 1).

Table 1

Definition of Constructs

Construct	Constitutive Definition	Operational Definition
Frequency of technology integration	The frequency that teachers used computer technology in the classroom with students to facilitate instructional activities	Measured with questionnaire item 15A, Daily= 3 Weekly= 2 Monthly= 1 Never= 0
Frequency of technology integration less SOL	Teacher's perceived lack of time to use technology with students because of the time needed to teach the SOL	Measured with questionnaire item 15B, Strongly Agree= 4 Agree= 3 Disagree= 2 Strongly Disagree= 1
Application of technology integration	The kinds of instructional activities that teachers assign to students that incorporate the use of computers, related technology, and software (i.e., drill and practice, tutorial, instructional games, simulations, problem solving, productivity)	Measured with questionnaire item 16.1-16.13, 3= Frequently 2= Occasionally 1= Rarely 0= Never
Teaching philosophy	A teacher's perceived teaching philosophy based on teaching practices that are consist with either constructivist or traditionalist teaching practices	Measured with questionnaire items 11.1-11.9, 4= Strongly Agree 3= Agree 2= Disagree 1= Strongly Disagree
Technical Proficiency (hardware)	A teacher's knowledge of computer and related technology operations necessary to integrate technology with other curriculum areas in the classroom.	Measured with questionnaire items 12.1-12.10, 1= Yes 0= No

(table continues)

Table 1 (continued)

Construct	Constitutive Definition	Operational Definition
Technical Proficiency (software)	A teacher's knowledge of computer software necessary to integrate technology with other curriculum areas in the classroom	Measured with questionnaire items 13.1-13.9, 1=Yes 0=No
Technical Proficiency (enabling conditions)	A teacher's knowledge of enabling conditions necessary to integrate technology with other curriculum areas in the classroom	Measured with questionnaire items 14.1-14.6, 4= Strongly Agree 3= Agree 2= Disagree 1= Strongly Disagree
Professional Development	The number of hours of technology professional development	Measured with questionnaire item 5A, 4= 21- more 3= 11-20 2= 6- 10 1= 1-5 0= None
	The format of technology professional development (i.e., multiple or single session) and kind of sessions (i.e., hands or not hands on) reported by a teacher	Measured with questionnaire items 6.1-6.5, 4= Strongly Agree 3=Agree 2=Disagree 1=Strongly Disagree
	A teacher's perception of time constraints that limit participation in technology professional develop activities (PDA) due to preparation for SOL PDAs	Measured with item 5B, 4= Strongly Agree 3= Agree 2= Disagree 1= Strongly Disagree 0= Neutral
Access to technical support	A teacher's perception of available technical support to assist with troubleshooting hardware and software problems in the classroom	Measured with items 17.1-17.6, 1= Yes 0= No

(table continued)

Table 1 (continued)

Construct	Constitutive Definition	Operational Definition
Access to technology integration support	A teacher's perception of available support to assist with the integration of technology with other curriculum areas in the classroom	Measured with items 18.1-18.9, 1= Yes 0= No
Access to computers hardware and related technology	Computer to student ratio in the classroom	Number of computers measured with item 7, 5= >11 4= 8-10 3= 5-7 2= 3-4 1= 1-2 0= 0 Number of students measured with item 8, 5= >20 4= 16-20 3= 11-15 2= 6-10 1= ≤5
	The availability of computer hardware and related technology in the classroom	Measured with items 9.1-9.9, 1= Yes 0= No
Access to computers software	The availability of software for student use in the classroom	Measured with items 10.1-10.14, 1= Yes 0= No

Overview of the Study

This dissertation has four chapters. Chapter I includes a description of the problem and context of the study, statement of the problem, purpose of the study, research questions, definitions, and a review of literature. The literature review is comprised of research that highlights connections between the dependent variables and independent variables. Theories are woven throughout the literature review to provide a theoretical foundation for understanding the past and present research. While the overarching theory of the theoretical framework is based on Kurt Lewin's field theory, three additional theories are presented throughout the literature review to provide a deeper understanding of the present study. The three theories are cognitive science theory, ACOT stages of evolution, and force field analysis.

The methodology used to conduct this quantitative study is presented in Chapter II. The chapter includes a description of the population, sample, and setting, as well as procedures used to address potential sources of error, deal with non-respondents, instrument validation and reliability, and data collection and analysis.

The findings of the study are discussed in Chapter III. The results include descriptive and inferential data yielded from statistical procedures (i.e., Chi-square Test of Independence, Independent Samples t-Test, Pearson's Correlations, and Multiple Linear Regression) conducted in the study. The Chi-square Test of Independence and Independent Samples t-Test were used to determine whether findings of the study could be generalized to the population. Next, there is a presentation of descriptive data for demographic, independent, and dependent variables. At the end of the chapter, there is a discussion of correlations between independent and dependent variables followed by results of multiple regression analysis of variables.

Chapter IV is the final chapter of the dissertation. The chapter includes a discussion of findings and conclusions, limitations of the study, implications for current practice, and recommendations for future research. The overarching theoretical framework and supporting theories that were presented in the literature review are revisited in this chapter to assist with the interpretation of findings from the present study.

Theoretical Framework

Kurt Lewin's field theory of 1936 indicates that behavior is a function of both personality and environment, B = F (P, E) (1975). That means an individual's personality interacts with conditions in the environment to produce specific behaviors (Lewin, 1998). Theoretically, one can assume that a teacher's personal attributes (e.g., teaching philosophy, technical proficiency) coupled with environmental variables (e.g., technical support, professional development) influence a teacher's use of computer technology in the classroom, as depicted in Figure 1.

A REVIEW OF LITERATURE

Technology Integration

The definition of technology integration as discussed in the present study emanated from ideas conveyed regarding the use technology in schools developed by various institutional entities (CEO Forum, 2001; ISTE, 1998; NCES, 2002; VDOE, 2003). The NCES (2002) defined technology integration as "the incorporation of technology resources and technology-based practices into the daily routines, work, and management of the schools" (p.75). According to ISTE, technology integration is realized when it is an integral component or tool for learning within the context of curriculum areas (ISTE, 1998). The CEO Forum on School Technology and Readiness (2001) indicated that students must be taught 21st century skills, "digital age literacy, inventive thinking, effective communication, and high productivity abilities" to navigate a global economy (p. 5).

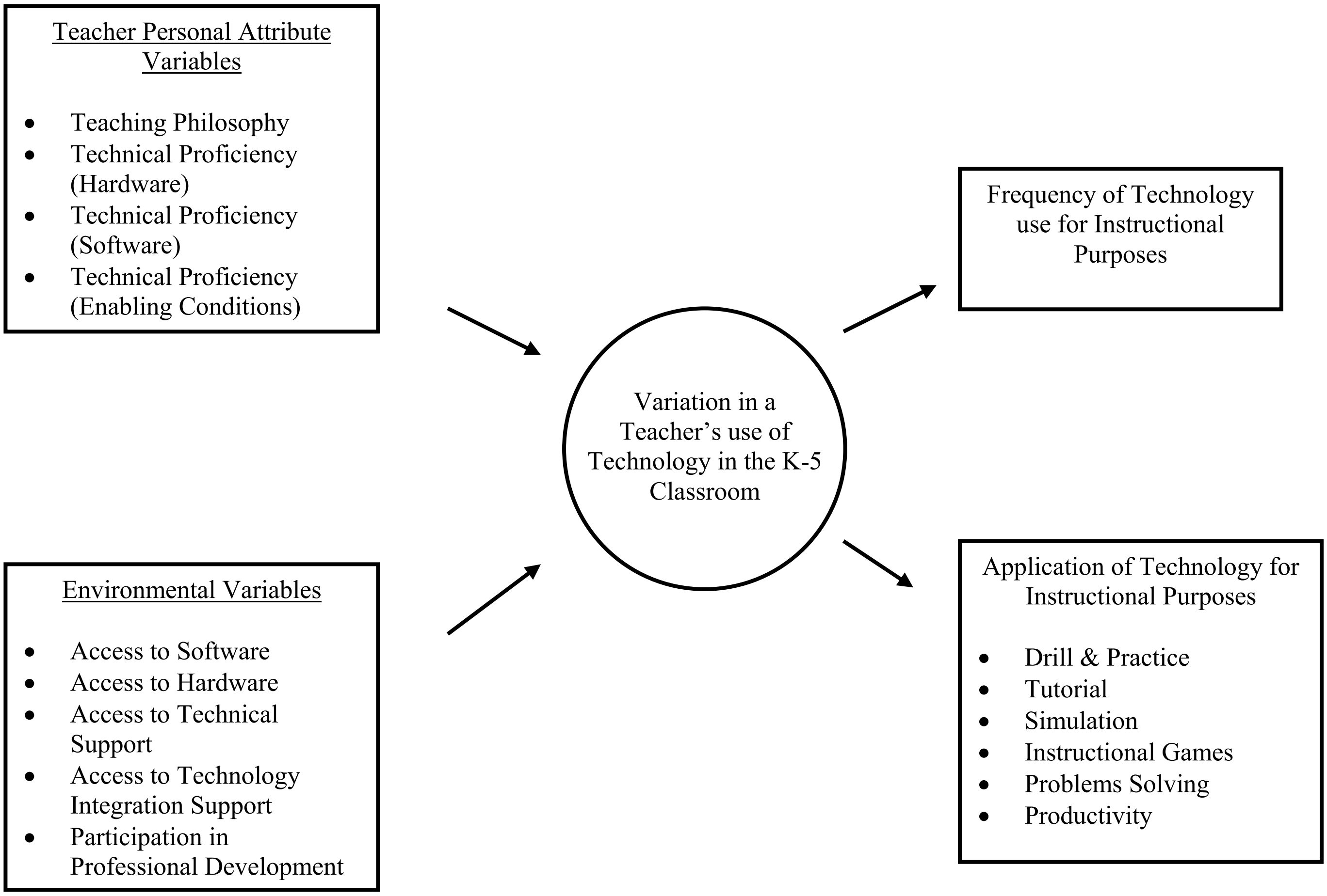

Figure 1. Theoretical Framework of the Study

In the present study technology integration is the frequency of technology used in the classroom for instructional purposes as well as the application of instructional technology in the elementary school classroom. According to Roblyer (2003), the terminology used to identify technology applications has changed throughout the years. However, she separated the various uses of technology for instructional purposes into distinct categories. Roblyer's categories are used in the present study. The categories are drill and practice, tutorial, instructional games, simulations, and problem solving. Roblyer (2003) would have referred to the final category as support tools, but in the present study, it was termed productivity.

Listed below are definitions for each technology application:

1. Drill and practice activities provide exercises in which students work example items, usually one at a time, and receive feedback on their correctness (p. 89).
2. Tutorials act like human tutors by providing all the information and instructional activities a learner needs to master a topic; information summaries, explanation, practice routines, feedback, and assessment (p. 88).
3. Instructional games are designed to increase motivation by adding game rules to learning activities; usually either drills or simulations (p. 88).
4. Simulation is a computerized model of a real or imagined system designed to teach how a system works (p. 94).
5. Problem-solving programs teach directly, through explanation and/or practice, the steps involved in solving problems or help learners acquire problem-solving skills by giving them opportunities to solve problems (p. 88).
6. Productivity is the use of technology to gather, organize, and/or generate an original product. Common support tools used to do productivity tasks are the word processor, spreadsheet, and database.

Teacher Personal Attributes and Technology Integration

The influence of a teacher's personal attributes on the frequency of computer integration and the kinds of instructional activities used in the classroom has been documented in empirical studies. Specifically, researchers have concluded that variables such as teaching philosophy (Becker& Riel, 2000; Ertmer et al., 1999; Sandholtz et al., 1997) and technical proficiency (Hernández-Ramos, 2005; Sandholtz & Reilly, 2004;

Vannatta & Fordham, 2004; Zhao et al., 2002) are correlated with a teacher's use of computer technology in the classroom.

Cognitive Science and Teaching Philosophy

Many instructional practices utilized in classrooms today emanate from a teacher's philosophy about teaching and learning. B. F. Skinner is known for the development of behavioral learning theories. According to Skinner (1974) humans have mental control over their responses. Teachers provide learning opportunities that reinforce expected behavior (i.e., operant conditioning). Learning is thought to be an external process; wherein, information (e.g., facts, concepts) is directly transmitted and learned behavior is observable and measurable. Behavioral theories are the basis for many teaching practices (i.e., behavior management and systematic instruction) implemented in classrooms today (Roblyer, 2003). Information is transmitted primarily through teacher-centered lecture, textbooks, drill and practice, repetition, and whole group instruction. Multiple-choice assessment is the primary means of evaluation of students' understanding (Becker, Ravitz, & Wong, 2000; Roblyer, 2003).

At the other end of the continuum are constructivists learning theories. Constructivism is based on the premise that learning occurs when students engage in deep thinking that facilitates understanding of facts and concepts. Instructional activities are designed to support synthesis of old and new information; "Understanding arises only through prolonged engagement of the learner in relating new ideas and explanations to the learner's own prior beliefs" (Becker et al., 2000, p. 3). Roblyer (2003) suggests that constructivism was conceived because of several learning theorists' frustration with the limitations of behaviorism. Becker and Riel (2000) indicated that the impetus for the use of constructivists teaching practices was due in part to national reform efforts to improve teaching and learning.

Instructional practices grounded in constructivism are thought to prepare students to work together and share information needed to solve problems that may be encountered in the future (Roblyer, 2003). Typically, teaching practices are used to facilitate a student-centered, group based, cooperative learning, and problem based environment (Becker & Riel, 2000; Becker et al., 2000; Ertmer, 2005). Among the theorists credited with learning theories that support constructivism are Piaget (cognitive constructivism), Dewey (inquiry learning), Vygotsky (socio-historical activity theories), Garfinkel (social constructivism), and Renate and Caine (brain based learning) (Becker & Riel, 2000).

Teaching Philosophy and Technology Integration

The computer and related technologies are merely tools used to facilitate teaching and learning (WestEd, 2002). The extent to which computer technology is integrated with other curricula in the classroom greatly depends on teaching philosophy. Research suggests that teaching philosophy guides a teacher's approach to teaching, particularly the selection of instructional activities and frequency of technology used in the classroom (Becker & Riel, 2000; Ertmer et al., 1999; Ertmer, 2005; Hernández-Ramos, 2005; Zhao et al., 2002).

In a study conducted to evaluate one state's technology initiative, Zhao et al. (2002) found that the most effective technology integration occurred when a teacher's pedagogical approach mirrored the technology used in the classroom to facilitate teaching. Traditionally, American teachers have primarily utilized teaching practices grounded in educational philosophies emanating from the behavioral science theories, specifically the direct transmittal of information (Roblyer, 2003). However, in recent years there has been a movement toward constructivist teaching practices.

Hernández-Ramos (2005) investigated the relationship between a teacher's philosophy and technology integration in the classroom. Analysis of 203 K-12 Silicon Valley teachers' responses revealed a positive relationship between teachers with constructivist philosophy and more frequent technology integration in the classroom. Those teachers who reported the integration of technology whenever possible as well as those who used technology in the classroom four to five times per week scored higher on a constructivist scale, ($F(1, 170) = 16.84$, $p = .000$) and ($F(2,169) = 4.985$, $p = .008$), respectively.

Additional findings proved that teachers who assigned computer technology-based projects to students rated higher on a constructivist belief scale. A mean of 3.17 represented the number of respondents who answered yes to the use of technology-based projects and a mean of 2.95 represented those who answered no; these findings were significant $F(1,171) = 16.84$, $p = .000$. It is the belief of some experts that projects are a vehicle for deeper learning thus one of the more sophisticated uses of technology in the classroom. Typically, projects require students to use multiple skills and complete varied tasks to successfully reach a goal (Becker et al., 2000).

Research conducted by Ertmer and Snoeyink (2002) suggested that teachers who implemented teaching practices consistent with constructivism, integrated technology with greater frequency and attempted more complex integration. During the two year span of the study, the researchers provided focused professional development for each of the veteran teachers who were novice computer users. Though only three teachers participated in this qualitative study, the research methods lead to an in-depth understanding of their technology integration practices.

The teachers participated in observations, one focus group, five extensive interviews, and responded to four questionnaires. Observations of participants indicated that all three teachers of grades two, four, and six exhibited instructional practices that were both traditional and constructive. However, the traditionalist' instructional tendencies of one participant were more prominent than those of the other two participants. They exhibited more constructivist instructional practices.

The traditionalist attempted to use lower level computer applications (e.g., Accelerated Reader) that would be equated with a drill and practice instructional methodology. Generally, the traditionalist did not see the worth of using technology to teach skills that had previously been taught to students without the use of technology. The researchers concluded that the traditionalist remained reluctant to integrated technology in the classroom throughout the two year duration of the study.

On the other hand, the two teachers that exhibited more constructivist tendencies were more willing to act as facilitators when computer technology was integrated in the classroom. Though the two constructivist teachers experienced frustration with the implementation of new computer applications, both teachers allowed students to take the lead and assist others with navigation of computer applications when the students' expertise was greater than the teachers.

Additionally, the instructional practices of one of the two teachers that demonstrate more constructivist tendencies became more pronounced as computer skills were acquired. For example, higher level computer applications were used to support literature instruction. Students conducted research, created hypermedia stacks to demonstrate connections between ideas, then presented information. The teacher realized that traditional assessment methods would not be the best way to measure students' presentations, so a rubric (i.e., constructivist assessment tool) was designed and used to evaluate presentations (Ertmer & Snoeyink, 2002).

Even though much research suggests that teaching practices driven by constructivist philosophy support the quantity and quality of technology integration in the classroom (Ertmer & Snoeyink, 2002; Roblyer, 2003), Eugene Judson (2006) warns that we must be weary of such findings. He cautions that there is not always evidence to support this assumed relationship. In a mixed methods study of 32 primary and secondary teachers, Judson (2006) found that self-reported survey responses did not match observations of the participants in the study. Even though constructivist teaching philosophy was reported by the majority of teachers (M=75.1, SD=11.9, n=32), observations revealed less than half (M=47.7, SD=18.9, n=32) actually utilized constructivist teaching practices when integrating technology in the classroom.

Technical Proficiency and Technology Integration

According to Sandholtz and Rielly (2004), as early as the 1980s the Association for Computing and Machinery (ACM) indicated that computer science was a necessary component of teacher preparation programs. Today, the importance of technical proficiency is still evident across the country in technology standards for instructional personnel. In fact, the very first standard of the *National Educational Standards for*

Teachers recommends that “Teachers demonstrate a sound understanding of technology operations and concepts” (ISTE, 2002, p. 305).

Various researchers have linked a teacher’s technical proficiency to the frequency of technology use and kinds of technology integration utilized in the classroom (Becker, Ravitz & Wong, 1999; Hernández-Ramos, 2005; Mueller, Wood, Willoughby, Ross, & Specht, 2008; Lowther, Inan, Strahl, & Ross, 2008; Zhao et al., 2002). When determining the technical proficiency of a teacher, researchers indicated that it is pivotal to consider knowledge of computer operations, software applications, and enabling conditions necessary to integrate technology with other curriculum areas in the classroom.

Becker, Ravitz, & Wong (1999) wrote the third report in a series published to disseminate data and analysis from the *Teaching, Learning, and Computing: 1998 National Survey* (TLC). At first glance one might be incline to think that findings from this study are obsolete because computer technology is often associated with innovation and constant change. However, this research was based on such a large and diverse sample that the data and analysis provide critical insight about the technical proficiency and pedagogical concerns of American teachers. Additionally, while technical advances (e.g., computers process information faster, content of software more relevant) have been made throughout the years, many applications for computer technology in the classroom remain the same. Consequently, many of the basic functions (e.g., save a file, multimedia presentation) used to measure the technical proficiency of a teacher in this study are still applicable today.

The TLC survey was administered to educators from three different samples. The first sample was drawn from a national probability sample of schools (i.e., 655 schools).

The second sample was a purposely drawn sample from schools (i.e., 110 schools) with the greatest per-capita computer technology. The third sample was purposely drawn from schools that implemented at least one substantial national or regional reform effort (i.e., 450 schools). The total number of participants in the study was 4,083 teachers; 2,251 teachers were from the original national probability sample, and the remaining participants were from the two purposely drawn samples.

The report highlighted findings that connected a teacher's technical proficiency to technology integration in the classroom. The survey items were designed to measure technical proficiency in terms of knowledge of operating system platform(s) and seven computer tasks. The majority of teachers (grades 4-12) surveyed indicated that they were very experienced (59%) or expert (11%) computer operators on at least one operating system platform (i.e., Macintosh, Windows/DOS, Apple II).

When the researchers' focus shifted to specific computer tasks, the percentage of teachers reporting proficiency decreased as computer tasks became more complex (Becker, Ravitz, & Wong, 1999). The following list represents the percentage of teachers able to complete each tasks measured on the survey: 75% display a disk drive, 18% create a multimedia document, 71% copy files from one disk to another, 63% use a web browser, 48% insert a graphic in a word processor document, 40% create a new database, and 26% develop a slide show using presentation software. The proficiency of all teachers surveyed was (M = 3.4) of 7 computer tasks; whereas, the proficiency of elementary school teachers was (M = 2.7) of 7 computer tasks.

Generally, no matter the platform teachers with greater expertise assigned computer tasks to students with greater frequency and variety than less skilled teachers.

Only one-third of the teachers regularly assigned computer assignments. Elementary teachers were more apt to assign "game and drill software" to provide remediation, while the integration of the word processor (50%), World Wide Web (30%), and CD-Rom reference software (34%) were assigned by all teachers (Becker et al., 1999, p. 2).

Hernández-Ramos (2005) arrived at a similar conclusion indicating that teachers who were not technically proficient were less willing to integration technology in the classroom. In fact, ninety-five percent of the 203 K-12 Silicon Valley teachers surveyed agreed that a teacher's level of technology proficiency does affect eagerness to integration technology with other curriculum areas in the classroom. In the study, a teacher's technical proficiency was determined based on knowledge of 11 software applications as well as the length of personal computer ownership.

While the length of personal computer ownership was not significant, knowledge of software was significant ($F(2,177) = 3.697$, $p = .027$). There was a difference in the average number of days per week that a computer was used with students in the classroom based on a teacher's software knowledge. Student computer use in the classroom was higher among advanced users ($M = 3.40$) of software applications than for beginner ($M = 2.25$) and intermediate users ($M = 2.65$). Teachers with greater knowledge of software applications allowed students to use "computers on average one more day per week than those who were less knowledgeable" (Hernández-Ramos, 2005, p. 48).

However, Becker et al. (1999) determined that the mere understanding of software applications does not always lead to a teacher's utilization of computer technology in the classroom. Analysis of 1998 TCL data indicated that there was not a substantial relationship between K-12 teachers skilled in the use of software applications and computer operations and the “variety and frequency of student software use” in the classroom (r=.29, r=.27) (Becker et al., 1999, p. 37). Additional analysis revealed that this trend was the same for elementary teachers of self-contained classes; there was a low correlation between skilled teachers and frequency in the assignment of computer work (r=.24). Among elementary teachers, the strongest associations between skilled teachers and the use of software for instructional purposes occurred with the following applications: word processor (r=.30), World Wide Web (r=.28), graphics (r=.25), presentation (r=.28), and multimedia authoring (r=.31).

In a study conducted in Tennessee researchers sort to determine the affects the Tennessee Ed Technology Launch (TnETL), a statewide technology initiative (Lowther et al., 2008). The program, implemented from 2003-2006, was designed to improve teachers’ technology skills and attitudes toward the integration of technology with curriculum and state standards. The ultimate goal of the program was to use computers to increase student achievement. This was a quasi-experimental study including approximately 12,420 students and 927 teachers from 26 schools (i.e., 13 experimental, 13 control).

The difference between schools in the two groups was that the experimental group had a full time technology coach. Among the essential responsibilities of the coach was to provide focused on-going professional development and one-on-one assistance with lesson plans, curriculum materials, and encouragement. Researchers noted that all schools across the state had adequate access to equipment in accordance with nationally recommended standards.

The findings of the TnETL indicated that technically proficient teachers in the experimental group integrated technology with greater frequency and variety than less proficient teachers in the control group. Additionally, the findings suggested that teachers in the experimental group developed computer and integration skills necessary to engage students in critical thinking and the use of computers as a learning tool. Researchers explored four categories of software (i.e., productivity, educational, testing, and Internet/research) used with students. Generally, students in the experimental group used software for productivity (i.e., word processing, presentation, concept mapping) and Internet/ research (i.e., Internet browser) with greater frequency and for more meaningful applications than students in the control group. There were no significant findings between students in the control and experimental groups for use of educational and testing software.

The Technology Skills Assessment (TSA) was used to determine a teacher's level of technology proficiency. Participants in the experimental and control groups rated their proficiency based on perceived ease in the completion of 47 tasks. The tasks were related to seven boarder technology skill sets (e.g., multimedia basics, using technology for learning, software basics, computer basics, advanced skills, and Internet basics). Significant effect sizes were reported for six of the seven boarder technology skill sets, with the exception of Internet basics.

These significant findings indicated that teachers in the experimental group reported greater perceived proficiencies in all areas, with the exception of Internet basics. Teachers in the experimental groups ease with technology (rated 1- not at all, 2- somewhat, 3- very easily) ranged from a mean of 2.13- 2.85. Teachers perceived greatest mastery with regard to computer basics (M=2.85, SD=0.26) and software basics (M=2.70, SD=0.40); whereas, advance skills (M=2.13, SD=0.61) and use of technology for learning (M=2.23, SD=0.60) were areas of less comfort.

However, on a scale (0 rarely observed -4 extensively observed) used to rate observed computer use, data suggested infrequent use of the software available to teachers. Even though, the findings indicated that teachers in the experimental group used three kinds of software (i.e., word processor, presentation, and concept map) significantly more than those in the control group, generally the observation of computer use was infrequent. The greatest percentages of teachers in the experimental group used software for Internet/ research (74%), word processing (57%), and drill/ practice/ and tutorials (52%). The percentages of teachers observed using the other types of available software was below 21%. The findings were based on random 15-minute observations made in classrooms (i.e., half control, half experimental classrooms).

A closer look at the raw data for the experimental group, found in the Appendix of the TnETL report, revealed that the teachers reported a moderate level of perceived proficiency with technology, especially in the areas of computer basics and software basics. However, observed computer use among students in the experimental group was not as frequent or suffocated as one might expect considering that teachers reported moderate to high technology skills.

Mueller et al. (2008) conducted a study in a mid size city in a large Canadian school district. The researchers found that comfort with computers (the study's measure of technical proficiency) was among the significant discriminate factors used to determine group membership of teachers considered high or low technology integrators.

Findings were based on data gathered from a random heterogeneous sample of 185 elementary and 204 secondary teachers who represented 94 elementary and 16 secondary schools.

Teachers identified as high integrators scored in the top 25% (elementary M=1.85-4.00, secondary M=2.15-4.00) on computer integration scale comprised of eight items. Whereas, low integrators scored in the bottom 25% (elementary M=0-.80, secondary M=0-.95) based on a 5-point Likert scale (never= 0 to a great deal= 4). While high integrators used computer technology with students more frequently, high and low integrators generally used similar applications with students. Technology was used most frequently by elementary teachers for productivity tasks such as planning and self-reporting. While the most popular student applications were the use of tool based software, subject software, on-line research and presentation software and to a lesser extent the use of assessment and communication software. Secondary teachers reported greater use of tool based software than elementary teachers.

Comfort with computers was among the 14 variables thought to characterize high integrators. A scale comprised of two items was used to measure comfort with computers (the measure of technical proficiency in this study). There was a significant difference between high (elementary M= 4.68, SD= .55; secondary M=4.77, SD= .42) and low integrators (elementary M= 3.27, SD= .86; secondary M= 3.38, SD= .88). According to ratings based on a 5-point Likert scale (1- very ill at ease/ unenthusiastic to 5- very at ease/ enthusiastic) high integrators were more comfortable with computers.

The results of the analysis indicated that the discriminant function explained 74% of separation between groups (i.e., high and low integrators) for elementary teachers and

68.1% of separation between groups for secondary teachers. With 95.3% accuracy the function classified 106 elementary teachers as high integrators, while 104 secondary teachers were classified as high integrators group with 90% accuracy. According to the discriminate function analysis comfort with computers was 1 of 7 variables deemed significant characteristics of high integration among elementary teachers, while comfort with computers was 1 of 6 significant characteristics among secondary teachers. Other significant characteristics that distinguish between high and low integrators were use of computers at home and school, computer training, attitude toward computers for instruction, experiences with computers, teaching efficiency, attitude toward work, and teaching belief (this variable elementary only).

Carol Becker (2007) studied technology integration of 36 elementary school teachers in three schools in southeastern Ohio. In this mixed methods (i.e., quantitative and qualitative) study, the researcher employed a purposeful selection of teachers (i.e., even distribution of teaching experience and grade level) from the three schools. The purpose of the study was to determine whether there was a relationship between technological experiences, skills, and integrative practices of teachers. Descriptives and correlations were among the analysis to explain the relationships between technical skills and frequency of integration. The findings provided evidence of infrequent and somewhat low tech integration reported by teachers with moderate software skills and novice hardware skills.

Teachers reported software proficiency (i.e., operational skills and software skills) in response to items in separate scales. In both instances, ratings were based on scales that ranged from 1 (novice) to 5 (expert). The scale used to rate operational skills included nine tasks (e.g., word processing, Internet navigation, graphic organizers). Teachers rated frequency of integration based on the same nine software tasks for which they reported operational skills; however, this time ratings were based on a Likert scale ranging from 1 (never) to 5 (daily). Among the items in the scale, entitled "Board Skills Assessment," teachers provided a broad rating with regard to technical proficiency for each of the general categories of software and hardware skills.

Teachers rated themselves closer to novice with regard to hardware proficiency (M=2.68, SD=0.99). Whereas, moderate software proficiency (i.e., operational skills, software skills) was reported on both scales (M=3.36, SD=1.27) and (M=3.32, SD=1.06), respectively. Infrequent technology integration (M=2.99, SD=1.45) for instructional purposes was reported based on teachers use of the nine items used to measure operational skills. When Becker conducted an analysis of relationships between perceived ability (i.e., software proficiency as measured by nine software in operational skills scale) and frequency of use (i.e., frequency as measure by use of nine software items) only graphic organizers yielded a significant relationship (r=.67, p=.0001).

The researcher concluded that there was "little or no evidence" that teachers' technical proficiency influenced their use of specific software applications in the classroom (Becker, 2007, p. 87). Generally, teachers integrated technology most frequently for tasks such as Internet navigation (M=4.03, SD=0.81), classroom management systems (M=4.00, SD=1.10), and word processing (M=3.39, SD=1.20). Whereas, integration occurred less frequently for e-mail (M=3.17, SD=1.77), creation of graphic organizers (M=2.83, SD=1.32), video and sound applications (M=2.22, SD=1.17), spreadsheets (M=2.14, SD=1.40), and database systems and data management (M=2.06, SD=1.24).

It is evident that some researchers conceptualize the technical proficiency construct as a measure of one's ability to operate hardware and software. However, Zhao et al. (2002) examined technical proficiency from another perspective, concluding that one must think beyond measuring ability to operate equipment and software applications. Standards for technical proficiency are too narrow; consequently, past research often measures part of what it takes for a teacher to be deemed technically proficiency (Zhao et al., 2002). A key component of technical proficiency that must be investigated is "knowledge of the enabling conditions" (Zhao et al., 2002, p. 486). A teacher must have the capacity to anticipate "what else is necessary to use a specific technology in teaching" (Zhao et al., 2002, p. 486).

In an evaluation of a state technology initiative, Zhao et al. (2002) conducted a study to examine why more teachers were not using technology. An average of $5,098 was awarded to K-12 teachers selected to implement technology rich projects. The study spanned one year and case studies were compiled for 10 of the 118 participants. The findings indicated that a new dimension of technical proficiency "knowledge of enabling conditions" contributed to teachers' implementation of technology projects in the classroom (Zhao et al., 2002, p.486). Less technically proficient (i.e., knowledge of computer operation, software, and enabling conditions) teachers were unable to follow through with technology integration projects.

For example, Willa, a kindergarten teacher and novice technology user, planned to use CUSeeMe software as part of an activity to teach moral and literacy skills. Though

Willa was able to operate the CUSeeMe software, she had little knowledge of high speed Internet and digital cameras necessary to operate the CUSeeMe software. As a result, Willa was not able to anticipate and avoid pitfalls that derailed of the project. Whereas, Jeff, an advanced technology user successfully completed an inquiry based science water quality project with students (9-12 grade). Jeff was able to assist students with the use of "probes, videos, computers, networks, servers" (Zhao et al., 2002, p. 491).

Though much of the research regarding teacher personal attributes proves that technical proficiency is essential to technology integration in classrooms, other research suggests that environmental variables deserve just as much consideration.

Environmental Variables and Technology Integration

Often environmental variables originate from those aspects of an educator's environment that are controlled by others. Typically, district level support to facilitate the use of computer technology in classrooms includes the provision of professional development, equipment, and technical assistance (i.e., technicians, technology integration specialists). Researchers have concluded that analysis of data from the study of environmental variables is imperative to the improvement of technology integration in the schools (Cuban, 2001; Ertmer et al., 1999; Ertmer & Snoeyink, 2002; Hernández-Ramos, 2005; Hughes, 2005; Kanaya et al., 2005; Sandholtz, 2001; Sandholtz & Reilly, 2004; Sandholtz et al., 1997; Vannatta & Fordham, 2004; Zhao et al., 2002).

Professional Development and Technology Integration

The nature of technology innovation is constant change, so continuous acquisition of new skills is necessary to increase the quantity and quality of technology integration in the classroom. The norm in a traditional school structure is to provide "one shot" professional development activities (PDA). Generally, the focus of the technology PDA is a specific software applications or general computer operation skills.

Throughout the last decade researchers have reported that traditional professional development activities (i.e., in-services) do not adequately prepare teachers to effectively integrate technology in the classroom (Ringstaff & Kelley, 2002; Sandholtz & Reilly, 2004; Sandholtz et al., 1997; Sugar, 2005). The NCES (2000) conducted a study of American teachers to determine the status of computer and Internet usage in classrooms. The stratified sample included 2,019 elementary and secondary teachers across 50 states. Analysis of the data revealed critical findings with regard to professional development, preparedness, and technology integration in the classroom.

According to the NCES (2000) professional development (i.e., in-service training) was among the most predominant means by which teachers develop pedagogy necessary to integrate technology in the classroom. Eighty-eight percent of teachers cited that profession development was an approach used to learn about the computer and Internet. Independent learning was the only other method of learning to use technology that exceeded in-service professional development.

For the most part, participation in professional development activities mirrored the availability of training. Generally, larger percentages of teachers reported participation in training in the areas of basic computer skills (83%) and software applications (81%). Internet use (75%) and technology integration (74%) were attended with greater frequency than advanced telecommunications (55%) and follow-up and/or advanced training (53%).

Even though professional development (i.e., in-service) was the second most reported means of acquiring technical skills, teachers did not dedicate a lot of time to participation in technology oriented PDA. In fact, only 12% of American teachers spent more than 32 hours engaged in technology related professional development activities during the three years prior to data collection. The number of hours that teachers participated in professional development activities generally ranged from 1-8 and 9-32 hours, 43% and 34%, respectively. A small percentage (10%) of teachers reported no participation in technology oriented professional development.

The majority of teachers did not feel prepared to use technology in the classroom. Among the teachers who reported participation, only one-third felt well prepared (10%) or very well prepared (23%) to use computers and the Internet in the classroom with students. Whereas, two-thirds of the teachers reported that they felt somewhat prepared (53%) or not well prepared (13%) at all. Generally, results of this study indicated that teachers who reported that they felt more prepared assigned each kind of computer technology activity to students with greater frequency.

The following eight activities were addressed on the survey: practice drills, problem solving/ data analysis, word processing/ spreadsheets, graphical presentations, demonstrations/ simulations, multimedia projects, CD-Rom research, and Internet research. The findings suggested that generally teachers used computers with students to do less complex tasks. Word processing/ spreadsheets (61%) were assigned the most; whereas, demonstrations/ simulations (39%) were assigned the least. There were positive trends in the data that revealed that teachers who felt more prepared assigned advanced activities to students. For example, 63% of well/ very well prepared teachers indicated the use of computer technology to do multimedia projects with students, whereas somewhat prepared or not prepared teachers were less likely to engage in this kind of activity, 38% and 23%, respectively.

A number of researchers have offered possible remedies to improve the effectiveness of PDA used to train teachers to integrate technology with other curriculum areas. Suggestions typically address time (i.e., frequency, intensity, duration) and content of professional development activities. Kanaya, Light, and Culp (2005) determined that teachers develop and implement technology rich lesson plans when they are trained in multiple sessions over short periods of time. Other researchers indicate that peer coaches and on-going PDA are methods that must be considered in the facilitation of effective technology integration (Ertmer et al., 1999; Sandholtz & Reilly, 2004; Sandholtz et al., 1997; Sugar, 2005). According to Roblyer, it is imperative that teachers are taught to "identify specific teaching and learning problems that technology can help address or how it can create important educational opportunities that did not exist without it" (Roblyer, 2003, p. 2).

Still other researchers suggest that professional developers must delve deeper into the psyche of teachers. The impact that a teacher's beliefs about teaching and learning has on pedagogy used in the classroom is thought to be a necessary component of a PDA (Albion & Ertmer, 2002; Ertmer, 2005; Grisham, Berg, Jacobs, & Mathison, 2002). In fact, Ertmer et al. (1999) indicated that professional developers must design activities in a way that impacts pedagogic beliefs, specifically challenging "the belief that technology is an add-on" (Ertmer et al., 1999, p.68).

ACOT: Five Stages of Evolution and Professional Development

Ten years ago, Sandholtz, Ringstaff, and Dwyer (1997) published groundbreaking research findings based on a longitudinal study of the Apple Classroom of Tomorrow (ACOT) project. The ACOT study spanned ten years and it remains one of the foremost in-depth studies of technology integration in public school classrooms. After several years of data collection and analysis in 1991 the focus of the ACOT project shifted to development of technology integration skills. A framework was designed to ensure that the foundation of the ACOT professional development model was based on researched components proven to support teacher development. The components, many of which were grounded in a constructivist philosophy, included opportunities for teachers to do the following:

- observe and reflect on a variety of teaching strategies, including direct instruction, team teaching, collaborative learning, project-based learning, and interdisciplinary learning
- engage in hands-on use of computers, productivity software, camcorders, and telecommunications as tools to support learning through composition, collaboration, communication, and guided practice
- interact with students in real classrooms
- share knowledge and experience with colleagues
- create specific plans for technology use in their own classrooms and schools (Sandholtz et al., 1997, p. 138)

Additional analysis of the data lead Sandholtz et al. (1997) to identify five instructional stages through which teachers evolve in three years, as they developed skills necessary to integrate technology in the classroom. The stages are entry, adoption, adaptation, appropriation, and invention; each stage is characterized by unique thoughts and instructional practices (see Figure 2).

Many components of the training model and stages used to describe teacher's thoughts and skill development are still applicable today. In fact, Sandholtz and Reilly (2004) recently studied a school district in California where frequent and high quality technology integration is underway in classrooms. The researchers attributed much of the success of the division's technology initiative to the design and implementation of professional development (Sandholtz & Reilly, 2004), that has many of the components of the ACOT professional development model.

Participants in the study were 260 teachers that serve approximately 4,600 students in grades K-8. The four components of the professional development program sponsored by the school district were: (1) classroom visits, (2) hands-on technology training, (3) group discussions, and (4) participant collaboration (Sandholtz & Reilly, 2004, p. 505). Professional development and equipment were provided for 20% of the teachers each year. Within five years all teachers were trained and received equipment.

Findings indicated that all teachers in the district integrated technology in the classroom regularly. Most teachers were at the adaptation or invention stages of technology use. They demonstrated technology integration skills that surpassed those of teachers that were involved in the ACOT study of 1997 with a similar number of years experience with technology. Often, teachers engaged students in instructional activities that required advanced technology use. Technology was frequently used to conduct research, create presentations, and other tasks that required students to incorporate a variety of thinking skills. The researchers attributed the advance and extensive technology integration to professional development activities that addressed

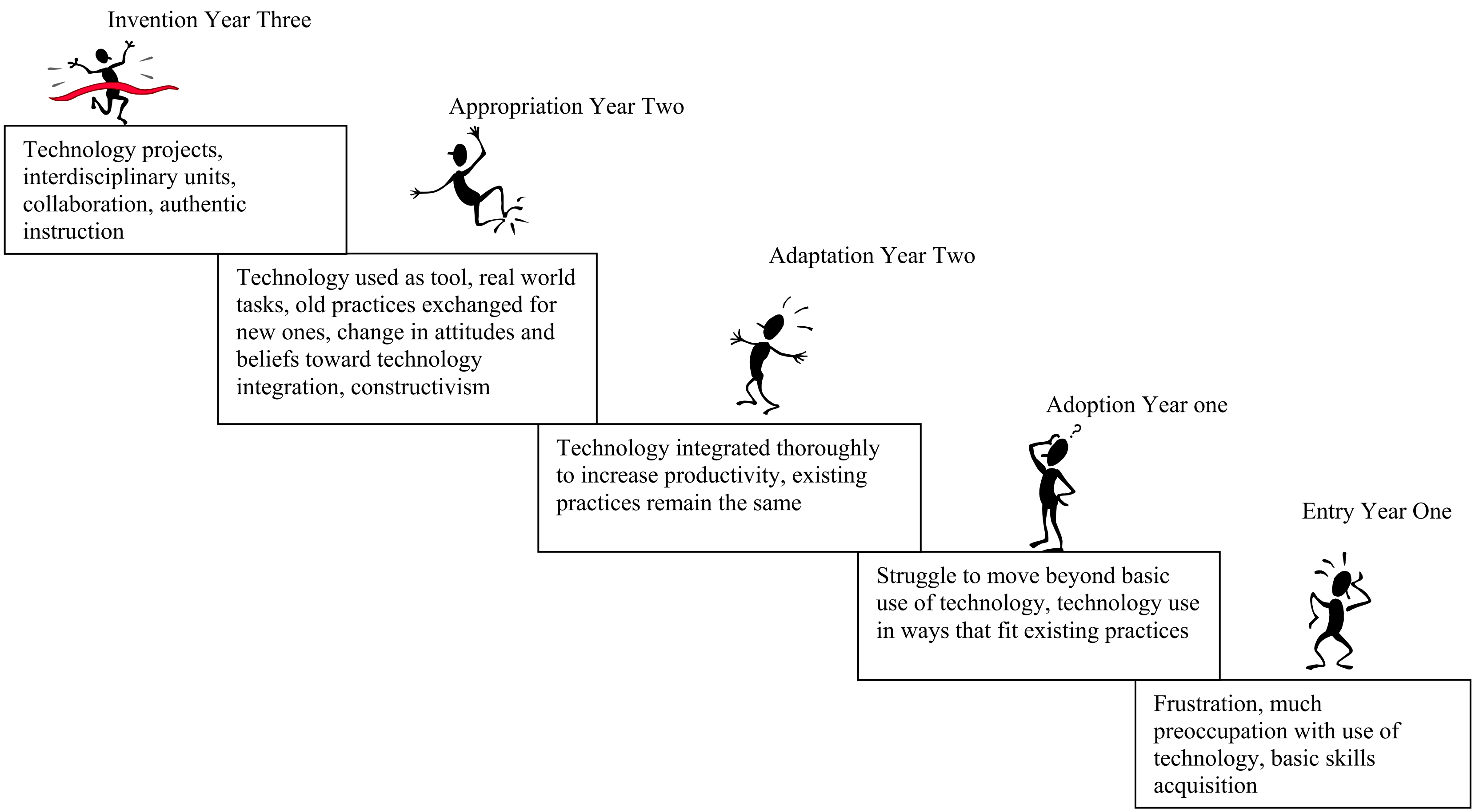

Figure 2. The five stages of evolution in movement toward technology integration based on ACOT research (Sandholtz, Ringstaff, & Dwyer, 1997).

“instructional rather than technological issues and generated a collegial network for support and ideas” (Sandholtz & Reilly, 2004, p.505).

Access to Equipment and Technology Integration

In the last decade, the national expenditure on computers for K-12 education has tripled to five billion dollars annually (WestEd, 2002). Researchers have confirmed that teachers and experts in the field of technology integration believe access to equipment (i.e., hardware, software, location) makes a difference in a teacher’s use of technology in the classroom (Bauer & Kenton, 2005; NCES, 2000; Norris, Sullivan, Poirot, & Soloway, 2003; Zhao et al., 2002). The NCES (2003) indicated that in 2001 the student to computer ratio was 5.4 to 1, down from a 12 to 1 ratio reported in 1998. While the national recommended student to computer ratio is 5 to 1 (U.S. Department of Education, 2004), some research suggests that even when the national average is achieved, computer use in schools is still infrequent and low tech (Cuban, 2001).

In a survey of American teachers conducted by the NCES in 2001 (2005a), teachers were asked to identify the kinds of technology needed in classrooms and the availability of technology. Teachers indicated that there was a need for the following kinds of technology: a teacher computer workstation with e-mail access (68%), World Wide Web access (61%), CD-Rom reference software (51%), and one computer workstation for every four students (49%). The kinds of hardware and software chosen least often were presentation software (35%), multimedia anchor software (21%), scanners (20%), and video cameras (18%).

Most teachers “strongly” agreed or “somewhat” agreed that computers and other technology were sufficiently available in their classrooms 25% and 32%, respectively

(NCES, 2005a, p. 1). However, a large percentage of teachers felt there remained a need for more computers and other technology. A third of the teachers “somewhat” disagreed or “strongly” disagreed that there were sufficient computers and related technology in their classrooms (19% and 15%, respectively) (NCES, 2005a, p. 2). Eight percent of teachers were undecided. A key trend in this data was that teachers who reported a higher student to computer ratio in their classrooms, generally reported dissatisfaction with the number of computers in the classroom for student use and vice versa.

The kinds of computer technology that teachers reported they needed were consist with teacher usage patterns reported by Becker et al. (1999), which suggested that teachers used technology more often for productivity (e.g., track grades, create lesson plans) not integration. When teachers assigned computer tasks to students, the Internet and CD-Rom reference software were among the most often used kinds of technology (Becker et al., 1999). The fact that teachers identified a need for presentation and multimedia anchor software with much less frequency suggests that high tech integration is less preferred by teachers.

Other research suggests that access to computer technology in schools, at a level that meets the national student to computer ratio (5:1), does not ensure more frequent and higher quality technology integration in the classroom. Larry Cuban (2001) explored technology integration in two Santa Clara, California high schools. Among the variables considered in the study were student and teacher computer access and usage. Analysis revealed that access and usage trends at the two high schools were consistent with national educational technology trends. For the most part, the amount of access that the two high schools had to computer technology exceeded national trends, “except for placement of computers in classrooms” (Cuban, 2001, p. 83).

Still, technology integration among teachers and students in the two schools was infrequent and low tech. Cuban’s observations revealed that the vast majority of teachers used traditional teaching practice (i.e., lecture, textbook) and computers were not used with students. When teachers did use computers with students, computers were typically used in ways that extended traditional pedagogy. Word processing and Internet research were among the most frequent uses of technology.

Cuban (2001) indicated that his findings have been criticized based on the premise that the formula used to calculate the student to computer ratio for the schools was flawed. The formula is such that the total number of students in the school is divided by the total number of computers. This sort of formula does not take into consideration the location of computers in schools. Research indicates that the location of computers in the school has an impact on integration in a classroom (Becker, Ravitz, and Wong, 1999; Mann et al., 1999).

In an analysis of TLC data, Becker et al. (1999) found that computer use was greater when computers were available in the classroom not the computer lab. Among the 43% of elementary school teachers that used computers with students, more than 20 times per year, seventy-eight percent of teachers had at least four computers located in their classroom. In fact, “For every subject-level combination examined, the more computers present in the classroom, the more likely that a teacher will have students use them frequently” (Becker et al., 1999, p. 9).

Norris et al. (2003) found that access to technology was among the significant factors in the prediction of teachers' use of technology in K-12 schools across four states (i.e., New York, California, Nebraska, and Florida). In this study 3,665 teachers from rural and urban areas were asked to provide responses to a questionnaire regarding demographics, attitudes, classroom practices, and technology access. Regression and correspondence analysis were conducted to determine the relationship between 44 independent variables and use of technology in K-12 classrooms.

Four of the six significant variables in the regression analysis were related to access to technology, while the other two significant variables were categorized as demographic and attitudinal. The most powerful predictor in the regression was number of computers available in the classroom ($t=3.67$, $p<0.001$). Also significant, but not as powerful a predictor in the integration of computers for curricular purposes was the availability of curricular software ($t=2.33$, $p=0.02$).

Generally, the majority of teachers had access to one or no computers in the classroom and sporadic use (i.e., less than twice per week) of the computer lab, 63.2% and 66.5%, respectively. Approximately 45% of teachers reported the use of computers for curricular purposes with students less than 15 minutes per week, while only 18% of teachers reported the use of computers with students 45 minutes or more per week. A correspondence analysis was conducted to gain a deeper understanding of the relationship (i.e., interdependence) between access and use of computers for curricular purposes. The results indicated that at least six computers must be available in the classroom to predict "more-than-sporadic" use of technology with students (Norris et al., 2003, p. 24).

Additionally, students must visit the computer lab two or more times per week “before it has a measurable” impact of frequency of technology use (Norris et al., 2003, p. 24).

However, in a study of technology integration in four schools where there was adequate access to computers (i.e., 4-5 computers per classroom) thirty technology savvy teachers still had difficulty achieving full integration. Bauer and Kenton’s (2005) findings suggest that the computer to student ratio may need to be even lower for the location of computers to make a significant difference in the frequency and kind of technology integration in the classroom.

Bauer and Kenton (2005) conducted a study to determine the obstacles to technology integration in a county school district located in the southern United States. Thirty technology savvy teachers from four of the county schools were included in the study: 12 elementary (grades K-8), 10 middle (grades 6-8), and 8 high (grades 9-12) school teachers. A purposeful sampling method was used to select teachers who administrators considered to be “tech-savvy” in terms of perceived superior ability to use computers in the classroom with students (Bauer & Kenton, 2005, p. 524). Participates’ responses to a survey, observation, and post observation interview were triangulated.

The technology profiles of the four schools revealed that access to technology in the schools was aligned with the national goal (5:1, student to computer ratio) (US Department of Education, 1996). On average each school had no less than 4-5 computers in each classroom for student use. At least one computer was designated for teacher use at each of the four schools. Two of the four schools provided 21st Century Computer Carts to teachers, which held oversized monitors useful for whole class viewing. Three of the schools with the exception of one elementary school had at least one computer lab.

One elementary and one high school had access to laptop computers with wireless Internet capability on a mobile cart.

The researchers determined that even with access to technology, the most technically proficient teachers did not fully integrate technology in the classroom. Only two teachers reported the integration of technology into instructional activities more than 75% of the time. The majority of participants, 24 of 30 teachers reported integration of computer technology less than 50% of the time. Responses to interviews indicated that out-dated hardware and inadequate software was among the leading constrains to technology integration.

Actually, 14 teachers (46.7%) stated that equipment (hardware) was "their biggest obstacle" (Bauer & Kenton, 2005, p. 533). Further analysis of the data revealed that tech-savvy teachers reported there were not enough computers in their classrooms. Limited access made it difficult for students to have sufficient time to complete assignments. To a lesser degree, but still evident in the findings, 13% of teachers reported that software was a concern. Specifically, the high cost, poor quality and variety of software were mentioned as well as software and hardware incapability.

Access to Support and Technology Integration

Several researchers have concluded that technology support is a key variable in a teacher's use of technology in the classroom (Hernández-Ramos, 2005; Ronnkivist, Dexter, & Anderson, 2000; Sandholtz & Reilly, 2004; Sugar, 2005; Zhao et al., 2002). Typically, support equates to the availability of personnel to assist with equipment (Hofer, Chamberlin, & Scot, 2004), as well as personnel that facilitates the actual integration of technology with curricula taught in the classroom.

In 1999 American teachers (36%) reported that insufficient technical support was among the leading constraints to technology use in classrooms (NCES, 2000). In 1998 eighty-seven percent of public schools had access to a technology coordinator. Sixteen percent of elementary and middle schools and 33% of high schools had one full-time technology coordinator (Ronnkivist et al., 2000). By 2003 the percentage of technology coordinators increased; thirty-four percent of elementary and 44% of secondary public schools had at least one full-time, paid technology coordinator or director dedicated to providing technical support for hardware, software, and the Internet (NCES, 2005b).

According to Ronnkivist, Dexter, and Anderson (2000) a technology coordinator's duties included a variety of tasks, from assistance with technical problems to help for teachers with technology integration in the classroom. However, the majority of a technology coordinator's time was delegated to supervision and assistance of teachers with computer classes (i.e., 15.72 hours per week), resolution of hardware issues and installation of software (i.e., 14.65 hours per week), not the support of a teacher's effort to integrate technology in the classroom (7.69 hours per week). Teacher assistance with technology integration, through professional development workshops (four times per year) and one-on-one (2 to 3 hours per week) help with technology integration in the classroom, was infrequent at the building level.

Hofer, Chamberlin, and Scot (2004) indicated that support for teachers in the integration of technology was most effective when it was a shared effort between a technology integration specialist and other technical personnel (i.e., technician, technology coordinator). Each person on the team has a unique role. Technical personnel engage in various activities to do with infrastructure, networks, and equipment. The technology integration specialists works with teachers, students, and other staff "to enhance instruction through the use of technology in the classroom" (Hofer et al., 2004, p. 24). Hofer et al. (2004) indicated that a small fraction (16%) of schools across the nation implement a team model that supports teachers in the technology integration process.

Virginia was cited among the states that implements collaborative technology support. Under the Code of Virginia Standards of Quality (§ 22.1-253.13:2) local school boards are required to allocate funds for the placement of one technical support person and one instructional technology resource teacher for every 1000 students (i.e., kindergarten through 12 grade) (Virginia Department of Education, 2007).

Ronnkivst et al. (2000) conducted a multiple regression analysis to determine the amount of variance in the frequency of teachers' technology use with students that could be attributed to a set of variables (e.g., quality of technology support, availability of technology support, teachers' computer expertise). They found that quality technology support accounted for most of the variance (43%) in the frequency of technology integration in the classroom. Similar findings were reported by Zhao et al. (2002), who concluded that technology integration in the classroom was dependent on a "healthy human infrastructure" (p. 512). Teachers who were less technically proficient and attempted to implement highly innovative technology projects were less successful. They were hindered when there was a greater reliance on technology support.

Generally, researchers have found that access to technology support for teachers does influence the frequency and kind of technology used with students in the classroom. According to Hernández-Ramos (2005) in classrooms where technology integration occurred “1-3 days a week” a greater proportion of teachers reported the availability of full-time technical support than part-time or no technical support (p.48). The exception to this finding was evident in classrooms where teachers reported highly frequent technology use (4-5 days a week) with students, in that instance integration was frequent regardless of the level of technical support.

Curriculum Area Distinctions and Technology Integration

Even though the curriculum area taught by a teacher was not a variable in this study, was considered in order to gain a deeper understanding of technology integration in the classroom. The use of computer technology to support instruction across curriculum areas is documented in studies (Barron, Kemker, Harmes, & Kalaydjian, 2003; Becker, Ravitz, and Wong, 1999; Mann et al., 1999). Typically, research associated with the integration of technology in elementary school classrooms has not been analyzed by curriculum area taught. Subject area distinctions have generally been reserved for analysis of data associated with secondary grade levels (i.e., middle school, high school).

However, increased accountability and ever expanding instructional standards for students’ learning have made it necessary for elementary school teachers to become more specialized. In recent years co-teacher teams and triangulated teams have allowed elementary school teachers to master one or two curriculum areas instead of struggling to gain and remain knowledgeable in all subjects (Butzin, 2005). Consequently, it is necessary to consider the technology integration patterns of elementary school teachers according to subject area taught.

In the TLC survey of American teachers, Becker et al. (1999) found that a greater percentage of elementary (73%) and secondary English teachers (65%) used computers with students than secondary teachers of other disciplines (i.e., math, science, social studies). Only 60% of science, 50% social studies, 38% foreign language and 37% math secondary teachers used computers with students. Only secondary teachers of computer (94%), business (82%), and vocation (73%) used computers with students more.

Other findings from the TLC survey indicated that teachers of certain grades (i.e., elementary, secondary) and subjects had a tendency to use the computer to support specific kinds of instructional activities (Becker et al., 1999). Greater percentages of teachers across all subject areas and grade levels assigned word processing tasks to students than any other kind of computer task. Overall, elementary self-contained teachers were more likely to assign tasks that required less analytic skills [i.e., word processing (6%), skill practice games (66%), and CD Rom (56%)]. Analytic or productivity tasks such as research on the World Wide Web (24%), simulations/ exploratory environments (36%), graphics (27%), spreadsheet and database (8%), multimedia (8%), and presentation (7%) were assigned by fewer elementary self-contained teachers.

With the exception of word processing there were distinctions in the kinds of computer tasks assigned by secondary teachers of English, math, science, and social studies. Generally, English teachers used computers with students to do word processing and research (i.e., CD-Rom and Internet). Math teachers assigned skill practice games and simulation/ exploratory environments. Science teachers assigned research and simulation/ exploratory environments and social studies assigned research and presentation tasks.

Barron et al. (2003) conducted a study of technology integration among 2,156 teachers in a large Florida school district. Like Becker et al. (1999), Barron et al. (2003) found distinctions in technology integration based on the subject area taught by a teacher. Barron et al. (2003) concluded that when the kind of technology instruction (i.e., problem solving, communication, productivity, and research) was a dependent variable and curriculum area taught (i.e., English, math, science, social studies) was an independent variable there were significant findings.

When computers were used for research or problem solving there was a significant difference across curriculum areas, χ^2 (3, n=413) = 20.3431, p=.0001 and χ^2 (3, n=409) = 12.2470, p=.0006, respectively. When teachers used computers to conduct research with students, more science teachers (51%) used computers with students than teachers of other curriculum areas [i.e., social studies (44%), English (30%), and math (24%)]. Similarly, when teachers used computers for problem solving with students, again science teachers (28%) were the leading users of computer technology, followed by social studies (23%), math (17%), and English (10%) teachers.

With regard to technology integration patterns of teachers, in accordance with curriculum area(s) taught, the findings of Barron et al. (2003) contradicted those of the Becker et al. (1999). The TLC survey findings indicated that more English teachers used computers with students than other secondary teachers of core subjects (i.e., math, science, social studies) (Becker et al., 1999). Whereas, Barron et al. (2003) concluded that more science teachers used computers with students to do research and problem solving. Researchers indicated that the difference in sampling methods may be the reason for the discrepancy between the TLC and the Florida school district findings (Barron et al., 2003).

Force Field Analysis and Movement Toward Technology Integration

Ultimately, the goal of this study is to provide information that could be used by change agents (teachers, administrators, school board members, and legislators) to increase frequency and varied application of technology in K-5 classrooms. Since teachers are a group within an organization, application of Kurt Lewin's force field analysis is a way to understand group dynamics (i.e., moving the group towards full technology integration). Kurt Lewin (1997) proposed that one way to promote change within a group (i.e., organization) is to identify forces that drive or restrain change. Driving forces move an organization toward change, while restraining forces oppose driving forces. Once forces in the field have been identified and one knows the point of dynamic equilibrium, it is possible to reach a desired point in the field by "reconceptualizing" forces when possible then increasing driving forces, decreasing restraining forces and/ or a combination of the two (Lifter, Kruger, Okun, Tabol, Poklop, & Shishmanian, 2005, p.23).

CHAPTER II

METHODOLOGY

This chapter addresses the methodology that was used to conduct this quantitative study of factors that influence a teacher's use of technology in the K-5 general education public school classroom. Specifically, a description of the population, sample, and setting are discussed as well as procedures that were used to reduce the potential sources of error, conduct instrument validation and reliability, collect and analysis data.

Population and Sample

The population selected for participation in this study consisted of 16,500 K-5 general education public school teachers throughout the state of Virginia. The population was determined based on the number of K-5 general education public school teachers in the state of Virginia with e-mail addresses in the database of Market Data Retrieval (MDR). Special education teachers and specialists (i.e., art, music, and physical education) were not included in the population, since the focus of the study was the integration of technology with core curricula (i.e., mathematics, reading, science, and social studies) in the K-5 classroom setting.

A link to the questionnaire was e-mailed to 1,408 K-5 general education public school teachers in the MDR database. Thirty-four teachers were unable to receive the e-mail due to full mailboxes, one mailbox was blocked, and five teachers opted out of the study. 172 teachers responded to the first request for participation in the study. A follow up e-mail was dispatched to the same teachers, thirty-four teachers were unable to receive the e-mail due to full mailboxes, six mailboxes were blocked, and six teachers opted out of the study. 160 teachers responded to the second request for participation in the study.

In total 332 teachers responded to the questionnaire located on the surveymonkey.com website. Questionnaires of teachers (19) that taught grades other than K-5 were excluded from the study. A total of 313 teachers submitted useable questionnaires.

About Market Data Retrieval

MDR is a Dun & Bradstreet Corporation that has been in business for 39 years. The MDR company headquarters is located in Shelton, Connecticut. The company has an e-mail database that includes 3.6 million K-12 educators nationwide. At the time that the study was conducted the company had the largest active database of K-12 educators in the country and the company's e-marketing practices were compliant with the CAN-SPAM act of 2003 (MDR, 2006), which ensured ethical e-mail practices. MDR databases were updated annually to ensure accuracy of educators' e-mail addresses.

Potential Sources of Error

Addressing potential sources of error was a critical issue in this study. According to Dillman, Tortora, & Bowker (1998) to ensure that results of a study could be generalized to a population, a researcher must keep the sources of error low. Since the teachers were required to respondent to a questionnaire posted on a website, sources for error were a bit different from those of other modes of data collection. The following sources of error are typically associated with survey research, but can pose unique issues when conducting a self-administered survey on a website:

Coverage error: The results of all units of a population not having a known probability greater than zero of inclusion in the sample that is drawn to represent the entire population. Thus some units in the population may have no chance of selection, some units may have multiple chances, and some units may not even qualify for the survey.

Sampling error: The result of only surveying a portion of the survey population rather than all of its members.

Measurement error: The result of inaccurate answers to questions that stem from poor question wording, poor interviewing, survey mode effects, and/ or the answering behavior of the respondent.

Nonresponse error: The result of not getting some people in the sample to respond to the survey request who, had they done so, would have provided a different distribution of answers than those who did respond to the survey (Dillman et al., 1998, p.2).

In this study, steps were taken to minimize the occurrence of error. A sample of K-5 general education public school teachers was systematically drawn from the MDR database. Every 10th teacher was chosen; whenever, the 10th e-mail address was unavailable the next e-mail address was selected as a replacement. The questionnaire that was distributed to teachers included only items that remained after a test of content validation and a pilot of the questionnaire to determine reliability.

Dealing with Non-respondents

In a historical review of research, Dooley and Lindner (2003) concluded that for the most part researchers have not taken adequate steps to reduce threats to external validity posed by non-respondents. They recommended that researchers use of the following four methods to address non-responders: compare early and late respondents, use “days to respond” as a regression variable, compare respondents to nonrespondents, and compare respondents on characteristics known as priori (Dooley & Lindner, 2003, p. 108).

In this study, the researcher used the Chi-Square Test of Independence and the Independent Sample t-Test to compare early/late respondents and based on the results inferences were made about non-respondents. For example, if the results of the comparison indicated that there was no significant difference between early/late respondents, then it was inferred that the responses of non-respondents would be no different from those of respondents represented in the sample. The responses were considered valid and generalizations were made to the population based on responses of respondents in the sample.

Development of the Questionnaire

The questionnaire used to measure a teacher's use of technology in the K-5 classroom was developed with the assistance of the following individuals: twenty-one computer resource specialists, two central office administrators, two elementary school assistant principals, and one communication skills specialist. The process for determining validity and reliability of the instrument was based in part on recommends of John Creswell's (1998) steps for conducting quantitative research.

Validity of the Questionnaire

1. Based on a review of literature to do with technology integration in schools and the researcher's practical knowledge of the field of technology integration, the researcher generated a list of 130 possible questionnaire items and seven domains thought to be associated with the variables addressed in the study. Questionnaire items for 4 of the domains in the study (i.e., available of software, knowledge of hardware and software, teaching philosophy) were loosely based on three scales (i.e., type of application software, technical proficiency, technology and you)

from a questionnaire developed by Pedro Hernandez-Ramos (2005) to measure technology integration of teachers in Santa Clara County, California (see Appendix E for permission letter).

2. A content validation instrument was created and distributed to eight educators. The content validation instrument was revised based on the feedback from the educators. Revisions included the addition of 33 items to the content validation instrument. The educators had difficulty placing some of the original items into three of the domains (i.e., technical proficiency, access to equipment, and access to support); consequently, the domains were revised. The new domains measured technical proficiency and access to equipment with regard to hardware and software separately. Additionally, technical proficiency with regard to enabling conditions became a separate measure. The domain used to measure access to support was split in to two separate domains, so technical support and support for the integration of technology became separate measures.
3. A revised content validation instruments was created; the new instrument included 163 possible questionnaire items and 10 domains. The domains represented dependent and independent variables to be addressed in the study. Due to the large number of items and domains the content validation instrument was split in to two separate validation instruments.
4. Part one of the content validation instruments was distributed to the two central office administrators and 10 computer resource specialists (see Table A1, Appendix A for instrument). Part two was distributed to 11 computer resource

specialists, two assistant principals, and one communication skills specialist (see Table A2, Appendix A for instrument).

5. Experts' responses yielded 105 viable questionnaire items (see Table A1 and Table A2, Appendix A for highlighted viable items). Items were rated based on correct domain placement, strength of association with domains, and clarity of written expression. Generally, only items that were placed in the correct domain, with an association of at least 3.5 on a 4 point rating scale, and clarity of at least 2.5 on a 3 point rating scale were considered valid (see Table A3-A8, Appendix A).
6. Seventy-eight of the 105 validated items were placed on the questionnaire. The following modifications will be made to the questionnaire in preparation for field testing. Ten items that did not meet the criteria of the validation process were added to the questionnaire. The 10 items (i.e., 6.2, 9.7, 11.3, 11.4, 11.9, 12.10, 16.13, 17.4, 18.1, and 18.2) were revised and added to scales (see Table A9 in Appendix A for scale items categorized by domain). The researcher's decision to revise and not discard the 10 items was based on the importance of the items to maintaining the integrity of the constructs. Items used to measure 6 of the 10 scales were shortened to phrases and question stems were added to motivate teachers to respond to the entire questionnaire. Respondents' feedback indicated that item 62 (see Table A2 in Appendix A) measured two ideas, so two items (i.e., 14.1 and 14.2) were created based on the item.

Reliability of the Questionnaire

According to Mark Litwin (1995) there are several ways to determine reliability of scales included in a questionnaire. In this study, due to the format of scales included in the questionnaire, reliability was measured in terms of the internal consistency of Likert scales. According to Litwin (1995) an alpha coefficient of .70 or above is an indication of satisfactory reliability. Two separate field tests were conducted to measure internal consistency of the four Likert scales included in the questionnaire. Prior to the second field test of the questionnaire, revisions were made to the instrument. Participants were no longer required to provide input regarding time required to respond to the survey, clarity of statements, and ease in using surveymonkey.com. The following steps were taken to determine the internal consistency of Likert scales:

1. Twenty-nine K-5 regular education teachers participated in field test one and 20 K-5 regular education teachers participated in field test two.
2. In early July 2007, the questionnaire was distributed to 51 K-5 regular education teachers. Twenty-nine of the 51 teachers responded to the questionnaire.
3. Data was downloaded and imported into SPSS for statistical analysis. Cronbach's Alpha coefficients were calculated using SPSS software to determine the internal consistency of the four scales. The reliability coefficients of the scales were .57, .62, .71, and .85, indicating that 2 of the 4 scales had good internal consistency (see Table 2).

Table 2

Alpha Reliability Coefficients from Field Test One Likert Scales 29 Participants

Scale	*N* (Items)	*M* (Scale Mean)	Scale *SD*	Alpha
Professional Development (Items: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6)	6	12.28	1.77	.57
Teaching Philosophy (Items: 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7, 11.8, 11.9)	9	29.79	3.35	.85
Enabling Conditions (Items: 14.1, 14.2, 14.3, 14.4, 14.5, 14.6)	6	17.7	2.04	.62
Application of Technology (Items: 16.1, 16.2, 16.3, 16.4, 16.5, 16.5, 16.6, 16.7, 16.8, 16.9, 16.10, 16.11, 16.12, 16.13)	13	33.97	5.59	.71

4. In early August 2007, the questionnaire was distributed to 29 K-5 regular education teachers; twenty teachers responded to the questionnaire. Cronbach's Alpha coefficients were calculated for Likert scales. Reliability coefficients for the four scales were .74, .89, .70, and .68 (see Table 3).

Analysis of findings from field tests indicated that the four Likert scales produced satisfactory reliability coefficients on either one or both field tests. Additionally, one item (i.e., 6.4) was deleted from the Professional Development scale to increase the internal consistency of the scale. In the researcher's opinion, deletion of this item did not reduce the integrity of the scale. The scale still had enough valid items to measure the various aspects of the Professional Development construct. Item 17.5 was redundant, item 17.2 measured the same idea; consequently, item 17.5 was deleted from the Technical Support scale. Furthermore, the researcher changed the format of six scales included in the questionnaire. After the field tests, respondents were required to check yes or no to each item in the six scales; whereas, on field test one and two participants were instructed to check all that apply. The modification was made to increase the likelihood that in future administrations of the questionnaire participants would carefully read each item in the six scales prior to responding (Dillman and Bowker, 2001).

Administration of the Questionnaire

The procedure for administration of the web based questionnaire was developed based on principles thought to reduce sampling errors and create respondent-friendly web questionnaires (Dillman & Bowker, 2001). In view of the fact that design of a web based questionnaire is different than other modes of data collection, Dillman and

Table 3

Alpha Reliability Coefficients Field Test Two Likert Scales 20 Participants

Scale	*N* (Items)	*M* Scale Mean	Scale *SD*	Alpha
Professional Development (Items: 6.1, 6.2, 6.3, *6.4, 6.5, 6.6)	5	12.6	1.98	.74
Teaching Philosophy (Items: 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7, 11.8, 11.9)	9	29.1	3.54	.89
Enabling Conditions (Items: 14.1, 14.2, 14.3, 14.4, 14.5, 14.6)	6	17.9	1.99	.70
Application of Technology (Items: 16.1, 16.2, 16.3, 16.4, 16.5, 16.5, 16.6, 16.7, 16.8, 16.9, 16.10, 16.11, 16.12, 16.13)	13	66.4	11.0	.68

Note: An asterisk has been placed beside deleted item to specify Alpha Reliability Coefficients calculated after item deletion.

Bowker (2001) recommended the following 14 principles be used to guide construction of a web questionnaire:

1. Introduce the web questionnaire with a welcome screen that is motivational, emphasizes the ease of responding, and instructs respondents on the action needed for proceeding to the next page.
2. Provide a PIN number for limiting access only to people in the sample.
3. Choose for the first question an item that is likely to be interesting to most respondents, easily answered, and fully visible on the first screen of the questionnaire.
4. Present each question in a conventional format similar to that normally used on paper self administered questionnaires.
5. Restrain the use of color so that figure/ground consistency and read-ability are maintained, navigational flow is unimpeded, and measurement properties of questions are maintained.
6. Avoid differences in the visual appearance of questions that result from different screen configurations, operating systems, browsers, partial screen displays and wrap-around text.
7. Provide specific instructions on how to take each necessary computer action for responding to the questionnaire and other necessary instructions at the point where they are needed.
8. Use drop-down boxes sparingly, consider the mode implications, and identify each with a “click here” instruction.

9. Do not require respondents to provide an answer to each question before being allowed to answer any subsequent ones.
10. Provide skip directions in a way that encourages marking of answers and being able to click to the next applicable question.
11. Construct web questionnaires so they scroll from question to question unless order effects are a major concern, and/or telephone and web survey results are being combined.
12. When the number of answer choices exceeds the number that can be displayed in a single column on one screen, consider double-banking with an appropriate grouping device to link them together.
13. Use graphical symbols or words that convey a sense of where the respondent is in the completion process, but avoid ones that require significant increases in computer memory.
14. Exercise restraint in the use of question structures that have known measurement problems on paper questionnaires, e.g., check-all-that- apply and open-ended questions. (p. 11-12)

While the researcher considered all 14 recommendations, advances in technology alleviated some issues once thought to be barriers to successful implementation of web surveys. For instance, with the advent of high speed Internet web pages load faster, so the use of background colors and graphics was not as problematic as in past years. Additionally, the MDR e-mail distribution system is designed to track participants that receive e-mails. This method of distribution increased the likelihood that only those educators identified for participation in the study received a link to the questionnaire.

Timeline for Distribution of the Questionnaire

A timeline was established for distribution and collection of data. To increase the response rate of this web based questionnaire whenever possible recommendations of Dillman, Tortora, and Bowker (1998) were considered in development of this timeline.

- On February 19, 2008, MDR e-mailed the first invitation to participants in the study. The e-mail included the following: a personalized greeting, introduction to the study, purpose of the study, benefits of participation, guarantee of confidentiality, start and end dates of the study, directions to link to the questionnaire, a link to the questionnaire, and an opt-out option (see Appendix C).
- On March 4, 2008, MDR sent an e-mail reminder. The e-mail included the following: a brief reminder of the importance of the study, benefits of participation, a guarantee of confidentiality, directions, and a link to the questionnaire, as well as an opt-out option. In addition, the e-mail included a statement expressing thanks to participants who completed the study and a request that they not attempt to complete the survey again (see Appendix D). The URL address to the questionnaire is http://www.surveymonkey.com/home.asp (see Appendix C and D).

Management of Data Collection

Surveymonkey.com software was used to collect data. Data was converted to excel format and downloaded from the surveymonkey.com website. The excel file was uploaded into the Statistical Package for the Social Sciences (SPSS) 13.0 for analysis. The researcher compared data on the surveymonkey.com website with data in the SPSS file three times to ensure that data was converted properly. Data uploaded to SPSS was recoded to numbers from words (e.g., agree, disagree) (see Table 4).

Procedures for Analysis of Data

The specific methodology used to carry out data analysis has been presented in Table 5. The statistical tests identified in the table were used to determine relationships between independent and dependent variables. All independent variables were included in multiple regression analysis to determine the sets of variables that were the best predictors of variation in a teacher's use of technology in the K-5 classroom (see Table 5 for Methodology Summary).

Table 4

Coding of Variables for Statistical Analysis

Item	Variable Name	Response	Code
1	Years of teaching experience	0- 5	1
		6- 10	2
		11- 15	3
		16- 20	4
		>20	5
2	Grade taught	K	6
		1	1
		2	2
		3	3
		4	4
		5	5
		Other	7
3	Gender	Male	0
		Female	1
4	Core subjects taught	Mathematics	1
		Science	2
		Social Studies	3
		Language Arts	4
		Other	0
5A	Number of hours (technology professional development)	21- more	4
		11-20	3
		6- 10	2
		1-5	1
		None	0
5B	Perceived time constraints tied to professional development for SOL instruction	Strongly Agree	4
		Agree	3
		Disagree	2
		Strongly Disagree	1
		Neutral	0
6.1, 6.2, 6.3, 6.4, 6.5	Format of technology professional development	Strongly Agree	4
		Agree	3
		Disagree	2
		Strongly Disagree	1

Note. * = reversed-scored item

(table continues)

Table 4 (continued)

Coding of Variables for Statistical Analysis

Item	Variable Name	Response	Code
7	Number of computers in classroom	>11	5
		8-10	4
		5-7	3
		3-4	2
		1-2	1
		0	0
8	Number of students in the classroom	>20	5
		16-20	4
		11-15	3
		6-10	2
		≤5	1
9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 9.9	Availability of computer hardware and related technology in the classroom	Yes	1
		No	0
10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9, 10.10, 10.11, 10.12, 10.13, 10.14	Availability of software for student use in the classroom	Yes	1
		No	0
11.1*, 11.2*, 11.3, 11.4, 11.5, 11.6, 11.7, 11.8, 11.9*	Teaching Philosophy	Strongly Agree	4
		Agree	3
		Disagree	2
		Strongly Disagree	1
12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8, 12.9, 12.10	Technical Proficiency (Hardware)	Yes	1
		No	0
13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7, 13.8, 13.9	Technical Proficiency (Software)	Yes	1
		No	0

Note. * = reversed-scored item

(table continues)

Table 4 (continued)

Coding of Variables for Statistical Analysis

Item	Variable Name	Response	Code
14.1, 14.2, 14.3, 14.4, 14.5, 14.6	Technical Proficiency (Enabling Conditions)	Strongly Agree	4
		Agree	3
		Disagree	2
		Strongly Disagree	1
15A	Frequency of Technology Integration	Daily	3
		Weekly	2
		Monthly	1
		Never	0
15B	Frequency Technology Integration Less SOLs	Strongly Agree	4
		Agree	3
		Disagree	2
		Strongly Disagree	1
16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8, 16.9, 16.10, 16.11, 16.12, 16.13	Application of Technology Integration	Frequently	3
		Occasionally	2
		Rarely	1
		Never	0
17.1, 17.2, 17.3, 17.4, 17.5, 17.6	Technical Support	Yes	1
		No	0
18.1, 18.2, 18.3, 18.4, 18.5, 18.6, 18.7, 18.8, 18.9	Technology Integration Support	Yes	1
		No	0

Table 5

Methodology Summary

Research question	Variables and Relationships	Description of data analysis	Reported data
What variables best predict the variation in a teacher's use of technology in the classroom?	Criterion variables: frequency of technology integration in the classroom for instructional purposes and application of technology integration for instructional purposes in the classroom	Descriptive statistics	Means, standard deviations, minimums, and maximums
	Predictor variables: teaching philosophy, technical proficiency (i.e., hardware, software, enabling conditions), technology (i.e., computers and related technology, software), technical support, technology integration support, and professional development.	Descriptive Statistics	Correlations and inter-item correlations among all categorical variables, finding from t-Test and chi-square tests, degrees of freedom, and p-values.
	Categorical variables: Gender=male or female, Years experience= years experience as a general education teacher, Grade taught= grade level, Curriculum Area(s) taught= all self-contain classroom		

(table continues)

Table 5 (continued)

Methodology Summary

Research question	Variables and Relationships	Description of data analysis	Reported data
What variables best predict the variation in a teacher's use of technology in the classroom?	Language arts, math, science, or social studies	Descriptive statistic	Correlations and inter-item correlations among all categorical variables, finding from t-Test and chi-square tests, degrees of freedom, and p-values.
	Univariate relationships	t-Test, Pearson correlations, and chi-square	Results of t-Test, Pearson correlations, and chi-square tests.
	Multivariate relationships	Multiple linear regression	Unstandardized coefficient (beta and standard error), standardized coefficients (beta, t statistic, and significances; collinearity statistic (tolerance and variance inflation factor).

CHAPTER III

The results of this quantitative study are presented in this chapter. The purpose of the study is to provide current data and analysis regarding factors that influence a teacher's use of technology in K-5 classrooms in the state of Virginia. The chapter includes descriptive and inferential statistics for variables addressed in the study. Several statistical procedures were used in the analysis (e.g., Chi-square Test of Independence, Independent Samples t-Test, Pearson's Correlations, and Multiple Linear Regression). The data and analysis presented in this chapter are the results of a comparison between early and late respondents, a description of demographic data, independent and dependent variables, as well as Pearson's Correlations and Multiple Regression Analysis for all variables. At the conclusion of the chapter, there is an analysis of teachers' general feedback regarding factors that influence technology integration in classrooms.

Comparison between Early and Late Respondents

All demographic data, independent, and dependent variables were analyzed to determine the statistical significance of differences between the responses to questionnaire items of early and late respondents in the sample. Early respondents were teachers who responded to the first e-mailed request for participation in the study; whereas, teachers who responded to the follow up e-mailed request for participation were considered late respondents. The Chi-Square Test of Independence was conducted to analyze categorical variables, while the Independent Samples t-Test was used to analyze interval variables. There were no statistically significant findings for categorical variables (i.e., gender, grade taught), no difference exist between proportions of observed and expected frequencies for categorical variables (see Table 6).

However, there were two statistically significant difference identified among the independent variables (i.e., technical support, software proficiency) analyzed with the

Independent Samples t-Test (see Table 7). Analysis of the Technical Support variable revealed that there was a significant difference between the means of early and late respondents (t=-2.49, p=.01), late respondents scored (M=5.70, SD=.89) significantly higher than early respondents (M=5.37, SD=1.32). Late respondents reported greater availability of technical support, on average they responded yes to more than five of six items. The largest difference in means was attributed to the availability of technical support to replace outdated hardware; late respondents reported more availability (M=.94, SD=.24) than early respondents (M=.83, SD=.38). Similarly, the availability of assistance to repair printers was greater for late respondents (M=.91, SD=.29) than early respondents (M=.83, SD=.38).

Additionally, there was a significant difference in mean scores for software proficiency of early and late respondents (t=1.95, p=.05). Early respondents (M=5.09, SD=1.69) reported significantly greater proficiency than late respondents (M=4.70, SD=1.73). On average teachers reported proficiency on five items of nine items on the scale (M=4.90, SD=1.72). Early respondents reported greater proficiency on every type of software, except Internet search engines. Early respondents (M=.86, SD=.35) reported significantly greater proficiency in the creation of multimedia presentations than late respondents (M=.76, SD=.43). No demographic, independent, and dependent interval variables were significant (see Tables 6, 7, and 8).

Overall, the findings of the statistical comparison of early and late respondents indicated that data gathered from respondents in the sample could be used to make generalizations regarding the population addressed in this study. The results of the majority of statistical tests showed that findings were not significant; there were no differences between early and late respondents.

Table 6

Chi-square Test of Independence for Categorical Variables: Comparison of Early and Late Respondents

		Respondents							
Characteristics	*Coding*	*Total*		*Early*		*Late*			
		N	*%*	*N*	*%*	*N*	*%*	*Chi-square*	*P*
Gender		313	100					.11	.74
	Male=0	22	7.0	12	3.8	10	3.2		
	Female=1	291	93.0	148	47.3	143	45.7		
Grade Taught		313	100					3.36	.65
	K=6	57	18.2	31	9.9	26	8.3		
	1=1	51	16.3	28	8.9	23	7.3		
	2=2	39	12.5	15	4.8	24	7.7		
	3=3	63	20.1	32	10.2	31	9.9		
	4=4	52	16.6	26	8.3	26	8.3		
	5=5	51	16.3	28	8.9	23	7.3		

Note. $*p \leq .05$, $**p \leq .01$

Table 7

Results of Independent Samples t-Test for Interval Variables: Comparison of Early and Late Respondents

		Respondents							
		Total	*Early*		*Late*				
Predictor Variable	*Coding*	*N Total Used/ Missing*	*N Total Used*	*M SD Min/ Max*	*N Total Used*	*M SD Min/ Max*	*t*	*df*	*p*
Years Teaching Experience	0-5=1 6-10=2 11-15=3 16-20=4 >20=5	313 0	160	3.16 1.47 1/5	153	3.39 1.46 1/5	-.35	311	.18
Frequency Technology Integration Less SOLs	SA=4 A=3 DA=2 SDA=1	284 29	150	2.39 .93 1/4	134	2.49 .87 1/4	-.86	282	.39
Professional Development Hours	21-More=4 11-20=3 6-10=2 1-5=1	305 8	157	2.48 1.22 0/4	148	2.34 1.12 1/4	1.04	303	.30
Professional Development Format	SA=4 A=3 D=2 SDA=1	305 8	157	1.91 1.12 1/4	148	2.07 1.19 1/4	1.53	303	.13

(table continues)

Table 7 (continued)

		Respondents							
		Total	*Early*		*Late*				
Predictor Variable	*Coding*	*N Total Used/ Missing*	*N Total Used*	*M SD Min/ Max*	*N Total Used*	*M SD Min/ Max*	*T*	*df*	*p*
Professional Development Less SOL	SA=4 A=3 D=2 SDA=1 Neutral=0	305 8	157	2.00 1.41 0/4	148	2.07 1.30 0/4	-.44	303	.66
Number of Students	>20=5 16-20=4 11-15=3 6-10=2 ≤5=1	300 13	156	4.43 .65 1/5	144	4.51 .59 3/5	-1.17	298	.24
Available Hardware	Yes=1 No=0	300 13	156	5.60 1.88 0/9	144	5.97 1.84 0/9	-1.72	298	.09
Number of Computers	>11=5 8-10=4 5-7=3 3-4=2 1-2=1 0=0	300 13	156	1.91 1.12 0/5	144	2.07 1.19 0/5	-1.20	298	.23

(table continues)

Table 7 (continued)

		Respondents							
		Total	*Early*		*Late*				
Predictor Variable	*Coding*	*N Total Used/ Missing*	*N Total Used*	*M SD Min/ Max*	*N Total Used*	*M SD Min/ Max*	*t*	*df*	*p*
Available Software	Yes=1 No=0	295 18	153	8.35 3.12 0/14	142	8.58 2.99 0/14	-.65	293	.52
Teaching Philosophy	SA=4 A=3 DA=2 SDA=1	293 20	152	28.64 4.11 19/36	141	28.71 3.97 19/36	-.14	291	.89
Proficiency Hardware	Yes=1 No=0	293 20	152	8.84 1.38 3/10	141	8.53 1.43 4/10	1.89	291	.06
Proficiency Software	Yes=1 No=0	293 20	152	5.09 1.69 0/9	141	4.70 1.73 1/9	1.95	291	.05*
Enabling Conditions	SA=4 A=3 DA=2 SDA=1	292 21	152	17.43 2.79 6/24	140	16.92 2.39 11/24	1.68	290	.09

(table continues)

Table 7 (continued)

				Respondents					
		Total	*Early*		*Late*				
Predictor Variable	*Coding*	*N Total Used/ Missing*	*N Total Used*	*M SD Min/ Max*	*N Total Used*	*M SD Min/ Max*	*t*	*df*	*p*
Technical Support	Yes=1 No=0	284 29	150	5.37 1.32 0/6	134	5.70 .89 1/6	-2.49	262	.01**
Technology Integration Support	Yes=1 No=0	283 30	150	4.96 2.91 0/9	133	5.45 2.91 0/9	-1.42	281	.16

Note. *p≤.05, **p≤.01

Table 8

Chi-square Test of Independence for Nominal Variables

		Respondents							
		Total	*Early*		*Late*				
Dependent Variable	*Coding*	*N Total Used/ Missing*	*N Total Used*	*M SD Min/ Max*	*N Total Used*	*M SD Min/ Max*	*t*	*df*	*p*
Frequency Technology Use	Daily=3 Weekly=2 Monthly=1 Never=0	284/ 29	150	2.07 .85 0/3	134	1.90 .87 0/3	1.74	282	.82
Application of Technology Integration	Frequently=3 Occasionally=2 Rarely=1 Never=0	284/ 29	150	16.89 .79 0/3	134	17.69 .79 0/3	-.85	282	.95

Note. *p≤.05, **p≤.01

Descriptives Statistics for Demographic Data

Questionnaire items one through four and eight (i.e., years teaching experience, grade taught, gender, subject taught, and number of students taught) were used to gather data pertaining to the background of teachers (see Table 9). Though teachers' levels of experience varied, teachers (120) with more than 20 years experience represented the largest percentage (33%) of respondents in a single category. Whereas, teachers (36) with 16-20 years experience (12%) was the single category with the least respondents. There was a relatively even distribution of teachers across grades K-5 that responded to the questionnaire. The largest percentage of respondents was from grade three (20%) and the smallest was from grade two (13%). Generally, the percentage of respondents from each of the other grade levels (i.e., one, four, and five) ranged from 16-18%.

The remaining demographic data revealed both males (22) and females (291) responded to the questionnaire, the majority of respondents were female (93%). Of the respondents who were surveyed, most teachers reported teaching language arts (91%), mathematics (90%), science (81%), and social studies (80%). While the majority of teachers (95%) reported 16 or more students in their classrooms, only 15 teachers (5%) reported having 11-15 students and even fewer teachers (.3%) reported less than five students in their classrooms.

Descriptives Data for Dependent Variables

There were two dependent variables in this study, frequency (i.e., item 15A) and application of computers and related technology (i.e., items 16.1-16.13) used in the classroom for instruction. The scale used to measure the frequency of technology integration in the classroom ranged from 0-3 (i.e., *never, monthly, weekly, daily*). The results indicated that 47% of the 284 teachers that reported use of technology for instructional purposes with students 1-3 days per week (M=1.99, SD=.86). To a

Table 9

Descriptive Statistics for Demographic Data

Characteristic	*Code*	*Total*	
		N	*%*
Gender			
	Male=0	22	7.0
	Female=1	291	93.0
	Total	313	
	Missing	0	
Grade Taught			
	K=6	57	18.2
	1=1	51	16.3
	2=2	39	12.5
	3=3	63	20.1
	4=4	52	16.6
	5=5	51	16.3
	Total	313	
	Missing	0	
Subject Taught Mathematics			
	Yes	282	90.1
	No	31	9.9
	Total	313	
	Missing	0	
Subject Taught Language Arts			
	Yes	284	90.7
	No	29	9.3
	Total	313	
	Missing	0	
Subject Taught Science			
	Yes	253	80.8
	No	60	19.2
	Total	313	
	Missing	0	
Subject Taught Social Studies			
	Yes	250	79.9
	No	63	20.1
	Total	313	
	Missing	0	

Table 9 (continued)

Characteristic	*Code*	*Total*		*M* *SD* *Min. /Max.*
		N	*%*	
Years Experience				
	0-5=1	47	15.0	3.27
	6-10=2	61	19.5	1.47
	11-15=3	67	21.4	1/5
	16-20=4	36	11.5	
	>20=5	102	32.6	
	Total	313		
	Missing	0		
Number of students				
	≤5=1	1	.3	4.47
	6-10=2	0	0	.63
	11-15=3	15	5.0	1/5
	16-20=4	125	41.7	
	>20=5	159	53.0	
	Total	300		
	Missing	13		

somewhat lesser extent teachers (30%) reported the use of technology one or more times daily, followed by teachers (17%) who reported the use of technology for instruction 1-3 days per month (see Table 10).

Even though 77% of teachers reported the integration of technology for instructional purposes daily or weekly, data also indicated that there was not much variety in the application of computers and related technology activities assigned to students. A Likert scale was administered to teachers to measure the application of computers and related technology activities assigned to students. Thirteen items (i.e., 16.1-16.13) were included in the scale and items were rated 3 (*frequently*), 2 (*occasionally*), 1 (*rarely*), or 0 (*never*).

The means were calculated for each item within the scale, the mean scores ranged from .43- 2.05. Teachers reported with greatest frequency (i.e., occasional use) that students were assigned to use computers and related technology to complete word processing (M= 2.05, SD= 1.04) and test taking (M=2.0, SD= 1.22) tasks. Teachers rarely or never assigned tasks that involved animation (M= .43, SD= .77), e-mail (M= .65, SD= .96), simulation (M= .80, SD= .93), or database (M= .95, SD= 1.01) (see Table 11).

Descriptive Data for Independent Variables

This section is comprised of descriptive data for the independent variables. The independent variables in this study were professional development hours, professional development format, available hardware, available software, student to computer ratio, teaching philosophy, hardware proficiency, software proficiency, enabling conditions proficiency, technical support, and technology integration support.

Professional Development Hours

The vast majority of the teachers (99%) reported some level of participation in technology oriented professional development during the last two years. Item 5A was

Table 10

Descriptive Data for Dependent Variables for Frequency of Integration

Variable	*Code*	*Total*		*M* *SD* *Min. /Max.*
		N	*%*	
Frequency Tech Integration				
	Never=0	20	7.0	1.99
	Monthly=1	47	16.5	.86
	Weekly=2	133	46.8	0/3
	Daily=3	84	29.6	
	Total	284		
	Missing	29		
Frequency Tech Integration Less SOL				
	Strongly Agree=4	45	15.8	2.44
	Agree=3	69	24.3	.90
	Disagree=2	135	47.5	1/4
	Strongly Disagree=1	35	12.3	
	Total	284		
	Missing	29		

Table 11

Descriptive Data for the Assignment of Computer Tasks Likert Scale

Item	*Item reverse scored*	*N*	*M* *SD* *Min/Max*	*% Never/ Rarely)*	*% Occasionally/ Frequently)*
Simulation	No	284	.80 .93 0/3	77.1 (48.6/28.5)	22.9 (16.9/6.0)
Internet to Email Others	No	284	.65 .96 0/3	82.0 (60.9/21.1)	18.0 (9.9/8.1)
Internet Research	No	284	1.70 1.05 0/3	37.7 (18.3/19.4)	62.3 (35.9/26.4)
Database	No	284	.95 1.01 0/3	68.3 (45.4/22.9)	31.7 (23.2/8.5)
Tutorials	No	284	1.74 1.12 0/3	37.0 (20.8/16.2)	63.0 (31.0/32.0)
Instructional Games	No	284	1.89 1.07 0/3	28.9 (15.8/13.0)	71.1 (37.3/33.8)
Solve Problems	No	284	1.02 1.07 0/3	65.5 (44.0/21.5)	34.5 (22.9/11.6)
Multimedia Projects	No	284	1.19 1.02 0/3	58.1 (33.5/24.6)	41.9 (31.0/10.9)
Create Animation	No	284	.43 .77 0/3	88.0 (71.5/16.5)	12.0 (9.5/2.5)
Create Concept Maps	No	284	1.44 1.00 0/3	45.1 (24.3/20.8)	54.9 (41.9/13.0)

(*table continues*)

Table 11 (continued)

Item	*Item reverse scored*	*N*	*M* *SD* *Min/Max*	*% Never/ Rarely)*	*% Occasionally/ Frequently)*
Take Test	No	284	2.00 1.22 0/3	30.6 (21.5/9.2)	69.4 (17.3/9.2)
Desktop Publishing	No	284	1.40 1.12 0/3	52.4 (29.2/23.2)	47.6 (26.1/21.5)
Word Processing	No	284	2.05 1.04 0/3	23.9 (13.7/10.2)	76.1 (33.5/42.6)

used to measure the number of hours that teachers participated in technology oriented professional development. Generally, teachers reported a little more than 10 hours (M=2.42, SD=1.17) of participation in professional development. The largest percentage of teachers (29%) in a single category reported 1-5 hours; whereas, the smallest percentage of teachers (21%) reported 11-20 hours of participation. Only two teachers (.7%) reported no participation in professional development (see Table 12).

There was a second item (5B) used to gather additional information regarding teachers' participation in technology oriented professional development. In light of the current wave of accountability in education associated with student achievement, the researcher thought it was necessary to know the impact that preparation to teach state academic standards had on the amount of time that teachers dedicated to technology oriented professional development. The majority of teachers disagreed (M=2.03, SD=1.35) with the item. They felt that the amount of time spent in technology oriented professional development was not lessened by participation in professional development required to teach academic standards.

However, it should be noted that even though the overall item mean indicated disagreement, a fairly large number of teachers reported some degree of agreement or neutrality in response to item 5B. Approximately, forty percent of teachers indicated that preparation to teach core standards adversely influenced the amount of time spent in technology oriented professional development and another 23% of teachers reported neutral responses (see Table 12). Data from analysis pertaining to this item was not included in the final linear regression.

Professional Development Format

The format of technology oriented professional development in which teachers participated during the last two years was measured on a four point (*strongly agree-*

Table 12

Descriptive Data for Professional Development Independent Variables

Variable	*Code*	*Total*		*M* *SD* *Min/Max*
		N	*%*	
Professional Development Hrs				
	None=0	2	.7	2.42
	1-5=1	88	28.9	1.17
	6-10=2	73	23.9	0/4
	11-20=3	65	21.3	
	21-more=4	77	25.2	
	Total	305		
	Missing	8		
Tech Professional Development Less SOL				
	Strongly Agree=4	40	13.1	2.03
	Agree=3	94	30.8	1.35
	Disagree=2	77	25.2	0/4
	Strongly Disagree=1	24	7.9	
	Neutral=0	70	23.0	
	Total	305		
	Missing	8		

strongly disagree) five item (6.1-6.5) Likert scale. Overall, teachers agreed with the majority of items on the scale (see Table 13). Mean scores for each item on the scale ranged from 3.28 to 2.81. The strongest agreement was in response to items 6.2 and 6.3. Teachers strongly agreed (32%) or agreed (64%) that participation in professional development was hands-on (M=3.28, SD=.54). Similarly, they reported strong agreement (32%) or agreement (64%) with participation in professional development aimed at teaching specific pieces of software (M=3.03, SD=.66). Agreement with items 6.1 and 6.4 was not as strong as it was for other items on the scale. Teachers reported participation in both single (M=2.81, SD=.76) and multiple session professional development (M=2.83, SD=.77).

Availability of Computers and Related Hardware

Items 9.1- 9.9 were used to measure the availability of computers and related hardware in the classroom. The mean score for the scale was (M=5.77, SD=1.87), generally teachers reported access to at least six of nine items (see Table 14). There were a few responses at extreme ends of scale. Two teachers (.7%) reported that no computers and related hardware were available, while eight teachers (3%) reported all nine items were available. Among the most available hardware in the classroom were high speed Internet (92%) and printers (85%); whereas, hand held devices (9%) and scanners (31%) were least available (see Figure 3).

Based on the sums of items seven (i.e., number of students) and eight (i.e., number of computers), the student to computer ratio was calculated. The teachers reported there were 6,447 students and 1,369 computers available for instructional purposes. The student to computer ratio was 9:1. Even though, the student to computer ratio was higher than the national average, the majority of teachers (75%) reported that at least 1-4 computers were available for student use in their classrooms. Only 24 teachers

Table 13

Descriptive Data for Professional Development Likert Scale

Item	Item reverse scored	*N*	*M* *SD* *Min/Max*	% Agree (Strongly Agree/ Agree)	% Disagree (Strongly Disagree-Disagree)
Generally multiple session professional development	No	305	2.83 .77 1/4	67.2 (19.0/48.2)	32.8 (3.3/29.5)
Typically hands on sessions	No	305	3.28 .54 2/4	95.7 (31.8/63.9)	4.3 (0/4.3)
Attended training specific software	No	305	3.03 .66 1/4	85.2 (20.3/64.9)	14.8 (2.6/12.1)
Typically single session professional development	No	305	2.81 .76 1/4	70.2 (16.1/54.1)	29.8 (5.2/24.6)
At least one session related to handheld technology (iPod)	No	305	2.97 .84 1/4	76.7 (26.9/49.8)	23.3 (6.6/23.3)

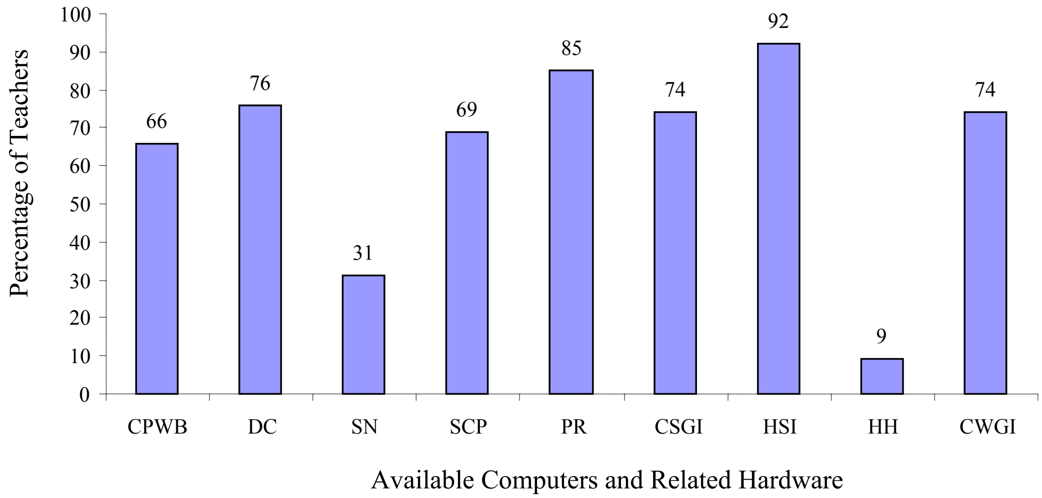

Figure 3. Percentage of teacher reported availability of computers and related hardware (CPWB= Computer, projector, whiteboard, DC= Digital camera, SN=Scanner, SCP= Single computer, projector, PR= Printer, CSGI= Computers to support small group instruction, HSI= High speed Internet, HH= Hand held device, CWGI= Computers to support whole group instruction).

Table 14

Descriptive Data for Available Hardware and Software Independent Variables

Variable	*Code*	*Total*		*M* *SD* *Min. /Max.*
		N	*%*	
Hardware in classroom				
	Yes=0	2	.7	5.77
	Yes=1	6	2.0	1.87
	Yes=2	9	3.0	0/9
	Yes=3	22	7.3	
	Yes=4	31	10.3	
	Yes=5	45	15.0	
	Yes=6	65	21.7	
	Yes=7	65	21.7	
	Yes=8	47	15.7	
	Yes=9	8	2.7	
	Total	300		
	Missing	13		
Software in Classroom				
	Yes=0	5	1.7	8.46
	Yes=1	2	.7	3.05
	Yes=2	5	1.7	0/14
	Yes=3	6	2.0	
	Yes=4	17	5.8	
	Yes=5	9	3.1	
	Yes=6	28	9.5	
	Yes=7	25	8.5	
	Yes=8	44	14.9	
	Yes=9	45	15.3	
	Yes=10	33	11.2	
	Yes=11	27	9.2	
	Yes=12	23	7.8	
	Yes=13	15	5.1	
	Yes=14	11	3.7	
	Total	295		
	Missing	18		

(8%) reported access to more than 11 computers and nine teachers (3%) reported no computers were available (see Table 15). The majority of teachers (95%) reported there were 16 or more students in their classrooms (see Table 9).

Availability of Software

The availability of software for use with students in the classroom was measured with items 10.1-10.14. Teachers responded yes or no to the availability of 14 software items. The mean rating for availability of software items was 8.46 with a standard deviation of 3.05. Only 2% of teachers indicated that none of the software items were available; whereas, 15% indicated the availability of at least nine software items (see Table 14). Large percentages of teachers reported that the availability of software to do the following tasks: presentations (88%), concept maps (83%), desktop publishing (82%), drawing (79%), and spreadsheets (79%). On the other hand, teachers reported less availability of software to create animation (30%), web pages (24%), and simulations (20%) (see Figure 4).

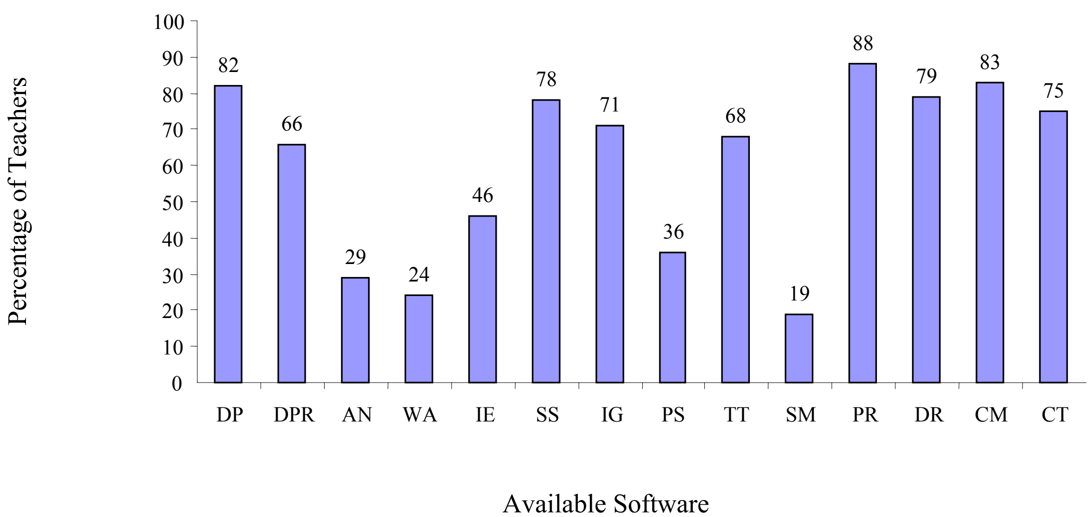

Figure 4. Percentage of teacher reported availability for each type of software (DP= Desktop publishing, DPR= Drill and practice, AN= Animation, WA= Webpage authoring, IE= Image editing, SS= Spreadsheet, IG= Instructional games, PS= Problem solving, TT= Tutorial, SM= Simulation, PR= Presentation, DR= Drawing, CM= Concept maps, CT= Computerized test).

Table 15

Descriptive Data for Available Computers in Classrooms

Variable	*Code*	*Total*		*M* *SD* *Min. /Max.*
		N	*%*	
Number computers in classroom				
	0=0	9	3.0	1.99
	1-2=1	101	33.7	1.15
	3-4=2	123	41.0	0/5
	5-7=3	43	14.3	
	8-10=4	0	0	
	>11=5	24	8.0	
	Total	313		
	Missing	13		

Teaching Philosophy

Teaching philosophy was measured with nine items (11.1-11.9) on a four point Likert scale that ranged from 1 (*strongly disagree*) to 4 (*strongly agree*). Teachers who reported strong agreement or agreement with items on the scale were considered more committed to a constructivist teaching philosophy than a traditional teaching philosophy. Teachers' rating on items (11.1-11.9) ranged from 3.02- 3.42, which indicated that the majority of teachers either agreed or strongly agreed with all of the items on the scale. Teachers' agreement was strongest (M=3.42, SD=.65) with item 11.1, where 94% agreed or strongly agreed that students use of computers was not a waste of time. Slightly less teachers (82%) agreed or strongly agreed (M=3.02, SD=.66) with item 11.9, indicating that teachers thought the use of computers in the classroom facilitated cooperative learning experiences for students (see Table 16).

Hardware Proficiency

Ten items (12.1-12.10) were used to measure technical proficiency with hardware used in the classroom. The mean rating for the scale was 8.69 with a standard deviation of 1.41. The largest percentage of teachers (37%) reported proficiency in the use of 10 hardware items; whereas, the smallest percentage of teachers (.3%) indicated proficiency in the use of only three or four pieces of hardware (see Table 17). Teachers were most proficient with switching on a computer (100%) and a printer (100%), operating a computer (100%) and a printer (99%), taking a digital picture (96%), and changing an ink cartridge (92%). While fewer teachers were skilled enough to operate a whiteboard (66%) and to operate a hand held device (58%) (see Figure 5).

Table 16

Descriptive Data for Constructivist Teaching Philosophy Likert Scale

Item	*Item reverse scored*	*N*	*M SD Min/Max*	*% Agree (Strongly Agree/ Agree)*	*% Disagree (Strongly Disagree-Disagree)*
Computers waste of time	Yes	293	3.42 .65 1/4	94.2 (49.1/45.1)	5.8 (1.4-4.4)
Computers do not increase learning	Yes	293	3.31 .68 1/4	90.8 (42.0/48.8)	9.2 (1.4/7.8)
Computers Promotes Real World learning	No	293	3.23 .61 1/4	91.1 (32.1/59.0)	8.9 (.3/8.9)
Computers Promote Increased Instruction	No	293	3.15 .69 1/4	84.3 (31.7/52.6)	15.7 (.7/15.0)
Students should produce real world products	No	293	3.04 .68 1/4	80.5 (24.2/56.3)	19.5 (1.0/18.4)
Same activity whole class	Yes	293	3.10 .61 1/4	89.1 (22.5/66.6)	10.9 (1.7-9.2)
Technology learning student centered	No	293	3.05 .64 1/4	82.6 (22.5/60.1)	17.4 (.3/17.1)
Deeper Understanding Concepts	No	293	3.35 .56 1/4	96.5 (39.2/57.3)	3.4 (.3/3.4)
Computers facilitate cooperative learning	No	293	3.02 .66 1/4	81.6 (21.5/60.1)	18.4 (1.0/17.4)

Table 17

Descriptive Data Technical Proficiency Independent Variables

Variable	Code	Total		*M* *SD* *Min/Max*
		N	%	
Proficiency Software				
	Yes=0	1	.3	4.90
	Yes=1	4	1.4	1.72
	Yes=2	20	6.8	0/9
	Yes=3	39	13.3	
	Yes=4	53	18.1	
	Yes=5	69	23.5	
	Yes=6	50	17.1	
	Yes=7	40	13.7	
	Yes=8	14	4.8	
	Yes=9	3	1.0	
	Total	293		
	Missing	20		
Proficiency Hardware				
	Yes=1	0		8.69
	Yes=2	0		1.41
	Yes=3	1	.3	3/10
	Yes=4	1	.3	
	Yes=5	9	3.1	
	Yes=6	15	5.1	
	Yes=7	28	9.6	
	Yes=8	49	16.7	
	Yes=9	83	28.3	
	Yes=10	107	36.5	
	Total	293		
	Missing	20		

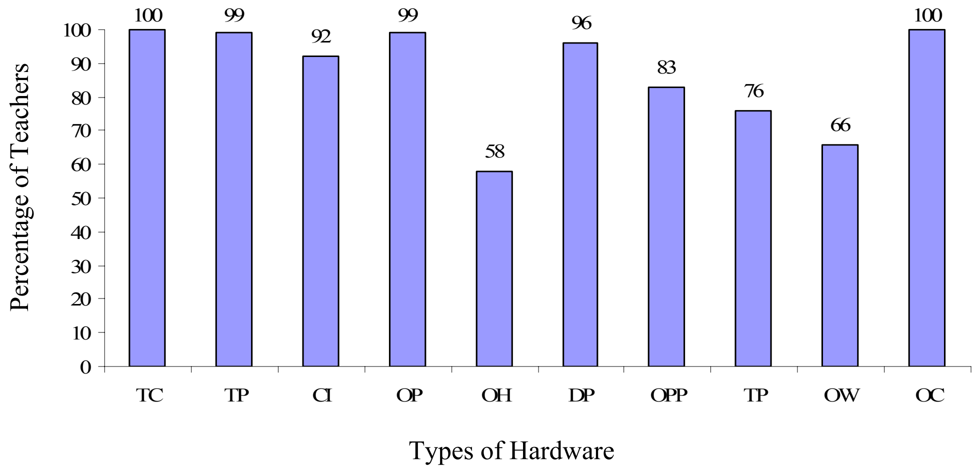

Figure 5. Percentage of teachers proficient with each type of hardware (TC= Turn on computer, TP= Turn on printer, CI= Chang ink cartridge, OP= Operate printer, OH= Operate hand held device, DP= Take digital picture, OPP= Operate projector, TP= Transfer digital pictures, OW= Operate whiteboard, OC= Operate computer).

Software Proficiency

Software proficiency was measured with items 13.1-13.9. On average teachers reported proficiency on five items (M=4.90, SD=1.72). One teacher (.3%) reported proficiency with only one item, while three teachers (1%) reported proficiency with all nine items (see Table 17). The largest percentages of teachers reported proficiency in conducting Internet searches (98%) and creating multimedia presentations (81%). Teachers were less skilled in the creation of Podcast (5%), hypermedia presentations (14%), and web pages (28%) (see Figure 6).

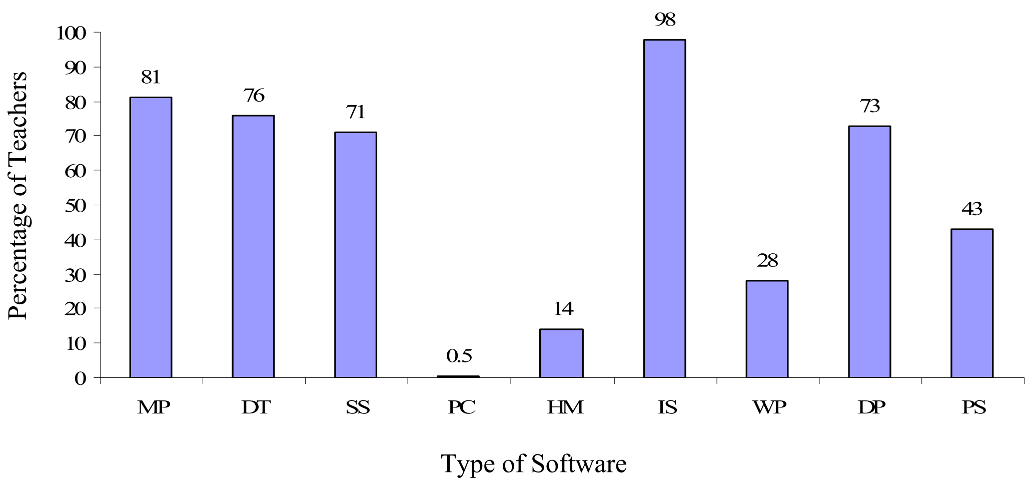

Figure 6. Percentage of teachers proficient with each type of software (MP= Multimedia presentation, DT= Desktop publishing, SS= Spreadsheet, PC= Podcast, HM= Hypermedia, IS= Internet search, WP= Webpage authoring, DP= Drill and practice, PS= Problem solving).

Enabling Conditions Proficiency

Knowledge of enabling conditions was measured with six items (14.1-14.6) on a four point Likert scale that ranged from 1 (*strongly disagree*) to 4 (*strongly agree*). Generally, the mean scores revealed agreement with items on the scale, the mean scores ranged from 2.68- 3.19. However, agreement with items on the scale was not very strong, only one of six items on the scale generated a mean score above 3.0. For the most part, teachers (90%) reported that they knew who to call for assistance (M=3.19, SD=.67), but fewer teachers (64%) reported enough proficiency to make alternative technology plans (M=2.68, SD=.69) (see Table 18).

Availability of Technical Support

The availability of technical support was measured with items 17.1- 17.6. On average teachers indicated that at least five of six types of support were available (M=5.53, SD=1.15). The majority of teachers (79%) reported the availability of all six types of technical support. Only three teachers (.3%) responded that no technical support was available (see Table 19). The largest percentages of teachers reported support to troubleshoot network problems (98%), while the smallest percentage of teachers reported support to repair printers (87%) (see Figure 7).

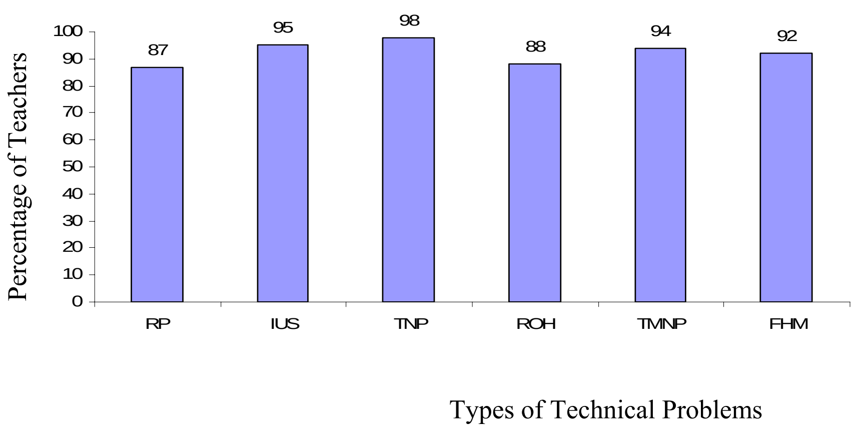

Figure 7. Percentage of teacher reported availability of technical support to assist with technical problems (RP= Repair printer, IUS= Install updated software, TNP= Troubleshoot minor network problems, ROH= Replace outdated hardware, TMNP= Troubleshoot major network problems, FHM= Fix hardware malfunctions).

Availability of Technology Integration Support

The availability of support to assist with technology integration was measured with nine items (18.1- 18.9). On average, teachers reported the availability of at least five of nine types of support (M=5.19, SD=2.92). Generally, less than half of the teachers reported availability of support to assist with four of the nine tasks. Only 18% of the teachers indicated that all nine types of support were available, while 9% of teachers

Table 18

Descriptive Data for Enabling Condition Likert Scale

Items	Item reverse scored	*N*	*M* *SD* *Min/Max*	% Agree (Strongly Agree/ Agree)	% Disagree (Strongly Disagree-Disagree)
Make Alternate Technology Plans	No	292	2.68 .69 1/4	63.7 (54.8/8.9)	36.3 (4.1/36.3)
Anticipate Problems that Occur Tech Projects	No	292	2.96 .61 1/4	83.9 (14.4/69.5)	16.1 (2.1/14.0)
Know who to call for immediate assistance	No	292	3.19 .67 1/4	89.8 (31.2/58.6)	10.3 (2.1/8.2)
Anticipate Solutions to Software Problems	No	292	2.76 .64 1/4	70.9 (7.9/63.0)	29.1 (3.1/26.0)
Anticipate Alternative Grouping Hardware Malfunction	No	292	2.77 .64 1/4	72.3 (7.9/64.4)	27.7 (3.4/24.3)
Makes preparation to teach in classroom when lab not available	No	292	2.83 .69 1/4	74.0 (12.7/61.3)	26.0 (3.8/22.3)

indicated there was support to assist with all nine tasks (see Table 19). The majority of teachers (82%) reported support was available to model technology instruction, but a much smaller percentage of teachers (34%) indicated support was available to write lesson plans (see Figure 8).

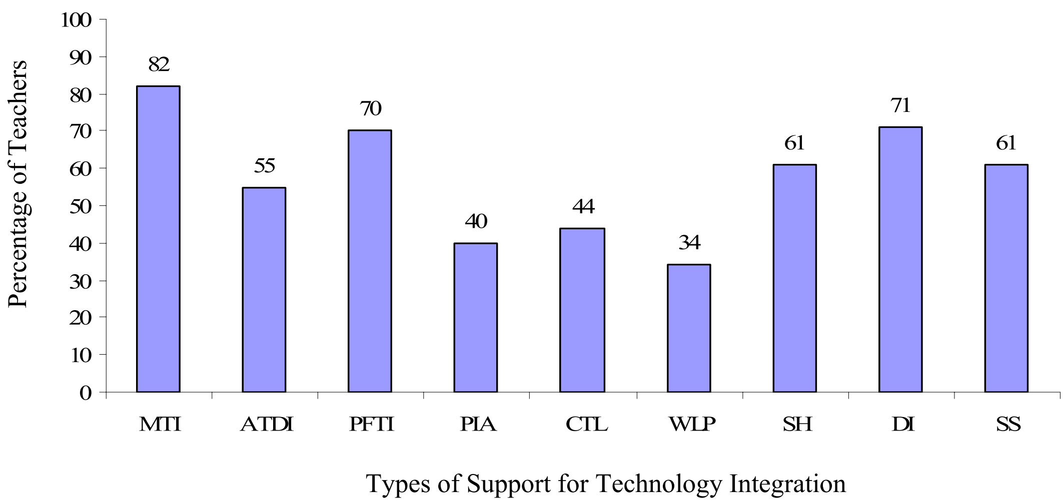

Figure 8. Percentage of teacher reported support available to assist with technology integration (MTI= Model technology instruction, ATDI= Assist with setup for technology instruction, PFTI= Plan for technology instruction, PIA= Provide immediate assistance, CTL= Co-teach technology lessons, WLP= Write lesson plans for teachers, SH= Suggest hardware to teach SOL, DI= Disseminate innovative information, SS= Suggest software to teach SOLs).

Correlations for Independent and Dependent Variables

Pearson correlation coefficients were calculated for all independent and dependent variables to determine relationships between independent and dependent variables. The results indicated that 8 of 11 independent variables yielded significant positive correlations with the dependent variable, frequency of technology integration in the classroom (see Table 20). Additionally, the findings indicated that significant relationships existed between 10 of 11 independent variables and the dependent variable, application of technology integration in the classroom (see Table 21).

Table 19

Descriptive Data Available Support Independent Variables

Variable	Code	Total		*M* *SD* *Min/Max*
		N	%	
Technology Integration Support				
	Yes=0	25	8.8	5.19
	Yes=1	18	6.4	2.92
	Yes=2	17	6.0	0/9
	Yes=3	26	9.2	
	Yes=4	24	8.5	
	Yes=5	36	12.7	
	Yes=6	23	8.1	
	Yes=7	37	13.1	
	Yes=8	27	9.5	
	Yes=9	50	17.7	
	Total	283		
	Missing	30		
Technical Support				
	Yes=0	3	1.1	5.53
	Yes=1	3	1.1	1.15
	Yes=2	7	2.5	0/6
	Yes=3	6	2.1	
	Yes=4	15	5.3	
	Yes=5	25	8.8	
	Yes=6	225	79.2	
	Total	284		
	Missing	29		

Independent Variables and Frequency of Technology Integration

Eight of the eleven independent variables had significant positive relationships with the dependent variable frequency of technology integration. The significant independent variables were professional development hours, professional development format, available hardware and software, teaching philosophy, hardware and software proficiency, and enabling conditions. Independent variables that did not bare a significant relationship with frequency of technology integration were student to computer ratio, technical support, and technology integration support. Teaching philosophy had the strongest correlation ($r=.30$, $p \leq .01$), teachers that utilized more constructivist teaching practices integrated technology in the classroom with greater frequency. Software proficiency ($r=.13$, $p \leq .01$), hours of professional development ($r=.17$, $p \leq .01$), and enabling conditions proficiency ($r=.17$, $p \leq .01$) rendered the weakest correlations with the dependent variable.

Independent Variables and Application of Technology Integration

Ten of eleven independent variables had significant relationships with the dependent variable application of technology integration in the classroom. The independent variables were professional development hours, professional development format, student/ computer ratio, available hardware and software, teaching philosophy, hardware and software proficiency, enabling conditions proficiency, and technology integration support. Most of the relationships between independent variables and the dependent variable were positive linear relationships, with the exception of the negative relationship between student to computer ratio and the application of technology integration.

Table 20

Pearson Correlation Coefficient for Predictor Variables and Frequently of Technology Integration in K-5 Classroom

Variable	*N*	*r*
Professional Development Hrs	284	.17**
Professional Development Format	305	.20**
Student to Computer Ratio	282	-.11
Available Hardware	284	.20**
Available Software	284	.23**
Teaching Philosophy	284	.30**
Proficiency Hardware	284	.23**
Proficiency Software	284	.13**
Enabling Conditions	284	.17**
Technical Support	284	.08
Technology Integration Support	284	.10

Note. *p≤.05, **p≤.01

Table 21

Pearson Correlation Coefficient Predictor Variables and Application of Technology for Use with Students in the K-5 Classroom

Predictor Variable	*N*	*r*
Professional Development Hrs	284	.13*
Professional Development Format	284	.22**
Student to Computer Ratio	282	-.14*
Availability of Hardware	284	.32**
Availability of Software	284	.52**
Teaching Philosophy	284	.37**
Proficiency Hardware	284	.21**
Proficiency Software	284	.40**
Enabling Conditions	284	.32**
Technical Support	284	.06
Technology Integration Support	284	.22**

Note. *p≤.05, **p≤.01

The strongest relationships were between available software ($r=.52$, $p\leq.01$), software proficiency ($r=.40$, $p\leq.01$), and teaching philosophy ($r=.37$, $p\leq.01$) and application of technology integration. The weakest relationships were between the independent variables student to computer ratio ($r=-.14$, $p\leq.05$) or professional development hours ($r=.13$, $\leq.01$) and the application of technology integration. Technical support was the only independent variable that had no significant relationship with the dependent variable.

Inter-Item Correlations

There were several significant correlations found between the independent variables in this study. An analysis of the correlation matrix that includes all independent variables for this study showed that coefficient correlations ranged from ($r=.13$, $p\leq.01$) to ($r=.41$, $p\leq.01$) (see Table 22). As would be expected, higher correlations were found between predictor variables that measured similar constructs, but required separate scales of measurement because of distinct differences.

For example, one of the higher correlations was found between available software and available hardware ($r=.42$, $p\leq.01$). Both coefficients were used to measure availability of items related to computers, but computer software and hardware are distinctly different. Other notable coefficient correlations in the $r=.40$ range were found between professional development hours and professional development format, hardware proficiency and software proficiency, teaching philosophy and enabling conditions proficiency.

Dealing with multicollinearity

Lomax (2001) defines multicollinearity "as a strong linear relationship between two or more of the predictors" (p.62). Among the concerns associated with multicollinearity are "instability of regression coefficients across samples" and a

Table 22

Inter-Item Correlations Dependent and Independent Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
Frequency Technology Integration	1 284												
Application Technology Integration	.320** .000 284	1 284											
Prof. Dev. Hours	.168** .005 284	.134** .024 284	1 305										
Prof. Dev. Format	.199** .001 284	.222** .000 284	.405** .000 305	1 305									
Available Hardware	.202** .001 284	.322** .000 284	.162** .005 300	.135* .020 300	1 300								
Available Software	.227** .000 284	.523** .000 284	.077 .187 295	.160** .006 295	.417** .000 295	1 295							

(table continues)

Table 22 (continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13
Teaching Philosophy (Constructive)	.299** .000 284	.367** .000 284	.218** .000 293	.231** .000 293	.290** .000 293	.165** .005 293	1 293						
Proficiency Hardware	.228** .000 284	.205** .001 284	.160** .006 293	.071 .224 293	.312** .000 293	.172** .003 293	.302** .000 293	1 293					
Proficiency Software	.128* .031 284	.397** .000 284	.204** .000 293	.226** .000 293	.258** .000 293	.372** .000 293	.265** .000 293	.441** .000 293	1 293				
Proficiency Enabling Conditions	.173** .004 284	.318** .000 284	.146* .012 292	.276** .000 292	.220** .000 292	.247** .000 292	.417** .000 292	.224** .000 292	.328** .000 292	1 292			
Technology Integration Support	.102 .087 283	.224** .000 283	.073 .218 283	.134* .024 283	.320** .000 283	.359** .000 283	.164** .006 283	.165** .005 283	.254** .000 283	.182** .002 283	1 283		
Technical Support	.084 .156 284	.058 .000 284	.039 .510 284	.104 .081 284	.171** .004 284	.132* .026 284	.028 .636 284	-.016 .792 284	.082 .169 284	.079 .186 284	.278** .000 283	1 284	
Ratio Student to Computer	-.105 .081 276	-.138* .022 276	-.075 .202 291	-.080 .174 291	-.270** .000 291	-.131* .027 286	-.088 .141 284	-.058 . 330 284	-.108 .070 284	-.089 .137 283	.007 .909 275	-.117 .051 276	1 291

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

significant R^2 when "none of the individual predictors are significantly different from zero" (Lomax, 2001, p. 62). While there are several methods for the detection of multicollinearity, in this study the researcher conducted two types of collinearity diagnostics (i.e., variance inflation factors [VIF] and tolerance levels) to determine the possible existence of multicollinearity.

All eleven predicator variables were included in the two regression models for the purpose of computing variation inflation factors (VIF) and tolerance levels. According to Wetherill (as cited in Lomax, 2001), one can assume predictors are uncorrelated when the VIF for each predictor variable is less than 10. It should be noted that the VIF may range from one to infinite (Crown, 1998). Additionally, tolerance values near one signal independence among variables; whereas, values near zero signal that variables are multicollinear. Consequently, "researchers would like the tolerance for each variable to be high (close to one) rather than low" (Crown, 1998, p. 73).

Data rendered from the two regression models substantiated that multicollinearity was not an issue; the regression coefficients did not measure the same constructs. In both regression models, frequency of technology integration and application of technology integration, the VIF range was 1.1 to 1.5. The most frequently occurring VIF was 1.4. Similarly, in both models the tolerance levels range from approximately .70 to .90, the most frequently occurring value was approximately .70. In both models, only the independent variables, student to computer ratio and technical support had a higher, but still acceptable tolerance levels (.90).

Multiple Linear Regression Models

Multiple Linear Regression analysis was conducted to determine whether the independent variables explained the dependent variables in the study. The researcher hypothesized that the eleven independent variables (*i.e., professional development hours,* *professional development format, available hardware, available software, teaching philosophy, hardware proficiency, software proficiency, enabling conditions proficiency, technology integration support, technical support, and student to computer ratio*) could be used to predict the two dependent variables (i.e., frequency and application of technology integration). The results of statistical tests for each regression model are reported in Tables 23 and 24.

In both models, the findings were significant. The slopes of the regression lines were not equal to zero; therefore, the null hypotheses were rejected for both models. A review of the model summary for the first dependent variable, frequency of technology integration in the classroom, showed an R-square of 16%. This R-square value indicated that a small amount (16%) of variance in the dependent variable can be predicted by the eleven independent variables. Results of the ANOVA (R^2 = .16, F (11, 2.95) = 4.69, p=.00) confirm that this was a significant linear regression. The regression equation was Ŷ= -1.17 + .04 (professional development hours) + .04 (professional development format) + -.01 (available hardware) + .05 (available software) + .05 (teaching philosophy) + .10 (hardware proficiency) + -.05 (software proficiency) + -.003 (enabling condition proficiency) + -.01 (technology integration support) + .05 (technical support) + -.01 (student/ computer ratio). Three of eleven independent variables were significant predictors, available software (t=2.67, p=.01), teaching philosophy (t=3.36, p=.00), and hardware proficiency (t=2.49, p=.02).

Table 23

Linear Regression Coefficients for Dependent Variable Frequency of Technology Integration

	Unstandardized Coefficients		*Standardized Coefficients*			*Collinearity Statistics*	
Predictor	*B*	*Std. Error*	*Beta*	*t*	*Sig.*	*Tolerance*	*VIF*
(Constant)	-1.17	.570		-2.048	.042		
Prof Develop Hours	.043	.046	.058	.919	.359	.787	1.271
Prof Develop Format	.042	.026	.106	1.626	.105	.745	1.343
Available Hardware	-.009	.033	.019	.272	.786	.669	1.494
Available Software	.053	.020	.178	2.666	.008	.717	1.395
Teaching Philosophy	.047	.014	.221	3.360	.001	.734	1.362
Proficiency Hardware	.098	.040	.162	2.448	.015	.728	1.374
Proficiency Software	-.047	.034	-.095	-1.385	.167	.678	1.475
Proficiency Enabling	-.003	.021	-.010	-.152	.879	.745	1.343
Tech Integrate Support	-.011	.019	-.039	-.597	.551	.756	1.322
Technical Support	.047	.044	.064	1.068	.286	.885	1.130
Student Computer Ratio	-.006	.088	-.047	-.787	.432	.881	1.136

Table 24

Linear Regression Coefficients for Dependent Variable Application of Technology Integration

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	*B*	*Std. Error*	*Beta*	*t*	*Sig.*	*Tolerance*	*VIF*
(Constant)	-11.752	4.457		-2.636	.009		
Prof Develop Hrs	.061	.362	.009	.169	.866	.787	1.271
Prof Develop Format	.198	.203	.055	.975	.330	.745	1.343
Available Hardware	.201	.255	.047	.791	.430	.669	1.494
Available Software	1.074	.155	.395	6.930	.000	.717	1.395
Teaching Philosophy	.452	.109	.235	4.163	.000	.734	1.362
Proficiency Hardware	-.222	.314	-.040	-.708	.480	.728	1.374
Proficiency Software	.765	.267	.168	2.864	.005	.678	1.475
Proficiency Enabling	.173	.168	-.058	1.032	.303	.745	1.343
Tech Integrate Support	-.068	.150	-.025	-.452	.651	.756	1.322
Technical Support	-.273	.346	-.040	-.787	.432	.885	1.130
Student Computer Ratio	-.031	.060	-.027	-.516	.606	.881	1.136

A review of the model summary for the second dependent variable, application of technology integration in the classroom, showed a higher R-square of .39. In this model, 39% of variance in the dependent variable could be predicted by the eleven independent variables. The regression equation was Ŷ= -11.75 + .06 (professional development hours) + .20 (professional development format) + .20 (available hardware) + 1.07 (available software) + .45 (teaching philosophy) + -.22 (hardware proficiency) + .77 (software proficiency) + .17 (enabling condition proficiency) + -.07 (technology integration support) + -.27 (technical support) + -.03 (student/ computer ratio). Three of the eleven independent variables were significant, available software (t=6.93, p=.00), teaching philosophy (t=4.16, p=.00), and software proficiency (t=2.86, p=.01). Results of the ANOVA (R^2 = .39, F (11, 591) = 15.1, p=.00) indicated that this was a significant linear regression, so the model was a predictor of application of technology integration in the classroom.

Discussion of Multiple Regression Results

The regression equation for model one indicated that 16% of variance in the dependent variable, frequency of technology integration in the K-5 classroom, was predicted by the eleven independent variables (see Table 25). However, a large portion of the variance in the prediction was attributed to the following significant independent variables: available software, teaching philosophy, and hardware proficiency. On average teachers had access to at least 8 of 14 pieces of software listed on the questionnaire. The largest percentages of teachers reported access to software to do presentations, concept maps, desktop publishing, drawing and spreadsheets. Teachers reported least access to software to do simulations, animation, and web pages. The predominant teaching philosophy reported by teachers was constructive not traditional. The mean scores for the nine items on the scale ranged from 3.02-3.42 with 81-94% of teachers expressing varying levels of agreement with items that represented the constructivist philosophy. Teachers preferred to engage students in tasks that required complex thinking with real world applications. Teachers acted as facilitators guiding students through tasks in a manner that supported deeper understanding of concepts, collaboration with others, hands-on work, resolution of dilemmas, and production of real world artifacts. Teachers also reported hardware proficiency on at least 9 of 10 pieces of hardware. They reported the greatest proficiency in general operation of computers, printers, and digital cameras; whereas, they reported less proficiency in the operation of hand held devices (e.g., iPod) and the interactive whiteboard.

In the second model a greater amount of variance (39%) in the dependent variable (i.e., application of technology integration) was predicted by the eleven independent variables (see Table 26). However, much of the variance was attributed to three significant independent variables (i.e., available software, teaching philosophy, and software proficiency). The difference in variation in model two was attributed to software proficiency rather than hardware proficiency. In addition to the presents of constructivist philosophy and access to software, a teacher's proficiency with software made a difference in the application of technology in the classroom. On average teachers reported proficiency on at least 5 of 9 kinds of software. Most often proficiency was reported in the use of software to conduct Internet searches and create multimedia presentations, while teachers indicated insufficient skills to use software to develop Podcast, hypermedia presentations, and web pages.

Comments Regarding Factors that Influence Technology Integration

The last two items on the questionnaire were open ended. The first item was a request for input to do with factors not mentioned in the questionnaire that influenced technology integration in teachers' classrooms. The second item was designated for teachers to provide general feedback about the questionnaire and experiences with technology. Even though, the majority of the responses to item one provided feedback regarding factors that were already measured in the questionnaire, the researcher still analyzed the comments.

Table 25

Analysis of Variance for Dependent Variable Frequency of Technology Integration

Source	*SS*	*Df*	*MS*	*F*	*p*
Regression	32.483	11	2.953	4.609	.000
Error	168.513	263	.641		
Total	200.996	274			

Table 26

Analysis of Variance for Dependent Variable Application of Computer Activities

Source	*SS*	*Df*	*MS*	*F*	*p*
Regression	6498.393	11	590.763	15.083	.000
Error	10301.076	263	39.168		
Total	16799.469	274			

The comments from item one provided critical insight about respondents' unique experiences with technology integration in their classrooms. Comments were categorized in Table 27 and summarized in this section. It should be noted that general comments for item two were not categorized or summarized due to magnitude of similarities with comments in open ended item one (see Appendix H for item 2 general comments). Overall, the comments suggested that equipment, support personnel, time, technical proficiency, professional development, grade level, and incentives were factors that influenced integration in classrooms.

In fact, the majority of comments were categorized under three categories (i.e., equipment, support personnel, and time). Equipment was mentioned by the largest cluster of teachers (38). Based on the comments there was a difference in access, quality, and quantity of computers and software available to teachers; twenty-eight comments indicated that equipment was a constraint. Generally, the following concerns were reported: outdated or limited computers and software, poor access to computer labs, inadequate infrastructure, poor Internet access, lack of funding to purchase technology, and policy restrictions on the use of computers. On the other hand, other comments (4) indicated that availability of laptop computers and Smartboards were a positive influence on the integration of technology in the classroom.

The teachers mentioned support personnel in 17 comments. The majority of teachers expressed that there were not enough support personnel to provide immediate assistance. Primarily, insufficient support was described as access to personnel on a limited number of days. While other comments indicated that persons assigned to assist

Table 27

Teachers' Comments Regarding Factors that Influence Technology Integration

Factors	*Total Number of Comments*	*Technology Integration in Classroom*		
		Support	*Constraint*	*Neutral*
Equipment	38	4	28	6
Support Personnel	17	3	13	1
Time	12	0	10	2
Technical Proficiency	7	2	3	2
Prof Development	4	3	0	1
Grade Level	6	0	5	1
Incentive	1	0	0	1
Total	85	12	59	14

(e.g., did not respond to request for help) were unwilling or lacked technical proficiency to provide the support needed to resolve technical problems. Conversely, three comments suggested that technical support was superior; teachers received assistance with lesson plans, classroom instruction, and professional development.

Twelve comments were categorized as adversely influencing technology integration due to time constraints. For the most part, teachers mentioned there was not sufficient time to setup equipment, prepare materials, and write lesson plans in preparation for technology integration. Districtwide instructional pacing and standardized testing were also cited as deterrents to the use of technology in the classroom.

Professional development, grade level, and incentives were factors that influenced teachers' integration, but were least mentioned in response to item one. Teachers cited professional technology conferences, colleagues, students, and technology resource teachers in relation to professional development. Only one teacher mentioned incentives and rewards in connection with technology integration, but it was unclear whether the teacher felt incentives and rewards were a constraint or support tied to integration of technology in the classroom.

Chapter IV

In the last 30 years, much of the technology integration in schools has been infrequent and low tech. Nonetheless some researchers, educators, and policy makers remain steadfast in the belief that technology is a tool that should be used in schools to facilitate teaching and learning. Additionally, states across the country have been required to use technology in schools to improve student achievement (NCLB) and equip students with technology skills necessary to navigate the 21st Century workplace.

The purpose of this study was to provide current data and analysis regarding factors that influence a teacher's use of technology in K-5 classrooms in the state of Virginia. The data and analysis from this study could be used to facilitate technology integration efforts, intended to heighten frequency and vary the application of technology integration in schools. To this end, this study was designed to identify sets of independent variables (e.g., teaching philosophy, access to hardware, access to software, hardware proficiency) that could be used to predict the two dependent variables (i.e., frequency and application of technology integration). This chapter includes research findings and conclusions, limitations of the study, implications for practice, and recommendations for future research.

Discussion of Research Findings and Conclusions

This section includes a discussion of independent variables that were significant predictors (within regression models 1 and 2) of the two dependent variables as well as a comparison of the findings and conclusions of this study with those of prior research in the field. The findings and conclusions are explained in the context of the theoretical framework and supporting theories that were presented in the literature review.

Discussion of General Research Findings and Theoretical Framework

Overall, the general research findings and conclusion of this study were consistent with the overarching theory presented in the theoretical framework (i.e., Kurt Lewin's field theory). In this study, the researcher found that a teacher's behavior (i.e., frequency and application of technology integration) was a function that emanated from both personality and environment, B = F (P, E) (Lewin, 1975). In both regression models, the independent variables that explained variation in the dependent variables stemmed from a teacher's personality and environment. Though model one accounted for a very small portion of the variance (R^2 = .16) in frequency of technology integration, among the independent variables in the model were three significant independent variables, two related to personality (teaching philosophy and hardware proficiency) and one related to the environment (available software). The variance explained by the independent variables in model two was greater (R^2 = .39), still Kurt Lewin's field theory held weight; teaching philosophy (i.e., personality), software proficiency (i.e., personality), and available software (i.e., environment) were significant among independent variables that influenced a teacher's application of technology in the K-5 classroom.

Teaching Philosophy: The Conclusions and Findings of this Study

The findings of this study support three conclusions with regard teaching philosophy, frequency, and application of technology integration in K-5 classrooms. The primary conclusion is that teaching philosophy was correlated with both frequency and application of technology integration. Findings from the inter-item correlation analysis revealed that of all the independent variables two of the strongest positive relationships was between teaching philosophy and each of the dependent variables, frequency (r=.30,

$p \leq .05$) and application ($r=.37$, $p \leq .05$) of technology integration. It was also concluded that teaching philosophy was a predictor of frequency and application of technology integration. Findings from both regression analyses indicated teaching philosophy was among the significant independent variables and accounted for variance in the frequency ($t=3.36$, $p=.00$) and application ($t=4.16$, $p=.00$) of technology integration. Even though, model one only predicted 16% of variance in the frequency of technology integration, teaching philosophy was the most powerful predictor in the model. In model two, teaching philosophy was the second strongest predictor in the model that accounted for 39% of variance in the application of technology integration.

The third conclusion was that the majority of teachers reported agreement with the implementation of constructivist teaching methods, but frequency and application of integration were not commensurate with the strength of reported commitment to constructivist teaching practices. In the researcher's opinion, the level of commitment to constructivist teaching practices reported by teachers should have equated to frequent and varied integration. However, the findings of the study revealed that frequency was moderate and application was not varied. On the teaching philosophy scale, over 80% of the teachers expressed some degree of agreement with constructivist teaching practices. However, only 30% of teachers reported integration daily, while only 47% of the teachers reported integration 1-3 days per week. Additionally, most teachers integrated word processing and testing applications, but only occasional use was reported for integration that involved word processing ($M=2.05$, $SD=1.04$) and testing ($M=2.0$, $SD=1.22$). Furthermore, teachers rarely or never integrated other applications such as those used for animation (M=.43, SD=.77), e-mail (M=.65, SD=.96), simulation (M=.80, SD=.93), or database (M=.95, SD=1.01).

Teaching Philosophy: A Comparison of Findings with Past Research

The significance of the teaching philosophy variable was not surprising. There is evidence in cognitive theory as well as other studies (Ertmer and Snoeyink, 2002; Hernandez-Ramos, 2005; Judson, 2006; Zhao et al., 2002) that substantiate the connection between teaching philosophy and technology integration. Constructivist learning theories that emanated from cognitive research supports the use of teaching practices that engage students in deep, prolonged thinking in order to facilitate learning (Becker et al., 2000). Therefore, teachers who function from a constructivist philosophical base would be expected to use tools (i.e., computers and related technology) that immerse students in complex learning experiences such as collaboration, critical thinking, and the like to solve problems.

In this study, the researcher concluded that the strength of teachers' commitment to constructivist teaching philosophy was not commensurate with the frequency and varied application of technology integration. The research of Zhao et al. (2002) and Judson (2006) provided two probably reasons for why technology integration may not have been commensurate with constructivist philosophy in this study.

Zhao et al. (2002) found that while "certain technologies are simply better suited for some tasks than others," teachers were more likely to successfully integrate technology when the technology was consistent with their pedagogical beliefs (p. 492). Even though, Zhao et al. (2002) did not specifically label pedagogical beliefs as constructivist or traditional, the researchers did cite a connection between pedagogy and the application of technology integration. Zhao's finding suggests that teachers may have used more traditional practices in the classroom than were cited in responses to this study.

Judson (2006) warned that we must be weary of findings that support the relationship between constructivist philosophy and technology integration. He cautions that there is not always evidence to support this assumed relationship. Judson found that self-reported survey responses did not match observations of the participants. Even though constructivist teaching philosophy was reported by the majority of teachers, observations revealed less than half actually utilized constructivist teaching practices when integrating technology in the classroom.

Teaching philosophy and frequency. In this study, the researcher concluded there was a correlation between teaching philosophy and frequency. Additional findings revealed that teaching philosophy was a predictor of frequency. The findings of the present study bare similarities to those of Ertmer and Snoeyink (2002) and Hernandez-Ramos (2005). In all three studies, researchers found that teachers who implemented constructivist teaching methods also integrated technology with greater frequency.

The findings of a study conducted by Ertmer and Snoeyink (2002) indicated that two of the three veteran teachers demonstrated more constructivist teaching methods than a counterpart who demonstrated greater use of traditional teaching methods. The researchers noted that one possible reason for increased frequency was the willingness of the two constructivist teachers to give up a measure of control to students and act as facilitators of technology integration in the classroom. Students with greater technical proficiency than teachers were allowed to take the lead with technology, when this was necessary to facilitate successful technology integration in the classroom.

Hernandez-Ramos found that constructivist teaching philosophy was a significant predictor of frequency of technology use with students. Those teachers who integrated technology whenever possible as well as those teachers who integrated technology in the classroom four to five times per week, scored higher on a constructivist scale ($F(1, 170) = 16.84$, $p = .000$) and ($F(2,169) = 4.99$, $p = .008$), respectively.

Teaching philosophy and application. For the most part, the findings of this study are consistent with those of Hernandez-Ramos (2005), Ertmer and Snoeyink (2002), and Riel and Becker (2000). In all four studies, researchers found a connection between constructivist teaching philosophy and application of technology integration. However, Hernandez-Ramos (2005), Ertmer and Snoeyink (2002), and Riel and Becker (2000) not only documented a connection, but they found evidence of advanced technology application that was not evident in this study.

Hernandez-Ramos (2005) found that teachers who assigned technology based projects to students scored higher on a constructivist beliefs scale. Constructivist teachers were more apt to assign technology based projects to students. This finding was based on significant findings of a one-way ANOVA test used to determine whether there was a significant difference between constructivist and non-constructivist teachers and the assignments of technology projects. The findings of the ANOVA were significant $F(1,171) = 16.84$, $p = .000$. There was a difference in the scores of constructivist versus non-constructivist teachers and the assignment of technology based projects ($M=3.17$ and $M=2.95$), respectively. According to Becker et al. (2000), projects require students to use multiple skills and complete varied tasks to reach a goal. The assignment of projects was considered an advance application and consistent with constructivist teaching methods.

Ertmer and Snoeyink (2002) found that teachers who demonstrated more constructivist tendencies were more apt to overcome barriers and attempt advance applications of technology with students. Two of the three veteran teachers who displayed more constructivist tendencies were more willing to attempt technology projects with students despite discomfort and inexperience with the software required to complete the projects. The projects completed with students of constructivist teachers involved advance applications, students were engaged in multiple steps to complete tasks and the tasks required multiple steps to process information.

Becker and Riel (2000) found an indirect relationship between constructivist teaching pedagogy and application of technology integration. Specifically, teachers who were more professionally engaged (i.e., Teacher Leaders, Teacher Professionals) generally demonstrated more constructivist tendencies and integrated technology with greater variety. They assigned students to use software (i.e., e-mail, multimedia presentation) that required communication and production of real world artifacts; the activities are advance applications and are consistent with constructivist pedagogy.

Technical Proficiency: Conclusions and Findings of This Study

Three conclusions were drawn from the findings of this study with regard to hardware proficiency and frequency of technology integration. First, there is a relationship between hardware proficiency and frequency of technology integration in the classroom. The results of the inter-item correlation analysis revealed a significant, but weak positive correlation between hardware proficiency and frequency of technology integration ($r=.23$, $p \leq .01$). The second conclusion is that hardware proficiency was a predictor of frequency of technology integration. Findings from the regression analysis substantiated that hardware proficiency ($t=2.45$, $p=.015$) was one of the three significant predictors (i.e., hardware proficiency, teaching philosophy, and software availability) in the frequency of integration in the classroom. However, hardware proficiency was the weakest of the predictors in regression model one. The model only predicted 16% of variance in the frequency of technology integration.

The third conclusion is that the level of hardware proficiency reported by teachers equated to a moderate to low frequency of integration. While the majority of teachers reported moderate to high hardware proficiency ($M=8.69$, $SD=1.41$), the frequency of integration was moderate to low moderate ($M=1.99$, $SD=.86$). The researcher expected the frequency of integration to be greater, since there was moderate to high hardware proficiency. However, the findings of this study revealed that the moderate to high hardware proficiency equated to proficiency of basic computer skills (e.g., turn on computer or take digital picture). Perhaps, teachers needed to report an even higher level of proficiency to have a greater impact on frequency of integration. One must also consider that model one only accounted for 16% of the variance in the frequency of technology integration. Since the model accounted for such a small portion of variance, the other two significant variables in model one as well as other variables that were not addressed in this study were likely contributors to the moderate to low moderate frequency of integration.

The researcher arrived at three conclusions with respect to software proficiency and the application of technology integration in the classroom. The first conclusion is that there was a relationship between software proficiency and the application of technology integration. This relationship was evident among the findings of the inter-item correlation analysis that showed a significant positive correlation between software proficiency and the application of technology integration ($r=.40$, $p \leq .01$).

The second conclusion was that software proficiency is a predictor of application of technology integration. Software proficiency was one of three variables (software proficiency, teaching philosophy, and software availability) significant in the prediction of application of technology integration. In fact, software proficiency was the second most influential predictor ($t=2.85$, $p=.01$) in model two, the model used to predict application of technology integration.

Finally, based on the findings of this study it was concluded that the application of technology integration was commensurate with the level of software proficiency. Teachers reported moderately low software proficiency and there was less variety in the application of technology integration. Generally, teachers were skilled enough to operate slightly more than half of the nine software items on the software proficiency scale ($M=4.90$, $SD=.1.72$). The majority of teachers reported proficiency in the use of popular software programs such as Internet software (98%) and multimedia software (81%), but teachers reported less proficiency in the use of software that required greater skill. The applications that most teachers used were those that involved less skill to integrate such as word processing (76%), instructional games (71%), test taking (69%), tutorials (63%), and Internet research (62%).

Technical Proficiency: A Comparison of Findings with Past Research

The findings of this study bare similarities and differences to those of researchers who have studied technical proficiency and frequency of technology integration (Becker, 2007; Becker et al., 1999; Hernandez-Ramos, 2005; Lowther et al., 2008; Mueller et al., 2008). In this study, technical proficiency was measured with two separate independent variables (i.e., hardware proficiency and software proficiency). However, in much of the past research in the field of technology integration hardware and software proficiency have been considered as one intertwined independent variable (sometimes-termed technical proficiency, operational skills). As a result, there is not always a clear distinction between hardware proficiency and software proficiency in past research. Consequently, the two independent variables have been discussed together in this section of the dissertation to facilitate the comparison of the findings of this study with past studies.

In a study conducted by Mueller et al. (2008), discriminant factor analysis was used to predict high and low technology integrators. Teachers' comfort with computers (i.e., the measure of technical proficiency) was among the significant independent variables that could be used to distinguish high integrators from low integrators. Mueller et al. (2008) also found a significant positive correlation between technical proficiency and frequency of integration ($r=.61$, $p<.002$).

Mueller et al. (2008) also reported findings with regard to technical proficiency, frequency, and application of technology integration. Teachers who were high integrators were decisively more comfortable (i.e., proficient) with technology than low integrators (i.e., high integrators elementary $M= 4.68$, $SD= .55$, secondary $M=4.77$, $SD= .42$; low integrators elementary M= 3.27, SD= .86, secondary M= 3.38, SD= .88). The ratings were based on a 5-point Likert scale 1 (*very ill at ease/ unenthusiastic*) to 5 (*very at ease/ enthusiastic*).

According to Mueller et al., the average frequency of integration reported by secondary high integrators (M=2.89, SD=.50) was higher than that of elementary high integrators (M=2.39, SD=.46). Integration frequency ratings were based on a 5-point Likert scale 0 (*never*) to 4 (*a great deal*). Additional findings indicated that the application of technology integration among elementary teachers, identified as high integrators, revealed that the most frequent integration was reported for use of tool-based software, on-line research, subject specific, and presentation software. Applications used least often were for assessment and communication software.

In many respects, Mueller et al.'s findings mirrored those of the present study. In both studies, there was a positive correlation between technical proficiency and frequency of integration. However, in the study conducted by Mueller et al. (2008) the correlation was stronger ($r=.61$, $p<.002$) than in the present study ($r=.40$, $p\leq.01$). Additionally, in the study conducted by Mueller et al. (2008) there was not a distinction made between hardware and software proficiency and the frequency of integration tasks were categorized somewhat differently than in the present study.

Nonetheless, in both studies teachers with moderate to high proficiency (hardware proficiency in this study), reported moderate to low frequency of technology integration. The findings of the study conducted Mueller et al. (2008) suggested that teachers with moderate to high technical proficiency integrated software applications such as the word processor, instructional games, tutorials, and Internet research with students. In the present study, teachers reported similar integration of applications, but teachers reported low moderate software proficiency.

In a statewide study conducted in Tennessee, researchers sort to determine the affects of the Tennessee Ed Technology Launch (TnETL) implemented from 2003-2006 (Lowther et al., 2008). Researchers concluded that teachers in the TnETL experimental group demonstrated greater technical proficiency, because they participated in the TnETL program. Findings also showed that teachers in the experimental group integrated technology with greater frequency and varied use of applications than less technically proficient teachers in the control group.

Researchers explored four categories of software (i.e., productivity, educational, testing, and Internet/research) used with students. Students in the experimental group used software for productivity (i.e., word processing, presentation, concept mapping) and Internet/ research (i.e., Internet browser) with greater frequency and for more meaningful applications than students in the control group. There were no significant findings for use of educational software and testing software with students.

A closer look at data from the experimental group revealed that teachers reported a moderate level of perceived proficiency with advanced skills (i.e., technology for learning, multimedia basics, and Internet basics). While moderately high proficiency was reported for skills categorized as computer basics and software basics. However, observed computer use among students in the experimental group was not as frequent and use of a variety of applications was not as evident as one might expect considering teachers reported moderate to high technical proficiency for advanced skills, computer basics, and software basics.

While the categorization of skills used to measure technical proficiency the study conducted by Lowther et al. (2008) were not exactly the same as in the present study, proficiency with computer basics and software basics were isolated therefore useful for comparison of the two studies. The findings of Lowther et al. (2008) suggested that even though teachers in the experimental group reported higher proficiency, especially in the areas of computer basics and software basics than counterparts in the control group, the observed computer use of students in the experimental group was infrequent and there was not varied use of applications (Lowther et al., 2008).

Nonetheless, in both studies, teachers reported with greatest frequency the integration of word processing and Internet research applications with students. Additionally, the findings Lowther's study and the present study support the conclusion that hardware proficiency or computer basics made a difference in the frequency of integration and software proficiency or software basics made a difference in the varied application of integration.

Hernandez-Ramos (2005) studied several variables thought to influence technology integration in Silicon Valley schools. An ANOVA was one of the statistical analyses conducted to determine whether there was a difference in frequency of technology integration among teachers based on software proficiency. The findings indicated that software proficiency was significant ($F(2,177) = 3.697$, $p = .027$) in the analysis of frequency of technology integration based on teacher reported level of software proficiency. Teachers who reported greater software proficiency also reported greater frequency of technology integration in the classroom.

Computer use in the classroom was higher among students of teachers who reported advanced use (M=3.40) of software applications than for students of beginner (M=2.25) and intermediate users (M=2.65). In fact, teachers with greater proficiency assigned computer activities on average one day per week more than less proficient counterparts. Hernandez-Ramos' findings were somewhat different from the findings of the present study in that hardware not software proficiency was significant in the prediction of frequency of technology integration in the present study. On the other hand, the two studies are similar in that the researchers searched for a connection between technical proficiency and frequency of integration.

Based on analysis of the 1998 TLC data, Becker et al. (1999) determined that there was a relationship between computer expertise and technology integration in classrooms. One of the measures used to determine teachers computer expertise was based on knowledge of seven computer tasks. Frequency was based on how often teachers assigned computer tasks to students. Generally, the findings indicated that as proficiency with the seven computer tasks increased, teachers used computers with students "more frequently and in more ways" (p. 36).

On average secondary teachers reported proficiency on 3.4 of 7 tasks; whereas, elementary teachers reported a lower level of proficiency (2.7 of 7 tasks). Word processing, research (CD-Rom and Internet), and skill practice were the most frequently assigned applications among teachers who used technology with students at least three times per year. Researchers concluded, "Even if teachers themselves are skilled in a particular type of software that is not a guarantee that they will have their students use that software" (Becker et al., 1999, p.37).

Additional findings from the study revealed that thirty percent of American teachers (grades 4-12) did not use computers with students at all. While seventy-one percent of all teachers in the TLC study integrated technology occasionally, only one-third of the teachers regularly assigned computer assignments. Elementary teachers were more apt to assign "game and drill software" to provide remediation, while the integration of the word processor (50%), World Wide Web (30%), and CD-Rom reference software (34%) were assigned by all teachers (Becker et al., 1999, p. 2).

In both studies, there were correlations between technical proficiency and technology integration (frequency and application). Generally, elementary teachers in the present study reported greater technical proficiency (i.e., hardware and software). While 71% of all teachers in the TLC study integrated technology occasionally, only one third used technology with students regularly (i.e., 20 times or more per school year). Teachers in the present study engaged students in the use of technology with greater frequency than teacher in the TLC study. Over 70% of teachers in the present study integrated technology in the classroom daily or weekly. In both studies, the use of software applications was quite similar; generally, elementary teachers integrated word processing, instructional skill/ tutorial games, and Internet or CD-ROM.

Carol Becker (2007) conducted a study of technology integration including 36 elementary school teachers in three schools in southeastern Ohio. While the purpose of the study was to determine whether there was a relationship between technological experiences, skills, and integrative practices of teachers, analysis of data provided findings to do with technical proficiency and frequency and application of integration.

Among the findings was evidence of infrequent and somewhat low tech integration reported by teachers with moderate software skills and novice hardware skills.

Moderate software proficiency (i.e., operational skills and software skills) was reported on two scales (M=3.36, SD=1.27) and (M=3.32, SD=1.06), respectively. At the other end of the continuum, teachers rated themselves closer to novice with regard to hardware proficiency (M=2.68, SD=.99). Additionally, teachers reported infrequent technology integration (M=2.99, SD=1.45). The researcher concluded that there was "little or no evidence" that technical proficiency influenced use of specific software applications in the classroom (Becker, 2007, p. 87). Generally, teachers integrated technology most frequently for tasks such as Internet navigation (M=4.03, SD=0.81), classroom management systems (M=4.00, SD=1.10), word processing (M=3.39, SD=1.20).

In Becker's study (2007), software proficiency was moderate, but in the present study, software proficiency was moderate to low. Hardware proficiency was higher (moderate to high) than the novice hardware proficiency reported in Becker's study. Becker's findings with regard to software proficiency and frequency were consistent with the findings of the present study. For the most part, Becker did not find significant correlations between software proficiency and frequency of integration. On the other hand, Becker reported moderate software proficiency on two scales and less varied use of software applications, this finding was not consistent with the present study. In the present study, software proficiency was a predictor of application of technology integration. In both studies, similar applications (word processor, Internet, instructional games/ tutorials) were used with students. Becker (2007) attributed the possibility of weak correlations to flawed question structure (i.e., teachers not understanding the survey questions) or inability of young students to read (i.e., teachers of lower grades frequently reported not using some software because of students' inability to read).

Software Availability: Conclusions and Findings of this Study

There were three conclusions with regard to the availability of software, frequency, and application of technology integration. The first conclusion is that software availability was correlated with both frequency and application of technology integration. The findings of the inter-item correlation analysis revealed a significant positive correlation between availability of software and both frequency ($r=.28$, $p<.01$) and application ($r=.52$, $p<.01$) of technology integration. The second conclusion was that software availability was a predictor of both frequency and application of technology integration. While software availability was the most influential of the three predictors (software availability, teaching philosophy, and software proficiency) of application ($t=6.93$, $p=.00$), it was the second most powerful of three predictors (software availability, teaching philosophy, and hardware proficiency) of frequency ($t=2.67$, $p=.01$). The strength of the influence of software availability is also evident in the findings of regression model one that explained 16% of variance in frequency and regression model two that explained 39% of variance application of technology integration.

The third conclusion is that the frequency and the varied application of technology integration were commensurate with the availability of software. The findings of the study indicated that teachers reported moderate availability of software ($M=8.46$, $SD=3.05$). Teachers also reported moderate to low moderate frequency of integration and moderate to low application of integration. These findings would be expected in that teachers need software in order to integrate technology.

In the researcher's opinion, the frequency of integration should not be as impacted by availability as the application technology integration. Frequency of integration should be less impacted by limited software availability, since teachers could engage students in activities that required only the use of available software. Whereas, less availability of software would decrease opportunities to integrate a variety of software across curriculum areas, since some software are better suited for integration with certain curricular than other software.

Software Availability: A Comparison of Findings with Past Research

There have not been a vast number of studies exclusively focused on determining the influence of software availability on the frequency and the application of technology integration. However, it is somewhat common to find a variable dedicated to software availability intertwined with other variables such as availability of computers and/or equipment, in this regard software has been one of the variables often considered in the study of technology integration (Bauer and Kenton, 2005; Cuban, 2001; Norris et al., 2003; Zhao et al., 2002).

In an investigation of technology integration in two Silicon Valley high schools, Cuban (2001) concluded that abundant access to technology did not boost the frequency and varied application of technology in classrooms. According to Cuban (2001), access to technology in the two high schools surpassed the national standard for technology access in schools. Even with great access, technology was used infrequently and the application of technology was not varied, generally, technology was used to extend traditional teaching practices.

Primarily, computer use at school was for teacher productivity (e.g., Internet searches related to planning for instruction, communication with colleagues and parents, report grades), not for instructional purposes that supported integration of computers with the core curriculum. Computer use with students was infrequent, only 4 of 35 teachers observed integrated computers seamlessly with curriculum. Typically, observations revealed that when computers were used with students, generally teachers assigned tasks that required the use of software to do word processing and to conduct Internet searches to do reports. Interviews with 33 students, twelve of whom were shadowed during the study, revealed "little or no use of technology for instruction" (Cuban, 2000, p. 90).

For the most part, Cuban's findings do not support the findings of the present study. Cuban (2001) reported abundant access to technology (e.g., hardware, software), which should have equated to frequent use of computers and varied use of software applications for instructional purposes. However, it should be noted that Cuban's estimate of availability was based on school wide calculations of equipment, not availability of equipment in each classroom. In the present study, teachers used technology with greater frequency, but the most frequent application of software was similar to the applications of software in the two high schools. Generally, in both studies the use of word processor and Internet software were prevalent with students.

Norris et al. (2003) studied factors thought to predict teachers' use of technology in K-12 schools across four states (i.e., New York, California, Nebraska, and Florida). Regression and correspondence analysis were conducted to determine the relationship between 44 independent variables and use of technology in classrooms. Four of the six significant predictors of computer use with students were related to access to technology or infrastructure.

Among the four significant predictors related to access to technology and infrastructure was the availability of curricular software. While the availability of curricular software (t=2.33, p=.02) was not the most powerful predictor, it was one of the significant predictors of computer use for curricular integration. Approximately 45% of teachers reported the use of computers for curricular purposes with students less than 15 minutes per week, while only 18% of teachers reported the use of computers with students 45 minutes or more per week.

Norris et al. (2003) concluded that the lack of access to technology (e.g., curricular software) was a probable reason for the less than notable impact of technology on teaching and learning. The findings of Norris et al. were consistent with the findings of the present study in that software availability was a predictor of frequency of integration. Even though, Norris et al. reported frequency of integration in minutes per week and in the present study frequency of integration was reported in days, weeks, months, the researcher estimated that frequency of integration was greater in this study.

Zhao et al. (2002), in a qualitative study of one state's evaluation of a technology projects funded by a technology grant, concluded that distance and dependence on technological resources (e.g., software) were a deterrent to teachers' successful completion of technology projects. In part, the finding of this study indicated that the most successful technology projects were those that required minimal acquisition of resources. The findings of Zhao et al. (2002) were consistent with the findings of the present study in that the availability of technology resources (e.g., software) was associated with successful integration (frequency).

Bauer and Kenton (2005), in a study of 30 technology savvy teachers indicated that software availability influenced frequency of technology integration. Only 2 of 30 teachers reported using computers with students more than 75% of the time. The majority of teachers (24 of 30) reported the integration of technology less than 50% of the time. Interviews revealed that 13% of teachers stated that software was a concern, due to the high cost, incompatibility, poor quality and variety of software. The findings of Bauer and Kenton (2005) were similar to those of the present study in that frequency of integration was impacted by availability of software and the frequency of integration among technology teachers was lessened by limited technology resources (e.g., software).

Limitation of Study

This study provides data and analysis with regard to the status of K-5 teachers and technology integration in the state of Virginia. However, there were limitations to the study that should be considered in the interpretation of findings and conclusions.

1. The researcher was unable to effectively disaggregate data related to curriculum area distinctions due to incorrect collection of data. While respondents were able to select all subject areas taught the previous school year, data for each subject area rendered no numerical means for variation in a comparison.
2. The data were based on teachers' perceptions of abilities and philosophies. In some instances teachers' perceptions may have been inaccurate. In fact, Judson (2006) found that in a mixed methods study of 32 primary and secondary teachers less than half of the teachers who reported the use of constructivist teaching practices actual

utilized the practices when integrating technology in the classroom. However, due to fiscal and time constraints the researcher was unable to conduct observations that may have been useful in substantiating teachers' responses.

Implications for Practice

While the respondents in this study come from a state that does have a research based long range plan for technology integration in schools, the findings of this study could be used by the state board of education and state legislators to inform future plans for technology integration. In this study, quantitative data revealed that teaching philosophy, software proficiency, hardware proficiency, and available software were significant among the independent variables that were predictors of frequent and/ or varied application of technology integration. Additionally, qualitative data garnered from teachers' general feedback indicated that insufficient and/ or inequitable distribution of resources (i.e., hardware, software, and technology integration support) were the most influential factors in the integration of technology in the classroom.

The following implications for practice could be considered in the development of goals and objectives for professional development as well as plans for the allocation of technology resources. In the future, the state's plan for professional development should address teaching philosophy, software proficiency, and hardware proficiency to promote increased and varied technology integration. At the same time, consideration should be given to the allocation of technology resources to ensure sufficient and equitable access to technology (i.e., hardware, software, technology integration support), at a level that would move the state forward on the continuum of technology integration.

Professional Development Based on a True Assessment of Technical Proficiency

The state board of education must revisit methods used to determine a teacher's true ability to integrate technology in the classroom, prior to refinement and development of professional development goals and objectives. The methods used to assess technical (i.e., hardware and software) proficiency and identify philosophical orientation (i.e., traditional, constructivist) should be uniform across the state and provide an accurate, comprehensive picture of teachers' skills and philosophical orientation. Data from the assessment should be used to refine and/or develop professional development goals and objectives that address teachers' needs.

At this time, school divisions across the state use various methods for determining whether teachers have met technical proficiency standards for instructional personnel. Additionally, technical proficiency standards for instructional personnel do not address philosophical orientation. While the various methods of measurement (e.g., multiple choice tests, portfolios, general teacher evaluations) implemented by localities across the state do provide information, the information must be more comprehensive to ensure an accurate assessment of technical proficiency and measure of philosophical orientation. Based on findings of this study, meeting the states standards for technical proficiency for instructional personnel does not necessarily equate to frequent and/ or varied integration of technology in K-5 classrooms for a large portion of teachers.

There needs to be a statewide authentic assessment that would render an accurate, comprehensive measure of technical proficiency and philosophical orientation. The authentic assessment should include, but not be limited to observations by skilled technology integration specialists and administrators, use of an automated simulation assessment, along with a portfolio assessment. Technology integration specialists should be trained to not only collaborate with teachers and provide professional development, but integration specialists should be trained to provide administrators with feedback regarding technical proficiency and philosophical orientation of instructional personnel. Administrators should be trained to evaluate the quality and quantity of integration in classrooms and a rubric should be given to administrators that could be used to measure technology integration in classrooms. At this time, some school divisions may provide administrators with rubrics for the evaluation of technology integration, however, this is not the case across the entire state.

An automated simulation computer program should be used to present teachers with technology integration scenarios. Teachers' responses could be used to measure technical proficiency and philosophical orientation. This form of assessment would require teachers to do actual tasks and make integration decisions, rather than just say what they would do without any contextual connections. In some instances, respondents would need to provide written explanations to substantiate decisions to integrate technology. As teachers advance through scenarios responses would provide in depth insight with regard to technical proficiency and philosophical orientation.

The use of a portfolio assessment would provide yet another method of gathering evidence with regard to technical proficiency and philosophical orientation. Teachers should be given the opportunity to gather work samples that demonstrate proficiency and orientation. The portfolio could include narratives, photographs, and other artifacts from students and teachers. A rubric could be developed to guide teachers in the selection of samples (i.e., a collection of work). Data garnered from authentic forms of assessment (e.g., observations, automated simulated assessment, portfolio) should be used to design professional development.

Professional Development Grounded in Research Proven Practices

Once the state board of education has a uniform and comprehensive assessment system in place, that captures the true needs of teachers, it should modified or create new goals and objectives to drive professional development. In part, the goals and objectives for the professional development should be to increase technical proficiency and cultivate the use of constructivist teaching methods. In this study, technical (i.e., hardware and software) proficiency and constructivist teaching philosophy were significant predictors in frequency and/or application of technology integration. To improve the likelihood that teachers acquire the necessary technical skills and teaching methods consistent with constructivism, professional development activities across the state should be based on research proven instructional practices.

While professional development in the field of technology integration has been widely studied, one of the earliest and well-known professional development efforts is the Apple Classrooms of Tomorrow project. Many of the professional development practices from the ACOT project could be adopted and serve as a model for professional development efforts across the state. Several of the components for professional development identified in the ACOT project are grounded in constructivist pedagogy. The components were effective in the promotion of technical proficiency and constructivist teaching practices among teachers who participated in the project. In accordance with the research findings from the ACOT project, technology oriented professional development should have the following distinct components:

- observe and reflect on a variety of teaching strategies, including direct instruction, team teaching, collaborative learning, project-based learning, and interdisciplinary learning
- engage in hands-on use of computers, productivity software, camcorders, and telecommunications as tools to support learning through composition, collaboration, communication, and guided practice
- interact with students in real classrooms
- share knowledge and experience with colleagues
- create specific plans for technology use in their own classrooms and schools (Sandholtz et al., 1997, p. 138)

The findings of the ACOT research not only identified distinct components that should be present in professional development, but the findings offered useful information for monitoring teachers' development of technical proficiency and implementation of teaching practices consistent with constructivist philosophy. To this end, ACOT researchers identified and characterized five instructional stages through which teachers evolved as skills and practices were developed that facilitated technology integration in classrooms. The stages were entry, adoption, adaptation, appropriation, and invention (Sandholtz et al., 1997).

The findings of the present study suggest that the majority of teachers were at either the adoption or the adaptation stages. Generally, at the adoption stage technology is used to fit existing practices. While other teachers were at the adaptation stage, at this stage teachers primary use technology to increase productivity and use of technology fits within existing practices (e.g. traditional instructional practices). According to the findings of the present study, professional development should be designed to move teachers beyond the basic uses of technology.

Equitable Allocation of Technology Resources

Throughout the last decade, the state board of education and state general assembly have allocated millions of dollars annually to reduce the cost of educational technology efforts for localities. Additionally, the state board of education and state general assembly have taken strides to investigate the availability of technology (Lemke, Quinn, Zucker & Cahill, 1998) and funding (i.e., sources, methods, sustainability, fiscal capacity) to support integration efforts across the state (Joint Legislative Audit and Review Commission, 2003).

The state board of education commissioned a technology study in 1998, among the findings of the study there was evidence of inequitable distribution of technology resource across the state. The researchers recommended that the state study equity issues and revise funding formulas to work toward the equitable distribution of federal and state funds for instructional technology (Lemke et al., 1998). Later, the state general assembly commissioned a study of funding for educational technology (JLARC, 2003).

Among the findings of the state study was evidence that school divisions across the state funded educational technology efforts through various sources. Much of the funding came from federal (e.g., E-Rate program, Educational Technology Grant program), state (special technology initiatives and funding through standards of quality), and local sources (e.g., local lottery proceeds, construction grant programs) (JLARC, 2003). However, the local school divisions bared the greatest responsibility for funding local technology integration efforts. Consequently, the fiscal capacity of the localities largely influenced the availability of educational technology resources in school districts across the state.

The findings of the present study suggest that the localities' fiscal capacity remains a prominent challenge at the heart of the equitable distribution of resources. Even though, the state bases distribution of resources in part on each locality's ability to pay for a portion of technology expenditures, there is evidence in the findings of the present study that some school districts lack resources to adequately support technology integration efforts (see Appendix G for teachers general comments). This is not surprising, taking into account the many types of expenditures necessary to sustain technology integration in a school division. Expenditures range from computer replacement, Internet access, technology support personnel to technology oriented professional development.

Nonetheless, the findings of this study suggest that the state must continue working toward adequate and equitable distribution of resources to ensure that every student and teacher has sufficient access to hardware, software, and technology integration support in classrooms. A new or modified funding formula should be developed in order to increase the allocation of funds and facilitate equitable distribution of the following technology resources across the state:

1. Computers (i.e., at least 5:1 student to computer ratio in every classroom)
2. Innovative hardware devices (i.e., hand held devices)
3. Technology integration support
4. Software (e.g., for complex application such as animation, web pages, and simulations)

Recommendations for Future Research

The researcher identified three recommendations for future research. The consideration of these recommendations would be useful in moving the state forward on the technology integration continuum in K-5 classrooms across the state.

1. Researchers should conduct periodic studies of the relationships between independent variables (i.e., that influence teachers to integrate technology) and dependent variables that represent the actual integration of technology (i.e., frequency and application). The data gathered from the research should inform the state's plan for technology integration. Additionally, the state should use an analytical approach, similar to Kurt Lewin's method of force field analysis to conceptualize findings in a way that facilitates change efforts (see Appendix I for Lewin's force field analysis applied to the findings of this study).
2. Additional research should be conducted to understand the relationship between constructivist teaching practices and the application of technology integration. The present study indicated that teachers who ascribe to constructivist teaching methods, generally report use and varied application of technology integration. However, researchers need to pinpoint why constructivist teachers generally do not engage students in more frequent and complex applications of integration (e.g., simulation, problem solving) that would be consistent with constructivist methods.
3. There is a need for research aimed at understanding the impact that technology integration has on instruction and learning. The findings of this study indicated that a large percentage of teachers attended less technology oriented professional development because of the time committed to professional development aimed at teaching core standards. With this in mind, it would be useful to know whether technology integration has less impact on teaching and learning because of time committed to traditional methods for teaching core standards without the use of technology.

4. There is a need for a current meta-analysis of studies to investigate factors that influence technology integration. Since technology is constantly evolving, a current meta-analysis might reveal new information about factors. The information could be used to facilitate the use of technology, ultimately leading to improvements in professional development and a host of other factors that influence technology integration efforts.

Reflection

Technology integration has been a part of my professional life for the last 18 years. Throughout the years, my motivation to use technology with students has not waned. In my present job, as an assistant principal, I still believe technology should be used in the classroom just like any other tool- to convey an idea, motivate, and engage students in learning. Naturally, my belief in the value of technology as an educational tool led me to wonder why some teachers use technology with students, while others do not. Even as a new teacher, there were times when the integration of technology in a lesson required more time for lesson preparation and implementation. But, I thought the use of technology as a tool increased students' interest in learning and created another way to promote deeper thinking experiences for students.

In this study, I explored the influence of several variables on a teacher's decision to integrate technology in the classroom. In my opinion teaching philosophy (i.e., constructivist versus traditional) was the most compelling variable. Some research in the field of technology integration suggested that the mere use of technology facilitated the growth of constructivist philosophy in teachers. Other research indicated that teachers who ascribe to constructivist instructional practices used technology with greater frequency and variety because the tool is useful in the facilitation of constructivist teaching methods. It seemed to me that a key to increased and varied integration in classrooms would be getting teachers to ascribe to constructivist pedagogy.

While I still believe teaching philosophy is one of the most compelling variables in a teacher's integration of technology, I now have a greater understanding of the impact that other variables such as professional development, integration support, and equipment have on integration efforts. I feel the affects of these variables on technology integration are greater than I thought. However, I am optimistic that as professional development evolves and the overall expense to fund integration efforts decreases, the integration of technology in the classroom will become more frequent and varied over time. I believe, just as the pencil, book, overhead projector and other innovations of the past slowly gained frequent and varied use over time, so will the integration of technology in K-5 classrooms.

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APPENDIX A

INSTRUMENT USED TO GET FEEDBACK REGARDING CONTENT VALIDATION OF SCALES PART I
(Adapted from Robert Hitt)

Table A1

Directions:
Each statement requires three responses. One for each category – Domain, Association, and Clarity.

Domain – There are five domains listed below. Read each statement on pages three through six, identify the domain in which the statement should be classified, then circle the number of the domain.

1 = Participation in professional development.
2 = Availability of computer related hardware in the building.
3 = Access to software in the building.
4 = Availability of technical support.
5 = Availability of support to assist with technology integration.

Association – Decide the strength of association with the domain that you have selected and circle the number:

1 = Not associated.
2 = Somewhat associated.
3 = Associated.
4 = Strongly associated.

Clarity – Read each statement and decide how clear it is. I am trying to ensure that statements are not ambiguous or confusing. Rate the clarity of each statement by circling a number.

1 = Not clear, remove, or omit.
2 = Somewhat unclear, revise.
3 = Clear.

If you give a statement a 1 or 2 for association or clarity, please write a suggestion beside the statement. Your feedback will be helpful in improving the clarity of the statement. If you have questions, please feel free to contact me at trrogers@vbschools.com or 757-478-7035.

Note:

- Please rate each item as honestly and thoughtfully as possible.
- Please separate the first two pages, so you have directions and definitions in view while rating each statement.
- Please read the definitions listed below. The definitions provide a description of each domain.

Domain Definitions:

1. *Participation in technology oriented professional development.* This domain is intended to measure a teacher's participation in professional development activities. Examples of professional development activities would range from a traditional one time training session aimed at teaching one topic (e.g., a software program) to a non-traditional training that occurred over an extended period of time in multiple sessions. Opportunities for peer observation, independent learning, and/or observation and feedback from a trainer following a training session are other examples of professional development activities.
2. *Availability of computer related hardware in the building.* This domain is intended to measure the availability of computer related hardware (e.g., printers, scanners, digital cameras, hand-held devices) for use with students in the building.
3. *Access to software in the building.* This domain is intended to measure the availability of software for use with students in the building.
4. *Availability of technical support.* This domain is intended to measure a teacher's perceived availability of technicians to keep technology working properly. This person installs new hardware and software programs as well as resolves hardware and software difficulties. For example, this person may fix or replace a crashed hard drive or install the latest version of a software program (e.g., Microsoft Office). This person does not assist teachers with the planning and implementation of technology integration in the classroom.
5. *Availability of technology integration support.* This domain is intended to measure a teacher's perceived availability of support to assist with technology integration. This person's primary job is to help teachers integrate technology with other curriculum areas in the classroom. For example, this person assists with setup of technology for daily lessons, planning for integration, and modeling various uses of technology in the classroom. This person's primary job is not fixing and replacing hardware and software.

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
1. A single computer, projector, and interactive white board (e.g., SMART board) are available for use in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
2. I have attended professional development training presented in a multiple session format	1 2 3 4 5	1 2 3 4	1 2 3
3. Students have access to desktop publishing software	1 2 3 4 5	1 2 3 4	1 2 3
4. Teachers have visited my classroom to watch me model teaching with technology	1 2 3 4 5	1 2 3 4	1 2 3
5. Student have access to drill and practice software (e.g., Fast Math)	1 2 3 4 5	1 2 3 4	1 2 3
6. There is a person in my school/ district that models the use of technology for instruction in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
7. There are digital cameras available for my students to complete a project that requires the use of digital cameras	1 2 3 4 5	1 2 3 4	1 2 3
8. There is not a person in my school/ district to assist with the setup of technology for daily instructional activities in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
9. Generally, I have attended "one shot" training sessions to learn how to use specific software programs	1 2 3 4 5	1 2 3 4	1 2 3
10. There is a person designated to printer repair	1 2 3 4 5	1 2 3 4	1 2 3
11. There is a person in my school/ district that installs upgraded software	1 2 3 4 5	1 2 3 4	1 2 3
12. Typically, I have attended hands-on training sessions to learn how to use a specific software program	1 2 3 4 5	1 2 3 4	1 2 3
13. Students have access to software to create animation (e.g., Frames, Claymation)	1 2 3 4 5	1 2 3 4	1 2 3
14. I have attended hands-on professional development training in the operation of hardware	1 2 3 4 5	1 2 3 4	1 2 3

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
15. I have observed another teacher modeling the use of a specific software application in the classroom with their students	1 2 3 4 5	1 2 3 4	1 2 3
16. Typically, I have attended “one shot” professional development training to learn how to operate a computer	1 2 3 4 5	1 2 3 4	1 2 3
17. I have participated in peer observation of a colleague that integrated technology in the classroom	1 2 3 4 5	1 2 3 4	1 2 3
18. There is a person in my school/ district designated to assists with planning for the integration of technology	1 2 3 4 5	1 2 3 4	1 2 3
19. I have not been observed by a trainer following a technology oriented professional development activity	1 2 3 4 5	1 2 3 4	1 2 3
20. Students have access to web page authoring software	1 2 3 4 5	1 2 3 4	1 2 3
21. There is a person I can call to change my password, when I am unable to log on to the network	1 2 3 4 5	1 2 3 4	1 2 3
22. Students have access to image editing software (e.g., Photo Shop)	1 2 3 4 5	1 2 3 4	1 2 3
23. There is a person in my school/ district available to assist with planning of technology integration projects	1 2 3 4 5	1 2 3 4	1 2 3
24. There is a person in my school/ district designated to provide immediate assistance with technology integration each day	1 2 3 4 5	1 2 3 4	1 2 3
25. I have not received feedback from a trainer regarding my implementation of technology integration following a training session	1 2 3 4 5	1 2 3 4	1 2 3
26. There is a person designated to co-teach technology lessons in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
27. There is a scanner available for my students to use to complete assignments	1 2 3 4 5	1 2 3 4	1 2 3
28. There is a person in my school/ district that replaces outdated hardware	1 2 3 4 5	1 2 3 4	1 2 3

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
29. There is a person in my school/ district that writes technology integration lesson plans for teachers to use in the classroom	1 2 3 4 5	1 2 3 4	1 2 3
30. Student have access to spreadsheet software	1 2 3 4 5	1 2 3 4	1 2 3
31. When my computer screen is on the fritz, there is a person designated to the repair	1 2 3 4 5	1 2 3 4	1 2 3
32. There is a person in my school/ district to assist with installation of software	1 2 3 4 5	1 2 3 4	1 2 3
33. Primarily, I have read books to learn how to integrate technology in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
34. Students have access to instructional game software (e.g., Carmen Sandiego, Science Court)	1 2 3 4 5	1 2 3 4	1 2 3
35. Students have access to problem solving software (e.g., Thinkin Things, The King's Rule, Alien Rescue)	1 2 3 4 5	1 2 3 4	1 2 3
36. There is a person in my school/ district that troubleshoots major technical problems on the network (e.g., server crashes)	1 2 3 4 5	1 2 3 4	1 2 3
37. There is not a person in my school/ district that provides learning materials helpful in the integration of technology in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
38. There is not a person available in my school/ district to suggest the best hardware to use when teaching specific SOL objectives	1 2 3 4 5	1 2 3 4	1 2 3
39. For the most part, I have taught myself to integrate technology in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
40. Students have access to tutorial software (e.g., Reading for Meaning, Reader Rabbit)	1 2 3 4 5	1 2 3 4	1 2 3
41. Students have access to simulation software (e.g., Edmark's Virtual Lab)	1 2 3 4 5	1 2 3 4	1 2 3
42. There is a person in my school/ district that maintains network security (e.g., SPAM, viruses)	1 2 3 4 5	1 2 3 4	1 2 3

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
43. There is a person in my school/ district that disseminates information about the latest technology innovations that I can use in my classroom with students	1 2 3 4 5	1 2 3 4	1 2 3
44. There is not a person in my school/ district to assist with hardware malfunctions (e.g., hard drive crashes)	1 2 3 4 5	1 2 3 4	1 2 3
45. A single computer and projection device are available for use in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
46. Generally, I attended one session trainings to learn how to integrate technology in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
47. There are not a printer available for my students to print assignments	1 2 3 4 5	1 2 3 4	1 2 3
48. There is a person available in my school/ district to suggest the best software to use when teaching specific SOL objectives	1 2 3 4 5	1 2 3 4	1 2 3
49. I have attended at least one professional development session to learn how to use computer related technology (e.g. iPod)	1 2 3 4 5	1 2 3 4	1 2 3
50. Computers are not available to support the use of technology for small group instruction in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
51. High Speed Internet access is available to students in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
52. Students have access to presentation software	1 2 3 4 5	1 2 3 4	1 2 3
53. Handheld devices (e.g., iPod, Palm) are available for student use to complete assignments	1 2 3 4 5	1 2 3 4	1 2 3
54. Students have access to drawing software (e.g., KidPix)	1 2 3 4 5	1 2 3 4	1 2 3
55. There are computers available to support the use of technology for whole group instruction in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
56. Students have access to concept/ mind mapping software (e.g., Kidspiration)	1 2 3 4 5	1 2 3 4	1 2 3
57. Students have access to computerized tests (e.g., Accelerated Reader)	1 2 3 4 5	1 2 3 4	1 2 3

Thank you.

APPENDIX A (continued)

INSTRUMENT USED TO GET FEEDBACK REGARDING CONTENT VALIDATION OF SCALES
(Adapted from Robert Hitt)

Table A2

Directions:
Each statement requires three responses. One for each category – Domain, Association, and Clarity.

Domain – There are five domains listed below. Read each statement on pages three through ten, identify the domain in which the statement should be classified, then circle the number of the domain.

1 = Teaching philosophy.
2 = Technical proficiency with regard to hardware.
3 = Technical proficiency with regard to software.
4 = Technical proficiency with regard to enabling conditions that support the use of technology.
5 = Application of technology used with students in the classroom.

Association – Decide the strength of association with the domain that you have selected and circle the number:

1 = Not associated.
2 = Somewhat associated.
3 = Associated.
4 = Strongly associated.

Clarity – Read each statement and decide how clear it is. I am trying to ensure that statements are not ambiguous or confusing. Rate the clarity of each statement by circling a number.

1 = Not clear, remove, or omit.
2 = Somewhat unclear, revise.
3 = Clear.

If you give a statement a 1 or 2 for association or clarity, please write a suggestion beside the statement. Your feedback will be helpful in improving the clarity of the statement. If you have questions, please feel free to contact me at trrogers@vbschools.com or 757-478-7035.

Note:

- Please rate each item as honestly and thoughtfully as possible.
- Please separate the first two pages, so you have directions and definitions in view while rating each statement.
- Please read the definitions listed below. The definitions provide a description of each domain.

Domain Definitions:

6. *Teaching philosophy*. This domain is intended to measure a teacher's teaching philosophy. Some of the statements written in this instrument explain instructional practices that are consistent with either a traditionalist (teacher-centered) or constructivist (student-centered) teaching philosophy. For example, the traditionalist teaches through the direct transmittal of information; lecture and reading from textbooks are a primary source of information. The use of computers and related technology with students is primarily to provide drill and practice to support learning. Whereas, the constructivist engages students in projects filled with hands-on learning opportunities; often students work in cooperative groups to solve real-world problems. The constructivist would have students apply learned skills to expand understanding of concepts. Students conduct simulations, create real world products, and solve authentic problems with the use of the computer and related technology.
7. *Technical proficiency of a teacher with regard to hardware*. This domain is intended to measure a teacher's knowledge of hardware necessary to integrate computer technology with other curriculum areas in the classroom.
8. *Technical proficiency of a teacher with regard to software.* This domain is intended to measure a teacher's knowledge of software necessary to integrate computer technology with other curriculum areas in the classroom.
9. *Technical proficiency of a teacher with regard to enabling conditions.* This domain is intended to measure a teacher's ability to determine what else is necessary to use a specific technology in teaching. For example, students assigned to send e-mail to an expert might have difficulty with this task if the network was not functioning. A teacher that is technically proficient with regard to enabling conditions would have the general technical proficiency to anticipate a solution to a networking problem; even though, the primary goal of the activity was to send an e-mail.
10. *Application of technology used with students in the classroom*. This domain is intended to measure the kinds of instructional activities (e.g., drill and practice, simulation, problem-solving) that a teacher assigns to students. These instructional activities integrate technology with other curriculum areas to support teaching and learning in the classroom. The kinds of instructional activities assigned to students should not be confused with a teacher's philosophy (i.e., one's beliefs regarding instructional practices).

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
58. I have a highly prescribed curriculum to teach and using computers to teach is a waste of time	1 2 3 4 5	1 2 3 4	1 2 3
59. Typically, I am prepared to use an alternate software program in case the original program I planned to use malfunctions	1 2 3 4 5	1 2 3 4	1 2 3
60. I know how to use multimedia presentation software (e.g., PowerPoint)	1 2 3 4 5	1 2 3 4	1 2 3
61. Computers can be an effective learning tool for my students to use	1 2 3 4 5	1 2 3 4	1 2 3
62. Typically, I make alternate technology plans because I am able to anticipate problems that might occur during technology projects	1 2 3 4 5	1 2 3 4	1 2 3
63. I assign students to use a handheld device (e.g., Palm, iPod) to do tasks (e.g., gather data, organize data, create concept maps, create Podcast, write)	1 2 3 4 5	1 2 3 4	1 2 3
64. I assign students to use the computer to produce artwork (e.g., ImageBlender, Pixie, Twist, Photoshop)	1 2 3 4 5	1 2 3 4	1 2 3
65. It is difficult for me to anticipate technical problems that might occur when integrating technology in the classroom	1 2 3 4 5	1 2 3 4	1 2 3
66. Communication with students is not enhanced when I use computers (e.g., homework posted on web page, newsletters)	1 2 3 4 5	1 2 3 4	1 2 3
67. I know how to write lesson plans that incorporate hardware	1 2 3 4 5	1 2 3 4	1 2 3
68. I know how to switch on a computer	1 2 3 4 5	1 2 3 4	1 2 3
69. Using a computer in the classroom does not increase my students access to information needed to learn the SOLs	1 2 3 4 5	1 2 3 4	1 2 3
70. I do not assign students to use the computer to do basic drawing (e.g., KidPix, Twist, ImageBlender, Pixie)	1 2 3 4 5	1 2 3 4	1 2 3

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
71. I do not assign students to use the computer for video conferencing to communicate with others (e.g., experts, students)	1 2 3 4 5	1 2 3 4	1 2 3
72. I know how to use desktop publishing software (e.g., Microsoft Publisher) to produce a product (e.g. newsletter)	1 2 3 4 5	1 2 3 4	1 2 3
73. I know how to write lesson plans that incorporate software	1 2 3 4 5	1 2 3 4	1 2 3
74. Typically, my students do not finish technology projects because I am unable to anticipate software problems	1 2 3 4 5	1 2 3 4	1 2 3
75. Typically, I am able to anticipate technical problems, so I know who to call for immediate assistance	1 2 3 4 5	1 2 3 4	1 2 3
76. I assign students to use simulation software (e.g., Odell Lake, Oregon Trails, SimCity, Edmark's Virtual Lab)	1 2 3 4 5	1 2 3 4	1 2 3
77. Generally, I anticipate solutions to software problems that might occur when students are given computer based assignments	1 2 3 4 5	1 2 3 4	1 2 3
78. Computers can be used to assist students with learning (e.g., writing, data analysis, and problem-solving)	1 2 3 4 5	1 2 3 4	1 2 3
79. Students should not be engaged in authentic tasks related to the real world that requires problem-solving	1 2 3 4 5	1 2 3 4	1 2 3
80. I assign students to use Internet search engines (e.g., Google, Yahooligans) to conduct research	1 2 3 4 5	1 2 3 4	1 2 3
81. I assign students to use the Internet to e-mail others (e.g., experts, scientists)	1 2 3 4 5	1 2 3 4	1 2 3
82. I assign students to use presentation software (e.g., KidPix, PowerPoint) to present information	1 2 3 4 5	1 2 3 4	1 2 3
83. Teachers who engage students in project-based learning should consider the use of rubrics and portfolios for assessment	1 2 3 4 5	1 2 3 4	1 2 3
84. Teachers should use rubrics whenever possible to assess students' learning	1 2 3 4 5	1 2 3 4	1 2 3

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
85. I know how to use spreadsheet software (e.g., Excel)	1 2 3 4 5	1 2 3 4	1 2 3
86. My teaching is enhanced when I use the computer to create instructional materials	1 2 3 4 5	1 2 3 4	1 2 3
87. I know how to use software to create a Podcast	1 2 3 4 5	1 2 3 4	1 2 3
88. I assign students to use the Internet (e.g., virtual tours of museums) to find information related to concepts	1 2 3 4 5	1 2 3 4	1 2 3
89. Computers helps me facilitate real-world learning in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
90. I know key terminology (e.g., menu, options) necessary to explain software problems to those who provide assistance	1 2 3 4 5	1 2 3 4	1 2 3
91. The overall quality of instruction in my classroom is increased, when I use the computer as a teaching tool	1 2 3 4 5	1 2 3 4	1 2 3
92. I assign students to use the computer to produce web pages (e.g., FrontPage, Netscape Composer)	1 2 3 4 5	1 2 3 4	1 2 3
93. I know key terminology (e.g., USB port, disk drive) necessary to explain hardware problems to those who provide assistance	1 2 3 4 5	1 2 3 4	1 2 3
94. I know how to archive e-mail for storage on my hard drive	1 2 3 4 5	1 2 3 4	1 2 3
95. I know how to use hypermedia software (e.g., Mpower, HyperStudio)	1 2 3 4 5	1 2 3 4	1 2 3
96. I know how to use an Internet search engine (e.g., Google, Yahooligans)	1 2 3 4 5	1 2 3 4	1 2 3
97. I know how to use web page authoring software (e.g., Front Page) to design a web page	1 2 3 4 5	1 2 3 4	1 2 3
98. I know how to use image editing software	1 2 3 4 5	1 2 3 4	1 2 3
99. I assign students to use computer software (e.g., Mpower, HyperStudio) to produce hypermedia projects	1 2 3 4 5	1 2 3 4	1 2 3
100. I assign students to use a database to perform basic tasks (e.g., organize data, sort data)	1 2 3 4 5	1 2 3 4	1 2 3

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
101. Students should be engaged in authentic tasks that produce real world products (e.g., a director creates a movie)	1 2 3 4 5	1 2 3 4	1 2 3
102. With technology, teaching and learning are student-centered rather than teacher-directed	1 2 3 4 5	1 2 3 4	1 2 3
103. I know how to use drill and practice software (e.g., Fastmath)	1 2 3 4 5	1 2 3 4	1 2 3
104. I know how to use problem solving software (e.g., The King's Rule, Alien Rescue)	1 2 3 4 5	1 2 3 4	1 2 3
105. Students learn more when I do not use the computer as a teaching tool	1 2 3 4 5	1 2 3 4	1 2 3
106. I assign students to use computer software to do tutorials (e.g., Reading for Meaning, Bailey's Book House, Millie's Math House)	1 2 3 4 5	1 2 3 4	1 2 3
107. I assign students to use computer software to play instructional games (e.g., Carmen Sandiego, Science Court)	1 2 3 4 5	1 2 3 4	1 2 3
108. I assign students to use computer software to solve problems (e.g., Thinkin Things, The King's Rule, Alien Rescue)	1 2 3 4 5	1 2 3 4	1 2 3
109. I know how to use simulation software (e.g., Oregon Trails, SimCity, Edmark's Virtual Lab) to solve problems	1 2 3 4 5	1 2 3 4	1 2 3
110. Using computers with students allows me to teach students with a variety of learning styles	1 2 3 4 5	1 2 3 4	1 2 3
111. I know how to use software to do video conferencing (e.g., Skype)	1 2 3 4 5	1 2 3 4	1 2 3
112. I assign students to use a computer to produce multimedia projects that incorporate a variety of media (e.g., text, images, video, and audio)	1 2 3 4 5	1 2 3 4	1 2 3
113. I know how to use drawing software on the computer (e.g., KidPix)	1 2 3 4 5	1 2 3 4	1 2 3
114. When planning for technology integration, I anticipate quick fixes for hardware that my students use	1 2 3 4 5	1 2 3 4	1 2 3

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
115. When planning for technology integration, I anticipate quick fixes for software that my students use	1 2 3 4 5	1 2 3 4	1 2 3
116. Generally, I anticipate an alternate grouping of students in case hardware malfunctions	1 2 3 4 5	1 2 3 4	1 2 3
117. Student gain a deeper understanding of concepts when they are required to solve real world problems	1 2 3 4 5	1 2 3 4	1 2 3
118. I know how to use software (e.g., Outlook) to send e-mail	1 2 3 4 5	1 2 3 4	1 2 3
119. I know how to use software to create a database (e.g., Microsoft Access)	1 2 3 4 5	1 2 3 4	1 2 3
120. I know how to save a file downloaded from the Internet	1 2 3 4 5	1 2 3 4	1 2 3
121. I do not know how to save a file	1 2 3 4 5	1 2 3 4	1 2 3
122. I know how to navigate through directories to attach a file to an e-mail	1 2 3 4 5	1 2 3 4	1 2 3
123. Computers integrated into the instructional process facilitates students' ability to work collaboratively	1 2 3 4 5	1 2 3 4	1 2 3
124. Having students use the computer to complete assignments does not prepare them for the 21st century workforce	1 2 3 4 5	1 2 3 4	1 2 3
125. I do not know how to select the print function from a menu to send a print job to a printer	1 2 3 4 5	1 2 3 4	1 2 3
126. Project-based learning works best when the role of the teacher is that of facilitator rather than a direct provider of information	1 2 3 4 5	1 2 3 4	1 2 3
127. I know how to incorporate the use of computers when there are only enough computers for students to work in groups	1 2 3 4 5	1 2 3 4	1 2 3
128. I know how to copy a file to a CD	1 2 3 4 5	1 2 3 4	1 2 3
129. I know how to turn on a printer	1 2 3 4 5	1 2 3 4	1 2 3

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
130. Students learn more when the computer is not used during instructional activities	1 2 3 4 5	1 2 3 4	1 2 3
131. I assign students to use spreadsheets to perform basic tasks (e.g., calculate numbers, create graphs, or charts)	1 2 3 4 5	1 2 3 4	1 2 3
132. I know how to install a software program	1 2 3 4 5	1 2 3 4	1 2 3
133. I know how to load paper in a printer	1 2 3 4 5	1 2 3 4	1 2 3
134. I know how to use word processing software (e.g., Microsoft Word)	1 2 3 4 5	1 2 3 4	1 2 3
135. I know how to change a printer ink cartridge	1 2 3 4 5	1 2 3 4	1 2 3
136. I do not know how to operate a handheld device (e.g., iPod, Palm)	1 2 3 4 5	1 2 3 4	1 2 3
137. I do not assign students to use the computer to create concept/ mind maps (e.g., Kidspiration, Inspiration)	1 2 3 4 5	1 2 3 4	1 2 3
138. I assign students to use the computer to create animation (e.g., Frames, Claymation)	1 2 3 4 5	1 2 3 4	1 2 3
139. I assign students to use the computer to take tests (e.g., Accelerated Reader)	1 2 3 4 5	1 2 3 4	1 2 3
140. I know how to open and work with more than one program at a time	1 2 3 4 5	1 2 3 4	1 2 3
141. When my students use computers, all students must work on the same activity at the same time	1 2 3 4 5	1 2 3 4	1 2 3
142. I know how to change page setup options (e.g., switch page orientation to landscape)	1 2 3 4 5	1 2 3 4	1 2 3
143. I do not know how to rename a file	1 2 3 4 5	1 2 3 4	1 2 3
144. I do not know how to take pictures with a digital camera	1 2 3 4 5	1 2 3 4	1 2 3
145. Typically, my students do not finish technology projects because I am unable to anticipate hardware problems	1 2 3 4 5	1 2 3 4	1 2 3
146. I know how to operate a projection device	1 2 3 4 5	1 2 3 4	1 2 3
147. I know how to connect a computer to a projection device	1 2 3 4 5	1 2 3 4	1 2 3

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
148. I anticipate solutions to hardware problems that might occur when students are required to complete assignments on the computer	1 2 3 4 5	1 2 3 4	1 2 3
149. Generally, I am prepared to use an alternate piece of hardware in case the original hardware malfunctions	1 2 3 4 5	1 2 3 4	1 2 3
150. I know how to connect a digital camera to my computer for the transfer of images	1 2 3 4 5	1 2 3 4	1 2 3
151. I know how to save a file to a specified directory	1 2 3 4 5	1 2 3 4	1 2 3
152. I know how to operate an interactive white board (e.g., SMART Board)	1 2 3 4 5	1 2 3 4	1 2 3
153. I do not assign students to use drill and practice software (e.g., Fast Math)	1 2 3 4 5	1 2 3 4	1 2 3
154. I assign students to use computer software to create a database (e.g., MaxData, Microsoft Access)	1 2 3 4 5	1 2 3 4	1 2 3
155. When plans for technology integration in the computer lab are derailed, I try to achieve the lesson objective with technology that I have in my classroom	1 2 3 4 5	1 2 3 4	1 2 3
156. Generally, I anticipate substituting one software program for another in case the software I planned to use malfunctions	1 2 3 4 5	1 2 3 4	1 2 3
157. Typically, I integrate the fewest number of software programs into a lesson, so I am able to anticipate a solution to a software malfunction	1 2 3 4 5	1 2 3 4	1 2 3
158. Generally, I incorporate only one piece of hardware at a time in my lessons, so I am able to anticipate a solution to a hardware malfunction	1 2 3 4 5	1 2 3 4	1 2 3
159. I assign students to use writing tools (e.g., thesaurus) in a word processor	1 2 3 4 5	1 2 3 4	1 2 3
160. I know how to back up a file to a CD	1 2 3 4 5	1 2 3 4	1 2 3
161. I know how to connect an interactive white board to my computer	1 2 3 4 5	1 2 3 4	1 2 3

Content Validation Instrument

Questionnaire statements	Domain	Association	Clarity
162. Students should not participate in assessing their own work within project-based learning activities	1 2 3 4 5	1 2 3 4	1 2 3
163. I assign students to use desktop publishing software (e.g., Microsoft Publisher, Print Shop) to produce a product (e.g., newsletters, brochures)	1 2 3 4 5	1 2 3 4	1 2 3

Thanks.

APPENDIX A (continued)

PART I STATISTICS FOR THE CONTENT VALIDATION OF SCALES

Table A3

Content Validation Data for Variables: Categorization of Items into Domains by Experts, N=12

Expected domain	Domains									
	Professional Development		Access Hardware		Access Software		Technical Support		Integration Support	
Items	N	%	N	%	N	%	N	%	N	%
1. Access hardware	1	8	10	**83**					1	8
2. Professional development	12	**100**								
3. Access software					11	**92**			1	8
4. Professional development	3	25					1	8	8	67
5. Access software					11	**92**			1	8
6. Integration support	1	8					3	25	8	67
7. Access hardware			11	**92**	1	8				
8. Integration support			1	8			4	33	7	58
9. Professional development	11	**92**					1	8		
10. Technical support					1	8	11	**92**		
11. Technical support					2	17	10	**83**		
12. Professional development	10	**83**	1	8	1	8				
13. Access software			1	8	11	**92**				
14. Professional development	11	**92**							1	8
15. Professional development	4	33							6	67
16. Professional development	11	**92**			1	8				
17. Professional development	5	42							7	58
18. Integration support							2	17	10	**83**
19. Professional development	8	67							4	33

(table continues)

Table A3 (continued)

Content Validation Data for Variables: Categorization of Items into Domains by Experts, N=12

Expected domain	Domains									
	Professional Development		Access Hardware		Access Software		Technical Support		Integration Support	
Items	N	%	N	%	N	%	N	%	N	%
20. Access software					12	**100**				
21. Technical support							12	**100**		
22. Access software					12	**100**				
23. Integration support							1	8	11	**92**
24. Integration support							1	8	11	**92**
25. Professional development	3	25							9	75
26. Integration support	1	8							11	**92**
27. Access hardware			11	**92**	1	8				
28. Technical support			2	17			9	75	1	8
29. Integration support									12	**100**
30. Access software					12	**100**				
31. Technical support							12	**100**		
32. Technical support					1	8	11	**92**		
33. Professional development	6	50							6	50
34. Access software					12	**100**				
35. Access software					12	**100**				
36. Technical support							12	**100**		
37. Integration support									12	**100**
38. Integration support			1	8			1	8	10	**83**

(table continues)

Table A3 (continued)

Content Validation Data for Variables: Categorization of Items into Domains by Experts, N=12

Expected domain	Domains									
	Professional Development		Access Hardware		Access Software		Technical Support		Integration Support	
Items	N	%	N	%	N	%	N	%	N	%
39. Professional development	4	33	1	8					7	58
40. Access software					12	**100**				
41. Access software					12	**100**				
42. Technical support							12	**100**		
43. Integration support	1	8							11	**92**
44. Technical support							12	**100**		
45. Access hardware			12	**100**						
46. Professional development	10	**83**							2	17
47. Access hardware			12	**100**						
48. Integration support							1	8	11	**92**
49. Professional development	12	**100**								
50. Access hardware			10	**83**					2	17
51. Access hardware			7	58	3	25			2	17
52. Access software					12	**100**				
53. Access hardware	1	8	11	**92**						
54. Access software					11	**92**			1	8
55. Access hardware			11	**92**					1	8
56. Access software					11	**92**			1	8
57. Access software					12	**100**				

(table continues)

APPENDIX A (continued)

PART II STATISTICS FOR THE CONTENT VALIDATION OF SCALES

Table A4

Content Validation Data for Variables: Categorization of Items into Domains by Experts, N=14

Expected domain	Domains									
	Teaching Philosophy		Proficiency Hardware		Proficiency Software		Enabling Conditions		Technology Application	
Items	N	%	N	%	N	%	N	%	N	%
58. Teaching philosophy	13	**93**					1	7		
59. Enabling conditions					8	57	5	36	1	7
60. Proficiency software			1	7	13	**93**				
61. Teaching philosophy	12	**86**							2	14
62. Enabling conditions			1	7			13	**93**		
63. Technology application			2	14			1	7	11	79
64. Technology application	1	7			1	7			12	**86**
65. Enabling conditions					1	7	12	**86**	1	7
66. Teaching philosophy	12	**86**							2	14
67. Proficiency hardware			9	64			1	7	4	29
68. Proficiency hardware			13	**93**					1	7
69. Teaching philosophy	13	**93**					1	7		
70. Technology application	4	29			1	7	1	7	8	57
71. Technology application	3	21	2	14			1	7	8	57
72. Proficiency software					13	**93**			1	7
73. Proficiency software (13)	1	8			7	54	2	15	3	23

Note. Missing data were not tabulated in percentages. N equals 14 unless otherwise noted in parenthesis beside the item. Blank slots indicate that none of the participants placed the item in the domain.

(table continues)

Table A4 (continued)

Content Validation Data for Variables: Categorization of Items into Domains by Experts, N=14

Expected domain	Domains									
	Teaching Philosophy		Proficiency Hardware		Proficiency Software		Enabling Conditions		Technology Application	
Items	N	%	N	%	N	%	N	%	N	%
74. Enabling conditions					3	21	10	71	1	7
75. Enabling conditions					1	7	13	**93**		
76. Technology application					2	14			12	**86**
77. Enabling conditions					2	14	12	**86**		
78. Teaching philosophy	12	**86**							2	14
79. Teaching philosophy	14	**100**								
80. Technology application							1	7	13	**93**
81. Technology application							1	7	13	**93**
82. Technology application					2	14	1	7	11	79
83. Teaching philosophy	12	**86**					1	7	1	7
84. Teaching philosophy	1	**93**							1	7
85. Proficiency software					14	**100**				
86. Teaching philosophy	11	79					2	14	1	7
87. Proficiency software					13	**93**			1	7
88. Technology application									14	**100**
89. Teaching philosophy	10	71					2	14	2	14
90. Proficiency software					11	79	3	21		
91. Teaching philosophy	11	79					2	14	1	7
92. Technology application	1	7			2	14			11	79
93. Proficiency hardware			11	79			3	21		
94. Proficiency hardware			1	7	12	86	1	7		
95. Proficiency software (13)					13	**100**				

(*table continues)*

Table A4 (continued)

Content Validation Data for Variables: Categorization of Items into Domains by Experts, N=14

Expected domain	Domains									
	Teaching Philosophy		Proficiency Hardware		Proficiency Software		Enabling Conditions		Technology Application	
Items	N	%	N	%	N	%	N	%	N	%
96. Proficiency software					12	**86**	2	14		
97. Proficiency software					14	**100**				
98. Proficiency software					14	**100**				
99. Technology application					1	7			13	**93**
100. Technology application					1	7			13	**93**
101. Teaching philosophy	1	**86**					1	7	1	7
102. Teaching philosophy	12	**86**					2	14		
103. Proficiency software (13)					13	**100**				
104. Proficiency software					13	**100**				
105. Teaching philosophy	13	**93**							1	7
106. Technology application										
107. Technology application									14	**100**
108. Technology application									14	**100**
109. Proficiency software					13	**93**	1	7		
110. Teaching philosophy	12	**86**					1	7	1	7
111. Proficiency software					14	**100**				
112. Technology application									14	**100**
113. Proficiency software					14	**100**				
114. Enabling conditions	1	7	5	36			8	57		
115. Enabling conditions					4	29	9	64	1	7
116. Enabling conditions (15)			3	20			12	**80**		
117. Teaching philosophy	13	**93**							1	7

(table continues)

Table A4 (continued)

Content Validation Data for Variables: Categorization of Items into Domains by Experts, N=14

Items	Expected domain	Domains: Teaching Philosophy N	%	Proficiency Hardware N	%	Proficiency Software N	%	Enabling Conditions N	%	Technology Application N	%
118.	Proficiency software (15)					15	**100**				
119.	Proficiency software (15)					15	**100**				
120.	Proficiency hardware (15)			1	7	12	80	2	13		
121.	Proficiency hardware (15)			1	7	13	87				
122.	Proficiency hardware (15)					14	93	1	7		
123.	Teaching philosophy (15)	12	**80**							3	20
124.	Teaching philosophy (15)	14	**93**							1	7
125.	Proficiency hardware (15)			1	7	13	87	1	7		
126.	Teaching philosophy (15)	13	**87**					2	13		
127.	Proficiency hardware (15)	1	7					7	47	7	47
128.	Proficiency hardware (15)			2	13	12	80	1	7		
129.	Proficiency hardware (15)			15	**100**						
130.	Teaching philosophy	13	**93**							1	7
131.	Technology application					2	14	1	7	11	79
132.	Proficiency hardware			3	21	9	64	2	14		
133.	Proficiency hardware			13	**93**			1	7		
134.	Proficiency software					14	**100**				
135.	Proficiency hardware			13	**93**	1	7				
136.	Proficiency hardware			12	**86**	2	14				
137.	Teaching philosophy	1	7					1	7	12	86
138.	Teaching philosophy							1	7	13	93

Table A4 (continued)

Content Validation Data for Variables: Categorization of Items into Domains by Experts, N=14

Items	Expected domain	Domains: Teaching Philosophy N	Teaching Philosophy %	Proficiency Hardware N	Proficiency Hardware %	Proficiency Software N	Proficiency Software %	Enabling Conditions N	Enabling Conditions %	Technology Application N	Technology Application %
139.	Teaching philosophy							1	7	13	93
140.	Proficiency hardware					13	93	1	7		
141.	Teaching philosophy	8	57					2	14	4	29
142.	Proficiency hardware			3	21	11	79				
143.	Proficiency hardware			1	7	12	86	1	7		
144.	Proficiency hardware			13	**93**	1	7				
145.	Enabling conditions			1	7			12	**86**	1	7
146.	Proficiency hardware			14	**100**						
147.	Proficiency hardware			14	**100**						
148.	Enabling conditions			2	14			11	79	1	7
149.	Enabling conditions			5	36			9	64		
150.	Proficiency hardware			13	**93**	1	7				
151.	Proficiency hardware			2	14	11	79	1	7		
152.	Proficiency hardware			13	**93**	1	7				
153.	Technology application	4	29							10	71
154.	Technology application	2	14							12	**86**
155.	Enabling conditions							12	**86**	2	14
156.	Enabling conditions					3	21	11	79		
157.	Enabling conditions	1	7			2	14	11	73		
158.	Enabling conditions	1	7	3	21			10	71		
159.	Technology application	1	7			1	7	3	21	9	64

(table continues)

Table A4 (continued)

Content Validation Data for Variables: Categorization of Items into Domains by Experts, N=14

Items	Expected domain	Domains									
		Teaching Philosophy		Proficiency Hardware		Proficiency Software		Enabling Conditions		Technology Application	
		N	%	N	%	N	%	N	%	N	%
160.	Proficiency hardware			4	29	8	**86**	2	14		
161.	Proficiency hardware			14	**100**						
162.	Teaching philosophy	14	**100**								
163.	Technology application	1	7					1	7	12	**86**

APPENDIX A (continued)

PART I STATISTICS FOR THE CONTENT VALIDATION OF SCALES

Table A5

Content Validation Data for Variables: Strength of Association for Items Placed in Domains, N=12

Expected domain	Professional Development			Access Hardware			Access Software			Technical Support			Integration Support		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
1. Access hardware				10	3.70	.483									
2. Professional	12	3.83	.389												
3. Access software							11	3.90	.302						
4. Professional															
5. Access software							11	3.81	.405						
6. Integration															
7. Access hardware				11	3.81	.405									
8. Integration															
9. Professional	11	3.54	1.04												
10. Technical										11	3.73	.467			
11. Technical										10	3.90	.316			
12. Professional	10	4.00	.000												
13. Access software							11	3.82	.405						
14. Professional	11	3.81	.405												
15. Professional															
16. Professional	11	3.63	.674												
17. Professional															
18. Integration													10	3.90	.316
19. Professional															

(table continues)

Table A5 (continued)

Content Validation Data for Variables: Strength of Association for Items Placed in Domains, N=12

Expected domain	Domains														
	Professional Development			Access Hardware			Access Software			Technical Support			Integration Support		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
20. Access software	12	3.83	.389												
21. Technical										12	3.75	.452			
22. Access software							12	3.83	.389						
23. Integration													11	3.91	.302
24. Integration													11	3.91	.302
25. Professional															
26. Integration													11	3.45	.688
27. Access hardware				11	3.91	.302									
28. Technical															
29. Integration													12	3.92	.289
30. Access software							12	3.83	.389						
31. Technical										12	3.92	.289			
32. Technical										11	3.91	.302			
33. Professional															
34. Access software							12	3.75	.452						
35. Access software							12	3.75	.452						
36. Technical										12	3.83	.389			
37. Integration													12	3.58	.669
38. Integration													10	3.50	.707

(table continues)

Table A5 (continued)

Content Validation Data for Variables: Strength of Association for Items Placed in Domains, N=12

Expected domain	Domains														
	Professional Development			Access Hardware			Access Software			Technical Support			Integration Support		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
39. Professional															
40. Access software							12	3.83	.389						
41. Access software							12	3.75	.452						
42. Technical										12	3.67	.651			
43. Integration													11	3.36	.674
44. Technical										12	3.67	.779			
45. Access hardware				12	3.83	.389									
46. Professional	10	3.70	.483												
47. Access hardware				12	3.83	.577									
48. Integration													11	3.73	.467
49. Professional	12	3.75	.452												
50. Access hardware	10	4.00	.000												
51. Access hardware															
52. Access software							12	3.83	.389						
53. Access hardware				11	3.91	.302									
54. Access software							11	3.91	.302						
55. Access hardware				11	3.91	.302									
56. Access software							11	3.91	.302						
57. Access software							12	3.67	.651						

(table continues)

APPENDIX A (continued)

PART II STATISTICS FOR THE CONTENT VALIDATION OF SCALES

Table A6

Content Validation Data for Variables: Strength of Association for Items Placed in Domains, N=14

Expected domain	Domains														
	Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
58. Philosophy	13	3.70	.480												
59. Conditions															
60. Software							13	3.92	.277						
61. Philosophy	12	3.58	.515												
62. Conditions										13	3.54	.519			
63. Application															
64. Application													12	3.50	.492
65. Conditions										12	3.67	.492			
66. Philosophy	12	3.08	.515												
67. Hardware															
68. Hardware				13	3.77	.438									
69. Philosophy	13	3.38	.768												
70. Application															
71. Application															
72. Software							13	3.77	.439						
73. Software (13)															

Note. Missing data were not tabulated in percentages. N equals 14 unless otherwise noted in parenthesis beside the item. Blank slots indicate that none of the participants placed the item in the domain.

(table continues)

Table A6 (continued)

Content Validation Data for Variables: Strength of Association for Items Placed in Domains, N=14

Expected domain	Domains														
	Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
74. Conditions															
75. Conditions										13	3.31	.855			
76. Application													12	3.58	.515
77. Conditions										12	3.33	.492			
78. Philosophy	12	3.50	.522												
79. Philosophy	14	3.43	.646												
80. Application													13	3.69	.480
81. Application													13	3.69	.480
82. Application															
83. Philosophy	12	3.42	.669												
84. Philosophy	13	3.62	.506												
85. Software							14	3.93	.267						
86. Philosophy															
87. Software							13	3.62	.506						
88. Application													14	3.64	.497
89. Philosophy															
90. Software															
91. Philosophy															
92. Application															
93. Hardware															
94. Hardware															
95. Software (13)							13	3.85	.376						

(*table continues*)

Table A6 (continued)

Content Validation Data for Variables: Strength of Association for Items Placed in Domains, N=14

Expected domain	Domains														
	Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
96. Software							12	3.75	.452						
97. Software							14	3.79	.426						
98. Software							14	3.57	.514						
99. Application													13	3.69	.480
100. Application													13	3.77	.439
101. Philosophy	12	3.92	.289												
102. Philosophy	12	3.83	.389												
103. Software (13)							13	3.93	.277						
104. Software							14	3.86	.856						
105. Philosophy	13	3.69	.480												
106. Application													14	3.71	.468
107. Application													14	3.71	.468
108. Application													14	3.79	.426
109. Software							13	3.62	.506						
110. Philosophy	12	3.75	.452												
111. Software							14	3.79	.426						
112. Application													14	3.79	.426
113. Software							14	3.79	.426						
114. Conditions															
115. Conditions															
116. Conditions (15)										12	3.67	.651			
117. Philosophy	13	3.85	.376												

(table continues)

Table A6 (continued)

Content Validation Data for Variables: Strength of Association for Items Placed in Domains, N=14

Items	Expected domain	Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
118.	Software (15)							15	3.87	.352						
119.	Software (15)							15	3.87	.352						
120.	Hardware (15)															
121.	Hardware (15)															
122.	Hardware (15)															
123.	Philosophy (15)	12	3.67	.492												
124.	Philosophy (15)	14	3.71	.469												
125.	Hardware (15)															
126.	Philosophy (15)	13	3.77	.439												
127.	Hardware (15)															
128.	Hardware (15)															
129.	Hardware (15)				15	3.80	.414									
130.	Philosophy	13	3.85	.376												
131.	Application															
132.	Hardware															
133.	Hardware				13	3.85	.376									
134.	Software							14	4.00	.000						
135.	Hardware				13	4.00	.000									
136.	Hardware				12	3.67	.492									
137.	Philosophy	12	3.50	.905												
138.	Philosophy	13	3.85	.376												

(table continues)

Table A6 (continued)

Content Validation Data for Variables: Strength of Association for Items Placed in Domains, N=14

	Expected domain	Domains														
		Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
Items		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
139.	Philosophy	13	3.69	.630												
140.	Hardware															
141.	Philosophy															
142.	Hardware															
143.	Hardware															
144.	Hardware				13	3.92	.277									
145.	Conditions										12	3.50	.674			
146.	Hardware				14	3.86	.363									
147.	Hardware				14	3.86	.363									
148.	Conditions															
149.	Conditions															
150.	Hardware				13	3.38	.870									
151.	Hardware															
152.	Hardware				13	3.54	.877									
153.	Application															
154.	Application													12	3.83	.389
155.	Conditions										12	3.58	.515			
156.	Conditions															
157.	Conditions															
158.	Conditions															
159.	Application															

(table continues)

Table A6 (continued)

Content Validation Data for Variables: Strength of Association for Items Placed in Domains, N=14

Expected domain		Domains														
		Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
Items		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
160.	Hardware															
161.	Hardware				14	3.71	.469									
162.	Philosophy	14	3.57	.852												
163.	Application													12	3.83	.389

APPENDIX A (continued)

PART I STATISTICS FOR THE CONTENT VALIDATION OF SCALES

Table A7

Content Validation Data for Variables: Clarity of Items Placed in Domains, N=12

Expected domain	Domains														
	Professional Development			Access Hardware			Access Software			Technical Support			Integration Support		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
1. Access hardware				10	3.00	.000									
2. Professional	12	2.83	.389												
3. Access software							11	3.00	.000						
4. Professional															
5. Access software							11	2.82	.405						
6. Integration															
7. Access hardware				11	3.00	.000									
8. Integration															
9. Professional	11	2.82	.405												
10. Technical										11	2.72	.467			
11. Technical										10	2.90	.316			
12. Professional	10	3.00	.000												
13. Access software							11	2.82	.405						
14. Professional	11	3.00	.000												
15. Professional															
16. Professional	11	2.91	.302												
17. Professional															
18. Integration	10	2.90	.316												
19. Professional															

(table continues)

Table A7 (continued)

Content Validation Data for Variables: Clarity of Items Placed in Domains, N=12

Expected domain	Domains														
	Professional Development			Access Hardware			Access Software			Technical Support			Integration Support		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
20. Access software							12	3.00	.000						
21. Technical															
22. Access software							12	3.00	.000						
23. Integration													11	2.91	.302
24. Integration													11	2.82	.405
25. Professional															
26. Integration													11	2.82	.603
27. Access hardware				11	3.00	.000									
28. Technical															
29. Integration													12	3.00	.000
30. Access software							12	3.00	.000						
31. Technical										12	2.92	.289			
32. Technical										11	3.00	.000			
33. Professional															
34. Access software							12	2.75	.452						
35. Access software							12	2.83	.389						
36. Technical										12	3.00	.000			
37. Integration													12	2.67	.492
38. Integration													10	2.70	.483

(table continues)

Table A7 (continued)

Content Validation Data for Variables: Clarity of Items Placed in Domains, N=12

Expected domain	Professional Development			Access Hardware			Access Software			Technical Support			Integration Support		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
39. Professional															
40. Access software							12	2.92	.289						
41. Access software							12	2.75	.452						
42. Technical										12	3.00	.000			
43. Integration													11	2.82	.603
44. Technical										12	2.92	.289			
45. Access hardware				12	3.00	.000									
46. Professional	10	3.00	.000												
47. Access hardware				12	2.75	.452									
48. Integration													11	2.91	.302
49. Professional	12	2.92	.289												
50. Access hardware				10	3.00	.000									
51. Access hardware															
52. Access software							12	3.00	.000						
53. Access hardware				11	2.91	.302									
54. Access software							11	2.91	.302						
55. Access hardware				11	3.00	.000									
56. Access software							11	2.91	.302						
57. Access software							12	2.83	.389						

(table continues)

APPENDIX A (continued)

PART II STATISTICS FOR THE CONTENT VALIDATION OF SCALES

Table A8

Content Validation Data for Variables: Clarity of Items Placed in Domains, N=14

Expected domain	Domains														
	Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
58. Philosophy	13	2.85	.376												
59. Conditions															
60. Software							13	3.00	.000						
61. Philosophy	12	2.92	.289												
62. Conditions										13	2.92	.277			
63. Application															
64. Application													12	2.83	.577
65. Conditions										12	2.83	.389			
66. Philosophy	12	2.92	.289												
67. Hardware															
68. Hardware				13	2.85	.376									
69. Philosophy				13	2.85	.376									
70. Application															
71. Application															
72. Software							13	3.00	.000						
73. Software (13)															

Note. Missing data were not tabulated in percentages. N equals 14 unless otherwise noted in parenthesis beside the item. Blank slots indicate that none of the participants placed the item in the domain.

(table continues)

Table A8 (continued)

Content Validation Data for Variables: Strength of Association for Items Placed in Domains, N=14

Expected domain	Domains														
	Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
74. Conditions															
75. Conditions										13	2.84	.555			
76. Application													12	3.00	.000
77. Conditions										12	2.92	.289			
78. Philosophy	12	2.92	.289												
79. Philosophy	14	2.86	.535												
80. Application													13	3.00	.000
81. Application													13	3.00	.000
82. Application															
83. Philosophy	12	2.83	.389												
84. Philosophy	13	3.00	.000												
85. Software							14	2.93	.267						
86. Philosophy															
87. Software							13	2.92	.277						
88. Application													14	2.93	.267
89. Philosophy															
90. Software															
91. Philosophy															
92. Application															
93. Hardware															
94. Hardware															
95. Software (13)							13	3.00	.000						

(table continues)

Table A8 (continued)

Content Validation Data for Variables: Clarity of Items Placed in Domains, N=14

Expected domain	Domains														
	Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
Items	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
96. Software							12	3.00	.000						
97. Software							14	2.93	.267						
98. Software							14	2.93	.267						
99. Application													13	2.92	.277
100. Application													13	2.92	.277
101. Philosophy	12	3.00	.000												
102. Philosophy	12	2.92	.289												
103. Software (13)							13	3.00	.000						
104. Software							14	3.00	.000						
105. Philosophy	13	2.92	.277												
106. Application													14	3.00	.000
107. Application													14	3.00	.000
108. Application													14	2.92	.267
109. Software							13	3.00	.000						
110. Philosophy	12	3.00	.000												
111. Software							14	3.00	.000						
112. Application													14	2.93	.267
113. Software							14	3.00	.000						
114. Conditions															
115. Conditions															
116. Conditions (15)										12	2.92	.289			
117. Philosophy	13	2.92	.277												

(table continues)

Table A8 (continued)

Content Validation Data for Variables: Clarity of Items Placed in Domains, N=14

		Domains														
	Expected domain	Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
Items		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
118.	Software (15)							15	2.93	.258						
119.	Software (15)							15	2.93	.258						
120.	Hardware (15)															
121.	Hardware (15)															
122.	Hardware (15)															
123.	Philosophy (15)	12	2.92	.289												
124.	Philosophy (15)	14	2.93	.267												
125.	Hardware (15)															
126.	Philosophy (15)	13	3.00	.000												
127.	Hardware (15)															
128.	Hardware (15)															
129.	Hardware (15)				15	2.93	.258									
130.	Philosophy	13	3.00	.000												
131.	Application															
132.	Hardware															
133.	Hardware				13	3.00	.000									
134.	Software							14	3.00	.000						
135.	Hardware				13	3.00	.000									
136.	Hardware				12	2.83	.389									
137.	Philosophy	12	3.00	.000												
138.	Philosophy	13	3.00	.000												

(table continues)

Table A8 (continued)

Content Validation Data for Variables: Clarity of Items Placed in Domains, N=14

Items	Expected domain	Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
139.	Philosophy	13	3.00	.000												
140.	Hardware															
141.	Philosophy															
142.	Hardware															
143.	Hardware															
144.	Hardware				13	3.00	.000									
145.	Conditions										12	2.92	.289			
146.	Hardware				14	3.00	.000									
147.	Hardware				14	3.00	.000									
148.	Conditions															
149.	Conditions															
150.	Hardware				13	2.77	.599									
151.	Hardware															
152.	Hardware				13	2.85	.555									
153.	Application															
154.	Application													12	3.00	.000
155.	Conditions										12	3.00	.000			
156.	Conditions															
157.	Conditions															
158.	Conditions															
159.	Application															

(table continues)

Table A8 (continued)

Content Validation Data for Variables: Clarity of Items Placed in Domains, N=14

		Domains														
	Expected domain	Teaching Philosophy			Proficiency Hardware			Proficiency Software			Enabling Conditions			Technology Application		
Items		N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD
160.	Hardware															
161.	Hardware				14	3.00	.000									
162.	Philosophy	14	2.79	.579												
163.	Application													12	3.00	.000

APPENDIX A (continued)

QUESTIONNAIRE ITEMS SORTED BY DOMAIN

FOLLOWING CONTENT VALIDATION

Table A9

Domain: Professional Development

Item	Questionnaire Item	Total Items
6.1	I have attended professional development training presented in a multiple session format (1)	5
6.2*	Typically, I have attended hands-on training sessions to learn how to use technology	
6.3	Typically, I have attended hands-on training sessions to learn how to use a specific software program (12)	
6.4	Generally, I have attended "one shot" training sessions to learn how to use specific software programs (9)	
6.5	I have attended at least one professional development session to learn how to use computer related technology (e.g. iPod) (49)	

Note: Items with an asterisk did not meet the criteria for inclusion in the domain, but were so closely related to the definition of domain that the research deemed it was necessary to include the item to maintain the integrity of domain. Numbers within parenthesis indicate the item number in the actual content validation instrument. Items with two asterisks meet the criteria for inclusion in the domain, but the items were unintentionally deleted from the questionnaire.

(table continues)

Table A9 (continued)

Domain: Availability of Computer Hardware & Related Technology for Student Use

Item	Questionnaire Item	Total Items
9.1	A single computer, projector, and interactive white board (e.g., SMART board) are available for use in my classroom (1)	9
9.2	There are digital cameras available for my students to complete a project that requires the use of digital cameras (7)	
9.3	There is a scanner available for my students to use to complete assignments (27)	
9.4	A single computer and projection device are available for use in my classroom (45)	
9.5	There is not a printer available for my students to print assignments (47)	
9.6	Computers are not available to support the use of technology for small group instruction in my classroom (50)	
9.7*	High Speed Internet access is available to students in my classroom (51)	
9.8	Handheld devices (e.g., iPod, Palm) are available for student use to complete assignments (53)	
9.9	There are computers available to support the use of technology for whole group instruction in my classroom (55)	

(table continues)

Table A9 (continued)

Domain: Availability of Software Applications for Student Use

Item	Questionnaire Item	Total Items
10.1	Students have access to desktop publishing software (3)	14
10.2	Student have access to drill and practice software (e.g., Fast Math) (5)	
10.3	Students have access to software to create animation (e.g., Frames, Claymation) (13)	
10.4	Students have access to web page authoring software (20)	
10.5	Students have access to image editing software (e.g., Photo Shop) (22)	
10.6	Student have access to spreadsheet software (30)	
10.7	Students have access to instructional game software (e.g., Carmen Sandiego, Science Court) (34)	
10.8	Students have access to problem solving software (e.g., Thinkin Things, The King's Rule, Alien Rescue) (35)	
10.9	Students have access to tutorial software (e.g., Reading for Meaning, Reader Rabbit) (40)	
10.10	Students have access to simulation software (e.g., Edmark's Virtual Lab) (41)	
10.11	Students have access to presentation software (52)	
10.12	Students have access to drawing software (e.g., KidPix) (54)	
10.13	Students have access to concept/ mind mapping software (e.g., Kidspiration) (56)	
10.14	Students have access to computerized tests (e.g., Accelerated Reader) (57)	

(table continues)

Table A9 (continued)

Domain: Teaching Philosophy of Teachers

Item	Questionnaire Item	Total Items
11.1	I have a highly prescribed curriculum to teach and using computers to teach is a waste of time (58)	9
11.2	Using a computer in the classroom does not increase my students access to information needed to learn the SOLs (69)	
11.3*	Computers helps me facilitate real-world learning in my classroom (89)	
11.4*	The overall quality of instruction in my classroom is increased, when I use the computer as a teaching tool (91)	
11.5	Students should be engaged in authentic tasks that produce real world products (e.g., a director creates a movie) (101)	
11.6	With technology, teaching and learning are student-centered rather than teacher-directed (102)	
11.7	Student gain a deeper understanding of concepts when they are required to solve real world problems (117)	
11.8	Computers integrated into the instructional process facilitates students' ability to work collaboratively (123)	
11.9*	When my students use computers, all students must work on the same activity at the same time (141)	

(table continues)

Table A9 (continued)

Domain: Technical Proficiency of Teachers with Computers & Related Hardware

Item	Questionnaire Item	Total Items
12.1	I know how to switch on a computer (68)	10
12.2	I know how to turn on a printer (129)	
12.3	I know how to change a printer ink cartridge (135)	
12.4	I know how to operate a printer (133)	
12.5	I know how to operate a handheld device (e.g., iPod, Palm) (136)	
12.6	I know how to take pictures with a digital camera (144)	
12.7	I know how to operate a projection device (146)	
12.8	I know how to connect a digital camera to my computer for the transfer of images (150)	
12.9	I know how to operate an interactive white board (e.g., SMART Board) (152)	
12.10*	I know how to operate a computer	

(table continues)

Table A9 (continued)

Domain: Technical Proficiency of Teachers with Software Applications

Item	Questionnaire Item	Total Items
13.1	I know how to use multimedia presentation software (e.g., PowerPoint) (60)	9
13.2	I know how to use desktop publishing software (e.g., Microsoft Publisher) to produce a product (e.g. newsletter) (72)	
13.3	I know how to use spreadsheet software (e.g., Excel) (85)	
13.4	I know how to use software to create a Podcast (87)	
13.5	I know how to use hypermedia software (e.g., Mpower, HyperStudio) (95)	
13.6	I know how to use an Internet search engine (e.g., Google, Yahooligans) (96)	
13.7	I know how to use web page authoring software (e.g., Front Page) to design a web page (97)	
13.8	I know how to use drill and practice software (e.g., Fastmath) (103)	
13.9	I know how to use problem solving software (e.g., The King's Rule, Alien Rescue) (104)	
13.10**	I know how to use simulation software (e.g., Oregon Trails, SimCity, Edmark's Virtual Lab) to solve problems (109)	
13.11**	I know how to use software to do video conferencing (e.g., Skype) (111)	
13.12**	I know how to use software (e.g., Outlook) to send e-mail (118)	
13.13**	I know how to use software to create a database (e.g., Microsoft Access) (119)	
13.14**	I know how to use word processing software (e.g., Microsoft Word) (134)	

(table continues)

Table A9

Domain: Technical Proficiency of Teachers with regard to Enabling Conditions

Item	Questionnaire Item	Total Items
14.1	Typically, I make alternate technology plans because I am able to anticipate problems that might occur during technology projects (62)	6
14.2	Typically, I make alternate technology plans because I am able to anticipate problems that might occur during technology projects (62)	
14.3	Typically, I am able to anticipate technical problems, so I know who to call for immediate assistance (75)	
14.4	Generally, I anticipate solutions to software problems that might occur when students are given computer based assignments (77)	
14.5	Generally, I anticipate an alternate grouping of students in case hardware malfunctions (116)	
14.6	When plans for technology integration in the computer lab are derailed, I try to achieve the lesson objective with technology that I have in my classroom (155)	

(table continues)

Table A9 (continued)

Domain: Application of Technology for Instruction With Students in the Classroom

Item	Questionnaire Item	Total Items
16.1	I assign students to use simulation software (e.g., Odell Lake, Oregon Trails, SimCity, Edmark's Virtual Lab) (76)	13
16.2	I assign students to use the Internet to e-mail others (e.g., experts, scientists) (81)	
16.3	I assign students to use the Internet (e.g., virtual tours of museums) to find information related to concepts (88)	
16.4	I assign students to use a database to perform basic tasks (e.g., organize data, sort data) (100)	
16.5	I assign students to use computer software to do tutorials (e.g., Reading for Meaning, Bailey's Book House, Millie's Math House) (106)	
16.6	I assign students to use computer software to play instructional games (e.g., Carmen Sandiego, Science Court) (107)	
16.7	I assign students to use computer software to solve problems (e.g., Thinkin Things, The King's Rule, Alien Rescue) (108)	
16.8	I assign students to use a computer to produce multimedia projects that incorporate a variety of media (e.g., text, images, video, and audio) (112)	
16.9	I do not assign students to use the computer to create concept/ mind maps (e.g., Kidspiration, Inspiration) (137)	
16.10	I assign students to use the computer to create animation (e.g., Frames, Claymation) (138)	
16.11	I assign students to use the computer to take tests (e.g., Accelerated Reader) (139)	
16.12	I assign students to use desktop publishing software (e.g., Microsoft Publisher, Print Shop) to produce a product (e.g., newsletters, brochures) (162)	
16.13*	I assign students to use writing tools (e.g., thesaurus) in a word processor (159)	

(table continues)

Table A9 (continued)

Domain: Availability of Support to Assist Teachers with Technical Problems

Item	Questionnaire Item	Total Items
17.1	There is a person designated to printer repair (10)	6
17.2	There is a person in my school/ district that installs upgraded software (11)	
17.3	There is a person I can call to change my password, when I am unable to log on to the network (21)	
17.4*	There is a person in my school/ district that replaces outdated hardware (28)	
17.5	There is a person in my school/ district that troubleshoots major technical problems on the network (e.g., server crashes) (36)	
17.6	There is not a person in my school/ district to assist with hardware malfunctions (e.g., hard drive crashes) (44)	

(table continues)

Table A9 (continued)

Domain: Availability of Support to Assist with Technology Integration

Item	Questionnaire Item	Total Items
18.1*	There is a person in my school/ district that models the use of technology for instruction in my classroom (6)	9
18.2*	There is not a person in my school/ district to assist with the setup of technology for daily instructional activities in my classroom (8)	
18.3	There is a person in my school/ district available to assist with planning of technology integration projects (23)	
18.4	There is a person in my school/ district designated to provide immediate assistance with technology integration each day (24)	
18.5	There is a person designated to co-teach technology lessons in my classroom (26)	
18.6	There is a person in my school/ district that writes technology integration lesson plans for teachers to use in the classroom (29)	
18.7	There is a person available in my school/ district to suggest the best hardware to use when teaching specific SOL objectives (38)	
18.8	There is a person in my school/ district that disseminates information about the latest technology innovations that I can use in my classroom with students (43)	
18.9	There is a person available in my school/ district to suggest the best software to use when teaching specific SOL objectives (48)	

APPENDIX B

TECHNOLOGY INTEGRATION QUESTIONNAIRE

Technology Integration Questionnaire

1. Technology Integration Questionnaire

Dear Colleague,
Thanks in advance for taking time to respond to this questionnaire. Teachers who participated in the field test of this questionnaire indicated that it took no longer than 16 minutes to respond. The questionnaire includes several scales designed to measure unique facets of your experience with technology in the classroom. Directions are provided through out the questionnaire to assist with entering responses to questions. If you are disconnected prior to completion of the survey, just click the link to the questionnaire that was provided in the e-mail. The link will allow you to return to the exact point in the questionnaire where you left off. Again, your assistance is greatly appreciated.

2. Background

How many years have you been a teacher, including this year?

Enter number of years [ ]

Select the grade level that you taught this past school year.

◯ Kindergarten ◯ First ◯ Second ◯ Third ◯ Fourth ◯ Fifth ◯ Other

Please select your gender.

◯ Female
◯ Male

Please check the core subject(s) you taught this past school year.

☐ Mathematics
☐ Science
☐ Social Studies
☐ Language Arts
☐ Other

3. Technology Oriented Professional Development

I have participated in ____ hours of technology oriented professional development during the last two years. (Note: One three credit technology related college course is comparable to 37.5 hours of professional development.)

◯ None ◯ 1-5 ◯ 6-10 ◯ 11-20 ◯ 21-more

In the last two years, I participated in less technology oriented professional development because I have dedicated more time training to teach core (i.e., math, reading, writing, social history, and/ or science) standards of learning.

◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree

Page 1

Technology Integration Questionnaire

Please respond to the following statements regarding your participation in technology professional development throughout the last three years.

	Strongly Agree	Agree	Disagree	Strongly Disagree
Generally, I have attended training presented in a multiple session format.	○	○	○	○
Typically, I have attended hands-on training sessions to learn how to use technology.	○	○	○	○
I have attended training to learn how to use specific software programs.	○	○	○	○
Generally, I have attended "one shot" professional development training.	○	○	○	○
I have attended at least one professional development session to learn how to use computer related technology (e.g. iPod).	○	○	○	○

4. Computers & Related Hardware in Your Classroom

How many operating computers were available for student use in your classroom last school year?

Number of Computers ____________

How many students were in your classroom last school year?

Number of students ____________

Technology Integration Questionnaire

Please select "Yes" or "No" to indicate the availability of hardware for use with students in your classroom last school year.

	Yes	No
A single computer, projector, and interactive white board (e.g., SMART board)	◯	◯
A digital camera	◯	◯
A scanner	◯	◯
A single computer and projection device	◯	◯
A printer	◯	◯
Computers to support the use of technology for small group instruction.	◯	◯
High Speed Internet	◯	◯
Handheld devices (e.g., iPod, Palm)	◯	◯
Computers to support the use of technology for whole group instruction in my classroom.	◯	◯

5. Software In Your Classroom

Technology Integration Questionnaire

Please select "Yes" or "No" to indicate the availability of software applications for use with students in your classroom last school year.

	Yes	No
Desktop publishing software (e.g., Microsoft Publisher)	○	○
Drill and practice software (e.g., Fast Math)	○	○
Animation software (e.g., Frames, Claymation)	○	○
Web page authoring software	○	○
Image editing software (e.g., Photoshop)	○	○
Spreadsheet software	○	○
Instructional games (e.g., Carmen Sandiego, Science Court)	○	○
Problem solving software (e.g., Thinking Things, The King's Rule, Alien Rescue)	○	○
Tutorial software (e.g., Reading for Meaning, Reader Rabbit)	○	○
Simulation software (e.g., Edmark's Virtual Lab)	○	○
Presentation software (e.g., Microsoft PowerPoint)	○	○
Drawing software (e.g., KidPix)	○	○

Concept or mindmapping software (e.g., Kidspiration)	◯	◯
Computerized test (e.g., Accelerated Reader)	◯	◯

6. Teaching Philosophy

Please indicate the degree to which you agree or disagree with the following statements:

	Strongly Agree	Agree	Disagree	Strongly Disagree
Using computers to teach my curriculum is a waste of time.	◯	◯	◯	◯
Using computers does not increase my students learning of the SOLs.	◯	◯	◯	◯
Computers helps me facilitate real-world learning in my classroom.	◯	◯	◯	◯
The quality of instruction in my classroom is increased, when I use the computer as a teaching tool.	◯	◯	◯	◯
Students should be engaged in producing real world products (e.g., a director creates a movie).	◯	◯	◯	◯
With technology, teaching and learning are student-centered rather than teacher-directed.	◯	◯	◯	◯
Students gain a	◯	◯	◯	◯

deeper understanding of concepts when they are required to solve real world problems.				
Computers facilitate students' collaboration.	◯	◯	◯	◯
When my students use computers, all students must work on the same activity at the same time.	◯	◯	◯	◯

7. Knowledge of Computers & Related Hardware

Tell us about your knowledge of computers and related hardware. Please select "Yes" or "No" to indicate whether you know how to do each task without assistance.

	Yes	No
Switch on a computer	◯	◯
Switch on a printer	◯	◯
Change a printer ink cartridge	◯	◯
Operate a printer	◯	◯
Operate a handheld device (e.g., iPod, Palm)	◯	◯
Take pictures with a digital camera	◯	◯
Operate a projection device	◯	◯
Connect a digital camera to my computer for the transfer of images	◯	◯
Operate an interactive white board (e.g., SMART Board)	◯	◯

Operate a computer	○	○

8. Knowledge of Software Applications

Tell us about your knowledge of the following software applications. Please select "Yes" or "No" to indicate whether you know how teach an instructional activity to students without assistance using each software application.

	Yes	No
Multimedia presentation software (e.g., PowerPoint)	○	○
Desktop publishing software (e.g., Microsoft Publisher)	○	○
Spreadsheet software (e.g., Excel)	○	○
Software to create a Podcast	○	○
Hypermedia software (e.g., Mpower, HyperStudio)	○	○
Internet search engine (e.g., Google, Yahooligans)	○	○
Web page authoring software (e.g., Front Page)	○	○
Drill and practice software (e.g., Fastmath)	○	○
Problem solving software (e.g., The King's Rule, Alien Rescue)	○	○

9. Enabling Conditions

Technology Integration Questionnaire

Tell us about your ability to anticipate and solve problems that might occur when integrating technology during instructional activities.

	Strongly Agree	Agree	Disagree	Strongly Disagree
Typically, I make alternate technology plans.	○	○	○	○
I anticipate problems that might occur during technology projects.	○	○	○	○
I know who to call for immediate assistance.	○	○	○	○
Generally, I anticipate solutions to software problems that might occur when students are given computer based assignments.	○	○	○	○
Generally, I anticipate an alternate grouping of students in case of hardware malfunctions.	○	○	○	○
When plans for technology integration in the computer lab are derailed, I try to achieve the lesson objective with technology that I have in my classroom.	○	○	○	○

10. Technology Integration In Your Classroom

Technology Integration Questionnaire

How frequently do you integrate computers or related technologies (e.g. iPod) with other curriculum areas in your classroom to teach students?

◯ Daily (1 or more times per day) ◯ Weekly (1-3 days per week) ◯ Monthly (1-3 days per month) ◯ Never (Less than once per month)

There is so much pressure to teach lessons that directly prepare students to take the SOLs that technology is not used daily.

◯ Strongly Agree ◯ Agree ◯ Disagree ◯ Strongly Disagree

How frequently do you assign students to use the computer and related technology to complete instructional activities in your classroom?

	Frequently	Occassionally	Rarely	Never
Simulation software (e.g., Odell Lake, Oregon Trails)	◯	◯	◯	◯
Internet to e-mail others (e.g., experts, scientists)	◯	◯	◯	◯
Internet to find information related to concepts (e.g., virtual tours of museums)	◯	◯	◯	◯
Database to perform basic tasks (e.g., organize data, sort data)	◯	◯	◯	◯
Tutorials (e.g., Reading for Meaning, Bailey's Book House, Millie's Math House)	◯	◯	◯	◯
Play instructional games (e.g., Carmen Sandiego, Science Court)	◯	◯	◯	◯
Solve problems (e.g., Thinkin Things, The King's Rule, Alien Rescue)	◯	◯	◯	◯
Produce	◯	◯	◯	◯

multimedia projects that incorporate a variety of media (e.g., text, images, video, and audio)				
Create concept/ mind maps (e.g., Kidspiration, Inspiration)	○	○	○	○
Create animation (e.g., Frames, Claymation)	○	○	○	○
Take tests (e.g., Accelerated Reader)	○	○	○	○
Desktop publishing (e.g., Microsoft Publisher, Print Shop) to produce a product (e.g., newsletters, brochures)	○	○	○	○
Word processor (e.g., Microsoft Office) to publish writing	○	○	○	○

11. Availability of Technical Support

Technology Integration Questionnaire

Please select "Yes" or "No" to complete the following statements based on the availability of technical personnel to assist with maintaining computers and related technology in your classroom. There is a person who ________.

	Yes	No
repairs printers	○	○
installs upgraded software	○	○
troubleshoots minor network problems (e.g., password changes)	○	○
replaces outdated hardware	○	○
troubleshoots major technical problems on the network (e.g., server crashes)	○	○
fixes hardware malfunctions (e.g., hard drive crashes)	○	○

12. Availability of Support to Assist with Technology Integration in the Classr...

Technology Integration Questionnaire

Please select "Yes" or "No" to complete the following statements based on the availability of personnel to assist with technology integration in your classroom. There is a person who _____.

	Yes	No
models the use of technology for instruction in my classroom	○	○
assists with the setup of technology for daily instructional activities in my classroom	○	○
assists with planning for the integration of technology	○	○
provides immediate assistance with technology integration each day	○	○
co-teaches technology lessons in my classroom	○	○
writes technology integration lesson plans for teachers to use in the classroom	○	○
suggests the best hardware to use when teaching specific SOL objectives	○	○
disseminates information about the latest technology innovations that I can use in my classroom with students	○	○

suggests the best software to use when teaching specific SOL objectives	○	○

13. Thanks for your assistance!

If other factors (e.g., organizational support) not mentioned in this questionnaire have influenced your use of technology in the classroom, please tell us about those factors.

Thanks! You have successfully completed the survey. I am truly grateful for your assistance. If you would like to provide a general comment about the survey or your experience with technology in the classroom, please respond below.

General comments

APPENDIX C

COVER LETTER WITH QUESTIONNAIRE URL EMBEDDED

February 12, 2008

Dear Fellow Educator:

We are writing to request your assistance with a study of teachers' use of technology in K-5 classrooms. We are interested in finding out what factors influence the frequency and application of technology used in K-5 classrooms across the state of Virginia.

The questionnaire should take no more than 16 minutes to complete. When you click the link below you will be connected to the questionnaire located on the SurveyMonkey.com website. If you are disconnected prior to completion of the questionnaire, just return to this e-mail and click the link again to reconnect at the point where you left off. Feel free to contact us, if you have questions or comments about this study.

(Hypertext Link to Questionnaire)

Your participation in the study is voluntary, but your input is valuable. You were randomly selected to participant in this study because you fit the demographic of teachers that we are studying and you are one of the approximately 16,500 K-5 general education teachers in the Market Data Retrieval database.

Please know that your responses will be kept confidential. You will not be asked to give your name or any other information that would identify you. Results of the study will be available through the Virginia Tech database.

Your help with this important study is greatly appreciated.

Sincerely,

Tonya P. Rickman-Rogers
Researcher and Doctoral Student
1200 Green Garden Circle
Virginia Beach, VA 23456
757-478-7035

Dr. Travis Twiford
Associate Professor School of Education
Hampton Roads Center
1444 Diamond Springs Road
Virginia Beach, VA 23455
757-363-3931

APPENDIX D

FOLLOW-UP E-MAIL COVER LETTER WITH QUESTIONNAIRE URL EMBEDDED

February 19, 2008

Dear Fellow Educator:

Last week, you were e-mailed an invitation to participate in a study of teachers' use of technology in K-5 classrooms. You were randomly selected from the Market Data Retrieval database of K-5 teachers in the state of Virginia. Your response to the questionnaire is extremely important to ensure the validity of the study. Colleague, we need your help. The questionnaire should take no more than 16 minutes to complete and your responses will be confidential. Please click the link below to connect to the questionnaire.

(Hypertext Link to Questionnaire)

If you started the questionnaire and you wish to resume where you left off, please return to the original e-mail and click the link. Feel free to contact us, if you have questions or comments about this study. If you have already responded to the questionnaire, please accept our sincere thanks for your assistance. Your input regarding factors that influence the frequency and application of technology in the classroom is extremely valuable.

Your help with this important study is greatly appreciated.

Sincerely,

Tonya P. Rickman-Rogers
Researcher and Assistant Principal
Green Run Elementary
1200 Green Garden Circle
Virginia Beach, VA 23456
757-478-7035

Dr. Travis Twiford
Associate Professor School of Education
Hampton Roads Center
1444 Diamond Springs Road
Virginia Beach, VA 23455
757-363-3931

APPENDIX E

PERMISSION TO USE HERNANDEZ RAMOS' QUESTIONNAIRE

From: Pedro Hernández Ramos
Sent: Thursday, May 11, 2006 12:32 PM
To: Tonya
Subject: Re: Graduate Student Interest in Replicating Your Study
Tonya,
Thank you for your interest in my research. You are, of course, free to use my questionnaire (that's one reason why it was published as an Appendix to the article), provided you acknowledge me as the creator of the instrument and give the proper citation to the article. Also, if you decide not to use the entire instrument, you must indicate that somewhere in your dissertation.
Good luck,
Pedro

Pedro Hernández-Ramos, PhD
Assistant Professor
Director of the MA Emphasis in Teaching and Learning with Technology
Department of Education
&
Associate Director
Center for Science, Technology, and Society
Santa Clara University

APPENDIX F

IRB APPROVAL LETTER

VirginiaTech

Office of Research Compliance
Carmen T. Green, IRB Administrator
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24061
540/231-4358 Fax 540/231-0959
e-mail ctgreen@vt.edu
www.irb.vt.edu
FWA00000572(expires 1/20/2010)
IRB # is IRB00000667

DATE: February 6, 2008

MEMORANDUM

TO: Travis W. Twiford
Tonya Rickman-Rogers

FROM: Carmen Green

SUBJECT: **IRB Exempt Approval:** "Analysis of Factors That Influence a Teacher's Use of Computer Technology in the K-5 Classroom" , IRB # 08-047

I have reviewed your request to the IRB for exemption for the above referenced project. I concur that the research falls within the exempt status. Approval is granted effective as of February 6, 2008.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in previously approved human subject research activities to the IRB, including changes to your study forms, procedures and investigators, regardless of how minor. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.

2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

cc: File

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APPENDIX G

TEACHER'S RESPONSES TO QUESTIONNAIRE OPEN ENDED ITEM ONE

Respondents were given the option to write factors (e.g., organizational support) not mentioned in the questionnaire that influenced technology use in their classrooms. The responses listed below are the original text from the questionnaire, with the exception of word substitutions marked with the letter x. The letter x has been used to block information that would identify respondents. An asterisk has been placed beside comments that address more than one factor and the entire comment has been placed under each category that the comment addresses. Whenever comments were placed under more than one category, the part of the comment that was associated with the factor has been underlined.

Support Personnel

1. Lack of personnel in technology department
2. Little support at individual school, but exists for the county
3. Very unhelpful TRT
4. Tech support is only in our school 1 day a week is we are lucky.
5. *xxxxxxxxxx xxxxxx is very progressive in their use of Instructional Technology. We have several ITRT's (Instructional Technology Resource Teachers) that are available to help us use technology in the classroom, create lessons with technology, and provide in services. I have been lucky to work at a school that is a "Showcase School" for Smartboards. Technology has greatly enhanced the way I teach and how my students learn.
6. Technology support person is only available for two days per week – cannot help troubleshoot immediately
7. We only have tech support one day a week
8. *We have a media specialist (the librarian) who teaches all day but is happy to help when he has a free moment. We have a technology person that will help install software, fix minor problems etc....if you submit a work order. His schedule is not fixed, so we never know when he will be in the building. We have a TRT (Teacher Resource Tech. person) that works in the building twice a week, however is only a resource for teachers. She will not work with children and is only available during our "non-teaching" time---which in elementary school is non-existent. She mostly e-mails us suggested web sites and works in the office. Nothing against her, but her job description does not benefit students in K-5 situations. We have a computer lab, but every time you take a class---the computers freeze up! It is too frustrating and a waste of instructional time. We have new laptops, that work well. You just have to transport them from the computer lab---and you can't leave your students unsupervised–so this is almost impossible. We have one smartboard to share in our school---it is great, but again, if something happens with the software, you have wasted instructional time. Ideally, you would use your lunch or before and afterschool to set the smartboard lesson up----but it has to be shared, so that is not always a choice. It all boils down to elementary teachers having no time to research, or set up lessons using technology and the available help, is not available. If I seem frustrated, I am!

9. *Only 1 working computer this year in class. Also, our technology person is seldom available to repair problems and does not return emails.
10. Response to request for assistance
11. *Lack of computers in classroom – no immediate help if something goes wrong – I usually teach with activities that are more hands on than using a computer – I teach 10 minute lesson because of the kids younger age – by the time I get all the technology hooked up and working an activity that I could have taught in another way in ten minutes has taken one hour.
12. *Having the time to make something to use on a computer such as a PowerPoint. Also, needing an extra body in the room to help facilitate one group using computers and problems solving with them while the other person works with the students who are not on the computers.
13. Some technical support comes from our county's central office.
14. We do not have someone to answer questions/resolve problems with technology on a daily basis, therefore when a problem arises I can not count on immediate help.
15. *Lack of tech support, time restraints (strict district wide pacing guide), accessibility to equipment
16. *I have one teacher computer and two outdated dinosaurs which have Reader Rabbit and other drill games on them. I used Accelerated Reader on my teacher computer. We do have a technology person who is wonderful but she is not here everyday. Please forgive me for not replying sooner, but I have been dealing with the illness of an elderly parent. I hope this has helped you in your survey. Sincerely, xxxxxx xxxxx
17. We have usually had a person to help with computers for those who need that help. I am able to work with a program and figure it out with little help. When I need help on a new program I usually call the tech person if for a few minutes to provide the help I need.

Equipment

1. *I have one teacher computer and two outdated dinosaurs which have Reader Rabbit and other drill games on them. I used Accelerated Reader on my teacher computer. We do have a technology person who is wonderful but she is not here everyday. Please forgive me for not replying sooner, but I have been dealing with the illness of an elderly parent. I hope this has helped you in your survey. Sincerely, xxxxxx xxxxx
2. Our school uses carts with laptops that may be brought to the classroom which hold a whole class set of computers. These are great!
3. Number of computers to students
4. Number of computers available in classroom
5. No computer lab—computers on cart not available often
6. 17 laptops now housed in my room have increased the use of technology this year
7. Most of the technology in my classroom I have gotten through donors online, purchased myself, or the school gives it to me because no one else in the school will use it.
8. Available equipment
9. I only have one hookup for internet for 4 computers

10. While I have three computers in my classroom, they are designated for use with Break Through to Literacy only. All other programs require a trip to the computer lab which is difficult with Kindergarten.
11. Outdated equipment
12. I teach a weekly lesson in the computer lab is the one major reason why answering the questions was difficult. The main one in the classroom is used for writing/ printing or research. The other one of two is mine and I have to monitor it's use while I'm teaching those that aren't doing enrichment activities.
13. United Streaming
14. I don't use technology in the classroom as often as I would like due to the limited number of computers available to students in the classroom. There is a computer lab that is open occasionally, but it is often difficult to schedule a time to use it that fits with my schedule.
15. Lack of funding to purchase technology equipment.
16. Although last year I had no computers in my classroom, this year I have 25 laptops in my room, which students use on a daily basis for a variety of activities.
17. *Lack of computers for students, time and software
18. I am a doctoral student focusing on technology integration. I have gotten 8 computers donated to my classroom for student use.
19. We have two Smartboards for each grade level. In addition, we have 10 carts of COWS to sign out. They have wireless internet and printer.
20. Restrictions placed by division on use/updates of technology
21. Outdated equipment prevents me from using most software. The computers cannot handle it.
22. Physical layout of the classroom-where the outlets/computer drops are located...lots of windows makes projection difficult in the classroom
23. *We have a media specialist (the librarian) who teaches all day but is happy to help when he has a free moment. We have a technology person that will help install software, fix minor problems etc....if you submit a work order. His schedule is not fixed, so we never know when he will be in the building. We have a TRT (Teacher Resource Tech. person) that works in the building twice a week, however is only a resource for teachers. She will not work with children and is only available during our "non-teaching" time---which in elementary school is non-existent. She mostly e-mails us suggested web sites and works in the office. Nothing against her, but her job description does not benefit students in K-5 situations. We have a computer lab, but every time you take a class---the computers freeze up! It is too frustrating and a waste of instructional time. We have new laptops, that work well. You just have to transport them from the computer lab---and you can't leave your students unsupervised–so this is almost impossible. We have one smartboard to share in our school---it is great, but again, if something happens with the software, you have wasted instructional time. Ideally, you would use your lunch or before and afterschool to set the smartboard lesson up----but it has to be shared, so that is not always a choice. It all boils down to elementary teachers having no time to research, or set up lessons using technology and the available help, is not available. If I seem frustrated, I am!

24. *Lack of computers in classroom – no immediate help if something goes wrong – I usually teach with activities that are more hands on than using a computer – I teach 10 minute lesson because of the kids younger age – by the time I get all the technology hooked up and working an activity that I could have taught in another way in ten minutes has taken one hour.
25. Lack of funds to purchase more technology for immediate use by all students in the classroom.
26. We only get the used and broken equipment. It is very sad – schools should receive top quality equipment, but we just get the leftovers—it doesn't matter how much training you have if the technology is not available to you.
27. The technology available in my classroom was mostly earned by my completion of the NETS T grant.
28. My county uses the computer program Breakthrough to Literacy for Kindergarten – so teachers are not able to integrate technology as easily with a half-day kindergarten program and the Breakthrough to Literacy program.
29. Lack of technology availability for whole class instruction
30. Would love to have my own lcd projector in class not have to share 4 with over 25 teachers (k-5)
31. Outdated computers that freeze when you use them
32. *Lack of computers and difficulty and time required to set them up for special lessons. IE-The same computer is used for many different things during the day and must be available.
33. *Lack of tech support, time restraints (strict district wide pacing guide), accessibility to equipment
34. Not enough electrical outlets in the classroom
35. *xxxxxxxxxx xxxxxx is very progressive in their use of Instructional Technology. We have several ITRT's (Instructional Technology Resource Teachers) that are available to help us use technology in the classroom, create lessons with technology, and provide in services. I have been lucky to work at a school that is a "Showcase School" for Smartboards. Technology has greatly enhanced the way I teach and how my students learn.
36. Availability affects frequency of use.
37. *I love using technology and I would use it even more if I could depend on it to always work!
38. *Only 1 working computer this year in class. Also, our technology person is seldom available to repair problems and does not return emails.

Time

1. Time involved
2. Time
3. The lack of planning time to create new plans.
4. Lack of time to vary from SOL objectives
5. *Lack of computers for students, time and software
6. We keep laptops out and ready to use at all times – too much instruction time is lost having to set-up

7. *We have a media specialist (the librarian) who teaches all day but is happy to help when he has a free moment. We have a technology person that will help install software, fix minor problems etc....if you submit a work order. His schedule is not fixed, so we never know when he will be in the building. We have a TRT (Teacher Resource Tech. person) that works in the building twice a week, however is only a resource for teachers. She will not work with children and is only available during our "non-teaching" time---which in elementary school is non-existent. She mostly e-mails us suggested web sites and works in the office. Nothing against her, but her job description does not benefit students in K-5 situations. We have a computer lab, but every time you take a class---the computers freeze up! It is too frustrating and a waste of instructional time. We have new laptops, that work well. You just have to transport them from the computer lab---and you can't leave your students unsupervised–so this is almost impossible. We have one smartboard to share in our school---it is great, but again, if something happens with the software, you have wasted instructional time. Ideally, you would use your lunch or before and afterschool to set the smartboard lesson up----but it has to be shared, so that is not always a choice. It all boils down to elementary teachers having no time to research, or set up lessons using technology and the available help, is not available. If I seem frustrated, I am!
8. *Lack of computers in classroom – no immediate help if something goes wrong – I usually teach with activities that are more hands on than using a computer – I teach 10 minute lesson because of the kids younger age – by the time I get all the technology hooked up and working an activity that I could have taught in another way in ten minutes has taken one hour.
9. *Having the time to make something to use on a computer such as a powerpoint. Also, needing an extra body in the room to help facilitate one group using computers and problems solving with them while the other person works with the students who are not on the computers.
10. *Lack of computers and difficulty and time required to set them up for special lessons. IE-The same computer is used for many different things during the day and must be available.
11. *Lack of tech support, time restraints (strict district wide pacing guide), accessibility to equipment
12. *I teach a half day kgn program. There is little time for technology.

Technical Proficiency

1. Infrequent use so do not know how to use the things as well as should
2. I am very interested in technology use in the classroom. I find most 4th graders are as computer savvy as most teachers.
3. Weekly lessons chosen for the computer lab are taught by myself and at times an LD teacher collabs with me. The lessons are created by myself based on what we're studying in science, social studies, etc.
4. *I love using technology and I would use it even more if I could depend on it to always work!
5. I find it difficult to try to catch up on all computer concepts when the lower grade levels do not teach the beginning concepts.

6. I did not grow up in a tech world. I am basically learning a foreign language when dealing with computers and other electronic equipment. I was a successful teacher for more than thirty year without having anything that required wires. When my chalk broke, it still worked!
7. I spent nine years as a Library Media Specialist

Grade Level
1. I teach first grade and a part of the questionnaire does not apply to my students and classroom.
2. Could have the students do more if they were not in kindergarten
3. *I teach a half day kgn program. There is little time for technology.
4. Something I have to do "whole class" because my students cannot read the instructions on their own.
5. Age and ability of students
6. I find it difficult to try to catch up on all computer concepts when the lower grade levels do not teach the beginning concepts.

Professional Development
1. NTTI at xxx
2. NTTI conference helped encourage & NETs
3. Learning from other teachers, student teachers
4. *xxxxxxxxxx xxxxxx is very progressive in their use of Instructional Technology. We have several ITRT's (Instructional Technology Resource Teachers) that are available to help us use technology in the classroom, create lessons with technology, and provide in services. I have been lucky to work at a school that is a "Showcase School" for Smartboards. Technology has greatly enhanced the way I teach and how my students learn.

Incentives for Using Technology
1. Enthusiasm and praise for using it.

APPENDIX H

TEACHERS' RESPONSES TO QUESTIONNAIRE OPEN ENDED ITEM TWO

Respondents were given the option to write general comments about the survey and/ or their experience with technology in the classroom. The responses listed below appear as the original text, with the exception that the letter x has been used to block information that would identify respondents.

Experience with Technology

1. I am learning a lot of wonderful things that can be used in my classroom. I still have a ways to go! Thanks
2. We need much more help at the elementary level
3. We have great computer tech support.... Believe me, I need it. The younger teachers just entering the profession are so "computer literate." Those of us who have been here awhile, have learned a great deal, but it's taken us time
4. I just got a "flip camera" and smart board in my room this year..Great!
5. I need more help and understanding
6. Technology is a great support tool of material taught. It offers a variety of ways to reinforce material.
7. We have 2 computers in our class every day and I have access to 22 computers when I sign up for them. I do find it difficult to maintain computer knowledge when lower lever teacher do not teach the basics. I do understand that this is due to the speed that advancements are made and the time limits we have on our lives.
8. Difficult to manage the up keep, cleaning, charging of laptops when many use them
9. We have technical support people in our school district; however, they are shared with other schools and definitely not available on a daily basis or to be on call for problems that arise during a planned lesson.
10. We need an in house technology persn to teach and maintain technology daily. Many teachers don't know how to use the equipment or have time to plan and hunt for sources.
11. Too many problems with Mac and Apple, we need to use pcs in the schools. Only these are compatable with the real world.
12. The biggest problem is time for planning the integration of these programs and assistance in doing so.
13. I take advantage of the vast supply of lessons, activities, and support materials available on the internet that can just be downloaded and used.
14. Have seen it as a great way to integrate standards while teaching 21st century skills such as technology, problem solving, collaboration, and creative communication
15. I would use technology more, but it is not available at the moment. Additionally, our school has a technology teacher, but she is useless. She spends all of her time in her office and is not available to help the students. Most of the time she is not even in the building. The students are even starting to pick up on this fact.
16. I don't use technology as much as I'd like to.

17. There are plenty of computers on carts in our building which we can sign up to use. Having computers in our classrooms would increase our daily use of these tools.
18. Our technology department (3 people) is the best! They provide the training and equipment for us to do a fantastic job with technology all day long. They always listen when we have suggestions, needs, ideas for new products, etc. They are truly considerate of the teachers and the students in their budget, planning, and service.
19. I feel in Kindergarten computers are great resources to supplement a student. I do not feel they should be □ rrepla teacher and students at all times which has been quoted to our teachers.
20. If this helps get rid of SOL's, great!!
21. Training at my school occurs in 10-15 minute sessions at faculty meetings held before school begins.
22. We need more technology experts and computers to use technology more effectively.
23. We are truly blessed with the technology available to students and teachers at our school. Everyone is encouraged to use the technology that has been made available to our school district. We also have 2 computer labs with open time □ rreplac for our classroom use. Each classroom is equipped with a smart board, projector, and document camera. Each lab has 32 computers, and we also have lap-tops that are available for classroom or individual use.
24. I love to use technology, but maintaining it is expensive and I don't believe enough money is in our budget to maintain technology nor to get new items needed
25. My comment is that last year we had two computers in each classroom. This year only one. So, I have to share my computer with the kids. It also isn't easy when I'm using the Smartboard for instruction, and I have a child that needs to take an AR test. There are time conflicts.
26. I don't usually have any help teaching technology even thought there is a person in the building.
27. Smartboard in my class this year has revolutionized my teaching. It's □ rreplaceable.
28. I feel technology is very important in the classroom. I do not view it as something "extra." I use my SMARTBoard everyday for several lessons per day. I would not be able to teach without it. I even taught my Kindergarteners how to use Powerpoint and do presentations for future kindergarteners. I love technology!
29. I use the computer lab several times a week, but only one computer in my room
30. Technology should only be a "tool" for elementary students. They are plugged in too much in today's society. They need physical contact, stimulation and eye contact with a human being, since many of them are lacking this in today's home setting.
31. I have found that I use technology much more frequently when it is readily available to me. When it is there and in my room for me to use all the time I am much more likely to use. In the past and sometimes now we have to share the technology items with many other teachers making it hard to use.
32. I enjoy applying technology to the classroom, however the technology needs to be updated and made available
33. We have laptops to use in the classroom and a TRT
34. Lesson plans that are available with technology connected would be very useful
35. The use of technology helps to engage the students to make learning more meaningful and lasting.

Questionnaire

1. Please forgive me for not replying sooner, but I have been dealing with the illness of an elderly parent. I hope this has helped you in your survey. Sincerely, xxxxxx xxxxx
2. Need more space for detailed comments. This is a forced survey which may lead to inaccurate answers. Needed more "neutral" options. In one area, you had agree/disagree answers but should have been yes/no choices.
3. I would have appreciated your asking me permission instead of telling me to do this. I do not have time to do these things.
4. The survey was very user friendly!!! Thanks
5. Good luck with your data collection. You have some misspellings in your survey.
6. On question 10, occasionally is misspelled.
7. I am not familiar with many of the software mentioned in the survey. When my students use computers they only go to websites and use the games and activities there, or to access information.
8. I'll be interested to hear what you learn!
9. Many of the software applications mentioned in the survey are not used in my classroom due to that age of my students.
10. Good survey. There is a lot more I wish I could do, but am limited by the number of computers available & restrictions put in place by the division.
11. Survey is very general – doesn't address issues associated with us technology in the classroom
12. You need to have an I don't know column along with the yes and no, not having one invalidates your survey
13. There were terms used in this survey with which I was unfamiliar. I may not have answered accurately because I did not know these terms. Even though you gave examples, my school may have different software for the same purpose. In other words, if I had better knowledge of the terms, I might have answered differently.

General Comment No Specific Area

1. Go xxxxxx!
2. Thanks
3. 1988 xx graduate
4. Hope this was helpful

APPENDIX I

KURT LEWIN'S FORCE FIELD ANALYSIS APPLIED TO THIS STUDY

While the majority of the variables explored in this study have been studied in the past, the teachers' responses provide current information regarding the influence of the variables on the frequency and application of technology integration in K-5 classrooms across the state. The variables are discussed in the context of Kurt Lewin's force field analysis. This analytical approach is not only useful for understanding the impact of the variables on technology integration across the state, but the approach offers opportunities to apply the findings of the study in a way that could move the state's technology integration effort forward.

According to Kurt Lewin's field theory (as cited in Lifter et al, 2005) opposing forces create dynamic equilibrium. Change occurs by increasing driving forces, decreasing restraining forces, or a combination of the two (Lifter et al, 2005). Change agents (e.g., teachers, administrators, school board members, state legislators) are those persons who manipulate forces, working to affect change, thus moving an organization toward the desired goal. In the following sections, independent variables have been conceptualized as either driving or restraining forces. Change agents may use data and analysis regarding forces to reconceptualize forces and/or reorient the direction of forces to stimulate change.

Force Field Analysis: Driving and Restraining Forces

Four of eleven factors were driving forces, moving teachers toward technology integration, those variables were teaching philosophy, technical support, professional development hours, and hardware proficiency. Seven of the eleven factors were restraining forces, moving teachers away from integration, those variables were available hardware (including computer to student ratio), available software, technology integration support, professional development format, enabling conditions proficiency, and software proficiency.

Driving Forces. Teaching philosophy was one of the most powerful driving forces. The findings of the present study were consistent with those of several past studies of the relationship between the two variables (i.e., constructivist philosophy and technology integration). Typically, teachers who ascribed to constructivist philosophy integrated technology with greater frequency and for more varied applications than teachers who were traditionalist (Becker & Riel, 2000; Ertmer et al., 1999; Sandholtz et al., 1997). The vast majority of teachers (80%) in the present study indicated agreement with technology integration practices that were consistent with constructivist teaching methods. Overwhelmingly, teachers reported the use of computers was not a waste of time and the use of computers led students to deeper understanding of concepts.

In a similar vein, teachers rated technical support extremely high. On average, teachers reported the availability of no less than five of six types of technical support. Based on responses, technicians were available to do a variety of tasks ranging from computer repair to resolution of network problems. The affirmative response to availability of technical support was not surprising, since technicians have installed and maintained technology in schools for many years. Before the focus on technology integration in schools shifted to concerns, such as frequency and application of integration, the infusion of computers, high speed Internet, and technicians in schools was a top priority.

To a somewhat lesser extent the hours dedicated to technology oriented professional development was among the driving forces. For the most part, teachers' averaged 6-10 hours of participation in technology oriented professional development during the two years prior to the study. When compared to teachers in a national study conducted by the NCES (2000), teachers in the present study engaged in more hours of professional development.

The NCES (2000) found a positive correlation between teachers who felt more prepared to use computers and the Internet in classrooms and the hours of participation in technology oriented professional development. According to the NCES (2000) teachers who participated in nine or more hours of professional development during a period that spanned three years, felt well or very well prepared to integrate technology in classrooms compared to counterparts who participated in less technology oriented PDA.

The final driving force was hardware proficiency. On average, teachers reported proficiency in the use of 8 of 10 pieces of hardware. The greatest proficiency was noted for hardware that required the use of basic skills; whereas, proficiency with hardware that required the use of advance skills was less prevalent. Most teachers were knowledgeable enough to switch on and operate computers and printers, but lacked skills necessary to operate hand held devices (e.g., iPod), white boards, or projection devices. When compared to other American elementary school teachers (Becker et al., 1999), the teachers in the present study reported greater technical proficiency.

Restraining forces. While hardware proficiency was a driving force, software and enabling conditions proficiency were restraining forces. On average, teachers were only skilled enough to operate a little more than four of the nine pieces of software. The majority of teachers reported proficiency in the use of Internet software and multimedia software; this was not surprising considering the popularity of the Internet and multimedia programs (e.g., PowerPoint). However, most teachers were not skilled enough to operate problem-solving, Podcast, hypermedia, and web page software; these programs often require mastery of complex skills. According to Zhao (2002), some types of software are better suited for certain instructional task. Consequently, in the present study, limited software proficiency could adversely affect learning experiences facilitated by the integration of technology.

Similarly, enabling conditions proficiency was a restraining factor. The vast majority of teachers reported that they knew who to call for immediate assistance. However, teachers' ratings were much lower for the other five items on the scale. Among the top reported deficiencies was difficulty with making alternate technology plans and anticipation of solutions to software problems. According to Zhao et al. (2002), knowledge of enabling conditions signals greater technical proficiency, in that this sort of proficiency requires teachers to anticipate technical difficulties and solutions based on a broad range of technical knowledge. Less proficiency in this area would likely result in less successful completion of technology integration lessons.

Additionally, a lack of support to assistance with technology integration was a restraining force. On average, teachers reported the availability of support to assist with five of nine tasks listed on the scale. Support was most available to model technology integration, disseminate technology information, and plan for technology integration, but support was least available to write lesson plans, provide immediate assistance, setup for integration, and co-teach lessons. These findings suggest that some of the most needed types of support were least available.

While Virginia is the only state in the country that allocates one instructional technology resource teacher (ITRT) for every 1,000 students (Virginia Society for Technology in Education, 2009), some teachers reported insufficient and/ or inadequate technology integration support. The findings of this study indicated that the technology integration support might be enhanced with the designation of at least one ITRT to each elementary school.

Much like the findings regarding technology integration support, the orientation of professional development activities was not consistently grounded in practices conducive to acquisition of technology skills. For instance, while a large percentage of teachers reported participation in hands-on professional development, fewer teachers reported participation in sessions related to handheld technology. Contradictory practices were also evident in the format of professional development sessions, similar percentages of respondents participated in one shot (i.e., single session) professional development as multiple sessions.

Research conducted by Kanaya et al. (2005) has shown that in order for teachers to develop and implement technology rich lesson plans professional development should span multiple sessions. Teachers need the opportunity to acquire technology skills in a progressive manner that is more likely facilitated by on going training and peer coaches (Ertmer et al., 1999; Sandholtz & Reilly, 2004; Sandholtz et al., 1997; Sugar, 2005) than a one shot professional development experience.

The fact that approximately 30% of the teachers did not attend professional development aimed at learning skills necessary to operate handheld devices and the fact that less than 10% of teachers had access to handheld devices suggests an ongoing struggle to acquirer and sustain cutting-edge hardware and software. One would think that the availability of software and hardware would not be restraining factors, since equipping schools with technology has been an essential part of national, state, and local educational reform efforts for at least the last 20 years. However, the dynamic nature of technology presents a unique challenge in that software and hardware (e.g., computers) must be continuously upgraded and/or replaced to keep pace with the latest innovations.

On average, teachers reported 8 of the 14 pieces of software were available for use in the classroom. The software that was most available was for presentations, concept maps, desktop publishing, and spreadsheets. However, a more telling statistic was that less than 30% of teachers had access to software needed to create animations, web pages, and simulations. These types of software are needed to facilitate specific kinds of automated learning experiences. For example, the absences of software to create simulations could decrease teachers' instructional capacity to engage students in certain kinds of experiments in which variables are manipulated to examine outcomes that would not otherwise be observable in the classroom.

On average, teachers reported the availability of six of nine pieces of hardware, but the student to computer ratio was 9:1. The availability of hardware, as reported on the available computers and related technology scale, was not as big a signal of a hardware deficit as the size of the computer to student ratio. In the present study, the ratio was 9:1, much higher than the national recommended ratio of 5:1 (U.S. Department of Education, 2004). Teachers' general comments suggest that there is an inequitable distribution of computers and related technology across the state. Some teachers reported access to computers, laptops, and Smartboards, while others reported much less access (see Appendix G for general comments).

Inequitable distribution of resources. When teachers provided feedback regarding factors that influenced integration of technology in classrooms, the most frequently mentioned factors were equipment and support. The following teachers' comments as well as comments found in Appendix G provide evidence of disparities in the availability of hardware, software, and technology integration support across the state:

1. *xxxxxxxxxxx xxxxxx is very progressive in their use of Instructional Technology. We have several ITRT's (Instructional Technology Resource Teachers) that are available to help us use technology in the classroom, create lessons with technology, and provide in services. I have been lucky to work at a school that is a "Showcase School" for Smartboards.Technology has greatly enhanced the way I teach and how my students learn.*

2. *There is a lack of computers for students, time, and software.*

3. *I have one teacher computer and two outdated dinosaurs which have Reader Rabbit and other drill games on them. I used Accelerated Reader on my teacher computer. We do have a technology person who is wonderful but she is not here everyday. Please forgive me for not replying sooner, but I have been dealing with the illness of an elderly parent. I hope this has helped you in your survey. Sincerely, xxxxxx xxxxx*

4. *Most of the technology in my classroom I have gotten through donors online, purchased myself, or the school gives it to me because no one else in the school will use it.*

5. *Our school uses carts with laptops that may be brought to the classroom which hold a whole class set of computers. These are great!*

6. *Lack of computers in classroom - no immediate help if something goes wrong - I usually teach with activities that are more hands on than using a computer - I teach 10 minute lesson because of the kids younger age - by the time I get all the technology hooked up and working an activity that I could have taught in another way in ten minutes has taken one hour.*

7. *We only get the used and broken equipment. It is very sad – schools should receive top quality equipment, but we just get the leftovers—it doesn't matter how much training you have if the technology is not available to you.*

APPENDIX J

RESEARCHER'S RESUME

Tonya P. Rickman-Rogers
Educator •18 Years

Postgraduate Professional License Commonwealth of Virginia
Secondary School Principal
Middle School Principal
Elementary School Principal
Middle Education Grades 4-8
Early Education Grade NK-4

B.A. Elementary Education · 1990
Brooklyn College - Brooklyn, New York

M.S. Education Administration · 1994
Old Dominion University - Norfolk, Virginia

PROFESSIONAL EXPERIENCE:

2004- Present **Virginia Beach City Public Schools, Virginia Beach, Virginia, Green Run Elementary School.**

Assistant Principal
Assist principal with overall administration of Title I school with 400+ student population and 55 faculty members

Responsibilities
Observe and evaluate faculty (PK-5)
Collaborate in development of school's academic continuous improvement plan
Supervise school testing program
Supervise special education services
Coordinate teacher mentor program
Coordinate safe school plan and crisis response team
Assist Principal in development of the annual professional development plan for teachers
Develop faculty handbook and master schedule
Maintain textbook and equipment inventories
Coordinate transportation services
Assist faculty and staff with interpretation of VBCPS policies
Assist principal with annual allocation of resources

2001- 2004 **Virginia Beach City Public Schools, Virginia Beach, Virginia, Newtown Road Elementary School.**

Assistant Principal
Assisted principal with overall administration of Title I School with 900+ student population and 90 faculty members
Responsibilities
Observed and evaluated teachers (PK-5)
Supervised special education services
Served as Principal's designee on student support services team & special education committee
Developed faculty handbook and master schedule

Served as school test coordinator for standardized testing program
Supervised transportation
Maintained textbook and equipment inventories

1998- 2001 **Virginia Beach City Public Schools, Virginia Beach, Virginia, White Oaks Elementary School.**

Computer Resource Specialist

Charged with promoting and facilitating the use of computers and related technology in the elementary school

Responsibilities

Assisted teachers with technology integration in classroom & lab
Collaborated with teachers in the development of technology integration lesson plans
Developed and implemented schoolwide technology plan
Assisted principal with purchase and allocation of hardware and software
Disseminated information regarding current technology innovations
Served as a liaison between the school and VBCPS Office of Technology Services
Provided technology oriented professional development for administrators and teachers
Resolved technical hardware and software technical problems

1994- 1998 **Virginia Beach City Public Schools, Virginia Beach, Virginia, Kingston Elementary School.**

Teacher

Charge with providing instruction for students in grade two (1994-1996) and five

Responsibilities

Developed and implemented lesson plans adhering to state and local standards
Designed and implemented positive classroom management plan
Designed instructional activities aimed at meeting individual needs of students
Communicated academic and behavioral expectations to parents and students
Integrated technology with core curriculum areas
Integrated research based best pedagogical practices to provide instruction
Planned activities to increase parental involvement in classroom and school
Created authentic assessment tools and used data to drive instruction

1990- 1994 **Norfolk Public Schools, Norfolk, Virginia, James Monroe Elementary School.**

Teacher

Charged with providing instruction for students in grade four (1994-1996) and three (1992-1994)

Responsibilities

Development and implemented thematic lesson plans adhering to state and local standards
Designed and implemented positive classroom management plan
Designed instructional activities aimed at meeting the individual needs of students
Communicated academic and behavioral expectations to parents and students
Integrated technology with core curriculum areas
Implemented practices that were aligned with whole language pedagogy and James Comer Model