


2005

## Effects of a Professional Development Initiative on Technology Innovation in the Elementary School

Delia Raymos Pass  
*University of North Florida*

Follow this and additional works at: <https://digitalcommons.unf.edu/etd>

 Part of the [Curriculum and Instruction Commons](#), and the [Elementary Education and Teaching Commons](#)

---

### Suggested Citation

Pass, Delia Raymos, "Effects of a Professional Development Initiative on Technology Innovation in the Elementary School" (2005). *UNF Graduate Theses and Dissertations*. 273.  
<https://digitalcommons.unf.edu/etd/273>

This Doctoral Dissertation is brought to you for free and open access by the Student Scholarship at UNF Digital Commons. It has been accepted for inclusion in UNF Graduate Theses and Dissertations by an authorized administrator of UNF Digital Commons. For more information, please contact [Digital Projects](#).  
© 2005 All Rights Reserved

Effects of a Professional Development Initiative on  
Technology Innovation in the Elementary School

by

Delia Raymos Pass

A dissertation submitted to the doctoral faculty in  
Educational Leadership in partial fulfillment  
of the requirements for the degree of

Doctor of Education

University of North Florida  
College of Education and Human Services

December, 2005

Unpublished work © Delia Raymos Pass

The dissertation of Delia Raymos Pass is approved:

**Signature Deleted**

\_\_\_\_\_  
Joyce T. Jones, Ed.D., Chair

November 4, 2005

**Signature Deleted**

\_\_\_\_\_  
Catherine Cavanaugh, Ph.D.

11-4-05

**Signature Deleted**

\_\_\_\_\_  
Susan R. Wallace, Ph.D.

11-4-05

**Signature Deleted**

\_\_\_\_\_  
David Whittinghill, Ph.D.

November 4, 2005

**Signature Deleted**

\_\_\_\_\_  
Kenneth T. Wilburn, Ph.D.

November 4, 2005

Accepting for the Department:

**Signature Deleted**

\_\_\_\_\_  
Joyce T. Jones, Ed.D., Chair  
Department of Counseling and Educational Leadership

July 31, 2007

Accepting for the College:

**Signature Deleted**

\_\_\_\_\_  
Larry G. Daniel, Ph.D., Dean  
College of Education & Human Services

August 24, 2007

Accepting for the University:

**Signature Deleted**

\_\_\_\_\_  
David E. W. Fenner, Ph.D.  
Dean of Graduate Studies

30 OCTOBER 2007

## Acknowledgements

I would like to acknowledge the people who helped me through my doctoral years. This journey has been a long but invaluable pursuit. I would especially like to thank my Chair, Dr. Joyce Jones, for her generous time and expertise in the educational field. Her support and encouragement has contributed to the completion of this document. I am particularly grateful for her energetic discourse, endless nights of editing, and gracious hospitality.

I am also appreciative of my doctoral committee for their support and encouragement. I would like to thank Dr. Catherine Cavanaugh for all of her “just in time” help with editing and technical matters. I would also like to thank Dr. David Whittinghill, who spent countless hours helping me make sense of my research data. His support and expertise encouraged me to understand my data thoroughly and to develop analytical thinking and research skills. I would also like to thank Dr. Susan Wallace, who joined my committee with enthusiasm and constructive editing suggestions.

My dissertation topic would have never been possible without the support of my principal, Mrs. Kellye Goostree. Her support of the technology initiative implemented during the research year at our school inspired me to excel and seek perfection through countless hours of web page developing, data collection, and professional development activities with our teachers. I would also like to thank the participant teachers who were willing to attend professional development activities, fill out questionnaires, and collect data weekly. Their professionalism in the development of an online collaborative learning resource for our students is evidence of their commitment to excellence.

Above all, I am grateful to my father, Victor E. Raymos, who taught me the value of knowledge and inspired me to persist. My lifelong love of learning would not exist without the encouragement and example of my father, who was the consummate educator. My mother, Dorothy C. Raymos, has been my constant source of support during this journey. Both of my parents have always been there when I needed them. Thank you both. I love you for everything you have been to me.

Last, but not least, I would like to thank my family, my husband Eddie, and my three daughters, Rachel, Ashley, and Arielle. They encouraged me to persevere and provided the fortitude to see this journey through to the end. Their unfailing patience and understanding during many long nights and weekends of work was unselfish and appreciated more than they realize. You are the most important part of my life and I love you deeply for your support during this long process-the completion of my dissertation.

## Table of Contents

Acknowledgements	iii
Table of Contents	iv
List of Tables	ix
List of Figures	x
Abstract	xi
Chapter One: Introduction	1
Background	2
Statement of the Problem	4
Purpose of the Study	7
Research Questions	9
Significance of the Research	11
Definition of Terms	16
Setting and Population	18
Research Methodology	18
Design	18
Instrumentation	19
Organization of Study	19
Chapter Two: Literature Review	21
Introduction	21
Policy Framework	22
Federal Accountability Legislation	23
State and Local Education Agency Accountability	28

Theoretical and Conceptual Framework	30
Constructivist Learning Theory	30
Principles of Adult Learning	32
Learning Theories and Technology Integration	35
Research on Technology	39
Constructivist Learning	39
Self-efficacy	46
Best Practices	55
Federal Accountability and Research	61
Conclusion	64
Chapter Three: Methodology	66
Research Questions	66
Research Design	69
Research Instruments	72
Teachers' Attitudes Toward Computers	72
Construct Validity and Internal Consistency Reliability for Scores on the Teachers' Attitudes Toward Computers v3.2a	74
Technology Proficiency Skills Assessment	75
Reliability for Scores on the Technology Proficiency Skills Assessment	76
Stages of Adoption of Technology	76
Reliability and Validity for Stages of Adoption	77
Teacher-reported Logs of Computer use Use by Students	77
Computer Lab Sign-in Logs	77
Hits on the PDG and WAG Websites	77
Informed Consent and Institutional Review Board Approval	78
Data Collection	79
Data Entry	80
Cronbach's Alpha	80
Data Analyses	81
Research Population and Sample	83

Research Setting	84
Research Site	84
Researcher's Role	84
Delimitations	85
Limitations	85
Research Groups	86
Professional Development Model	86
Professional Development Group (PDG)	87
Web-Access Groups (WAG)	90
Summary	91
Chapter Four: Presentation and Analysis of Data	92
Research Hypotheses	94
Demographic Profile of the Research Sample	98
Reliability Estimates	100
Descriptive Statistics for the Pre- and Post-Questionnaires	102
Research Groups	102
Testing of Assumptions	104
Homogeneity-of-slopes	104
Levene's Test of Equality of Error Variances	105
Box's M Test of Equality of Covariance Matrices	106
Analyses of the Hypotheses	106
Presentation of the Research Findings	107
Analyses of the Research Hypotheses	107
Research Hypothesis 1	107
Research Hypothesis 2	109
Research Hypothesis 3	112
Research Hypothesis 4	115
Research Hypothesis 5	116

Chapter Five: Summary, Implications, and Recommendations	119
Summary of the Study	119
Methodology	120
Participants	120
The Findings	120
Teacher Self-reported Logs of Computer Use by Students	121
Computer Lab Sign-in Logs	122
Website Use by PDG and WAG Groups	123
Discussion of Delimitations and Limitations	124
Discussion of the Findings	126
Interpretation of Results Within the Theoretical Framework	126
Relationship of the Findings to Previous Empirical Research	129
Implications for Practice	133
Conclusions and Recommendations	136
Recommendations for Further Research	139
Conclusion	140
Appendices	141
Appendix A Institutional Review Board Approval Form	142
Appendix B Request of Approval for Research from Local Education Agency	143
Appendix C Approval for Research from Local Education Agency	144
Appendix D Request for Participation	145
Appendix E Informed Consent Form	146
Appendix F Data Collection Instruments	147
Appendix G Factors for Teachers' Attitudes Toward Computers	156
Appendix H Permission for Use of Instruments	162



Appendix I Teacher-Reported Weekly Logs of Computer Use	164
Appendix J Request for Approval of Professional Development Activity	165
Appendix K Outline of Professional Development Activity	166
Appendix L Collaborate and Create Syllabus of Instruction	169
Appendix M Screen Shot of The Learning Page and School Website, with The Learning Page Link	171
Appendix N Third Grade Learning Page, with Social Studies and Science Pages	172
Appendix O Third Grade Lessons Linked to Social Studies and Science Pages	174
Appendix P Pre-Program Descriptive Statistics for (a) Teachers' Attitudes Toward Computers (Tacv3.2a)	176
Appendix Q Post-Program Descriptive Statistics for (a) Teachers' Attitudes Toward Computers (Tacv3.2a)	178
Appendix R Pre-Program Descriptive Statistics for (b) Technology Proficiency Self-Assessment (Tpsa v1.0)	180
Appendix S Post-Program Descriptive Statistics for (b) Technology Proficiency Self-Assessment (Tpsa v1.0)	181
Appendix T Pre- and Post-Program Descriptive Statistics for (c) Stages of Adoption	182
References	183
Vita	199

## List of Tables

Number		Title
		Page
Table 1	Research Design for Treatment and Comparison Groups	71
Table 2	Timeline for Data Collection	80
Table 3	Demographic Profile of the Research Sample	99
Table 4	Internal Consistency Reliability for scores on the Tac 3.2a Factors	101
Table 5	Internal Consistency Reliability for scores on the Tpsa , v1.0, 4 Factor Instrument	102
Table 6	Descriptive Statistics of Factors	103
Table 7	Adjusted Means MANCOVA	114

## List of Figures

Number	Title	Page
Figure 1	Collaborate and Create teacher resource website.	88
Figure 2	The Learning Page, third grade science lessons.	89
Figure 3	Example of teacher-made technology-integrated lesson.	90
Figure 4	Teacher-reported computer use by students, PDG and WAG.	117
Figure 5	2003-2004 weekly computer lab sign-in sheets.	117

## Abstract

This non-equivalent group study explored the impact of teacher participation in the development and use of a web-based instructional resource on computer utilization by students. The effects of participation in the technology initiative on teacher attitudes toward computers, technology proficiency, and stages of adoption of technology were also investigated. Teacher volunteers participated in a treatment group that received a professional development intervention and a comparison or web access group (WAG) that received no professional development. The treatment, or Professional Development Group (PDG), received instruction that modeled a constructivist hands-on approach to creating technology-rich lessons based on classroom curricula and Internet technologies to encourage technology integration in the classroom. The lessons were posted online using identical websites for both groups and accessed by students of the PDG and WAG teachers promoting the school-wide use of technology as a tool for active, directed learning. Use of the online resource was analyzed descriptively through computer lab usage logs, teacher-reported weekly logs, and number of hits on the websites. Utilization of the online resource by students of the professional development group of teachers was slightly higher than by students of the comparison group of teachers. The findings also indicated that exposure to the professional development intervention increased reported use of integrated applications and encouraged higher stages of adoption by the experimental group of teachers (PDG) than the comparison group of teachers (WAG).

## Chapter One: Introduction

It is often difficult to move from theory to practice in educational settings (Bednar, Cunningham, Duffy, & Perry, 1992; Bransford, 1990). Many professional development practices in education expected to promote a specific effect in the classroom are not successful, and often the professional development provided to classroom teachers to facilitate the integration of technology into the core curriculum fall short of the expectations (Baker, 1999; Semple, 2000; Tessmer, 1993). Computer technology that is used for more than an information-giving tool and is incorporated into the core curriculum remains an area of need in education (Provenzo, Brett, & McCloskey, 1999; Rakes, Flowers, Casey, & Santana, 1999). Programs used for teaching educators that are based on theories of learning do not always result in effective practices in the classroom (Mouza, 2003).

The purpose of the present study was to explore the effectiveness of a hands-on teacher professional development program and the availability of a web-based resource in integrating computer technology use by students into the core curriculum. The professional development program that was the focus of this study incorporated theoretical and conceptual models of learning to engage teachers in developing and implementing a web-based instructional resource based on technologies to transform student learning. The effects of participation in the professional development program on teacher attitudes toward computers, technology proficiency, and stages of adoption of

technology were investigated. The impact of teacher participation in developing the web-based learning resource on computer utilization by students was also explored.

### *Background*

The learning benefits of integrating instructional technology into the classroom have been well-documented by research (Archer, 2000; ChanLin, Huang, & Chan, 2003; Chen & McGrath, 2003; Duffy & Jonassen, 1991). The infrastructure, availability of computers, and access are rapidly becoming more equitable across school districts due to federal legislation that is intent on improving, reforming, and transforming public education (Rocap, Cassidy, & Conner, 1998). In 1995, the U. S. Department of Education and the Office of Educational Research and Improvement (OERI) funded a national Regional Technology in Education Consortia (RTEC) program to assist and support efforts to integrate advanced technologies into K-12 education and adult literacy programs. On February 15, 1996, President Bill Clinton issued the Technology Literacy Challenge that recognized both the significant role advanced technologies play in improving education and the growing and critical need for widespread technology literacy. Four technology-related goals were highlighted in this challenge: (a) professional development for teachers, (b) hardware, (c) connectivity, and (d) software and online resources. One of the greatest continuing challenges is facilitating the integration of instructional technology in the classroom by teachers who are not sufficiently prepared to confront these objectives (Edwards, 2002; Fulton, 2001; Poole & Morgan, 1998; Prain & Hand, 2003).

The No Child Left Behind Act (NCLB), signed into law by President George W. Bush in January 2002, not only reevaluated educational models in an effort to raise

national educational standards, but also attempted to provide students with the technological support necessary for success in a technologically advanced society. Since passage of the NCLB Act, the Regional Educational Laboratories (RELs), a network of 10 regional laboratories, have worked to build the capacity of the nation to respond to and implement the goals outlined in the legislation. With the support of the U. S. Department of Education Institute of Education Sciences (IES), formerly the OERI, the laboratories work as vital partners with state and local educators to use research to undertake the difficult issues of education reform and improvement, resulting in models for implementing systemic reform on a broad scale.

Although the most recent National Educational Technology Plan released in January 2005 reported that virtually all classrooms are now linked to the Internet, it remains clear that the application of educational technology in the schools is still inadequate. Providing the hardware without appropriate training on the endless possibilities for enriching the learning experience means that the great promise of technology is frequently unrealized (U. S. Department of Education, Office of Educational Technology [USDOE Office of Educational Technology], 2004). This latest National Technology Plan proposes seven major action steps to maximize the benefits in public education due to the rapidly evolving development of information and communication technology. Strengthening leadership at all levels, improving teacher training, and moving toward digital content are among the action steps recommended for preparing today's students for the opportunities and challenges of tomorrow (USDOE Office of Educational Technology).

### *Statement of the Problem*

Society in general is progressing into a global economy, and the educational environment should promote the effective use of technology to improve student achievement. Although computer technology use in the classroom is increasing, it is rarely utilized effectively (Barron, Kemker, Harmes, & Kalaydjian, 2003; Fulton, 2001). Effective professional development initiatives for classroom teachers are critical to increasing the frequency of computer technology use in the classroom by students (Barak, Maymon, & Harel, 1999; Barth, 1990; Becker & Riel, 2000; Bonk, Malikowski, Angeli, & Supplee, 2001; Brent, Brawner, & VanDyk, 2002). Comprehending the potential for technology to help students construct their own meaning, based on learning activities that include multiple modalities across multiple domains, is the goal of effective computer technology integration in the classroom (Mills & Tincher, 2003).

While much has been written about models of effective professional development for technology integration, there is a need for more information on the application of these models in real school settings. Studies have outlined the need to adopt performance indicators for administrators and teachers to promote active learning in the classroom (Barron et al., 2003; Bybee & Loucks-Horsley, 2000; Mills & Tincher, 2003; Mouza, 2003; Thompson & Knezek, 2002). As a result of some of these studies, the International Society for Technology in Education (ISTE) and the National Council for Accreditation of Teacher Education (NCATE) combined their goals to develop common standards and performance indicators that promote the realization of technology integration in the classroom by students and increased performance by administrators and teachers. Introducing new technology standards is considered to be an effective strategy for



promoting computer literacy among administrators, teachers, and students (Bybee & Loucks-Horsley; Mills & Tincher; Mouza; Thompson & Knezek), and encouragement of effective technology use in the classroom is the goal of current local, state, and federal technology initiatives.

While standards and performance indicators are the focus of organizations in the promotion of technology use and goals, teachers must also develop an understanding of the multiple levels of technology use in the classroom (Jonassen, 1996a; LaJoie & Derry, 1993; Mills & Tincher, 2003), and the identification of effective computer technology use is not always consistent. Computer use by students can range from lower-level skill-and-drill practice to activities promoting multimedia learning environments that utilize the potential for technology to help students construct meaning (Goddard, 2002; Halpin, 1999; Harel, 1990). This latter type of computer technology use includes learning activities that promote higher-order thinking by students. Technology is often used for drill and practice instruction instead of higher-order thinking, and the number of classrooms that have evolved to highly interactive multimedia learning environments is limited (Barron et al., 2003; Fulton, 2001; Jonassen, 1996a). Inquiry into the type of training that will encourage teachers to use computer technology to facilitate learning is essential to the successful promotion of technology integration in the K-12 classroom that is aligned with the core curriculum.

The professional development program that was the centerpiece for the present study was designed to control for factors that have been identified as possible inhibitors to technology use by teachers (Brent et al., 2002; David, 1994; Loucks-Horsley, 1998; Mills & Tincher, 2003). Some negative approaches to professional development include

training that is removed from the work site, lack of ongoing support, forced participation in in-service training, and providing canned training programs that do not fully utilize the rich body of personal and professional experiences of teachers. Teacher professional development must maximize the autonomy of the adult learner, who is also looked upon as an expert in his or her area of specialty.

Malcolm Knowles, an early advocate for adult learners in the United States, was one of the first educators to formally recognize the needs of adult learners. Knowles popularized the term “andragogy” to characterize best practices in teaching adults in contrast to “pedagogy,” the accepted practices for teaching children. Knowles’ seminal work, *The Adult Learner: A Neglected Species* (1984a), postulated a set of principles to guide the practitioner in designing instruction to meet the adult learners’ needs.

According to Knowles, in adult learning it must be recognized that the learner has accumulated life experiences that are a rich resource for learning and the adult’s learning needs are closely related to changing social roles. It follows that adults are motivated to learn by internal as well as external factors, and they learn best through problem centered approaches that focus on the immediate application of learning (Knowles).

Knowles’ principles of adult learning are highly congruent with the constructivist view of learning, which postulates that learning is an active process in which learners construct new ideas or concepts based upon their current or past knowledge. From the constructivist perspective, the learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure to do so. Cognitive structures such as schema and mental models provide meaning and organization to

experiences that allow the individual to move beyond the given information to personal understanding (Bruner, 1973).

Studies on constructivist learning address the difficulties of putting theories into practice in the classroom and promote the power of technology to transform learning (Bransford, 1990; Bruce & Levin, 2001; Chou & Moretti, 1992; Jonassen, Howland, Moore, & Marra, 2003; Jonassen, Peck, & Wilson, 1999). Ongoing instructional reform efforts promote the use of learner-centered cognitive constructivist teaching methods (Cobb, 1999; Jonassen, 2003; von Glasersfeld, 1989, 1995a, 1995b). From a constructivist perspective, the learner actively integrates new information with existing knowledge to construct meaning through experience and social settings. Replicating authentic learning environments in professional development sessions is necessary to promote the experience of real-world applications by teachers (Jonassen et al., 2003). There is a need for further testing and review of the research-based technology integration strategies that are reported in the professional literature to be effective in changing the epistemological beliefs of teachers and encouraging reform in teaching practices (Bruce & Levin, 2001; Bruce & Peyton, 1999; Bybee & Loucks-Horsley, 2000; Dexter, Anderson, & Becker, 1999). Promising programs are those that are grounded in the constructivist approach to teaching and learning, mindful of the needs and strengths of the adult learner.

#### *Purpose of the Study*

The purpose of this study was to explore the effectiveness of a hands-on teacher professional development program in integrating web-based computer technology use by students for meaningful learning aligned with core curricula. The professional development program in the present study incorporated both theoretical and empirically

tested models of learning to engage teachers in developing and implementing a web-based instructional resource. The study investigated the effects of participation in the professional development program on teacher attitudes toward computers, technology proficiency, and stages of adoption of technology. The study also explored the impact of teacher participation in developing the web-based learning resource on computer utilization by students.

The learning environment for the professional development program was established using a framework based upon constructivist learning theory and adult learning principles. Participants collaboratively developed lessons for a school-wide web-based resource and subsequently transferred this constructivist learning environment into the classroom through student utilization of the web-based resource. The ultimate goal of the program was to encourage the transfer of constructivist learning principles to student classroom activities involving knowledge construction through the use of web-based computer technology.

Teacher-created, technology-integrated lessons developed during the professional development sessions provided directed student access to the Internet through a school-based website. The availability of this online resource in the computer lab and the classroom encouraged teachers to increase student utilization of computer technology due to the accessibility of the lessons on the website. The primary hypothesis of this study was that the teachers who participated in the professional development group (PDG) would report improved attitudes toward computers, improved technology proficiency, and increased stages of adoption of technology. It was further hypothesized that students of the PDG teachers would utilize the school-wide web-based technology integrated

lessons with greater frequency than students of the comparison group teachers. These hypotheses led to the overarching research question: Does a school-wide technology initiative have a more positive impact on reported attitudes toward computers, technology proficiency, stages of adoption of technology, and student utilization of a web-based resource for learning by teachers who participate in the professional development technology intervention than teachers in the comparison group? Five research questions were formulated to test the assumptions of this study.

### *Research Questions*

#### *Research Question 1*

Will reported attitudes toward computers be more positive for teachers who participate in the professional development technology intervention than for teachers in the comparison group?

#### *Sub-questions to Research Question 1.*

a. Will there be a greater reported increase in enthusiasm/enjoyment toward computers by teachers who participate in the professional development technology intervention than teachers in the comparison group?

b. Will there be a greater reported decrease in anxiety toward computers by teachers who participate in the professional development technology intervention than teachers in the comparison group?

c. Will there be a greater reported decrease in avoidance of computers by teachers who participate in the professional development technology intervention than teachers in the comparison group?

d. Will there be a greater reported decrease in perceptions of computers as having a negative impact on society by teachers who participate in the professional development technology intervention than teachers in the comparison group?

e. Will there be a greater reported increase in positive attitudes about productivity of computers by teachers who participate in the professional development technology intervention than teachers in the comparison group?

### *Research Question 2*

Will there be greater reported increase in technology proficiency by teachers who participate in the professional development technology intervention than teachers in the comparison group?

#### *Sub-questions to Research Question 2.*

a. Will there be a greater reported increase in technology proficiency as it relates to Electronic Mail by teachers who participate in the professional development technology intervention than teachers in the comparison group?

b. Will there be a greater reported increase in technology proficiency as it relates to the World Wide Web by teachers who participate in the professional development technology intervention than teachers in the comparison group?

c. Will there be a greater reported increase in technology proficiency as it relates to Integrated Applications by teachers who participate in the professional development technology intervention than teachers in the comparison group?

d. Will there be a greater reported increase in technology proficiency as it relates to Integrating Technology into Teaching by teachers who participate in the professional development technology intervention than teachers in the comparison group?

*Research Question 3*

Will there be a greater reported increase in technology adoption by teachers who participate in the professional development technology intervention than teachers in the comparison group?

*Research Question 4*

Will there be a relationship between age, teaching experience and educational level and the dependent variables (Teacher's Attitudes Toward Computers, Technology Proficiency, and Stages of Adoption of Technology) in teachers who participate in both groups?

*Research Question 5*

Will there be a greater student utilization of the school-wide web-based resource in classes taught by teachers who participate in the professional development technology intervention than in classes taught by teachers in the comparison group?

*Significance of the Research*

According to the proceedings of *The Secretary's Conference on Educational Technology: Evaluating the Effectiveness of Technology* (Baker, 1999), the emphasis in schools' technology needs has shifted from building and implementing a technology infrastructure to evaluating the effectiveness of technology use in schools and classrooms. Although this shift in focus is well-documented by recent research (Chambers & Carbonaro, 2003; Hughes & Ooms, 2004; O'Bannon & Judge, 2004), the effective use of technology as a learning tool in the classroom remains illusive (Barron et al., 2003; Jonassen, 1996b; Mills & Tincher, 2003). Inquiry into effective methods for integrating technology into the classroom for student use is essential. Learning should

emphasize the active, constructive, collaborative, intentional, conversational, contextualized, and reflective qualities of learning (Jonassen et al., 2003).

Within a constructivist philosophy, teachers as learners are introduced to different perspectives of teaching using constructivist principles. The theoretical motivation for integrating these principles into the professional development program comes from the argument that technology can be viewed as both a cognitive tool and a context that enhances the learning process (Jonassen et al., 2003). One of the goals of the United States Congress' Web-Based Education Commission (2000) is research and development on how people learn in the Internet age. To fulfill this goal, it is necessary to employ professional development practices that encourage computer technology as a learning tool in the classroom (Jonassen, 2000). The professional development program examined in this study incorporated documented, empirically-based learning strategies to encourage the use of best practices in technology integration (Howard, McGee, Schwartz, & Purcell, 2000; Jonassen & Rohrer-Murphy, 1999; Niederhauser & Fields, 1999).

NCLB, Title II, Part D, Section 2401, "Enhancing Education Through Technology Act of 2001," Section 2402, Purposes and Goals, cites as a primary goal the improvement of student academic achievement through the use of technology in elementary and secondary schools. Additional goals of part D are:

- A. To assist every student in crossing the digital divide by ensuring that every student is technologically literate by the time the student finishes the eighth grade, regardless of the student's race, ethnicity, gender, family income, geographic location, or disability.



B. To encourage the effective integration of technology resources and systems with teacher training and curriculum development to establish research-based instructional methods that can be widely implemented as best practices by state educational agencies and local educational agencies ([www.ed.gov/policy/elsec/lcg/esca02/pg34.htm](http://www.ed.gov/policy/elsec/lcg/esca02/pg34.htm)).

Numerous federal initiatives and ongoing technology professional development programs have investigated and attempted to define and measure technology use in the schools (Becker & Riel, 2000; Goddard, 2002; Gonzales, Pickett, Hupert, & Martin, 2002; Kanaya, Light, & Culp, 2005; Mills & Tincher, 2003; Mouza, 2003; O'Bannon & Judge, 2004; Roblyer & Knezek, 2003; Schrum, 2005; Thompson, 2005). Many studies have examined teachers' use of technology and the varied ways in which technology use is defined and measured (Bebell, Russell, O'Dwyer, 2004; MacGregor & Lou, 2004/2005; Staples, Pugach, & Himes, 2005). Understanding the extent to which technology is being used by teachers and assessing the impact of technology on learning outcomes remains uncertain (Goddard, 2002; Hazzan, 2002/2003; Jonassen, 2003; Pederson & Liu, 2002/2003).

The development of more sophisticated learning tasks that directly engage learners is supported in the literature as an effective way to transform the way learning occurs (Bruce & Levin, 2001; Chou & Moretti, 1992; Craven, DiPasquo, Freitag, Mitchell, Nigam, et al., 2000; Jonassen et al., 1999). The present study examined the effects of experimentation with such a learning strategy for teachers in an elementary school and the subsequent effect on computer technology use in the classroom for students. The findings of this study may serve to inform others who seek to create more

effective learning environments for technology integration in real school settings. A professional development program modeled after principles of a constructivist-learning environment and adult learning principles may increase teacher understanding and use of technologies, and subsequently promote an increase in computer technology use by students of these teachers.

Another system of thought that has implications for practical educational practice and speaks to the significance of the present study has to do with influencing the educative quality of total environments. Every organization is a social system that serves as a way to help people meet human needs and achieve human goals (Goddard, 2002; Knowles, Holton, & Swanson, 1998; Rogers, 1995). The introduction and acceptance of any technology initiative requires a change in the culture of the organization or school.

A number of processes and models that encourage change have been identified through empirical research (David, 1994; Goddard, 2002; Little, 1993; Rogers, 1995; Stielgelbauer, 1994). According to Loucks-Horsley (1989), new models that reflect different ways of thinking about how change fits into today's educational systems are needed. Studies that identify characteristics of effective schools and practices cite the transformation of teaching and learning as an important aspect of systemic education reform (David). The deep seated systemic change demanded of current educational reform requires a new model of change (Loucks-Horsley; Stielgelbauer), that requires changing attitudes, perceptions, behaviors, relationships, and the way people collaborate (Stielgelbauer). Adopting an innovation is an active process that involves reinvention, and adopters must make the innovation their own if they are to continue using it (Rogers).

Professional development that is organized around real problems of practice must be a part of teacher education within the local school, opposed to the out-of-school “training” model that has been the dominant approach to learning opportunities available to teachers (Little, 1993). A professional development learning environment for teachers that promotes the transfer of what is learned to classroom pedagogy is necessary. Meaningful professional development is a critical element in asserting and sustaining change (Jonassen et al., 2003). The principles of andragogy (Knowles, 1974) are a system of elements that can be adopted in whole or in part as a conceptual framework for incorporating constructivist skills in a professional development initiative.

The professional development program investigated in this study allowed teachers to create technology integrated lessons aligned to their individual needs, taking ownership of the process and resources, including the posting of lessons on the web-based resource. The teacher activities incorporated theoretical models and practical applications of learning to engage teachers in the development and implementation of an instructional technology resource. This study may provide useful insights to school leaders who seek to implement change through technology innovations in their schools. The present study chronicled the experience of one school that was committed to introducing technology integration into the core curriculum. The findings of this study may be useful to other schools that are struggling with the implementation of technology integration into current curricula.

### *Definition of Terms*

The following definitions are provided to facilitate interpretation of this study.

*Andragogy:* A general theory for adult learning that emphasizes the importance of experience as well as self-direction and intrinsic motivation. This theory also emphasizes the role of problem-solving and its immediate value in learning activities; these qualities have been shown to be critical in computer learning tasks (Knowles, 1989).

*Computer literacy:* The level of expertise and familiarity someone has with computers. The term generally refers to the ability to use applications rather than to develop applications.

*Computer use as a learning tool:* The use of computers for knowledge construction in real-world contexts to complete authentic learning tasks that represent multiple perspectives and viewpoints; using computer software in education to help students with basic skills, logic, problem solving, and various other academic skills (Jonassen, 1995).

*Constructivist professional development:* In this study, learning sessions provided for teachers based upon principles of constructivist learning theory, including scaffolding, collaboration, authentic and active learning, and problem-solving.

*Effective computer technology use in education:* Using computer technology in the classroom as it relates to the core curriculum, as a learning tool for higher order thinking and problem-solving activities.

*Effective professional development in instructional technology:* The development of learning groups organized around real problems of practice that provide access to outside resources and expertise often drawing support from the community and modeled

around adult learning theories. Effective professional development also provides teachers with in-classroom assistance and support while they attempt to develop and implement new instructional practices that encourage the use of the computer as a learning tool for higher-order thinking and problem-solving activities (Jonassen, 2003).

*School-wide instructional website:* In the present study, an instructional website made up of technology-integrated lessons, collaboratively created by teachers in the professional development group (PDG). The lessons, aligned with core curricula and applicable to classroom instruction, were posted by grade level for students to access by teachers school-wide. This site was developed for the present study to provide specific web-based information and searches for students to use in technology-integrated lessons that minimized open surfing of the Internet.

*Technology integration in the school curriculum:* The instruction of students in subject matter content, utilizing technology to instill and reinforce the concepts and skills of the discipline on the instructional continuum.

*Technology proficiency:* Competence in four domains of computer technology use: (a) Electronic mail, (b) Worldwide Web, (c) Integrated Applications, and (d) Integrating Technology into Teaching, according to International Society for Technology in Education (ISTE) National Education Technology standards for teachers (Ropp, 1999).

*Constructivist learning environment:* In technology integration this includes hands-on activities, authentic learning in authentic settings, modeling of expert strategies for learning, problem-solving activities, scaffolding, collaboration, and group work (Jonassen, 1995).

*Professional Development Group (PDG):* In the present study, a volunteer group of teachers who collaboratively created technology-rich lessons for the school-wide web-based learning site based upon classroom curriculum in three, 2-hour, hands-on professional development sessions.

*Web-Access Group (WAG):* In the present study, a volunteer the group of teachers who received no professional development intervention, but had access to school-wide web-based learning site, with a 1-hour orientation on its use with students as a learning tool.

### *Setting and Population*

The setting for this study was a suburban public school in the southeastern United States. The participants were recruited from a sample of convenience, K-5 teachers who volunteered for the technology initiative. A total of 57 participants were divided into two groups. One group received the professional development treatment (PDG), and a comparison group (WAG) had access to the school-wide web-based resource, but did not participate in the professional development sessions. Thirteen teachers made up the non-research group (NRG), and had access to the website, but did not fill out the pre- and post-program questionnaires.

### *Research Methodology*

#### *Design*

A non-equivalent groups design (NEGD) was used in this study due to non-random assignment of participants. The non-equivalent groups design is susceptible to the internal validity threat of selection, therefore, all variables of the pre-test questionnaire, Teacher's Attitudes Toward Computers, Technology Proficiency, and

Stages of Adoption, were used as the covariate in the multivariate analysis of covariance (MANCOVA) to control for differences between the groups at the onset of the study. Both groups were measured with identical questionnaire items that have a history of yielding valuable and reliable data. Hypotheses 1 through 4 were analyzed using inferential statistics. Hypothesis 5 was examined descriptively.

### *Instrumentation*

Instruments were selected to evaluate the effects of two methods of promoting the integration of technology into the classroom. Three questionnaires previously used in educational research were combined and administered simultaneously to both groups in November of 2003, and again in May of 2004. The instruments included Teachers' attitudes Toward Computers version 3.2a (Tac3.2a), Technology Proficiency Self-Assessment version 1.0 (Tpsa), and Stages of Adoption. All instruments were well grounded in context, and reliability data were available from the publisher (Knezek, Christensen, Miyashita, & Ropp, 2000).

### *Organization of Study*

The study is organized into five chapters, with Chapter One presenting an overview of the study, background, statement of the problem, and purpose of the study. The chapter also introduces the research questions, significance of the research, definition of terms, setting and population, and research methodology. Chapter One concludes with the organization of the study.

Chapter Two provides a review of the related literature, beginning with an overview of the federal education accountability legislation related to technology integration in schools. Implications for local administrators and teachers are explored in

this section, followed by a discussion of the significance and relationship of learning theories to technology applications and professional development. Constructivist learning theory and adult learning principles are explored. Chapter Two also examines the effects of organizational change and systemic reform on the culture of the school. Innovation and change as related to technology use by individuals and organizations are briefly addressed.

A review of the empirical research on effective school applications of computer technology concludes the chapter. The section includes studies that focus on computer technology integration utilizing higher-order thinking, problem-based learning, group instruction, scaffolding, transfer of knowledge, use of hypertext, Web-based technologies, and Internet use in the classroom.

Chapter Three presents the null hypotheses and discusses the research methodology in greater detail. Discussion includes the population sample, instrumentation, data collection procedures, data analysis techniques, ethical considerations, delimitations, and limitations. Data analyses and findings are presented in Chapter Four. This work concludes with Chapter Five, where the study is summarized, findings are discussed, and conclusions and implications for practice are presented. The chapter closes with recommendations for further study.



## Chapter Two: Literature Review

### *Introduction*

The present study examined the outcomes of an initiative to integrate technology into the core curriculum of an elementary school. The teacher professional development program that was the centerpiece of the study was grounded in learning theory, best practices in adult learning, and the empirical knowledge base on technology integration in schools. A voluminous body of knowledge exists around these topics, but empirical studies that test the assumptions and examine the effects of accompanying practices in schools are relatively rare. This review of the literature begins with an overview of the federal educational accountability legislation that is the major impetus for local efforts to integrate technology into the K-12 core curriculum. It is the pressure to meet federally mandated goals and performance indicators for technology program implementation that prompted the adoption of technology standards at the state and local levels which, in turn, has pressured administrators and teachers to fully integrate technology into the core curriculum at the school level. This policy framework supports the significance of the present study.

The policy discussion is followed by a synthesis of the theories and applications from which the conceptual framework for the study was crafted. The discussion of the conceptual framework is followed by a critical review of the empirical research on technology integration in schools that further supports the need for the study. The chapter closes with a summary that relates this knowledge base to the need for the study.

### *Policy Framework*

The nation's latest National Education Technology Plan, released in January 2005, reported that the application of educational technology in the schools is still inadequate. The great promise of Internet technology is frequently unrealized, and this National Technology Plan reported seven major action steps and recommendations proposed to maximize the benefits in public education due to the rapidly evolving development of information and communication technology. Strengthening leadership at all levels, improving teacher training, and moving toward digital content are among the action steps recommended for preparing today's students for the opportunities and challenges of tomorrow (USDOE Office of Educational Technology, 2004).

The purpose of the 2004 National Technology Plan was to establish a national strategy supporting the effective use of technology to improve student academic achievement and preparation for the 21st century. The Plan provided an opportunity to reflect on the progress our nation has made as a result of a decade of increased federal, state, local and private investments in connecting classrooms to the Internet, providing students with computers, and equipping teachers with the skills they need to use technology as an instructional tool. This National Technology Plan was developed collaboratively with the U.S. Department of Education, seeking input from a broad audience, including students and various levels of educators.

The development of the new technology plan was a long-range national strategy that is looked upon as a guide for using technology effectively to improve student academic achievement either directly, or through integration with other approaches to systemic reform. Effective technology means employing the computer as a tool to increase student ability to use higher-order thinking, comparison/contrast, analysis and

synthesis of information (Jonassen et al., 2003). Numerous studies report that computers are in place for student use but the learning environment has not been set up for students to use technology effectively (Cuban, 1988).

Systemic education reform encouraged at the state and local levels by federal policy include requirements for scientifically based research and the development and evaluation of designs to improve student academic achievement according to the rigid assessments of standards implemented across the nation (Bybee & Loucks-Horsley, 2000; Sivin-Kachala & Bialo, 2000; Thomas & Knezek, 2002). Technology innovations often have a widespread positive impact on the entire school community and local education agency (David, 1994; Little, 1993).

#### *Federal Accountability Legislation*

Early federal programs focused on increasing access to technology as outlined in the report from the 1995 Secretary's Conference on Educational Technology. Subsequently, the first national technology plan in 1996 created a framework for a vision for the future. In 1996 the challenge for the nation was to help learners meet the challenges of the 21st century by connecting every classroom to the information superhighway with computers, good software, and well-trained teachers. These key priorities were identified to bring about the following four goals: (a) All teachers in the nation will have the training and support they need to help students learn using computers and the information superhighway; (b) All teachers and students will have modern multimedia computers in their classrooms; (c) Every classroom will be connected to the information superhighway; and (d) Effective software and on-line learning resources will be an integral part of every school's curriculum. Although this first technology plan

acknowledged that without trained and experienced teachers computer equipment would sit idle in classrooms, the percentage of technology money spent on professional development remains low (Edwards, 2002; Fulton, 2001). Problems identified as obstacles to introducing effective technology in the schools are teacher resistance and lack of sufficient training (Mouza, 2003). The National Center for Educational Statistics (NCES, 1999) observed that less than 20% of current teachers reported feeling very well-prepared to integrate educational technology into classroom instruction.

In 1999 the United States Congress' Web-Based Education Commission set out as one of its goals research and development on how people learn in the Internet age (Fulton, 2001). How students learn using technology is an important phenomenon in the development of curriculum and instruction, and directly relates to effective professional development that encourages computer technology use in the classroom. The majority of educational environments as they currently exist do not apply innovative utilization of technology by educators and students. The goal of promoting the effective use of technology is to improve student achievement, yet there is a definitive lack of practical implementations, and even fewer empirical validations of effective technology use linking educational technology and constructivism (Cobb, 1999).

*E-learning* (U. S. Department of Education [USDOE], 2000), the second national technology plan, moved beyond the goals of the original technology plan. The amount of progress moving toward integrating technology into teaching and learning and the continued advances in the affordability and capabilities of technology necessitated a strategic review and revision of the national educational technology plan in the fall of

1999 by the U.S. Department of Education. The outcome of this strategic review was five new national educational technology goals: (a) All students and teachers will have access to information technology in their classrooms, schools, communities and homes; (b) All teachers will use technology effectively to help students achieve high academic standards; (c) All students will have technology and information literacy skills; (d) Research and evaluation will improve the next generation of technology applications for teaching and learning; and (e) Digital content and networked applications will transform teaching and learning (USDOE, 2000).

According to USDOE (2000), research and evaluation studies demonstrated that school improvement programs that employ technology for teaching and learning yield positive results for students and teachers. The focus and goals of this national technology plan shifted from increased access to technology, to an effort of improved student achievement through the use of technology in the classroom. E-learning centered on how to help students who are growing up exposed to various technologies, and explored this trend and the implications for creating digital age educational opportunities to match the expectations these students. This effort created new priorities and actions to ensure that technology is being used effectively to prepare students for their future and enhance the educational environment.

One of the results of this national technology plan was the Educational Technology initiative (EdTech), supporting states throughout the nation with financial assistance in an effort to promote technology education nationwide. The EdTech initiative clearly stated the need for integrating technologies across the curriculum, as well as the need to research the effectiveness of these technologies. The primary goal of

the EdTech program was to improve student academic achievement through the use of technology in schools. It was also designed to assist students in crossing the digital divide by ensuring that every student is technologically literate by the end of eighth grade, and to encourage the effective integration of technology with teacher training and curriculum development to establish successful research-based instructional methods. For these goals to be realized, the educational leader must support and encourage technology innovations through school-based programs to improve technology-integrated teaching and learning practices within the schools. For schools to meet the technology use goals outlined at the local, state, and national levels, the administrator must encourage and support the school-wide adoption of technology innovations. Educational leaders must support and inspire teachers through a shared vision for comprehensive integration of technology into the school. The goals of EdTech grants are to: (a) Improve student academic achievement through the use of technology in elementary schools and secondary schools, (b) Assist students in becoming technologically literate by the time they finish the eighth grade, and (c) Ensure that teachers are able to integrate technology into the curriculum to improve student achievement.

The No Child Left Behind Act of 2001 (NCLB) charged the United States Secretary of Education with developing the nation's third National Education Technology Plan. That plan was officially released in January 2005. The goal was to develop a long-range national plan for educational technology to promote and enable measurement of the extent to which the nation's schools effectively use technology. The plan articulated a long-range national strategy and guidelines for using technology effectively to improve student academic achievement either directly or through integration with other

approaches to systemic reform (USDOE Office of Educational Technology, 2004). The plan also provided an opportunity for reflection on the progress our nation has made as a result of a decade of increased federal, state, local and private investments. Achievements included connecting classrooms to the Internet, providing students with computers, and equipping teachers with the skills they need to use technology as an instructional tool. In spite of this progress, an editorial in the *Journal of Research on Technology in Education* stressed the limited impact of technology on actual school reform (Schrum, 2005). The lack of any change in educational practice is attributed by some to the disconnect between the interests of policy makers, researchers, and the needs of teachers and schools (Bull, Knezek, Roblyer, Schrum, & Thompson, 2005).

There is an apparent agreement among scholars and practitioners that a move from preparation in technology to implementation is needed. In addition, the use of technology for knowledge construction in the classroom to promote greater learning gains is needed (Duffy & Jonassen, 1991). The integration of constructivist learning theory with technology is a relatively recent but logical progression in technology integration, because of the pervasiveness with which technology has influenced life, learning and work (Duffy & Jonassen, 1991). The task of devising instructional paradigms for the information age seems a natural one for the field of technology (Cobb, 1999). Many educational technologists have shown enthusiasm for constructivism, arguing that constructivism highlights what was always best in the education technology approach and could serve well as its new theoretical center (Bednar, Cunningham, Duffy, & Perry, 1991; Cobb, 1999; Duffy & Jonassen, 1991, 1992).

*State and Local Education Agency Accountability*

The primary goal of the EdTech program was the improvement of student academic achievement through the use of technology in schools. The program also encouraged the effective integration of technology with teacher training and curriculum development to establish successful research-based instructional methods. Through the EdTech program, the U. S. Department of Education provides grants to state educational agencies (SEAs) on the basis of their proportionate share of appropriated federal funding. Under this program the states may retain up to 5 % of their allocations for state-level activities, and they must distribute one-half of the remainder by formula to eligible local education agencies (LEAs) and the other one-half competitively to eligible local entities.

Goals of a technology innovation must extend beyond providing technology access in the classroom. Teaching methodologies that promote and enhance learning opportunities for all students, administrative support of teacher professional development, and school-wide technology innovations are an important contextual part of technology use in educational environments. Technology Standards for School Administrators (TSSA) are an initiative that has developed a national consensus on technology standards for school administrators (<http://cnets.iste.org/administrators>). Educational leaders must support and inspire teachers through a shared vision for comprehensive integration of technology into the school. TSSA asserted that educational leaders have a responsibility to promote and nurture a culture of responsible risk-taking by fostering an environment and culture conducive to the realization of a technology vision. The standards also exhort school leaders to advocate policies promoting continuous innovation with technology. To promote the effective use of technology within the educational environment, teachers



must be prepared to implement technology that directly engages students in learning. It is not enough to provide access to technology in the schools; it is necessary to implement a quality learning environment in which advanced technologies are used.

The second National Technology Plan, *E-learning* (USDOE, 2000), asserted the necessity of establishing a definition of technological literacy and assessing technology literacy through implementation of performance indicators based on the National Educational Technology Standards. These performance indicators have recently been adopted by many states across the nation. The National Educational Technology Standards (NETS) for Students were released in June 1998, NETS for Teachers in June 2000, and NETS for Administrators (TSSA) in November 2001. At the state level, 48 of the 51 states have adopted, adapted, aligned with, or otherwise referenced at least one set of standards in their state technology plans, certification, licensure, curriculum plans, assessment plans, or other official state documents. The NETs website lists these standards and identifies the states that have adopted the standards for administrators, teachers and students (National Educational Technology Standards [NETS], n.d.). These performance indicators include “effective teaching with technology.” Effective teaching with technology is defined as integrating computer technology with core curriculum as a classroom learning tool for higher-order thinking and problem solving activities (Mills & Tincher, 2003).

In summary, students are expected to achieve computer literacy by grade eight according to the National Educational Technology Standards performance indicators for students and state technology standards. The technology goals in No Child Left Behind

(NCLB) support computer technology use in the classroom as a learning tool and the need for teacher proficiency in technology through effective professional development.

### *Theoretical and Conceptual Framework*

The adoption of technology in the classroom by students through effective teacher training is supported by multiple theories of learning. A variety of theoretical frameworks can be applied to teacher professional development to promote technology integration in the classroom. This study is embedded in the traditions of the constructivism as expressed by Bruner (1966), Vygotsky (1978), Bandura (1977), Merriam and Caffarella (1999), Knowles (1998), and others. Constructivist learning theory will be explored first, followed by a discussion of the applicability of constructivism to adult learning and the applications of learning theory on technology integration in schools. These three themes form the conceptual framework for the study.

### *Constructivist Learning Theory*

The basic assumption of the constructivist stance maintains that learning is a process of constructing meaning; it is how people make sense of their experience (Merriam & Caffarella, 1999). Beyond this, constructivists differ among themselves as to the nature of reality, the role of experience, what knowledge is of interest, and whether the process of meaning-making is primarily individual or social (Steffe & Gale, 1995).

Constructivist theory as a general framework for instruction was initially based upon the study of cognition (Bruner, 1966). A major theme in Bruner's theoretical framework was that learning is an active process in which learners construct new ideas or concepts based upon their current and past knowledge. In more recent work, Bruner expanded the framework to encompass the social and cultural aspects of learning

(Bruner, 1986, 1990, 1996), similar to the perspective of Vygotsky's social development theory. The focus of both theories is cognitive development, and the major theme of the social constructivist framework is that social interaction plays a fundamental role in the development of cognition (Vygotsky, 1978).

Although there are a number of competing constructivisms (Phillips, 1995), there is the shared theory that constructivist learning increases knowledge transfer in students when adapted to principles of instructional design within a particular domain (Cobb, 1999). The importance of observing and modeling the behaviors, attitudes, and emotional reactions of others is a part of constructivism that is emphasized in the social learning theory of Bandura (1977). Social constructivism emphasizes the importance of culture and context in understanding what occurs in society and constructing knowledge based on this understanding (Derry, 1999). Vygotsky's social development theory can be compared to the work of Bruner, and Vygotsky's social constructivist perspective is complementary to the work of Bandura and social learning theory. More recently, Bandura focused his work on the concept of self-efficacy in a variety of contexts (1997).

In the educational environment, an approach to the less radical "social constructivist model" of learning theory seems to be appropriate (Hung & Chen, 1999), particularly in the elementary grades. The foundation of constructivist learning in an educational setting is that children actively construct their knowledge, and research shows that the modeling of this teaching approach during professional development programs will encourage a change in teacher pedagogy (Howard, McGee, Schwartz, & Purcell, 2000; Jonassen & Rohrer-Murphy, 1999).

The predominantly social constructive perspective of constructivism translates clearly to adult education where becoming knowledgeable involves acquiring the symbolic meaning structures appropriate to one's society. Since knowledge is socially constructed, teaching and learning is a process of negotiation involving the construction and exchange of personally relevant and viable meanings (Candy, 1991). This is especially true for adults. When information is assimilated to pre-existing notions and modified in light of new understanding, one's ideas gain complexity in the process of this understanding, and a critical insight is developed that increases learning in depth and detail (Brookfield, 1986).

### *Principles of Adult Learning*

Andragogy is a general theory for adult learning that emphasizes the importance of experience as well as self-direction and intrinsic motivation (Knowles, 1984a). This theory also emphasizes the role of problem-solving in learning activities. These qualities have been shown to be critical in computer learning tasks (Heerman, 1986; Zemke, 1984). The constructivist perspective is congruent with much of adult learning theory (Merriam & Caffarella, 1999), and the constructivist view of learning is particularly compatible with the notion of self-direction, since it emphasizes the combined characteristics of active inquiry, independence, and individuality in a learning task (Candy, 1991). With adult learners, learning activities and learning styles vary considerably due to physiology, culture, and personality. Therefore, generalizations about the nature of adult learning are difficult to make. The facilitation of adult learning is a highly complex psycho-social drama in which the personality of the individual and the contextual setting of the educational environment are crucial (Brookfield, 1986).

Knowles' concept of andragogy represents the first effort to develop a theory specifically for adult learning. Knowles emphasized that adults are self-directed and expect to take responsibility for decisions (Knowles, Holton, & Swanson, 1998). Adult learning programs must accommodate this fundamental aspect. Andragogy makes the following assumptions about the design of learning: (a) Adults need to know why they need to learn something; (b) Adults need to learn experientially; (c) Adults approach learning as problem-solving; and (d) Adults learn best when the topic is of immediate value.

In practical terms, andragogy means that instruction for adults needs to focus more on the process and less on the content being taught. Strategies such as case studies, role-playing, simulations, and self-evaluation are most useful, and teachers adopt a role of facilitator or resource rather than lecturer or grader. Andragogy applies to any form of adult learning and has been used extensively in the design of organizational training programs.

Of special relevance to the present study, Knowles (1984b) also provided an example of applying andragogic principles to the design of personal computer training: (a) There is a need to explain why specific things are being taught (certain commands, functions, operations, etc.); (b) Instruction should be task-oriented instead of memorization, and learning activities should be in the context of common tasks to be performed; (c) Instruction should take into account the wide range of different backgrounds of learners; learning materials and activities should allow for different levels/types of previous experience with computers; (d) Since adults are self-directed,

instruction should allow learners to discover things for themselves, providing guidance and help when mistakes are made.

Theories of adult learning such as andragogy (Knowles, Holton, & Swanson, 1999) or minimalism (Carroll, 1998), emphasize the importance of adapting instruction to the experience or interests of learners. According to these theories, there is no optimal sequence of instruction apart from the learner. The minimalism framework proposed by J. M. Carroll is a theory of how to design instruction for computer tasks, and the key ideas of minimalism include making learning tasks meaningful, active and self-directed learning, making error handling explicit, and linking training with actual use of the system (1995). The theory is a framework for the design of instruction, especially training materials for computer users. Carroll conceived the roots of minimalism to be firmly planted in the constructivism of Bruner and Piaget. The central idea of minimalist theory is to minimize the extent to which instructional materials obstruct learning, and focus the design on activities that support learner-directed activity and accomplishment (Carroll, 1998; Nowaczyk & James, 1993; van der Meij & Carroll, 1995). Minimalist theory emphasizes the necessity to build upon the learner's experience similar to Knowles' work.

#### *Learning Theories and Technology Integration*

Research shows that the use of technology in school communities can be more effective when structured around specific learning theories (Bednar et al., 1992; Dexter, Anderson, & Becker, 1999; Hughes, 2005; Jonassen, 2003; Mouza, 2003; Nicaise & Crane, 1999). Learning theory as an influence on the development and use of educational technologies has been traced in other studies as well (Halpin, 1999; Pugalee, 2001a,

2001b; Semple, 2000; Wang & Wedman, 2001). This discussion is limited to applications that are especially appropriate in promoting effective technology integration.

Technology integration is the process by which computer technology recreates or reorganizes the learning environment by being viewed in terms of function rather than application, process rather than approach (Mills & Tincher, 2003). For technology integration to happen, computers must be used as tools for learning (Jonassen, 2000), and computers and technology must be viewed in terms of function rather than application, process rather than approach (Becker, 1994).

The concept of “meaningful learning,” a more recent application of constructivist learning theory to technology use, encourages the use of technology to support constructive learning. Proponents of this perspective have developed principles of meaningful learning to engage active, constructive, intentional, authentic, and cooperative learning as goals for using technology in educational settings (Jonassen et al., 2003).

Constructivist learning theory is of particular interest to educational technology in part because it offers a new approach to instructional design. Seymour Papert and Idit Harcl (1991) contributed to constructivist learning theory by coining the term “constructionism” to mean “learning by making.” It was their claim that this constructionism was superior to the prevalent “instructionist” modes currently practiced in schools and that everything was better understood by being created. Papert (1980, 1993) maintained that children can understand concepts best when they are able to operationalize them through writing computer programs, and in his formulation of constructionism, technology can play a critical role in helping children learn.

Technological fluency is a related concept, used to describe the changing definition of what students need to know and do with technology (Fulton, 1997). Technological fluency is a combination of the information skills, communications skills, and technology skills necessary to function in a technological environment. Technologically fluent teachers are characterized by modeling technology use in the classroom, applying technology across the curriculum, applying technology to problem-solving and decision-making in authentic learning environments, and applying technology to facilitate collaboration and cooperation among learners (Bransford, 1990).

Another theory relevant to the use of computers for learning is the cognitive flexibility theory of Spiro, Feltovich, Jacobson, and Coulson (1992), which builds upon other constructivist theories and focuses on the nature of learning in complex and ill-structured domains (Spiro & Jehng, 1990). The ability to spontaneously restructure one's knowledge in adaptive response to radically changing situational demands (Spiro et al., 1992) can allow learners to gain a deeper understanding and is especially formulated to support the use of interactive technology, lending itself well to the constructivist rationale (Spiro et al., 1992).

Situated learning is a general theory of knowledge acquisition that has been applied in the context of technology-based learning activities for schools that focus on problem-solving skills (Cognition & Technology Group at Vanderbilt, 1993). Learning, as it normally occurs, is a function of the activity, context, and culture in which it occurs (i.e., it is situated), and this contrasts with most classroom learning activities that involve knowledge, as an out-of-context abstraction (Lave, 1993). Social interaction is a critical component of situated learning, as in Bandura's social cognitive theory and



constructivism in its various contexts. Situated learning is usually unintentional rather than deliberate (Lave & Wenger, 1991). Other researchers have further developed the theory of situated learning. Situated learning has antecedents in the work of Vygotsky and social learning, and all of these theories support the use of the computer as a learning tool that enables teachers and students to actively learn through the construction of knowledge. In this learning process teachers transfer their learning and integrate technology into the classroom through changed pedagogy.

Brown, Collins, and Duguid (1989) emphasized the idea of cognitive apprenticeship, which supports learning through the social construction of knowledge in an authentic, active environment of collaborative social interaction. Computers now play a major role in education in the form of computer-based learning systems, and because of their interactive nature they increase the motivation level of the learner. Brown et al. also emphasized the need for a new epistemology for learning, one that emphasizes active perception over concepts and representation. .

Significant learning and understanding by students is seen when constructivist-learning environments implementing technology are supported. According to the U. S. Department of Education 1995 forum report, the process of learning in the classroom can become significantly richer as students have access to new and different types of information. The report goes on to say that successful technology-rich schools generate impressive results for students, including improved achievement; higher test scores; improved student attitude, enthusiasm, and engagement; richer classroom content; and improved student retention and job placement rates.

There are numerous studies that demonstrate the effectiveness of educational environments that implement technology and constructivism in student learning activities on various levels (Cohen, 1997; Jonassen & Rohrer-Murphy, 1999; McDonough, 2001; Pugalee, 2001a, 2001b). The necessity of accommodating changes in theory and practice is addressed in an article by Jonassen and Rohrer-Murphy. These authors address the fact that constructivist approaches to learning are based on different epistemic and pedagogical assumptions and analyzing the needs, tasks, and outcomes for designing a constructivist environment is essential. Knowledge acquisition and transfer and the methods for analyzing learning outcomes must be consistent with the fundamental assumptions of the environments in which they are used (Jonassen & Rohrer-Murphy, 1999).

#### *Research on Technology*

This examination of the empirical literature focuses on multiple strands of research on approaches to technology integration. The discovery of innovative and thought-provoking ways to integrate various types of technology into classroom instruction is a challenge for educational systems across the nation. Establishing and implementing effective technology integration into the classroom is the goal of many educators and researchers today, yet the abundance of information on knowledge acquisition and learning theory is frequently not focused on the implementation of practical teaching methods for classroom teachers. Directly related to the need to integrate technology across the curriculum are contextual factors, such as the epistemological approaches of teachers, curriculum requirements, and the introduction to new instructional designs that are compatible with a technology-rich environment.

### *Constructivist Learning*

While constructivism is a well-documented theory of knowing and coming to know, it is not as yet a well-documented theory of teaching, and educators may find the leap into instruction aligned with this view of learning difficult (Fosnot, 1992).

Constructivist assimilation is the active process of organizing and transforming the experience, the process of “acting on” as well as teaching for conceptual understanding (Fosnot). Implementation of technology and constructivist approaches to teaching and learning into the classroom becomes an issue of putting theory into practice (Bednar et al., 1991). The need to transform what schools do and effectively prepare teachers to use new technology is an aspect of systemic education reform that has produced little evidence of widespread technology use in classrooms (David, 1994).

Although the Web-based Education Commission (2000) proposed the incorporation of technology and constructivist theory into all schools nationwide across the curriculum, the reality is that technology is not being implemented effectively or is not being implemented at all (David, 1994). Effective instructional designs based on relevant and well-developed theories of learning and cognition and the transformation of theory to pedagogy are complex (Bednar et al., 1992). There is a recognized need for the documentation of teaching methods to be clear and useful to the classroom teacher (Cobb, 1999; Fosnot, 1992; McDonough, 2001). This is a difficult step due to the need to identify what instructional strategies will facilitate concept construction and when they are needed (Fosnot). Well-designed materials and instructional environments are not enough to change approaches by teachers who hold strongly to objectivist and transmission beliefs (Fosnot).

The impact of digital technology on pedagogy in the traditional classroom is an important occurrence (Newman & Scurry, 2001), and determining effective use of technology instruction within the classroom is not always clear. The development of more sophisticated learning tasks that directly engage students in more effective learning and transform the way learning occurs in the classroom is essential and practical, and teachers are not comfortable with these tasks as they relate to technology. Teachers must begin to embrace technology with a higher level of comfort and proficiency so that they are confident about involving students in self-driven, technology-supported learning projects. To accomplish such goals it is necessary to establish a method of professional development that supports federal, state, and local goals to create environments in which the actual use and subsequent effects to use technology effectively in education are situations where students are actively constructing knowledge as technology implementation occurs seamlessly in the classroom (Newman & Scurry, 2001).

Constructivist theory supports conceptual understanding, and for teachers to effectively teach for understanding, a rethinking of curriculum and instruction development is necessary. If constructivism is to be taken seriously as a new paradigm for the information age, vision statements must at some point give way to a program of empirical research leading to a database for the learner types, conditions, and domains in which constructivist approaches have been useful (Cobb, 1999). Cobb demonstrated the “learner-as-scientist approach” to be useful in an environment where data is voluminous and widely distributed, such as the Internet. Cobb found that the goals of learning may be domain specific, including the transfer of knowledge to novel tasks, the conditions of learning, and the way definitional information is organized. The implications of Cobb’s

study suggest that the version of the expert's tools and procedures, or the learner-as-scientist approach, may be useful to learners in other domains, and promotes the constructivist view of teaching and learning with technology.

Technology use in the traditional classroom is usually restricted to the delivery of information in a teacher-centered classroom where the presentation of information is the focus and students are required to learn, and then recall information at a later date. The consistent interactive use of technology does not fit well into this traditional classroom setting, and changing the instructional setting in which students learn is not as simple as giving teachers new materials from which to teach (Jonassen & Rohrer-Murphy, 1999). Interactive learning environments designed from a constructivist model of learning are focused on student-centered learning that frequently incorporates technology to support the learning processes of inquiry and understanding.

Digital tools, including computers, multimedia, and the Internet work well in promoting an interactive learning environment for students to acquire knowledge in nonlinear states of creativity and discovery. Constructivist learning environments and open-ended learning environments are based on distinctly different epistemic and pedagogical assumptions than classical approaches to instructional design. Jonassen and Rohrer-Murphy (1999) described the use of activity theory as an appropriate framework for analyzing needs, tasks, and outcomes for designing constructivist learning environments with technology. A process for using activity theory as a framework for describing the components of an activity system for designing constructivist learning environments as they relate to technology use is outlined in Jonassen and Rohrer-Murphy's non-empirical paper, in which the author's argue that activity theory is a useful

framework for analyzing activities and settings that is similar to constructivism and situated learning.

Semple (2000) traced the development of various learning theories and their impact on educational technologies, arguing that the constructivist approach to learning provides the opportunity for authentic, computer-based learning environments to be established. This type of change will not take place if the significance of teacher professional development and support for effective use of educational technologies to improve student learning is ignored. Simply thinking up ways to use computers in traditional courses is not the solution (Semple). Teacher education and the transformation of epistemological outlook are crucial in the implementation of a constructivist environment using educational technologies.

There are numerous studies that examine the possibility of computer use being a powerful catalyst leading to more constructivist practices on the part of teachers (Becker, 1999; Dexter et al., 1999; Nicaise & Barnes, 1996). Becker and Riel (2000) found that teachers who are involved in collaborative planning and share their strategies for technology integration with colleagues are the most effective users computers in the classroom. Song and Keller (2001) found that the design of an effective learning environment includes principles based on empirical research, including the use of systematic motivational factors. Others have identified the modeling of constructivist approaches to teaching to be effective in promoting knowledge transfer (Cobb, 1999; Halpin, 1999; Jonassen, 2003), and the benefits of modeling an expert's cognitive processes while engaging in work within a problem-based learning environment have also been supported through empirical investigation (Pederson, 2002-2003; Wolf, Brush,

& Saye, 2003). The use of hypermedia authoring for knowledge construction (Chen, 2003; Nicaise & Crane, 1999) and the use of strategies that promote successful practices in teaching and learning such as cooperative learning, teaching to high standards, and utilizing problem-solving activities while integrating technology have all been found to encourage knowledge transfer in the learning environment. Professional development that is organized around real problems of practice must be a part of teacher in-service within the school system instead of the “training” model that has been the dominant approach to learning opportunities available to teachers (Little, 1993). Adequately preparing teachers to respond to the teaching demands embedded in most reform efforts through substantial and effective professional development is rare (Mouza, 2003).

One examination of effective professional development practices by Mouza (2003) was designed to help K-12 teachers effectively integrate technology into their classrooms; an interpretive case study design was employed to determine the impact of the training. Fifteen teachers experienced integration training (as opposed to skill-based training) that was predicted to increase confidence and prepare them to integrate technology in their classrooms. Major influences on teacher use of technology in the classroom that were reported included: (a) support teacher received from the school administration, (b) student population and needs, (c) collaboration with other teachers, and (d) availability of school resources. The study showed that integration training does effectively increase technology skills in teachers, although that was not the focus of the training.

Successful methods for promoting the use of technology in the classroom must consider all aspects of teaching and learning among teachers and students. The adoption

of a particular epistemological view is reflected in the theoretical framework from which a method or concept is introduced, and this becomes a necessary element of curriculum design when beginning a technology initiative to promote technology use in the classroom. It is not as simple as providing the infrastructure or even offering pre-made lessons for teachers to use. The necessary elements of successful technology integration throughout a school must begin with teacher beliefs and practices, and possibly altering attitudes and traditional procedures.

One study that demonstrated the need for additional examination of ways in which teachers may best integrate technology reported that for students to acquire technological fluency, they must be taught by technologically fluent teachers (Mills & Tincher, 2003). In this study, a technology professional development initiative was launched in a school district with the goal of revolutionizing classroom teaching practices. The researchers' primary assumption was that the process of preparing teachers to be technology integrators develops in stages in much the same way a person develops expertise in other areas. Acquiring expertise is a developmental process that requires much longer exposure to content to develop a high level of skills than what is attained through typical instructional programs or activities. Mills and Tincher's assumption is supported by the work of Lave and Wenger (1991), who proposed that beginners or newcomers move from the periphery of a community of practice to its center, and as they become more active and engaged within the culture, they assume the role of expert. Chi, Feltovich, and Glaser (1981) also found that mental models constructed by novices are different from the mental models of experts and this development of expertise is acquired in stages.



Other research has demonstrated that teachers who base instruction on constructivist learning theory organize information around conceptual clusters of problems and questions as opposed to facts in isolation (Duffy & Jonassen, 1992; Sprague & Dede, 1999). A goal of the constructivist approach is to move the learner into thinking in the knowledge domain as an expert user of that domain (Duffy & Jonassen, 1991, 1992). In the presence of the information revolution learners must be taught to move into the domain of problem-solver and take on the skills that require higher-order thinking and transfer of knowledge (Duffy & Jonassen, 1992). Learning activities should be authentic and tasks should be relevant. Problem-based activities as opposed to drill-and-practice should be used. Instead of concentrating on knowledge acquisition, problem-based activities allow a deeper understanding of the knowledge domain, and in this type of environment, technology is used as a tool to solve problems (Sprague & Dede).

Several notable studies of technology-rich environments in education assess the design of instruction and identify effective approaches to engage technology in educational settings to utilize technology in an optimal way for learning to occur (Jonassen, 2000; Nicaise & Crane, 1999; Venezky, 2001). Nicaise and Crane identified the importance of educational theory translating into classroom practice. Their goal was to apply constructivist and adult learning principles to show the effectiveness of knowledge construction in a technology-rich environment. The study provided evidence that teachers must go beyond information-giving roles and imparting fragmented content to avoid conditioning students to become passive participants who are unable to apply or use knowledge.

An area of evaluation research germane to the present study involves programs implemented to transform teacher epistemology through in-service training and graduate level university courses (Fosnot, 1992; Howard, McGee, Schwartz & Purcell, 2000). There continues to be a need for the development of instructional designs that promote the opportunities for teachers to construct pedagogical knowledge, dispositions, and skills in a supportive climate, and this is especially important when aligning instructional design to technology with a constructivist approach to learning (Cobb, 1999; Fosnot).

Howard et al. (2000) investigated whether constructivist practices may be modeled through the use of a constructivist approach in teacher training. The findings supported constructivist learning theory as an effective strategy for promoting conceptual change in teacher professional development and student learning. The study sought to investigate how teacher epistemological beliefs might be changed as a result of the training program by administering an epistemology questionnaire both before and after the training and examining the pretest-posttest differences. The trainers of the program were not aware of the specific purposes of the research instruments, which were based upon four of Schommer's (1990) five dimensions of epistemological beliefs: Fixed Ability, Simple Knowledge, Quick Learning, and Certain Knowledge. The data collected used an epistemology inventory with indicators on four factors related to constructivist teaching philosophies, and analysis of the data revealed significant changes in teachers' beliefs in three of the four factors.

### *Self-efficacy*

Bandura's (1977) concept of self-efficacy theorized that people's beliefs about their abilities lead to action agendas or goals that guide their decisions and behaviors.

The construct of self-efficacy has been widely used in research on human motivation and goal attainment. Researchers have used Bandura's theory in the field of educational technology to promote effective functioning and capability beliefs (Enochs, Riggs, & Ellis, 1993; Rosin & Weil, 1995).

A study by Lumpe and Chambers (2001) concluded that in the realm of technology school reform efforts, the assessment of context and self-efficacy beliefs is important so that teachers' belief patterns can serve as a needs assessment and program evaluation tool. The research began with a sample of 20 teachers who were part of the development of an instrument designed to assess teachers' context beliefs about using technology in the classroom. This goal was to development a tool that would be used to measure the importance of context and self efficacy in determining use of technology in the classroom with students, and to establish content validity for the tool. Next, a group of 307 teachers participated in a professional development program focused on the integration of technology with principles of engaged learning. The research investigated the belief patterns of teachers that may hinder or help technology implementation in the classroom and the effect of their beliefs on actual classroom behavior. The purpose of the program was to develop and support teachers as they integrated technology with principles of engaged learning and to define categories of contextual factors impacting teachers' beliefs about technology use. Factor analysis of the data identified two distinct factors—enabling beliefs and likelihood beliefs.

Environmental context is important in the case of a school technology initiative, and includes students, administrators, parents, teachers, buildings, equipment, and professional development. The individual change strategies advocated by Bandura (1997)

are not likely to have long-term impact on teachers' sense of efficacy without organizational supports that ameliorate the conditions that threaten teacher's sense of efficacy. Lumpe & Chambers (2001) found that instituted structural changes provided teachers with collegial, supervisory, community, and economic assistance which helped to contribute to their sense of efficacy in an effort to change attitudes and behaviors. The study was a concentrated effort to examine teachers' context beliefs about the use of technology in formal school settings.

A study by Oliver (1993) supported the notion that teacher education that includes technical computer knowledge and skills does not translate into more or better integration of instructional technologies into teaching. This research found that beginning teachers who had formal training in the use of computers as a personal tool did not differ in their use of computers for teaching from their peers who had not had the training. Factors other than technical knowledge and skill contribute to teachers' success at technology integration in their teaching.

The findings of a study by Albion (1999), suggested that effective teacher education programs that increase teacher's capability for integrating technology must have structure and content based upon an understanding of factors which contribute to successful technology integration. The design of courses may be adjusted to achieve the desired outcome of increased technology integration in the classroom by looking into such factors as teacher beliefs. Self-efficacy beliefs are an important and measurable component of the beliefs that influence technology integration, and there is mounting evidence that particular instructional strategies might be effective for increasing self-efficacy beliefs relevant to technology integration (Albion).

Many studies have identified lack of confidence in teaching with computers as a factor influencing the levels of use of computers by students and beginning teachers (Albion, 1996; Downes, 1993; Handler, 1993; Summers, 1990). Marcinkiewicz (1994) reported that teachers' use of computers for instruction was related to their belief in their ability to do so successfully. A number of personal variables including self-competence, belief in ability to use a computer for teaching, innovativeness, and willingness to change were found to be most closely related to computer use among the 170 elementary teachers in the research sample (Marcinkiewicz).

In a similar study by Honey and Moeller (1990), 20 elementary and secondary school teachers were interviewed, and they found that teachers with student-centered pedagogical beliefs were successful in integrating technology except in cases where anxiety about computers prevented them from appropriating the technology. In contrast, teachers with more traditional beliefs faced much greater change in their practices in order to integrate technology.

Additional studies have found that pre-service teachers lacked confidence in their capacity to teach successfully with computers despite possessing positive dispositions towards computer use (Albion, 1996; Downes, 1993). Other studies have linked teachers' sense of efficacy for teaching to patterns of classroom behavior known to yield achievement through an instrument designed to measure teachers' sense of efficacy for teaching (Gibson & Dembo, 1984). Finally, studies have shown this construct of teachers' sense of efficacy for teaching to be positively related to change in individual teacher practice (Smylie, 1988), ratings of lesson presentation, classroom management

and questioning (Saklofske, Michalyluk, & Randhawa, 1988), and teacher success in implementing innovative programs (Stein & Wang, 1988).

Research investigating the impact of variations in course design on elementary science teachers (Watters & Ginns, 1997) through a self-efficacy instrument developed by Riggs and Enochs (1990) demonstrated that when teachers' self-efficacy beliefs in their ability to use computers were increased through appropriate professional development, they were more likely to incorporate computers into their teaching strategies. These studies indicated teachers' beliefs and in particular, self-efficacy beliefs, are useful indicators of likely success at technology integration, and provide sufficient reason to undertake further investigations in this area and to consider what approaches to teacher education and professional development might be effective in increasing self-efficacy for teaching with technology (Albion, 1999).

The ideal method for developing teachers' self-efficacy for computer use from the standpoint of self-efficacy theory may be to provide them with training and support to work successfully with computers in their classrooms. A study conducted by Borchers, Schroyer, and Enochs (1992) demonstrated that a professional development program which included several workshops over an extended period and on-site support for participants was effective for increasing both self-efficacy and computer use.

Given the logistical problems of provided classroom based in-service for teachers, Albion (1996) examined alternative models. His work suggested that logistical problems might be overcome by developing multimedia materials to make examples of effective classroom use of technology available to a wider group than could participate in direct observation. This approach would be more cost-effective than classroom demonstrations,

and would effectively simulate the real experience viewed as essential to changing self-efficacy beliefs (Albion).

In one federally funded study of teacher candidates and collaborating teachers' experiences in learning to use technology during one school year for a variety of pedagogical and professional uses, sharing expertise and learning experiences in a collaborative environment positively influenced meaningful technology integration into the K-5 curriculum. In this study the challenge was to prepare today's and tomorrow's teachers to use technology by embedding meaningful uses of technology in support of the participating teachers' own professional learning and in support of the learning of students (Rosaen, Hobson, & Khan, 2003).

This collaborative approach was also found to be effective in facilitating teachers learning to use technology with students in meaningful ways. Rosaen et al. (2003) examined cooperative efforts between a university and school system. The study also examined collaborating teachers' and teacher candidates' perceptions of what they learned, participants' change of attitudes about technology over time, and the extent to which participants began to use their new knowledge for professional and pedagogical uses, as well as providing insights into further steps needed to foster collaborative and complementary learning experiences in the future (Rosaen et al.).

The relationship between computer self-efficacy, anxiety, experience, support and usage was investigated in a study by Fagan, Neill, and Woolridge (2003/2004). This investigation of key factors thought to affect an individual's use of information technology was drawn, in part, from Bandura's Social Cognitive Theory (1977). The key concept of perceived self-efficacy having a direct influence on the choice of task and

persistence in achieving the task has served as an integrative framework in numerous research studies addressing computer self-efficacy. Researchers identified factors that are theoretically related to computer self-efficacy (Marakas, Yi, & Johnson, 1998). The complementary relationship between computer-phobia literature and computer self-efficacy was examined in the individual traits that are antecedent to computer anxiety and computer self-efficacy in research by Thatcher and Perrewe (2002). Computer anxiety has also been viewed as a negative emotional reaction or effect that has been studied as a part of a larger research focus termed technophobia or computer phobia (Torkzadeh & Angulo, 1992), and computer anxiety has been shown to have a significant relationship to key instructional technology constructs such as attitudes toward computers, usage intention, usage behavior, and performance (Brosnan, 1998; Coffin, 1999; Durnell & Haag, 2002; Harrison & Ranier, 1992; Vician & Brown, 2002-2003).

A number of researchers found evidence that situational support is one of the factors that affect self-efficacy, and that various types of this support increase the ability of end-users. A study by Fagan et al. (2003/2004), reported that organizational support is positively related to computer self-efficacy in that a supported individual who is very anxious about technology interaction perceives that there is somewhere to turn for help. Vician and Brown (2002/2003) supported this factor in their conclusion that the development of an appropriate learning environment for a computing intensive course is key to providing a beneficial situation for all learners in order to reduce computer anxiety.

Numerous Technology Innovation Challenge Grant projects focused upon professional development designed to increase skill and confidence in technology use



through constructivist approaches to learning that include hands-on activities and authentic learning. The use of these methods has a positive effect on technology proficiency and attitudes toward computer use, as well as increased technology integration in the classroom. The development of skills in context, collaboration, constructivist approaches for teachers and students and systemic programs that are goal-driven are just a few of the approaches used by the TICG projects (Johnston & Toms Barker, 2002).

The implications of constructivism for professional development are profound, as the modeling of this approach to knowledge acquisition promoting active learning and student autonomy and initiative are not created by professional growth activities premised on the transmission view of learning (Johnston & Toms Barker, 2002). The constructivist approach to professional development promotes a collaborative spirit, an action-oriented agenda, and reflective practices (Johnston & Toms Barker).

The Technology Innovation Challenge Grant (TICG) initiatives included programs such as ACT Now! Global Connections; Key Instructional Design Strategies (KIDS); the Eiffel Project; Teacher Led Technology Project; the Iowa Distance Education Alliance; and Education Future NOW. All of these programs identified effective professional development strategies that encouraged the adoption of technology into the classroom by teachers without focusing on skills training alone (Johnston & Toms Barker, 2002). Instead, a technology integration approach was used based on indicators of a constructivist learning environment, such as hands-on activities, authentic learning, and higher-order thinking to solve problems that are usually left for the “experts.” These approaches to learning resulted in an increase in positive attitudes

toward computers and increased technology proficiency in teachers due to the higher level of understanding of computer technology knowledge achieved in these settings. In addition, technology integration in the classroom was more likely to occur in a setting similar to that modeled in the professional development sessions that followed indicators of a constructivist-learning environment (Johnston & Toms Barker).

While positive attitudes toward computers are positively correlated with teachers' extent of experience with computer technology (Loyd & Gressard, 1986), with familiarity, anxieties and fears tend to decrease as confidence increases. Positive teacher attitudes toward computers have been recognized by some studies as a necessary condition for effective use of information technology in the classroom (Woodrow, 1992), and the degree of classroom computer use has been closely tied to the extent of training in integrations techniques according to Pelgrum, Janssen Reinen, & Plomp (1993). Research supports the assumption that increased computer experience reduces computer anxiety in many teachers (Gardner, Discenza, & Dukes, 1993), yet the ability to reduce anxiety may also depend on the type of computer experience to which the teachers are exposed (McInerney, McInerney, & Sinclair, 1994). Changing teachers' attitudes is a key factor in fostering computer technology integration in the classroom (Marcinkiewicz, 1993/1994), and it is critical that teachers possess both positive attitudes and adequate computer literacy skills to successfully incorporate technology into the classroom. (Hignite & Echternacht, 1992).

The instructor who has learned to integrate technology into existing curricula may teach differently from the instructor who has received no such training (Christenson, 2002). In Christenson's study, 60 teachers in a suburban, public elementary school

received needs-based instruction in the integration of computers into classroom learning activities during the school year. Two similar public elementary schools in the same school district were used as comparison groups; educators at these schools received the normal district-level technology in-service training, but not the needs-based technology integration education delivered at the treatment school. The data gathered via the Teachers' Attitudes Toward Computers questionnaire, indicated that teachers who reported having received computer integration education exhibited more positive attitudes and these attitudes changed to a greater extent in the direction of more positive in the treatment site.

In an article by Russell (1996), six stages for learning to use technology were developed using an action research model. This information is important in identifying key times when intensive support with knowledge for a learner is an important need, and later stages that require less support. The identification and description of six stages and the application of metacognitive understanding of these stages as adults learn to use technology is useful in reducing anxiety through the learning of computer applications. This qualitative study identified learning in a context that represented understanding and practical application, by using a relevant activity for the application of technology skills combined with an understanding of stages a learner typically goes through during the learning process.

### *Best Practices*

In the context of initiatives proposed at local, state, and federal levels, successful approaches to student learning and achievement are influenced by professional development practices that impact the quality of teaching (Loucks-Horsley, 1998). The

support offered by administrators and the community is vital to the success of technology integration (Rice, Wilson, & Bagley, 2001), and inquiry such as the ACOT (Dwyer, 1992) study reinforced the necessity of administrative support.

The promotion of a new image that captures a dynamic view of schooling in which teachers guide students through individual and collaborative activities that encourage inquiry and the construction of knowledge is not new, but evidence of this method of teaching is remarkably low (David, 1994). More than one half of elementary and middle school teachers are non-users of computers for classroom instruction, about one third are occasional users, and about 1 in 10 is a daily user (Means & Olson, 1995).

The apparent paradox of high access and low use of technologies in classrooms persists after almost two decades of intense promotion of information technologies, and the abundance of access to new technologies have produced a modest shift from nonusers to occasional users and from occasional users to serious users. In a study by Cuban, Kirkpatrick, and Peck (2001), a gradualist, incrementalist view of change was supported, as well as an explanation of anomalies that remain in educational organizations despite the investment of funds, teacher and administrative time, and school resources in promoting technology integration in the schools. These researchers spent 7 months during the 1998-1999 school year investigating technology use in two schools using interviews and surveys from both teachers and students, sign-up data from media centers and computer labs, and the examination of reform efforts, accreditation reports, newspaper articles and technology grants to gather a complete picture of computer use for instruction.

Interviews with 21 teachers and 26 students in two high schools were analyzed. The data gathered from both schools in the study confirmed two commonly offered reasons for limited and infrequent computer use in classrooms and maintenance of teacher-centered instructional practices. The first reason was that teachers do not have sufficient time to incorporate technology into their curricula. In addition, computer and software training was not offered at times that worked with existing schedules, and the type of training was, in fact, irrelevant to teachers' specific needs (Cuban et al., 2001).

Another relevant finding in the study by Cuban et al. (2001) was that teachers' age, experience, and gender were not factors, and there was little difference in computer use between veteran and novice teachers, or between those with and without previous technological experience. There was also no teacher resistance or technophobia, reasons often cited in studies of teachers' use of computers. Based on faculty interviews and survey data, teachers who called for more and better technology were avid home computer users, and they believed in the future ubiquity of computers in society. This finding supports the importance of epistemological beliefs of teachers in the promotion of computer technology use in the classroom. It is the use of time in schools, the flawed nature of the technological innovation itself, and the contextual factors that exist in the organization that impede the adoption of computer technology by teachers, not individual factors of hostility to technology, inertia, or passive resistance.

In addition to how often computers are used by students, how they are being used is also important. Supporters and critics of school technology agree that available software and hardware are used in limited, even simple ways, often sustaining rather than transforming prevailing instructional practices (National Educational Assessment

Program, 1996; Wenglinsky, 1998). Current policy is based on the belief that the capacity to catalyze change in fundamental components of the educational system lies in the power of standards to specify what students should know and be able to do. Through technology education standards, changes will be initiated and unanswered questions will be answered from a systemic perspective (Bybee & Loucks-Horsley, 2000). Although the transition from theory to practice is essential for establishing greater gains in knowledge and understanding by teachers and students, technology innovations will continue to be a challenge to incorporate into learning environments. Processes that encourage change have been identified in research (David, 1994; Little, 1993; Loucks-Horsley, 1998; Rogers, 1995; Stielgelbauer, 1994), yet a new model of change must be used, one that reflects a different way of thinking about how change fits into today's educational systems (Loucks-Horsley). Instead of focusing on a linear approach to change, change is now approached with an emphasis on process and its context; effective change affects the very culture of schools (Stielgelbauer).

The use of successful change strategies in education, coupled with professional development practices, may produce positive outcomes for technology integration in education. The new overlapping processes of change are multifaceted, slower, and require changing attitudes, perceptions, behaviors, relationships, and the way people collaborate (Stielgelbauer, 1994). Adoption of innovations is an active process that involves much reinvention, and adopters must reinvent the innovation and make it their own if they are to continue using it (Rogers, 1995). If an innovation is to be successful, the expected consequences, advantages, and disadvantages must be clear, and a

technological innovation creates one kind of uncertainty in the mind of potential adopters (Rogers).

Technology innovations that show results in increased student learning; are clearly aligned with local, state, and federal standards; and that promote standard-based learning will be most readily adopted in current school systems according to the International Society for Technology Education (ISTE) and related studies (Bybee & Loucks-Horsley, 2000). For effective change to occur, there is an emphasis on process and context and the effort of change does not stress the organization to any meaningful degree, yet the changes go deeper than any surface treatment into the structure of organizations and the ways in which people work together (Cuban, 1988). This multifaceted slower change means changing attitudes, perceptions, behaviors, relationship, and the way people collaborate, in a new (overlapping) process of change (Stiegelbauer, 1994).

Little (1994) asserted that professional development approaches that include ambitious visions of teaching and schooling must be embedded in educational reform initiatives for policy changes and reform agendas to be successful. As reforms pose technical demands on the knowledge, skill, judgment, and imagination of individuals, implementation must begin in the classroom and be embraced by teachers. Professional development has the capacity to equip teachers individually and collectively to act as shapers, promoters, and well-informed critics of reforms, providing that professional development options locate problems of “implementation” such as technology integration, within this larger set of possibilities (Little).

A meta-analysis of five large-scale studies of education technology that identified resources that provide visions for new uses of technology in learning and instruction (Schacter, 1999) revealed numerous studies that consistently included the importance of effective professional development practices in encouraging technology integration into the classroom. Each of the studies analyzed found an overall impact of the effectiveness of technology integration in the classroom through positive gains in student achievement on researcher-constructed tests, standardized tests, and national tests. Evidence in some of the studies, however, showed that learning technology is less effective or ineffective when the learning objectives are unclear and the focus of the technology use is diffuse (Schacter).

Halpin (1999) investigated the effective use of technology and the impact of integrated computer literacy training on 56 pre-service teachers comparing two different technology integration models in a college-level methods course. Data sources included pre-course questionnaires, which assessed the pre-service elementary and science teacher's computer skills prior to entering the required methods course. Post-course questionnaires administered at the end of their first year of teaching assessed how frequently the teachers were using technology as an instructional tool in the classroom. The results of this study indicated that the inclusion of computer technology integration in the methods course increased the probability that teachers transferred the computer skills into their classrooms as compared to preservice teachers who learned computer skills in an isolated manner. The teachers did not perceive the integration of technology as an isolated instructional resource that would require additional instructional time, and instead computer literacy was used as a teaching tool for the subject content. These



results are not only applicable to preservice education, but also to in-service professional development programs as schools are seeking ways to train teachers in an effort to meet national technology standards (Halpin).

Current research supports the importance of integrating technology across the curriculum, and stresses the continued limited use of computers in the classroom (O'Bannon & Judge, 2004). There is a growing emphasis on integrating technology across the curriculum and a demand for teachers who are capable of integrating technology into instruction. Not only does this focus on teachers' classroom needs for student learning, but focusing on computer use aligned with current curricula promotes the use of computers as a learning tool, promoting meaningful learning (Jonassen et al., 2003). Multiple barriers to teachers' use of computers have been reported (Clark, 2000; National Center for Educational Statistics [NCES], 1999; Schrum, 1999). Other studies have reported that many teachers feel unprepared to meet the challenge of technology integration into classroom instruction (Schrum; Sprague, Kophman, & Dorsey, 1998).

#### *Federal Accountability and Research*

The NCES found in 2001 that only 33% of teachers felt ready to use computer-related tools in the classroom, while only 20% felt well-prepared to integrate technology into instruction. Numerous technology initiatives funded by the U. S. Department of Education have attempted to promote the use of technology to enhance instruction some of which are being reported. The Preparing Tomorrow's Teachers to Use Technology (PT3) initiative is examined in a paper by O'Bannon and Judge (2004), a project based on the principle that teachers must be capable of creating and delivering high-quality, technology-enhanced lessons to improve student learning. This study stressed the

importance of working with teachers who are exemplary users of technology, and the research findings on effective strategies for technology integration provided direction for a model of professional development. The study investigated to what degree participation in the ImPACT initiative improved mentor teachers' use of technology and increased the technical skills of mentor teachers.

A companion inquiry into obstacles of successful technology integration in schools prompted the ISTE to identify 10 essential conditions that must be present in every phase of an aspiring teacher's education to enable the creation of learning situations that included the powerful uses of technology. The findings of the study by O'Bannon and Judge (2004) indicated that the model developed for the PT3 initiative that embodied the characteristics of successful technology integration was effective in improving teachers' technical skills and their ability to integrate technology into instructional practice. The prerequisite factors included shared vision, access, skilled educators, professional development, technical assistance, content standards and curriculum resources, student-centered teaching, assessment, community support, and support policies. Many additional studies support these conditions, and although technology access is more readily available, teachers remain inadequately trained and computers are often underused or used improperly (O'Bannon & Judge).

Research studies that focused on successful or effective technology integration training cites instruction that has certain characteristics that are consistent with teacher classroom practices aligned with current curricula, and the absence of one-shot workshops that do not focus on the consistent use of computer technology in the classroom as an instructional tool (Sandholtz, 2001; Sandholtz, Ringstaff, & Dwyer,

1997). Additional methods found to be successful included site-based training to allow teachers to develop understanding in realistic settings with authentic learning tasks (Ringstaff & Kelley, 2002), and training that is consistent and spread over time so that teachers may strengthen skills and create methods of using technology with the curriculum (Beyerbach, Walsh, & Vannatta, 2001; Vannatta, 2000).

Teachers need professional development that employs hands-on active learning (Ringstaff & Kelly, 2002), is directly aligned with curriculum goals, and allows for follow-up support in their classrooms (Roblyer & Knezek, 2003). Exploring the technology, reflecting on learning, and collaborating with peers promotes their knowledge and confidence (Ringstaff & Kelly); and teachers must feel comfortable with technology before they can include it into instructional situations (O'Bannon & Judge, 2004). The principles that guide learning environments for children also apply to teachers (Sandholtz, 2001; Sandholtz et al., 1997), and meaningful learning tasks (Jonassen et al., 2003) may be used to model effective professional development integrating technology into classroom curriculum.

Many studies that are part of federal initiatives support a hands-on, research-based approach to professional development. These resources outline effective strategies that can be applied to the professional development of preservice and in-service teachers. The Alliance + Professional Development program was a technology-in-education project that provided technology training for teachers and identified specific criteria for effective training (Yepes-Baraya, 2000). The professional development model used in the Alliance + project was based on notions of causal mapping by Venezky (2001), systems thinking, and task analysis by Romiszowski (1986).

The need for teachers to receive professional development that includes hands-on learning, collegial approaches to learning, and active participation of teachers are just some of the desirable elements cited as effective guidelines for technology-related training. Professional development guidelines that embrace goals in the form of technological proficiency levels encourage the best use of technology in schools. Professional development programs designed to increase skill and confidence in technology use may be successful through integration techniques as opposed to focusing a training model for skill development (Mouza, 2003).

### Conclusion

This chapter provided an overview of the national policy framework for system education reform and the imperative within that framework for the meaningful integration of technology into the core curriculum at all levels of instruction. The chapter also explained the conceptual framework for the present study based upon constructivist learning theories, principles of adult learning, and best practices in technology integration. A review of the empirical literature related to technology integration through teacher professional development grounded in constructivism has demonstrated the efficacy of such approaches in increasing teacher self-efficacy and technology proficiency. The review also demonstrated the efficacy of constructivism in promoting the use higher-order thinking skills among children through technology-based lessons.

Chapter Three presents the null hypotheses and discusses the research methodology in greater detail. Discussion includes the population sample, instrumentation, data collection procedures, data analysis techniques, ethical considerations, delimitations, and limitations. Data analyses and findings are presented in

Chapter Four. This work concludes with Chapter Five, where the study is summarized, findings are discussed, and conclusions and implications for practice are presented. The chapter closes with recommendations for further study.

### Chapter Three: Methodology

The purpose of this chapter is to discuss the methodology used to explore the effect of a school-wide web-based technology initiative in an elementary school setting. This quasi-experimental comparison group study was conducted to examine the effect of the school-wide web-based learning environment and a professional development technology initiative on teacher's attitudes toward computers, teacher technology proficiency, teacher's stages of adoption of technology, and amount of utilization of the website by students. Inferential and descriptive analyses were completed. This chapter contains the research questions, design and procedures, including: the research hypotheses, the research sample, instrumentation, description of the school-wide web-based site, descriptions of the experimental and comparison groups, delimitations and limitations, data collection, and analyses.

#### *Research Questions*

##### *Research Question 1*

Will reported attitudes toward computers be more positive for teachers who participate in the professional development technology intervention than for teachers in the comparison group?

*Sub-questions to Research Question 1*

*a.* Will there be a greater reported increase in enthusiasm/enjoyment toward computers by teachers who participate in the professional development technology intervention than teachers in the comparison group?

*b.* Will there be a greater reported decrease in anxiety toward computers by teachers who participate in the professional development technology intervention than teachers in the comparison group?

*c.* Will there be a greater reported decrease in avoidance of computers by teachers who participate in the professional development technology intervention than teachers in the comparison group?

*d.* Will there be a greater reported decrease in perceptions of computers as having a negative impact on society by teachers who participate in the professional development technology intervention than teachers in the comparison group?

*e.* Will there be a greater reported increase in positive attitudes about productivity of computers by teachers who participate in the professional development technology intervention than teachers in the comparison group?

*Research Question 2*

Will there be greater reported increase in technology proficiency by teachers who participate in the professional development technology intervention than teachers in the comparison group?

*Sub-questions to Research Question 2*

a. Will there be a greater reported increase in technology proficiency as it relates to Electronic Mail by teachers who participate in the professional development technology intervention than teachers in the comparison group?

b. Will there be a greater reported increase in technology proficiency as it relates to the World Wide Web by teachers who participate in the professional development technology intervention than teachers in the comparison group?

c. Will there be a greater reported increase in technology proficiency as it relates to Integrated Applications by teachers who participate in the professional development technology intervention than teachers in the comparison group?

d. Will there be a greater reported increase in technology proficiency as it relates to Integrating Technology into Teaching by teachers who participate in the professional development technology intervention than teachers in the comparison group?

*Research Question 3*

Will there be a greater reported increase in technology adoption by teachers who participate in the professional development technology intervention than teachers in the comparison group?

*Research Question 4*

Will there be a relationship between age, teaching experience, educational level, and the dependent variables (Teacher's Attitudes Toward Computers, Technology Proficiency, and Stages of Adoption of Technology) in teachers who participate in both groups?



*Research Question 5*

Will there be greater student utilization of the school-wide web-based resource by students of teachers who participated in the professional development technology intervention than by students of teachers in the comparison group?

*Research Design*

A non-equivalent group design (NEGD) was used in this study. Participants volunteered, and assignment to groups was not random. As a result, the NEGD is susceptible to the internal validity threat of selection. It is possible that prior to the study differences between the groups could adversely affect the outcome of the study. Therefore all variables of the pretest questionnaires Teacher's Attitudes Toward Computers, Technology Proficiency, and Stages of Adoption were analyzed as a covariate in the multivariate analysis of covariance (MANCOVA) to control for differences in the groups at the onset of the study. Both groups were assessed with the same pre-program and post-program measure in identical settings, with a set of questionnaires that have a history of yielding valid and reliable data. This quasi-experimental design, although unable to allow the same degree of certainty about cause-and-effect relationships as an experiment does, can provide convincing circumstantial evidence regarding the effects of one variable on another.

The design implementation began by establishing two groups of teachers who volunteered to be a part of a technology initiative at one elementary school in the southeastern United States. The treatment group of volunteers received a professional development intervention (PDG), and the web-access group (WAG) or the comparison group was directed to a school-wide website for learning. The total number of subjects

studied was 57; 28 participants in the treatment group, and 29 participants in the comparison group. The professional development program (PDG) consisted of three 2-hour contact hours with an online resource page and ongoing support. The alternate web-access group (WAG) consisted of teacher participation in a 1-hour orientation in the use of the school-wide website as a resource for student learning. Comparison group teachers were given the option of using this web-based resource at their discretion in the classroom to supplement core curricula. All teachers in the school were given the opportunity to participate in the professional development program before the end of the 2003-2004 school year to provide equity of access to the resource for all teachers and all students. Participants in both groups of the study were required to maintain a weekly log of computer use by students for 18 weeks, beginning in January 2004 through May 2004. Both groups were pretested with identical questionnaires in identical settings in November 2003 before beginning the professional development group sessions. Identical questionnaires were administered in identical settings in May 2004, after the professional development intervention for the PDG group. Details of the research design are displayed in Table 1.

Table 1

*Research Design for Treatment and Comparison Groups*

Date	November Pre	Treatment	May Post
PDG Professional Development Group (Treatment)	O1 O2 O3	Professional development Program (3 2-hr.sessions=6 hrs.) + Contributing to school-wide website of lessons based on classroom curricula Collaborate and Create	O1 O2 O3
WAG Web Access Group (Comparison)	O1 O2 O3	Access to school-wide website of lessons based on classroom curricula The Learning Page	O1 O2 O3

Independent VariablesGroup 1 Treatment Group

Professional Development Intervention

Group 2 Comparison Group

Access to technology lessons and links posted on school-wide web-based learning site by professional development group

Covariates-Pre Questionnaire Items

- O1 Teachers' Attitudes toward Computers
- O2 Technology Proficiency Self-Assessment
- O3 Stages of Adoption of Technology

Dependent VariablesPost Questionnaire Items

- O1 Technology Proficiency Self-Assessment
- O2 Teachers' Attitudes toward Computers
- O3 Stages of Adoption of Technology

Descriptive Data

- O4 Weekly log of technology use by students in the classroom, teacher reported
- O5 Weekly log of computer lab use, sign-in sheets
- O6 Student hits on website (separated by experimental and comparison groups)

Websites, 3 separate sites, to access hits by PDG, WAG, or NRG\*

\*Learning The Learning Page/\*Professional Development Group Students-linked to professional development group teacher home pages on school website for access.

\*Learning WAG The Learning Page/\*Web-Access Group Students-linked to web-access group teacher home pages on school website for access.

\*Learning The Learning Page/\*Non-Research Group Access-linked to researcher and non-research group teachers home pages on school website for access.

### *Research Instruments*

The questionnaires used in this study measured teachers' attitudes toward computers, technology proficiency, and stages of adoption of technology. The instruments were chosen because the variables measured corresponded to those of interest to the present study's evaluation of the effect of two methods of promoting the integration of technology into the classroom for student learning. The three instruments were obtained from the book *Instruments for Assessing Educator Progress in Technology Integration* (Knezek et al., 2000). Written permission was obtained from the developers of all instruments in this study (Appendix H). Identical questionnaires were administered at the beginning of the study in November 2003 and at the end of the school year in May 2004. The questionnaires are well-grounded in context, and acceptable concurrent reliability and validity data are available. All instruments have been previously used in technology research (Knezek et al.).

#### *Teachers' Attitudes Toward Computers (TAC v 3.2a)*

This instrument was developed to measure teachers' attitudes and was originally constructed as a 10-part composite instrument that included 284 items spanning 32 Likert subscales (Christensen & Knezek, 1996). The version used in the present study was the

TAC 3.2a, 7-factor instrument; 5 of the 7 factors were selected as the most appropriate based upon the type of intervention used in this study.

The following computer attitude questionnaires contributed to the five sub-scales of the TAC version 3.2a used in this study, according to the developers (Christensen & Knezek, 1996).

1. The Computer Attitude Scale (Gressard & Loyd, 1986) measures confidence, liking, anxiety, and usefulness.
2. The Computer Use Questionnaire (Griswold, 1983) tests awareness.
3. The Attitudes Toward Computers Scale (Reece & Gable, 1982) measures general attitudes toward computers.
4. The Computer Survey Scale (Stevens, 1982) measures efficacy and anxiety.
5. The Computer Anxiety Rating Scale (CARS; Heinssen, Glass, & Knight, 1987) identifies technical capability, appeal of learning and using computers, being controlled by computers, learning computer skills, and traits to overcome anxiety.
6. The ATC (Attitudes Toward Computers; Raub, 1981) measures computer usage, computer appreciation, and societal impact.
7. The CAIN (Computer Anxiety Index; Maurer & Simonson, 1984) examines avoidance of, negative attitudes toward, caution with, and disinterest in computers (anxiety and comfort).
8. The BELCAT (Blombert-Erickson-Lowery Computer Attitude Task; Erickson, 1987) assesses attitudes toward learning about computers and towards computers themselves.

9. The Attitude Toward Computer Scale (Francis, 1993) measures the affective domain.

10. The Computer Attitude Questionnaire (CAQ; Knezek & Miyashita, 1993) rates computer importance, computer enjoyment, computer anxiety, and computer seclusion.

11. The Computer Attitude Items (Pelgrum, Janssen, Reinen, & Plomp, 1993) measures computer relevance, and computer enjoyment.

*Construct Validity and Internal Consistency Reliability for Scores on the Teachers' Attitudes Toward Computers v 3.2a*

The Teachers' Attitudes Toward Computers (TAC v3.2a) questionnaire was developed during 1995-97 for a study of the effects of technology integration education on the attitudes of teachers. Six hundred and twenty-one educators in Texas, Florida, New York, and California completed the TAC during 1995-96. A factor analysis of the 284 individual items on the questionnaire, using the 621 responses, indicated that between 4 and 22 different attributes were actually measured by the items collected from the 32 previously published subscales. Examination of the factor structures for all 4 - 22 feasible solutions resulted in selections of 7-factor, 10-factor, and 16-factor structures as the most meaningful representations of the domain (Christensen & Knezek, 1996).

The TAC was administered as a pilot test at a district training program in Port Arthur, Texas. Complete data were collected from 91 teachers prior to and after their 6-week training sessions. The paired data were viewed in many ways, including the originally published subscales, 7-factor, 10-factor, and 16-factor structures. Common to all views of the data was strong evidence that a reduction in anxiety about computers

occurred in participants during the course of their training sessions (Christensen & Knezek, 1996).

These findings were viewed as successful confirmation of the discriminant validity of the TAC scores. The structure is comprehensive, and its scoring procedure is to sum the numeric values of the responses for the related items to produce a Likert subscale score for each factor (Christensen, 1998). Table 4 lists internal consistency reliability values reported for scores on the Teachers' Attitudes Toward Computers, Tac v3.2a, 5 factors.

*Technology Proficiency Skills Assessment (TPSA v 1.0).*

The Technology Proficiency Self-Assessment (TPSA v1.0; Rópp, 1999) is a 20-item Likert-type instrument. It was designed to reflect four domains included in the International Technology in Education (ISTE) national educational technology standards for teachers. The self-assessment consists of 20 items, 5 each from the following domains of proficiency: (a) Electronic mail, (b) World Wide Web, (c) Integrated Applications, and (d) Integrating Technology into Teaching.

The TPSA was also designed to provide individuals with examples of the variety of ways that a proficient teacher candidate might use computers and technology in the classroom. In this manner, the TPSA could be used by a teacher candidate as a tool that would provide examples of technology proficiency as well as indicate progress toward proficiency. Although the content of the items on the Technology Proficiency Self-Assessment was tailored to teaching and learning with computers, the TPSA is essentially a measure of self-efficacy. Individuals are asked to rate their confidence in their ability to perform the tasks listed on the instrument.

### *Reliability for Scores on the Technology Proficiency Skills Assessment, TPSA v 1.0*

The scale yielded scores with a reliability (alpha) coefficient of .95 in its initial use in a study by Ropp (1999). In a more recent study, the full scale scores were found to have a reliability (alpha) coefficient of .94 from a set of 506 responses (Knezek et al., 2000). Alphas were also determined for scores on each of the four subscales: Electronic mail (.78), WWW (.81), Integrated Applications (.84) and Teaching with Technology (.88). The Technology Proficiency Self-Assessment was administered simultaneously with the pre- and posttest questionnaires in the present study and Internal Consistency Reliability for the TPSA v 1.0, 4-factor instrument is shown in Table 5.

### *Stages of Adoption of Technology*

This instrument was developed based on Russell's (1995) stage of technology adoption (Christensen, 1998). According to research conducted by Russell, adults learning new technology pass through six stages on their way to becoming confident technology users. Learners may begin at any point and progress through all six at their own rates. The stages include (a) awareness, (b) learning the process, (c) understanding and application of the process, (d) familiarity and confidence, (e) adaptation to other contexts, and (f) creative applications to new contexts. The stages of adoption of technology instrument was administered simultaneously with the pre- and posttest questionnaires in the present study.

### *Reliability and Validity for Stages of Adoption of Technology*

Internal consistency reliability measures cannot be calculated for data gathered through the Stages of Adoption of Technology instrument because it is a single-item survey. A high test-retest reliability estimate (.91) was obtained from a sample of 525 K-



12 teachers from a metropolitan north Texas public school district during August 1999 (Knezek et al., 2000). The Stages of Adoption of Technology items were included on two attitudinal questionnaires completed by educators as near to each other in time, as within the same hour, or separated in time by as much as one day. Educators never had access to the information provided on one survey while completing the other during this process. A Pearson product-moment correlation was calculated between scores on the two reported Stage measures as a form of test-retest reliability. The value of .91 indicates high consistency for these educators on reported stages.

#### *Teacher-reported Logs of Computer Use by Students*

The teacher-reported logs provided information on classroom and computer lab use as self-reported by teachers in both groups. The teacher-reported logs of computer use by students were collected weekly from January 2004 through May 2004. The logs identify utilization of the web-based resource by students of teachers in the PDG and WAG groups and were created by the researcher (see Appendix I).

#### *Computer Lab Sign-in Logs*

Computer lab logs were collected to identify a profile of actual lab use for the 2003-2004 school year, August 2003 through May 2004. Lab use was identified on the sign-in sheets to specify what students were accessing in the lab: utilization of the web-based resource, specific software programs, or general Internet use. The computer lab sign-in sheets were a data source that was always used in the school.

#### *Hits on the PDG and WAG Websites*

Website use was monitored by the researcher through the use of two identical websites with unique web addresses linked to individual teacher web pages. This method

separated the websites by PDG and WAG group and measured approximate website use by students of the two groups by keeping count of hits on each of the websites. The overall website use by week was monitored, and measured approximate student use since returning to the homepage and Internet searchers may account for some of the hits counted.

#### *Informed Consent and Institutional Review Board Approval*

Approval for the study was obtained from the Institutional Review Board for the protection of Human Subjects at the University of North Florida prior to the collection of any data (see Appendix A). A request for approval for research in the schools was submitted to the Assistant Superintendent of Curriculum and Instruction (Appendix B) and obtained (Appendix C).

The process for data collection was designed to protect teacher privacy, and the data were coded with no identifying labels for research purposes. The instruments were color-coded to identify the two participating groups in the study for the purpose of inquiry into the effect of the two methods of technology innovations. Numbers identifiable only by participants to assure anonymity in both groups matched pre- and post-questionnaire items, as well as the teacher-reported weekly logs of computer. The researcher was not able to identify individual teachers from the information provided.

The principal of the participating school supervised the primary data collection by the researcher. The consent procedures began with a request for interest in the study given to teachers at the participating school (Appendix D). The consent procedures included obtaining the signature of those participants who were involved in both groups of the technology initiative, and all participants signed an informed consent form

(Appendix E) before completing any questionnaires in this study. The participants received information on their involvement in the research and were provided a summary of the research proposal. The participants received a copy of the consent document, and the researcher has all documents on file. There were no conceivable issue of confidentiality and risk associated with participation in the study, and participants were assured that they could drop out of the study at any point in time. They were further assured of the confidentiality of all responses, as instrument were handled by the researcher only and the results were reported as grouped data.

#### *Data Collection*

The duration of the data collection was November 2003 through May 2004 as shown in Table 3. The three instruments were combined and used to gather pre- and posttest data from the participants in both groups (Appendix F). The pre- and post-questionnaire data were collected at the onset of the study, November 2003, and again in May 2004, and all instruments were administered simultaneously in identical settings. Permission was obtained from the developers for all instruments used (Appendix G). Participants used a self-selected identifier on pre- and posttest questionnaires to match pre- and post- questionnaire items. A weekly log (Appendix H) of student computer use was kept by teachers in both groups from January 2004 through May 2004, using the same identifier. These logs were placed in teacher mailboxes and picked up weekly by the researcher to help ensure accuracy of the data.

Table 2

*Timeline for Data Collection*  
 Questionnaire Administration, Treatment, and Weekly Logs

Groups	Pretest Questionnaire Items	November 2003	December 2003	January 2004	May 2004	Posttest Questionnaire Items
PDG	O1,O2,O3	Professional Development Treatment	Professional Development Treatment	Access to school-wide Website of lessons based on classroom curricula	Access to school-wide website of lessons based on classroom curricula	O1,O2,O3
WAG	O1,O2,O3	O1,O2,O3	One hour Orientation to website	Weekly Logs Access to school-wide Website of lessons based on classroom curricula	Weekly Logs Access to school-wide Website of lessons based on classroom curricula	O1,O2,O3
				Weekly Logs	Weekly Logs	

*Data Entry*

The completed questionnaires were scored manually. Reverse scoring of some items on the Teachers' Attitudes Toward Computers, Tac 3.2a, was completed prior to manually entering the data into an SPSS database. Teacher-reported weekly website use logs, computer lab logs, and hits on the websites were entered into Excel spreadsheets.

*Cronbach's Alpha*

Cronbach's alpha was used as an estimate of reliability on a set of 57 responses on the questionnaires to correct for bias and possible measurement error. There is a direct relationship between measurement error and reliability; therefore, an estimate of reliability reflects the proportion of measurement error in the variables used in this study. In analyzing the data from the non-equivalent group design, reliability of data from all

questionnaires was examined using Cronbach's alpha, which produces an upper-bound estimate of reliability.

### *Data Analyses*

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) in order to compare the two groups, professional development group, and web-access group. SPSS is a comprehensive and integrated statistical program for data description and hypothesis testing in the social sciences.

A multivariate analysis of variance (MANCOVA) was used for hypotheses testing to control for differences between the experimental and comparison groups and the dependent variables Teacher's Attitudes Toward Computers, Technology Proficiency Self-Assessment and Stages of Adoption. The alpha level was set at 0.05. Demographic data such as age, years of teaching experience, grade level taught, and educational level were analyzed to determine if a relationship existed between the quantitative dependent variables, teachers' attitudes toward computers, technology proficiency self-assessment and stages of adoptions, as well as actual computer utilization by students. To further interpret the findings, teacher-reported weekly logs of computer use, computer lab sign-in sheets and student hits on the website (divided by groups) were reported descriptively.

The independent variables in this study were participation in the professional development intervention (PDG) and the creation of the technology-integrated lessons to post on the web-based resource to be used by students as a supplement to learning, and the comparison group (WAG) teachers who attended an orientation to location and use of the website but attended no professional development sessions. The pretest variables from the set of questionnaires, Teacher's Attitudes Toward Computers, Technology

Proficiency, and Stages of Adoption, were the covariates in the multivariate analysis of covariance design or MANCOVA. The dependent variables in the quantitative analysis of this study were (a) Teachers' Attitudes Toward Computers, with 5 sub-factors, (b) Technology Proficiency, with 4 sub-factors, and (c) Stages of Adoption of Technology. The multiple factors used in the questionnaire, Teachers' Attitudes Toward Computers (Tacy3.2a), are Factor 1-Enthusiasm/Enjoyment, Factor 2-Avoidance, Factor 3-Anxiety, Factor 4-Negative Impact on Society and Factor 5-Productivity. Four sub-scales were used in the Technology Proficiency Self-Assessment (Tpsa v1.0), Factor 1-Electronic Mail, Factor 2-World Wide Web, Factor 3-Technology Applications, Factor 4-Technology Integration. Stages of Adoption instrument is a single-item survey.

Statistical Package for the Social Sciences (SPSS) was used to analyze the data. Cronbach's alpha coefficient was used to compute reliability estimates, and multivariate analysis of covariance (MANCOVA) was conducted to analyze the differences between the treatment group (PDG) and the comparison group (WAG).

Descriptive analysis was used to examine the utilization of the website by students of teachers in both groups by creating two separate sites for students of each group for purposes of accessing hits on the websites separately. The study also examined student use of computer technology through teacher reported weekly logs of computer use by both groups and hits on the website for both groups from January 2004 through May 2004; computer logs for the 2003-2004 school year were also collected and entered into Excel.

### *Research Population and Sample*

Using a sample of convenience, the participants for this study were recruited from teachers from grades K-5 at one public elementary school in a school district in the southeastern United States. The involvement of human subjects began at the onset of the 2003-2004 school year with recruitment from the teacher population through a teacher interest survey. Teachers volunteered from every grade level in this K-5 elementary school. The sampling model limited the population to which the findings of this study may be of interest to K-5 public school teachers in a suburban middle-class environment. The context of the population from which the sample was recruited was a high-achieving, innovative middle-class school with a population of 97% White, 1% African-American, and 2% Hispanic. These demographics limit the external validity of the findings.

The student population at the time of the study was 1,022. This included 739 White, 145 Black, 105 Hispanic, 21 Asian, 0 Indian, and 1 Pacific Islander. With the support of the principal, 57 out of the total faculty of 70 teachers volunteered. Those teachers who volunteered were distributed as equitably as possible, according to grade level, to make the research groups similar and collaboration on projects by grade level possible. Participants in this study ranged in age from 21 to 54 years, with a mean age of 33 and a standard deviation of 8.5. Typical to most elementary school settings, 100% of the participants were female, and in this sample 100% were White. The number of years of education varied; 62% held a Bachelor's Degree, 35% held a Master's Degree, and 3% held a Master's + 45 hours of coursework. The number of years of teaching experience for the sample ranged from 1 year to 27 years, with a mean of 8 years and a standard deviation of 5.8.

## *Research Setting*

### *Research Site*

The research site was a K-5 public school with all classrooms containing a minimum of three student computers and every teacher having a multimedia cart that included a large-screen TV, presentation box, computer, laser disk player, VCR, and printer. The computers linked to a network server and the Internet, and all student and teacher computers had a Windows 95 Operating System with Microsoft Office Professional Suite software. There was also a computer lab with 24 student computers and a teacher multimedia cart, two rolling labs with 20 wireless laptop computers on each cart, and two Classroom Performance Systems that engage students for testing/evaluation using wireless remote controls. Internet Explorer was the preferred browser for accessing The Learning Page throughout the research year, and the STS worked diligently with the researcher to ensure all student and teacher computers were in working order and accessible. The professional development model was based upon the availability of school resources that were adequate but underused (David, 1994; Goddard, 2002).

### *Researcher's Role*

The role of the researcher was an important aspect of the technology initiative instigated in this study. The researcher functioned as a participant in the process and became a leader among peers. The researcher provided all of the professional development activities for the PDG group and provided technology support of all participant teachers. Several teacher leaders emerged from the peer development group creating a collaborative learning team. While the researcher's role may be considered a limitation in a true experimental design, one of the assumptions of the present study is



that teachers as professional practitioner's learn and teacher best when given the opportunity to construct their own meaning.

#### *Delimitations*

This study was delimited to a middle-class suburban school with all female participants, therefore generalizations drawn from the findings should be limited to a similar setting. The study was further delimited to the effects occurring over a single academic year. The possible effects of administering an identical pre- and posttest to both groups also limit generalization, so that results may not necessarily generalize to a population that received no pretest. Due to the fact that the experimental and comparison groups were teachers in the same school, it is possible that the reactive effect of experimental treatments were due to the fact that the subjects knew that they were participating in a study, and may have reacted to the novelty, rather than the treatment.

#### *Limitations*

To insure that the groups were as similar as possible, grade-level teachers were distributed equally among the two groups and no previous technology experience was required for participation in the professional development initiative. The comparison group received no part of the professional development training, but it is feasible to assume that teachers would have conversations about this program. There is reasonable assurance that confounds were avoided and that there were no consistent differences between what happened to the experimental group and the comparison group other than the technology initiative training. There were no other major technology training programs or initiatives at the school for the 2003-2004 school year. Attrition did not occur, as the teachers who knew they might transfer or be out due to pregnancy did not

volunteer for the technology initiative and no other volunteers dropped out of the study. Due to the inability to randomly assign the groups, this study did not have high internal validity, yet given the real-world environment there was higher external validity, as teachers volunteered for one of two groups based upon personal preferences and levels of comfort.

### *Research Groups*

Two groups were formed from volunteers for the technology initiative in one elementary public school site. The majority of participants volunteered specifying a group preference, professional development or no professional development; while some of the volunteers gave no preference, willing to be placed in either group. The researcher attempted to distribute participants evenly by grade level for collaboration purposes.

The professional development program involved teacher participation in three 2-hour sessions and the development of a website of lessons and Internet links to be used as a classroom resource. The alternate method required that teachers participate in a 1-hour orientation to the resource, and use the resource in the classroom at their discretion. Communication with both groups was made regularly by e-mail and through morning announcements when new lessons were posted.

### *Professional Development Model*

The teacher learning environment for the professional development intervention was built upon principles of constructivist and adult learning theory and designed to control for factors that have been identified as possible inhibitors to technology use by teachers (Brent et al., 2002). The professional development intervention modeled higher-order thinking and learning by actively engaging teachers in knowledge construction

through the use of computer technology (Song & Keller, 2001), with teacher participants developing The Learning Page, a web-based resource of lessons and Internet links for student use. Empirically tested, constructivist, technology-rich learning environments that are desirable in the classroom were modeled during the hands-on interactive training (Craven et al., 2000; Jonassen, 2000; Jonassen, Peck, & Wilson, 1999).

The professional development model was grounded in a body of professional literature and empirical evidence that encouraged the integration of computer technology for active learning in the elementary classroom (Hung & Chen, 1999; Jonassen, 2000; Song & Keller, 2001). Teachers created lessons based on core curricula that included hyperlinks to specific websites for the construction of knowledge by students ensuring that students were able to search out appropriate information on the World Wide Web (Craven et al., 2000), guiding students to specific websites in their search for information. PDG teachers brought their grade-level lessons to the sessions and collaborated with other grade-level teachers on the development of technology-integrated projects and group activities for students to use across grade levels, creating interactions in which the knowledge in these sessions was socially constructed (Candy, 1991). Teacher-created lessons were posted on The Learning Page by grade level, enabling them to be accessed by K-5 teachers. Students and parents could access the lessons from home.

#### *Professional Development Group (PDG)*

The professional development intervention consisted of three 2-hour sessions available on the resource website Collaborate and Create, with continued follow-up contact with the facilitator/researcher. The Collaborate and Create sessions were posted on the website so the treatment group teachers (PDG) were able to work independently

outside of session times. The Collaborate and Create website also included access to multiple web-based resources to assist teachers in developing technology integrated lessons. See Figure 1 for the Collaborate and Create website resource.

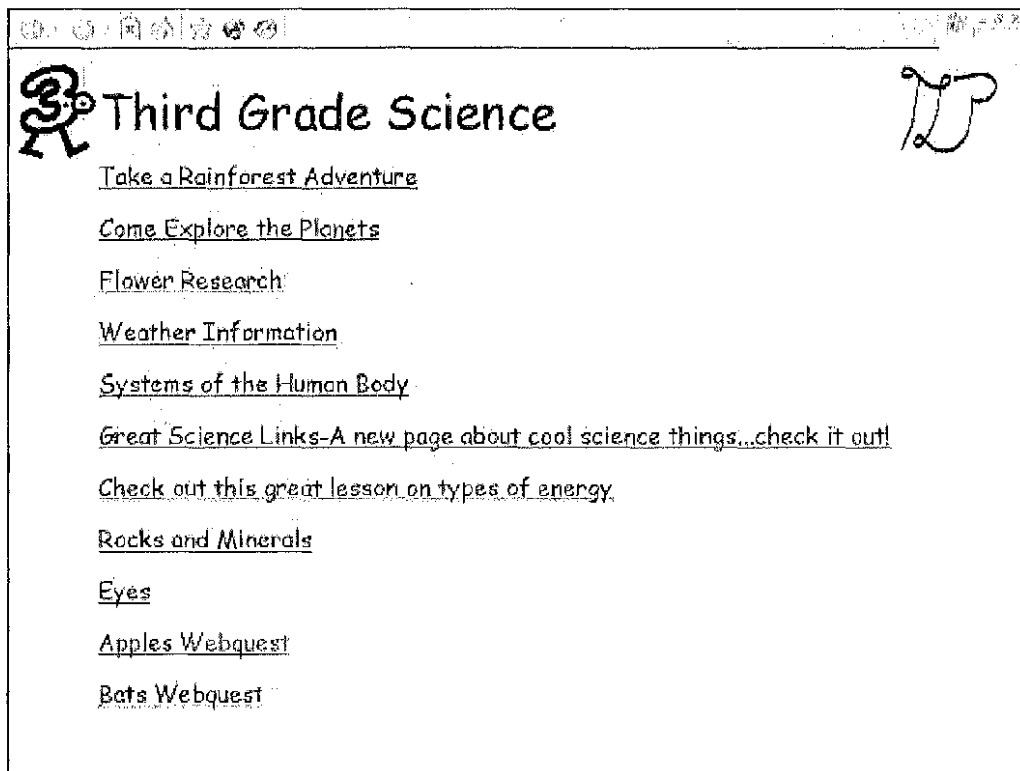
**Welcome to CollaborateandCreate.com©**

**A Computer Technology Integration Resource for Educators  
to promote online learning for students**

<u>Technology Resources</u>	
<u>Grade Level Resources</u>	This web page has been created as a resource for teachers attending Collaborate and Create© professional development sessions for the purpose of encouraging computer technology integration in the classroom with students.
<u>Current Topics</u>	
<u>In-service Topics</u>	The professional development sessions include information on how to create simple technology integrated lessons aligned with classroom curricula. Teachers use Internet websites for student inquiry and research. The teacher created lessons are then linked to The Learning Page for Students© so that they may access the lessons at school or at home.
<u>Professional Development</u>	
<u>How To</u>	The collaborate and create resource may be used by any teacher who is interested in creating and posting their lessons online. For more information on how to create and send a lesson go to <a href="#">more information!</a>
<u>More Information</u>	Teachers who would like to post technology integrated lessons on The Learning Page for Students © may e-mail the lesson in .doc, .txt, or .rtf formats to <a href="mailto:drpass@onlinefilefolder.com">drpass@onlinefilefolder.com</a>
<u>Feedback Form</u>	
<u>The Learning Page for Students©</u>	
<u>How to contribute lessons to The Learning Page for Students ©!</u>	

*Figure 1.* Collaborate and Create teacher resource website.

Teachers in the treatment group (PDG) were encouraged to contribute lessons to the Learning Page throughout the school year, and out of a group of 29, 3 to 5 teachers contributed new lessons on a regular basis. Examples of third grade science lesson pages posted on The Learning Page are shown in Figure 2, giving examples of the type of lessons created by teachers.



*Figure 2.* The Learning Page, third grade science lessons.

One lesson example, Chinese New Year, is shown in Figure 3. This lesson required that students work in cooperative groups using teacher-directed Internet websites to search for information on the “Chinese New Year.” Student products from this lesson could also be accessed online.



Figure 3. Example of teacher-made technology-integrated lesson.

### *Web-Access Group*

Participants in the web-access group (WAG) were made up of teachers who did not attend the professional development sessions, but who received a 1-hour orientation to the instructional resource website for students, The Learning Page, to use at their discretion with students. The Collaborate and Create website was also made available to WAG teachers, and although many teachers from this non-treatment group reported using the teacher resource, no WAG teachers contributed technology-integrated lessons for the student website.

### *Summary*

The purpose of this study was to examine the effects of a school-wide technology initiative and a professional development intervention on teachers' attitudes toward computer, technology proficiency and stages of adoption of technology. In addition, the amount of student utilization of the school-wide website was investigated.

Chapter Three included an explanation of the research methodology and procedures used in this study. The research design, independent and dependent variables, and the participants of the study were described, along with the context for professional development sessions and development of school-wide web-based learning site. The research instruments used in the study were also discussed and the methods used to collect and analyze the data were reported.

Chapter Four presents the findings of the research and a discussion of the data analyses. The findings are then applied to test research hypotheses 1 through 4. Descriptive statistics are used to discuss research hypothesis 5.

Chapter Five presents a summary of the findings, implications for policy makers and educational leaders and recommendation for policy and future research. Contributions of the study to the field of education and technology are presented. The chapter closes with recommendations for future research.

## Chapter Four: Presentation and Analysis of Data

The purpose of this study was to investigate the effects of a school-wide web-based technology initiative that employed two different approaches to preparing teachers to use a web-based instructional resource and integrate it into the core curricula. The dependent variables of interest were teachers' attitudes toward computers, technology proficiency, stages of adoption of technology, and level of utilization of the school-based web resource by students. For the present study teacher volunteers participated in one of two groups, the treatment group, the Professional Development Group (PDG) consisting of a 6-hour professional development module followed by active participation in building the web-based instructional resource, and the comparison Web-Access Group (WAG), consisting of a 1-hour orientation to the instructional resource website.

Five hypotheses guided the study. Three of the five hypotheses examined differences among the two groups of teachers, the Professional Development Group (PDG) and the Web-Access Group (WAG), in relation to the dependent variables: attitudes toward computers, technology proficiency, and stages of adoption of technology. The variable "attitudes toward computers" was measured utilizing five sub-scales of a standardized instrument: Teacher's Attitudes Toward Computers (Tac3.2a; Christensen & Knezck, 1996). The variable "technology proficiency" was measured utilizing four sub-scales of the Technology Proficiency Self-Assessment (Tpsa v1.0; Ropp, 1999), and Stages of Adoption (Christensen, 1998) was measured utilizing a single



score with a minimum of 1 and a maximum of 6 levels related to technology adoption in education. The three instruments combined made up the pre- and posttest sections of the questionnaire, with the pretest variables used as the covariate in the multivariate analysis of covariance (MANCOVA) and the post-program variables as the dependent variables. Hypothesis 4 examined the relationship between demographic data and the dependent variables: attitudes toward computers, technology proficiency, and stages of adoption of technology. Hypothesis 5 examined differences between the two comparison groups of teachers with respect to level of student utilization of the instructional website during the school day.

Null hypotheses were tested for each of the four primary hypotheses and related sub-hypotheses. Statistical analyses were performed using SPSS version 12.0 (SPSS, 2003). The data gathered included pre- and post-questionnaires, demographic data, and descriptive statistics, including teacher-reported weekly logs of computer use, logs of student computer lab usage, and follow-up open-ended surveys throughout the course of the technology initiative during the 2003-2004 school year. The data analyses included Cronbach's alpha to assess the reliability of scores on the research instrument and multivariate analysis of covariance (MANCOVA) for hypotheses 1 through 3, and the corresponding sub-hypotheses. Data for hypotheses 1 through 4 were analyzed simultaneously using MANCOVA, and reported individually. Hypothesis 5 was analyzed using descriptive statistics.

### *Research Hypotheses*

Each research hypothesis and null hypothesis is posited in this chapter, followed by presentation of the analyses conducted to test the null hypotheses. The five hypotheses, including the nine sub-hypotheses are:

#### *Research Hypothesis 1*

There will be a greater improvement in reported attitudes toward computers by teachers who participate in a professional development technology intervention than for teachers in the comparison group.

##### *Sub-hypotheses to Research Hypothesis 1*

a. There will be a greater reported increase in enthusiasm/enjoyment toward computers by teachers who participate in the professional development technology intervention than teachers in the comparison group.

*Ho:* There will be no difference in reported increase in enthusiasm/enjoyment toward computers by teachers who participate in a professional development technology intervention and teachers in the comparison group.

b. There will be a greater reported decrease in anxiety toward computers by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Ho:* There will be no difference in reported decrease in anxiety toward computers by teachers who participate in a professional development technology intervention and teachers in the comparison group.

c. There will be a greater reported decrease in avoidance of computers by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Ho:* There will be no difference in reported decrease in avoidance of computers by teachers who participate in a professional development technology intervention and teachers in the comparison group.

d. There will be a greater reported decrease in perceptions of computers as having a negative impact on society by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Ho:* There will be no difference in reported decrease in perceptions of computers as having a negative impact on society by teachers who participate in a professional development technology intervention and teachers in the comparison group.

e. There will be a greater reported increase in positive attitudes about productivity of computers by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Ho:* There will be no difference in reported increase in positive attitudes about productivity of computers by teachers who participate in a professional development technology intervention than teachers in the comparison group.

### *Research Hypothesis 2*

There will be a greater reported increase in technology proficiency by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Sub-hypotheses to Research Hypothesis*

a. There will be a greater reported increase in technology proficiency as it relates to Electronic mail by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Ho:* There will be no difference in reported increase in technology proficiency as it relates to Electronic mail by teachers who participate in a professional development technology intervention and teachers in the comparison group.

b. There will be a greater reported increase in technology proficiency as it relates to the World Wide Web by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Ho:* There will be no difference in reported increase in technology proficiency as it relates to the World Wide Web by teachers who participate in a professional development technology intervention and teachers in the comparison group.

c. There will be an increase in technology proficiency as it relates to Integrated Applications by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Ho:* There will be no difference in reported increase in technology proficiency as it relates to Integrated Applications by teachers who participate in a professional development technology intervention and teachers in the comparison group.

d. There will be a greater reported increase in technology proficiency as it relates to Teaching with Technology by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Ho:* There will be no difference in reported increase in technology proficiency as it relates to Teaching with Technology by teachers who participate in a professional development technology intervention and teachers in the comparison group.

*Research Hypothesis 3*

There will be a greater reported increase in technology adoption by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Ho:* There will be no difference in reported levels of technology adoption by teachers who participate in a professional development technology intervention and teachers in the comparison group.

*Research Hypothesis 4*

A relationship exists between age, teaching experience, and educational level and the dependent variables, teacher's attitudes toward computers, technology proficiency, and stages of adoption of technology.

*Ho:* No relationship exists between age and the dependent variables, teachers' attitudes toward computers, technology proficiency, and stages of adoption of technology.

*Ho:* No relationship exists between teaching experience and the dependent variables, teachers' attitudes toward computers, technology proficiency, and stages of adoption of technology.

*Ho:* No relationship exists between educational level and the dependent variables, teachers' attitudes toward computers, technology proficiency, and stages of adoption of technology.

### *Research Hypotheses 5*

There will be greater increase in utilization of the school-wide web-based learning site by students of teachers who participate in a professional development technology intervention than by students of teachers in the comparison group.

### *Demographic Profile of the Research Sample*

Participants in this study ranged in age from 21 to 54 years, with a mean age of 33 and standard deviation of 8.5. Typical to many elementary school settings, 100% of the participants were female, and in this sample 100% were White. There was far more diversity in the research population with respect to educational preparation and teaching experience, 61 % held a Bachelor's Degree, 35 % held a Master's Degree, and 3 % held a Specialist Degree, or Masters + 45. The number of years of teaching experience varied from 1 year to 27 years, with a mean of 8 years and a standard deviation of 5.8. Table 3 presents the demographic data for participants in the treatment and comparison groups in this study.

Table 3

## Demographic Profile of the Research Sample

Demographic Variable	PDG	WAG
Number	28	29
Age	21 to 54	22 to 53
<u>Grade Level</u>		
Kindergarten	6	6
First Grade	1	3
Second Grade	5	5
Third Grade	6	4
Fourth Grade	2	4
Fifth Grade	3	3
Related Arts	2	2
Special Education	3	2
Years Teaching	1 to 22	1 to 27
<u>Highest Degree</u>		
BA/BS	18	17
MA/MS	10	10
MA +	0	2
45/Specialist		

Age-PDG group-Range = 33, Mean = 31, Mode = 29, Standard Deviation=9.3

(minimum of 21 to maximum of 54); WAG group-Range = 31, Mean = 31,

Mode =20; Standard Deviation=7.2 (minimum of 22 to maximum of 53).

Years Teaching-PDG group-Range = 21, Mean = 8.5, Mode = 5; Standard Deviation= 5.2

(minimum of 1 to maximum of 22); WAG group-Range = 26, Mean = 7.7,

Mode = 4; Standard Deviation= 6.4 (minimum of 1 to maximum of 27).

*Reliability Estimates*

This study utilized three instruments that have been previously used in the field of technology research (Knezek et al., 2000). Teachers' Attitudes Toward Computers version 3.2a, (Tac v3.2a) Technology Proficiency for Self-Assessment (Tpsa v1.0), and Stages of Adoption of Technology (Christensen, 1998; Ropp, 1999) were combined and administered simultaneously before and after program treatment. When analyzing the data from the non-equivalent group design, data collected on all questionnaire variables were tested using Cronbach's Alpha, which produces an upper-bound estimate of reliability. Analysis found evidence of internal consistency reliability for data on all of the pre-and post questionnaire variables. Internal consistency reliability analyses were conducted on scores from the 90-items on the pre and post-test questionnaire used in this study, five sub-factors of Teachers' Attitudes Toward Computers (Tac 3.2a), four sub-factors of Technology Proficiency Self-Assessment (Tpsa v1.0), and the one-item instrument Stages of Adoption of Technology. All coefficients exceeded .70, indicating integrity in measuring the variables (Nunnally & Bernstein, 1994).

The internal consistency reliability alpha for scores on the 90-item research instrument was .96 from a set of 57 responses on the pretest variables and .96 on the posttest variables. Likewise, scores on the 69 items from the Teachers' Attitudes Toward Computers questionnaire version 3.2a were found to have a reliability alpha of .96 on the pretest variables and .95 on the posttest variables. Alphas were also determined for scores on each of the five sub-factors in the present study from a set of 57 responses and are compared to data from previous studies in Table 4.



Table 4

*Internal Consistency Reliability for Scores on the Tac 3.2a factors*

Tac 3.2a Factors	Alpha Previous Study	Alpha Pre-test Present Study	Alpha Post-test Present Study	No. Variables
Factor 1- Enthusiasm/Enjoyment	.98	.96	.93	15
Factor 2-Anxiety	.92	.98	.94	15
Factor3-Avoidance	.95	.83	.81	13
Factor 5-Negative Impact on Society	.85	.86	.85	11
Factor 6-Productivity	.96	.88	.86	15

Internal consistency reliability for scores on the Teachers' Attitudes toward Computers, Tac 3.2a, the 5 factors used in the present study; comparison of Cronbach's alpha previously reported and present study questionnaire results.

Technology Proficiency Self-Assessment instrument version 1.0 (Tpsa) consisted of 20 questions and 4 sub-scales. Scores from the entire instrument were found to have a reliability alpha of .92 from a set of 57 responses on the pretest variables and .87 on the posttest variables. Alphas were also determined for scores on each of the 4 sub-scales of the Tpsa pre- and posttest variables and compared to previous studies in Table 5 (Knezek et al., 2000). Stages of adoption self assessment lists 6 stages of technology integration, with stage 1 as the lowest level of technology adoption and stage 6 as the highest level of adoption. This assessment is a single-instrument survey and cannot be tested for internal consistency reliability. This measure was administered with the Tac and the Tpsa (Appendix F).

Table 5

*Internal Consistency Reliability for Scores on the Tpsa v1.0 4 Factor Instrument*

Tpsa v1.0 Factors	Alpha Previous Study	Alpha Pretest Present Study	Alpha Posttest Present Study	No. Variables
Factor 1- Electronic Mail	.78	.73	.72	15
Factor 2- World Wide Web	.81	.80	.66	15
Factor3- Integrated Applications	.84	.83	.79	13
Factor 4- Teaching with Technology	.88	.89	.85	11

Internal consistency reliability for scores on the Technology Proficiency Self-Assessment, Tpsa v1.0, 4 factor instrument (Ropp, 1999), comparing alphas for previous studies and pre- and posttest alphas for present study.

*Descriptive Statistics for the Pre- and Post-Questionnaires*

The descriptive statistics for individual factors and sub-factors for each domain of the research instrument are presented separately to maintain the focus of each domain.

Teachers' Attitudes Toward Computers (Tac 3.2a), Technology Proficiency Self-Assessment (Tpsa v1.0), and Stages of Adoption pre- and post-program statistics tables are presented in Appendices P, Q, R, S, and T.

*Research Groups*

Descriptive statistics for the treatment and comparison groups, professional development group (PDG), and web-access group (WAG) are presented in Table 6.

Table 6

## Descriptive Statistics of Factors

Dependent Variable	Research Group	Mean	Std. Deviation	N
Tac3.2a PostFactor1	PDG	3.7	0.5	28
	WAG	3.5	0.6	29
	Total	3.6	0.5	57
Tac3.2a PostFactor2	PDG	3.9	0.6	28
	WAG	3.9	0.7	29
	Total	3.9	0.6	57
Tac3.2a PostFactor3	PDG	4.3	0.3	28
	WAG	4.2	0.4	29
	Total	4.3	0.4	57
Tac3.2a PostFactor5	PDG	3.7	0.5	28
	WAG	3.7	0.5	29
	Total	3.7	0.5	57
Tac3.2a PostFactor6	PDG	4.0	0.4	28
	WAG	4.1	0.4	29
	Total	4.0	0.4	57
Tpsa PostElectronic Mail	PDG	3.9	0.6	28
	WAG	4.2	0.7	29
	Total	4.0	0.7	57
Tpsa PostWorldwide Web	PDG	4.3	0.5	28
	WAG	4.3	0.6	29
	Total	4.3	0.5	57
Tpsa Integrated Applications	PDG	3.7	0.8	28
	WAG	3.5	0.8	29
	Total	3.6	0.8	57
Tpsa PostTeaching withTechnology	PDG	3.7	0.9	28
	WAG	3.9	0.6	29
	Total	3.8	0.8	57
StagesofAdoption Post	PDG	5.0	1.1	28
	WAG	4.8	0.9	29
	Total	4.9	1.0	57

Summary of treatment and comparison group descriptive statistics of the dependent variable with covariates.

### *Testing of Assumptions*

Three assumptions were tested to determine the suitability of MANCOVA for analyzing the research data. Separate tests were conducted to assess: homogeneity of slopes, equality of error variances, and equality of covariance matrices.

#### *Homogeneity-of-slopes*

As is necessary in ANCOVA, the homogeneity-of-slopes assumption is tested before conducting the MANCOVA. The homogeneity-of-slopes assumption tests the interaction between the covariate and the factor, and a statistically significant interaction suggests that the differences on the dependent variable among groups vary as a function of the covariate. If the interaction is statistically significant, the results from the MANCOVA are not meaningful, and further analyses with MANCOVA should not be conducted. Using an interaction between research group and all covariates showed no statistically significant interaction ( $p > .05$ ) on dependent variables with the results as follows:

Dependent variables (posttest questionnaire) Teachers' Attitudes Toward Computers five sub-factors:

- 1-Enthusiasm/Enjoyment,  $F(2, 38) = .31, p = .73, n^2 = .02,$
- 2- Anxiety,  $F(2, 38) = .44, p = .65, n^2 = .02,$
- 3- Avoidance,  $F(2, 38) = .52, p = .60, n^2 = .03,$
- 5- Negative Impact on Society,  $F(2, 38) = .39, p = .68, n^2 = .02,$
- 6- Productivity,  $F(2, 38) = 1.51, p = .23, n^2 = .07$

Dependent variables (posttest questionnaire) Technology Proficiency Self-Assessment (Tpsa) four sub-factors:

- 1-ElectronicMail,  $F(2, 38) = .29, p = .75, n^2 = .01,$
- 2-WorldwideWeb,  $F(2, 38) = .15, p = .86, n^2 = .01,$
- 3-IntegratedApplications,  $F(2, 38) = .07, p = .93, n^2 = .00,$
- 4-TeachingWithTechnology,  $F(2, 38) = .24, p = .78, n^2 = .01$

Dependent variable Stages of Adoption,  $F(2, 38) = .14, p = .87, n^2 = .01$

### *Levene's Test of Equality of Error Variances*

Levene's test of Equality of Error Variances was performed before conducting the MANCOVA to test the null hypotheses that the error variance of the dependent variable is equal across groups. The interaction in the Levene's test of Equality of Error Variances was not statistically significant across all dependent variables, with a design of intercept and research group as interactions. In testing the error variance of the dependent variable for equality across groups, Levene's test of Equality of Error Variances yielded the following results, indicating that the interactions were not statistically significant ( $p > .05$ ):

Teachers' Attitudes Toward Technology (Tac 3.2a) five sub-factors:

- 1-Enthusiasm/Enjoyment,  $F(1, 55) = 1.29, p = .26$ ,
- 2-Anxiety,  $F(1, 55) = .05, p = .83$ ,
- 3-Avoidance,  $F(1, 55) = .77, p = .38$ ,
- 5-Negative Impact on Society,  $F(1, 55) = .00, p = .96$ ,
- 6-Productivity,  $F(1, 55) = .27, p = .60$ .

Teacher Proficiency Self-Assessment (Tpsa) four sub-factors:

- 1-ElectronicMail,  $F(1, 55) = .01, p = .91$ ,
- 2-WorldwideWeb,  $F(1, 55) = .00, p = .95$ ,
- 3-IntegratedApplications,  $F(1, 55) = .68, p = .41$ ,
- 4-TeachingwithTechnology,  $F(1, 55) = 1.21, p = .27$ .

Stages of Adoption, one-item instrument:

- Stages of AdoptionPost,  $F(1, 55) = 1.28, p = .26$ .

### *Box's M Test of Equality of Covariance Matrices*

Box's M test was used to test whether the variance-covariance matrices across the cells were the same. Since multivariate analysis of covariance assumes the equality of covariance matrices, Box's test of equality of covariance matrices is run to test the null

hypothesis that the observed covariance matrices of the dependent variables are equal across groups before continuing with MANCOVA. The present study indicated there were no statistically significant differences,  $p = .95$ , or  $p > .05$ .

### *Analyses of the Hypotheses*

Multivariate analysis was selected for the present study to minimize the inflated risk of Type I error, which is more likely to occur when multiple dependent variables are analyzed with univariate tests. Multivariate Analysis of Covariance (MANCOVA) is a procedure that uses several dependent variables concurrently within the same analysis. This analysis detects differences between groups, controlling for the influence of variables that might otherwise affect the analysis. The covariate is included in the analysis to control for differences of the variable, but is not the focus of the analysis. The test of the covariate evaluates the relationship between the covariate and the dependent variable controlling for the pretest factors in this study (Green, Salkind, & Akey, 2000).

Using the covariates goes beyond using only dependent and independent variables, and instead examines the effect of the independent variables on the dependent variables above and beyond the effects of the covariates on the dependent variables. Post hoc tests are normally used to determine the specific meaning of main effects or interactions, but post hoc tests are not available for analyses that include a covariate. Therefore, noteworthy results were examined using profile plots to determine the effect of the research groups on the dependent variables.

### *Presentation of the Research Findings*

The results of the MANCOVA are presented for each research hypothesis and sub-hypothesis. To test hypotheses 1 through 3, including the subscales of the

instruments, a MANCOVA procedure was used to determine the effect of the independent variables, the PDG and WAG groups, on the dependent variables: teachers' attitudes toward computers' 5 sub-scales, technology proficiency's 4 sub-scales and stages of adoption of technology.

Wilks lambda was conducted first to look for differences between the dependent variables due to the independent variables in this study, the PDG and WAG. The multivariate interaction between groups, PDG and WAG, and 90 dependent variables, with 90 pretest variables as a covariate indicated there was no statistically significant interaction between dependent variables due to the independent variables PDG and WAG ( $\lambda_{[10, 36]} = .635, p > .05$ ). Since the MANCOVA partially accounts for variance due to the covariates, a large effect size and a small sample size may produce results in the univariate tests that are meaningful. The lambda value of .635, a large effect size of 36%, and small sample size of 57 suggested that it might be meaningful to interpret the univariate tests imbedded in the multivariate analysis. Hypotheses 1 through 4, including the nine sub-hypotheses are presented in the following section.

#### *Analyses of the Research Hypotheses*

The results of statistical testing of hypotheses 1-4, including the nine sub-hypotheses, are reported here. Findings related to hypothesis 5 are reported with descriptive statistics.

#### *Research Hypothesis 1*

There will be a greater improvement in reported attitudes toward computers by teachers who participate in a professional development technology intervention than for teachers in the comparison group.

*Sub-hypotheses to Research Hypothesis 1*

a. There will be a greater reported increase in enthusiasm/enjoyment toward computers by teachers who participate in the professional development technology intervention than teachers in the comparison group.

The findings of the multivariate analysis of covariance indicated no statistically significant differences between groups for Teachers' Attitudes Toward Computers, Factor 1- Enthusiasm/Enjoyment,  $F(1, 45) = .14, p > .05$ , the null hypothesis was supported:

*Ho:* There will be no difference in reported increase in enthusiasm/enjoyment toward computers by teachers who participate in a professional development technology intervention and teachers in the comparison group.

b. There will be a greater reported decrease in anxiety toward computers by teachers who participate in a professional development technology intervention than teachers in the comparison group.

The findings of the multivariate analysis of covariance (MANCOVA) indicated no statistically significant differences between groups for Teachers' Attitudes Toward Computers, Factor 2-Anxiety,  $F(1, 45) = .77, p > .05, \eta^2 = .02$ , the null hypothesis was supported:

*Ho:* There will be no difference in reported decrease in anxiety toward computers by teachers who participate in a professional development technology intervention and teachers in the comparison group.



c. There will be a greater reported decrease in avoidance of computers by teachers who participate in a professional development technology intervention than teachers in the comparison group.

The findings of the multivariate analysis of covariance (MANCOVA) indicated no statistically significant differences between groups for Teachers' Attitudes Toward Computers, Factor-3,  $F(1, 45) = .25, p > .05, \eta^2 = .01$ , the null hypothesis was supported:

*Ho*: There will be no difference in reported decrease in avoidance of computers by teachers who participate in a professional development technology intervention and teachers in the comparison group.

d. There will be a greater reported decrease in perceptions of computers as having a negative impact on society by teachers who participate in a professional development technology intervention than teachers in the comparison group.

The findings of the multivariate analysis of covariance (MANCOVA) indicated no statistically significant differences between groups for Teachers' Attitudes Toward Computers, Factor-5,  $F(1, 45) = 2.14, p > .05, \eta^2 = .04$ , the null hypothesis was supported:

*Ho*: There will be no difference in reported decrease in perceptions of computers as having a negative impact on society by teachers who participate in a professional development technology intervention and teachers in the comparison group.

c. There will be a greater reported increase in positive attitudes about productivity of computers by teachers who participate in a professional development technology intervention than teachers in the comparison group.

The findings of the multivariate analysis of covariance (MANCOVA) indicated no statistically significant differences between groups for Teachers' Attitudes Toward Computers, Factor 6- Productivity,  $F(1, 45) = .39, p > .05, \eta^2 = .01$ , the null hypothesis was supported:

*Ho:* There will be no difference in reported increase in positive attitudes about productivity of computers by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Research Hypothesis 2*

There will be a greater reported increase in technology proficiency by teachers who participate in a professional development technology intervention than teachers in the comparison group.

*Sub-hypotheses to Research Hypothesis 2*

a. There will be a greater reported increase in technology proficiency as it relates to Electronic mail by teachers who participate in a professional development technology intervention than teachers in the comparison group.

The findings of the multivariate analysis of covariance (MANCOVA) indicated no statistically significant differences between groups for Technology Proficiency Self-Assessment, Electronic Mail,  $F(1, 45) = .00, p > .05, \eta^2 = .00$ , the null hypothesis was supported:

*Ho:* There will be no difference in reported increase in technology proficiency as it relates to Electronic mail by teachers who participate in a professional development technology intervention and teachers in the comparison group.

b. There will be a greater reported increase in technology proficiency as it relates to the World Wide Web by teachers who participate in a professional development technology intervention than teachers in the comparison group.

The findings of the multivariate analysis of covariance (MANCOVA) indicated no statistically significant differences between groups for Technology Proficiency Self-Assessment, Worldwide Web,  $F(1, 45) = .55, p > .05, \eta^2 = .01$ , the null hypothesis was supported:

*H<sub>0</sub>*: There will be no difference in reported increase in technology proficiency as it relates to the World Wide Web by teachers who participate in a professional development technology intervention and teachers in the comparison group.

c. There will be a difference in technology proficiency as it relates to Integrated Applications by teachers who participate in a professional development technology intervention than teachers in the comparison group.

The findings of the multivariate analysis of covariance (MANCOVA) indicated statistically significant differences between groups for Technology Proficiency Self-Assessment, Integrated Applications,  $F(1, 45) = 4.14, p < .05, \eta^2 = .08$ , the null hypothesis was rejected:

*H<sub>0</sub>*: There will be no difference in reported increase in technology proficiency as it relates to Integrated Applications by teachers who participate in a professional development technology intervention and teachers in the comparison group.

d. There will be a greater reported increase in technology proficiency as it relates to Teaching with Technology by teachers who participate in a professional development technology intervention than teachers in the comparison group.

The findings of the multivariate analysis of covariance (MANCOVA) indicated no statistically significant differences between groups for Technology Proficiency Self-Assessment, Teaching With Technology,  $F(1, 45) = .09, p > .05, \eta^2 = .00$ , the null hypothesis was supported:

*H<sub>0</sub>*: There will be no difference in reported increase in technology proficiency as it relates to Teaching with Technology by teachers who participate in a professional development technology intervention and teachers in the comparison group.

*Research Hypothesis 3*

There will be a greater reported increase in technology adoption by teachers who participate in a professional development technology intervention than teachers in the comparison group.

The findings of the multivariate analysis of covariance (MANCOVA) indicated statistically significant differences between groups for Stages of Adoption,  $F(1, 45) = 9.61, p < .05, \eta^2 = .18$ , the null hypothesis was rejected:

*H<sub>0</sub>*: There will be no difference in reported levels of technology adoption by teachers who participate in a professional development technology intervention and teachers in the comparison group.

One of the three hypotheses and one of the nine sub-hypotheses were supported. A statistically significant difference was found for sub-hypothesis 2c, there was a greater reported increase in technology proficiency as it related to Integrated Applications by teachers who participated in the professional development technology intervention than by teachers in the comparison group; and hypothesis 3, there was a greater reported increase in technology adoption by teachers who participated in the professional

development technology intervention than by teachers in the comparison group. Table 7 lists the research groups and interactions of the covariates and the adjusted mean and standard deviation of the dependent variables. The univariate tests imbedded within the multivariate analysis were reported to explain the larger Eta-square values from the MANCOVA, as the large effect size may be meaningful to the results in this study. The two hypotheses tests that yielded statistically significant differences, Technology Proficiency Self-Assessment sub-factor Integrated Applications and Stages of Adoption, are discussed in detail in Chapter 5.

Table 7

*Adjusted Means MANCOVA*

Dependent Variable	Groups	Mean	Standard Deviation	95 % Confidence Interval	
				Lower Bound	Upper Bound
Tac3.2aPostFactor1	PDG	3.6	.46	3.5	3.8
	WAG	3.6	.63	3.4	3.8
Tac3.2aPostFactor2	PDG	4.0	.63	3.8	4.1
	WAG	3.8	.67	3.7	4.0
Tac3.2aPostFactor3	PDG	4.3	.33	4.2	4.4
	WAG	4.2	.39	4.1	4.3
Tac3.2aPostFactor5	PDG	3.7	.48	3.6	3.9
	WAG	3.6	.53	3.4	3.7
Tac3.2aPostFactor6	PDG	4.0	.37	3.9	4.1
	WAG	4.1	.41	3.9	4.2
TpsaPostElectronic Mail	PDG	4.0	.63	3.8	4.2
	WAG	4.0	.67	3.9	4.2
TpsaPostWorld Wide Web	PDG	4.4	.52	4.2	4.6
	WAG	4.3	.59	4.1	4.5
TpsaPostIntegrated Applications	PDG	3.8	.81	3.5	4.0
	WAG	3.4	.83	3.2	3.6
TpsaPostTeaching With Technology	PDG	3.8	.88	3.5	4.0
	WAG	3.8	.63	3.6	4.0
StagesofAdoption Post	PDG	5.2	1.1	4.9	5.5
	WAG	4.6	.90	4.3	4.9

Summary of research groups with covariates, which adjusts the means of the dependent variables. Covariates appearing in the model were evaluated at the following values: Tac3.2a Pretest Factor1 = 3.6, Tac3.2a Pretest Factor2 = 3.9, Tac3.2a Pretest Factor3 = 4.3, Tac3.2a Pretest Factor5 = 3.6, Tac3.2a Pre test Factor6 = 4.0; Tpsa Pre-score E-mail = 4.0, Tpsa Pres-score World Wide Web = 4.2. Tpsa Pre-score Integrated Applications = 3.4, Tpsa Pre-score Teaching with Technology = 3.7; Stages of Adoption Pre = 4.5.

#### *Research Hypothesis 4*

A relationship exists between age, teaching experience, and educational level and the dependent variables, teacher's attitudes toward computers, technology proficiency, and stages of adoption of technology.

The findings of the multivariate analysis of covariance (MANCOVA) indicated no statistically significant relationship between age and the dependent variables, teacher's attitudes toward computers, technology proficiency, and stages of adoption of technology,  $F(1, 45) = 4.14$ ,  $p = .05$ ,  $\eta^2 = .08$ , the null hypothesis was supported:

*H<sub>0</sub>*: No relationship exists between age and the dependent variables, teachers' attitudes toward computers, technology proficiency, and stages of adoption of technology.

The findings of the multivariate analysis of covariance (MANCOVA) indicated no statistically significant relationship between teaching experience and the dependent variables, teachers' attitudes toward computers, technology proficiency, and stages of adoption of technology,  $F(1, 45) = 4.14$ ,  $p = .05$ ,  $\eta^2 = .08$ , the null hypothesis was supported:

*H<sub>0</sub>*: No relationship exists between teaching experience and the dependent variables, teachers' attitudes toward computers, technology proficiency, and stages of adoption of technology.

The findings of the multivariate analysis of covariance (MANCOVA) indicated no statistically significant relationship between educational level and the dependent variables teachers' attitudes toward computers, technology proficiency, and stages of adoption of technology,  $F(1, 45) = 4.14$ ,  $p = .05$ ,  $\eta^2 = .08$ , the null hypothesis was supported:

*Ho:* No relationship exists between educational level and the dependent variables, teachers' attitudes toward computers, technology proficiency, and stages of adoption of technology.

#### *Research Hypotheses 5*

There will be greater utilization of the school-wide web-based learning site by students of teachers who participate in a professional development technology intervention than by students of teachers in the comparison group.

This hypothesis was tested with descriptive statistics to analyze multiple methods of data collection to determine student use of the school-wide web-based learning site by groups of teachers, PDG and WAG. The multiple data sources were used to provide triangulation of three types of data to confirm positive use of the website by students in both groups. The types of data included weekly teacher self-reported forms collected from January 2004, the beginning of the study, through May 2004 as shown in Figure 4, and the 2003-2004 school year patterns of use of the computer technology lab as shown in Figure 5. In addition, the number of hits that registered on identical websites identified by PDG and WAG group for research purposes were collected to identify approximate use the website by students of the teachers in each of the groups from January 2003 through May 2004. Students of teachers in the PDG group showed a 20% greater increase in website use each week, with the WAG group averaging 300 hits per week and the PDG group averaging 500 hits per week. Patterns of change in website use such as increased use before statewide testing by students of teachers in the WAG and lowered use by students of teachers in the PDG. The PDG began the year with higher overall use,



while the WAG ended the year with higher overall use with website use by students of teachers in both groups increased at the end of the year.

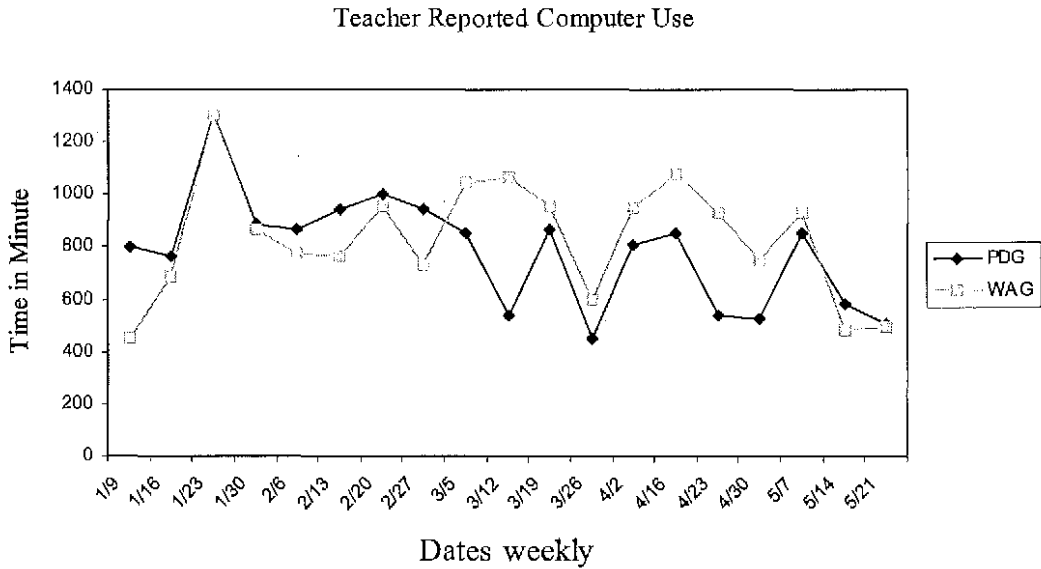


Figure 4. Teacher-reported computer use by students, PDG and WAG.

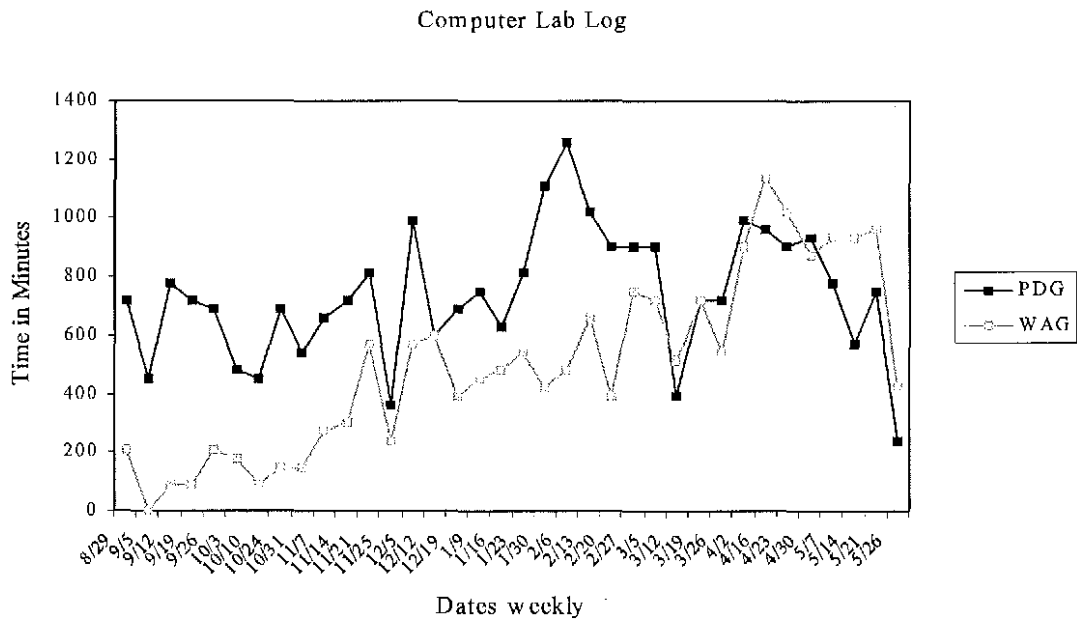


Figure 5. 2003-2004 weekly computer lab sign-in sheets.

Chapter Five presents a summary of the study, discussion of the results, and implications of the findings. Contributions of the present study to the knowledge base in computer technology integration in education are presented, and recommendations for practice and future research are made.

## Chapter Five: Summary, Implications, and Recommendations

Chapter Five begins with a summary of the study, including a brief review of the methodology, research questions, limitations and delimitations of the design. The summary is followed by the presentation and discussion of the findings. This includes speculation about the implications of the study for educational practice and its possible contributions to the technology integration knowledge base. The chapter concludes with recommendations for practice and future research.

### *Summary of the Study*

The purpose of this study was to investigate the effects of a school-wide technology initiative on teachers' attitudes toward computers, technology proficiency, stages of adoption of technology, and student utilization of a school-wide web-based resource of technology integrated teacher-created lessons called The Learning Page. Teachers volunteered for one of two groups, a treatment group, the Professional Development Group (PDG), and a comparison group, the Web-Access Group (WAG). The teachers of the PDG participated in a professional development intervention that involved building the school-wide web-based resource for student use, The Learning Page. The PDG group also accessed the researcher/facilitator-created website, Collaborate and Create, to support the professional development sessions as an ongoing resource for teachers.

### *Methodology*

This study explored and analyzed the effects of a school-wide web-based technology initiative. The dependent variables of interest were teachers' attitudes toward computers, technology proficiency, stages of adoption of technology, and amount of student utilization of the school-based web resource. The study investigated the effects of both a professional development intervention and its real-time implementation in an elementary school setting. A true experimental research design was neither possible nor desirable, and given the complexities and ongoing processes of an elementary school setting, much of the information that was gathered during the technology initiative was descriptive in nature (Marshall & Rossman, 1999).

### *Participants*

The involvement of human subjects began with recruitment from an elementary teacher population through a teacher interest survey. Participants ranged in age from 21 to 54 years, with a mean age of 33 and a standard deviation of 8.5. Typical to many elementary school settings, 100% of the participants were female, and in this sample 100% were White. Sixty-one percent of the participants held a Bachelor's Degree, 35% a Master's Degree, and 3% a Master's Degree + 45 additional graduate hours. The number of years of teaching experience varied from 1 to 27 years, with a mean of 8 and a standard deviation of 5.8.

### *The Findings*

The results of testing the research hypotheses 1 through 4 using multivariate analysis of covariance (MANCOVA) resulted in the failure to reject every hypothesis except hypothesis 2, sub-hypothesis (c), and hypothesis 3. A statistically significant

difference was found between groups for Technology Proficiency Self-Assessment Integrated Applications,  $F(1, 45) = 4.14$ ,  $p < .05$ ,  $\eta^2 = .08$ ; therefore the null hypothesis was rejected in hypothesis 2, sub-hypothesis (c). A statistically significant difference was found between groups for Stages of Adoption of Technology,  $F(1, 45) = 9.61$ ,  $p < .05$ ,  $\eta^2 = .18$ ; therefore the null hypothesis was rejected in hypothesis 3.

These results indicate that teachers who received a professional development intervention (PDG group) reported a greater increase in technology proficiency as it related to Integrated Applications and a greater increase in Stages of Adoption of technology than teachers in the comparison group.

Hypothesis 4 found that no statistically significant relationship existed between age, educational level, and years teaching experience, and the dependent variables, teachers' attitudes toward computers, technology proficiency, and stages of adoption of technology.

Research Hypothesis 5, there will be greater utilization of the school-wide web-based learning site by students of teachers who participated in the professional development technology intervention than students of teachers in the comparison group was supported. Results were reported descriptively and indicated that the students of teachers in the PDG group utilized the learning website more than students of teachers in the comparison group.

#### *Teacher Self-reported Logs of Computer Use by Students*

Analysis of the teacher-reported logs in Figure 4 provided information on classroom and computer lab use as reported by the teachers in both groups. The teacher-reported logs of computer use by students from January 2004 through May 2004

identified a higher utilization by students of teachers in the web-access group for general activities and skill building. The teachers in the Professional Development Group (PDG) reported using the website as a supplement to classroom curriculum, and teachers in both groups utilized the website on a consistent basis. This data source did not correlate with the Computer Lab Sign-in Logs or the registered hits on the PDG and WAG group websites.

### *Computer Lab Sign-in Logs*

The computer lab log data in Figure 5 provides a profile of actual lab use for the 2003-2004 school year from August 2003 through May 2004. Lab use increased, especially during the times of the study, from January to May. Inquiry was made by teachers to administration about the necessity of making arrangements to increase equity in signing up for the computer lab, as all teachers were unable to schedule time for their classes due to this increase. Computer lab use has remained high after the conclusion of the study, and there are plans to open a second computer lab in the school. In addition, some teachers included the website curriculum in their yearly evaluations to administrators, and the website has remained in use, is currently linked to the school website, and continues to be used by many teachers in the research site as well as other schools within the district.

The Professional Development Group (PDG) used the computer lab more throughout the entire year, with the exception of the weeks of state-wide testing, in which the web-access group (WAG) signed up for the computer lab more. This may be evidence of PDG group teachers using the lessons for a supplement to classroom curriculum, while

teachers in the WAG group used links to drills and skills, such as testing skills, free time with controlled Internet access, rather than for specific curriculum purposes.

#### *Website Use by PDG and WAG groups*

Website use was monitored by the researcher through the use of two identical websites linked to individual teacher web pages. This method recorded an approximate number of hits on the websites designated by teacher groups PDG and WAG. All teachers in the school were given equal access to the website, and 13 non-research group teachers (NRG) requested links and were linked to a third website to separate hits on the PDG and WAG sites. These teachers were interested in utilizing the website although they were not part of either research group.

The overall website use by week confirmed student use as evidenced by the weekly hits on the website from January 2004 through May 2004. These website hits were not only the result of student use of the online resource, but the counter also registered the number of times a student returned to the home page of the website or random hits created by search engines, therefore the results are approximate. The hits on the website correlate with the computer lab sign-in sheets when investigating use by students of each of the teacher groups. The PDG group hits were higher than those of the WAG group at the beginning of the year, and both groups' hits remained the same each week, at about 300 hits for the WAG students and 500 hits for the PDG students, except for the first two weeks of the study, when students of the WAG group only registered 200 hits per week. The number of hits by students of both groups remained consistent as the year progressed, indicating that the school-wide website was being utilized on a regular basis. The patterns of change in school-wide website use identified in both groups were the

patterns of use before state-wide testing, when the WAG group hits increased and the PDG groups decreased. The PDG began the year with higher overall use, while the WAG ended the year with higher overall use, and both groups increased after state testing.

The combination of multiple data collection methods combined the strengths and minimized the weaknesses of these methods of analysis in examining teacher and student use of the school-wide web-based site. The findings of this study related to greater self-reported use of Integrated Applications and higher Stages of Adoption of technology by teachers are explored in detail in the discussion of the results. These findings indicate that exposure to the professional development intervention increased reported use of integrated applications and encouraged higher stages of adoption by the experimental group of teachers (PDG) than by the comparison group of teachers (WAG). Triangulation of the descriptive data collected in this study lends support to the assumption that a school-wide technology innovation encourages an increase in technology integration into the classroom curriculum by students of teachers involved in the professional development intervention.

#### *Discussion of Delimitations and Limitations*

This study was delimited to one middle-class, suburban public elementary school that was chosen for convenience, principal support, and accessibility to the faculty and school resources. Consequently, caution must be exercised in generalizing the findings of the study to settings and populations that are dissimilar to the research sample. While simultaneous testing of the innovation in multiple schools would have strengthened generalizability, this was beyond the scope of the present study. The single school site may have limited the internal validity due to reactive effects of the experimental



arrangements. Since the two groups involved, experimental (PDG) and comparison (WAG), were teachers in the same school, they knew that they were participating in a study and may have reacted to the novelty, rather than the treatment (professional development intervention).

The study was further limited in that teachers were invited to participate and non-participants were not excluded from utilizing the website. Further, those who volunteered to participate were allowed to choose either the experimental group or the comparison group, introducing another possible limitation to the validity of the findings. However, results of the MANCOVA, utilizing the pretests as the covariate, indicated that there was no statistically significant difference between the two groups of teachers with respect to the variables of interest in this study at the onset.

Teachers volunteered for the technology initiative, and many of the participants had a preference for which group they wanted to participate. To help insure that the groups were as similar as possible, grade-level teachers were distributed equally among the PDG and WAG groups, and no previous technology experience was required for participation in the professional development initiative. Some of the teachers who volunteered for the technology initiative were willing to be a part of either group, making grade-level distribution possible. The comparison group received no part of the professional development training, but it is feasible to assume that teachers would have conversations about this program.

There is reasonable assurance that confounds were avoided and that there were no consistent differences between what happened to the experimental group and the comparison group other than the technology initiative training. There were no other

major technology training programs or initiatives at the school or within the county for the 2003-2004 school year. Attrition did not occur, as the teachers who knew in advance of transfers or family leave did not volunteer for the technology initiative, and no other participants dropped out of the study.

Although generalizability and internal validity were weakened by the selection of a single school in which to test the innovation and non-random assignment of participants to groups, there were also benefits to this design. This investigation into the effects of a school-wide initiative in a single school provided an opportunity to gather descriptive evidence on the impact of the innovation on the entire faculty. The present study mirrored the reality of promoting technology integration in a school setting where teachers have different levels of enthusiasm and commitment, different skill levels, and various professional and personal demands on their time that differentially affect their participation levels at any given point in the school year.

#### *Discussion of the Findings*

The findings of the present study are discussed in relationship to the theoretical framework and related to the empirical research upon which the study was based. Conclusions, implications for practice, and recommendations for further research are supported by this discussion.

#### *Interpretation of Results Within the Theoretical Framework*

The results of this study as they relate to the theoretical framework of constructivist and adult learning theories are discussed in this section. This study used a combination of learning theories that have been determined to contribute to effective learning with technology. A conceptual framework for the present study was developed

from theory and previous research in the area of professional development initiatives that sought to increase technology integration in the classroom, improve teachers' attitudes toward computers, improve technology proficiency, and increase stages of adoption of technology by teachers with their students. The professional development that was the focus of the present study incorporated practical applications of cognitive learning theory to engage teachers in the development and implementation of an instructional technology resource.

It is often difficult for teachers who are in favor of adopting constructivist instructional approaches to actually implement such approaches in the classroom. The move from objectivist epistemological orientations to more constructivist approaches has importance in the move to transform theory to pedagogy on a practical level for classroom teachers. The professional development intervention in this study encouraged teachers to move toward constructivist teaching practices by encouraging the use of computers and Internet technologies in their classroom instruction (Cobb, 1999; Craven, et al., 2000; Dexter, et al., 1999; Halpen, 1999; Hashweh, 1996).

The professional development design in the present study was based upon successful technology integration practices and stressed the importance of teachers' epistemological beliefs and the effect of these beliefs on how students are approached in the classroom. It was the assumption of the present research that modeling a professional development program after constructivist and adult learning principles would encourage a change in teacher pedagogy, and that teachers would increase the use of computer technology with their students as a result of this change. When information is assimilated to pre-existing notions and modified in light of new understanding, these ideas gain

complexity in the process of this understanding, and a critical insight is developed that increases learning in depth and detail (Bandura, 1977; Brookfield, 1983; Cohen, 1997; Edwards, 2002; Goddard, 2002; Handler, 1993).

Supporting teachers in creating their own lessons and taking ownership of the production and implementation of the lessons through online website posting in the present study encouraged innovation rather than the common professional development approach of offering pre-made lessons for teachers to use. Findings in the present study supported the effectiveness using a professional development model that supported active, directed learning with teachers so that they may model this type of learning with their students (Bonk, et al., 2001; Cobb, 1999; Dexter, et al., 1999; Halpin, 1999). Applying constructivist principles to instructional designs using technology as the tool for implementation created an accessible model of transferable knowledge in an online context, making learning unique and attractive to students (Jonassen, 2000; Mills & Tincher, 2003).

The social constructivist model of learning was appropriate for the elementary educational environment and was supported with some success in the professional development intervention in the present study. The professional development intervention in the present study modeled the foundation of constructivist learning in an educational setting where children actively construct their knowledge, use higher-order thinking, problem-solving, and real-world skills (Jonassen, 2000; Jonassen, et al, 2003). Changes in teacher pedagogy were presented in the professional development intervention by providing a hands-on, active learning environment where participants were encouraged to develop lessons with an emphasis on promoting students to invent ideas rather than

merely absorbing ideas presented to them by teachers. The professional development program in this initiative encouraged the transference of this type of teaching in the classroom which may promote a change in teacher practices (Becker & Riel, 2000; Cobb, 1999; Jonassen & Wilson, 1999; Mills & Tincher, 2003).

#### *Relationship of the Findings to Previous Empirical Research*

The findings in the present study support research that shows that teachers who are involved in collaborative planning and share their strategies for technology integration with colleagues are the most effective in the use of computers in the classroom with students (Becker & Riel, 2000). Teachers in the professional development group (PDG) reported a greater increase in using Integrated Applications and a greater increase in Stages of Adoption of Technology over the 18-week period subsequent to involvement in the professional development intervention than teachers in the comparison group (WAG).

The implementation of the school-wide technology initiative in the present study involved the positive support of administration and reinforces other studies finding the support offered by administrators and the community vital to the success of technology integration (Apple, Inc., n.d.; Rice, Wilson, & Bagley, 2001). The design of the learning environment that was the treatment variable in the present research included the use of systematic motivational factors, the modeling of constructivist approaches to teaching to promote knowledge transfer, and the modeling of an expert's cognitive processes while engaging in work within a problem-based learning environment, all techniques supported by empirical research (Cobb, 1999; Halpin, 1999; Jonassen, 2003; Pederson, 2002/2003; Song & Keller, 2001; Wolf et al., 2003). The use of hypermedia authoring for knowledge

construction was also utilized in the professional development program through the building of interactive computer technology lessons by teachers who were challenged to create hyperlinks that could be utilized by students in their lessons (Chen, 2003; Nicaise & Crane, 1999). Although this knowledge construction was a simple form of the knowledge construction process, teachers associated the building of an interactive environment as a process where students were able to build knowledge in a specific, directed environment. Teachers developed lessons that integrated Internet technology through the building of curriculum-based lessons that included hyperlinks to specific websites for the construction of knowledge by students. This strategy ensured that students were able to search out information provided on the World Wide Web through a form of scaffolding by the elementary school teacher. This scaffolding required teachers in the professional development group to provide specific websites through hyperlinks within lessons posted on a school-wide website.

The professional development intervention also used strategies that have been demonstrated to promote successful practices in teaching and learning such as cooperative learning, teaching to high standards, and utilizing problem-solving activities while integrating technology (Jonassen et al., 2003). The present study provided a real-world setting in which teachers developed and implemented technology-integrated lessons through a school-wide website that students could access in the classroom, computer lab, or at home. This type of professional development, organized around real problems of practice, was a part of teacher in-service within the school system. This provided for teachers a practical model that could be transferred into the classroom with their students, and the learning was useful and relevant, something they could integrate

into their existing curriculum. This type of training was atypical to the training model that is most often the dominant approach to learning opportunities available to teachers (Little, 1993).

The introduction and acceptance of any technology initiative requires a change in the culture of the organization or school. A number of processes and models that encourage change identified through empirical research include the need for change in today's educational systems (David, 1994; Little, 1993; Loucks-Horsley, 1998; Rogers, 1995; Stielgelbauer, 1994). The technology initiative in the present study encouraged new approaches to implementing online learning in the curriculum. The model focused on process and context and was multifaceted, seeking to account for changes in attitudes and perceptions toward technology and develop relationships and behaviors that encouraged real collaboration among all teachers in the initiative in both groups. By providing a different learning environment for training teachers to use technology, the type of learning environment had a critical effect on the teachers' ability to transfer learning and integrate technology into the classroom with their students. Other empirical studies have shown evidence of this type of transfer which occurs when similar relationships and experiences in the learning environment hold across situations and the environment where learning is to be applied (Brown, Collins, & Duguid, 1989; Halpern & Hakel, 2003; Jonassen, Campbell, & Davidson, 1994; Willis & Cifuentes, 2005).

The school-wide technology initiative and professional development program for the present study was based on the empirical research that supports the importance of professional development for teachers in promoting technology integration into the core curriculum and student use of technology for higher-order thinking. This school-wide

technology initiative was organized around real problems of practice: it occurred on the school site; it was relevant to grade-level learning objectives, classroom activities and practices; and it included follow-up support to meet the individual needs and concerns of the teachers (Mills & Tincher, 2003; Mouza, 2003).

Integration of computer technology in the classroom is a notable challenge across the nation's schools. The technology initiative in this study provided evidence of increased computer use by students of teachers involved in the study and contributes to the knowledge base of effective computer technology integration methods. The present study may have a positive impact on related future research. The study was successful in addressing the disconnect between the interests of researchers and the needs of teachers and schools by establishing a practical focused research agenda that included a professional development program that supported the needs of the classroom teacher (Bull et al., 2005).

In the present study teachers made use of an online website of technology integrated lessons in which they developed technology-integrated lessons and resources that were shared with colleagues within and across grade levels. This group effort created an ongoing support system that encouraged a collaborative approach to teaching and learning. This reinforces the findings of Jonassen et al. in their study of teacher candidates and collaborating teachers' experiences while learning to use technology for a variety of pedagogical and professional uses. In the Jonassen et al study teachers share expertise and learning experiences in a collaborative environment influencing meaningful technology integration into the K-5 curriculum (2003). It is important to integrate technology across the curriculum, and there is a demand for teachers who are capable of



integrating technology into instruction with a growing emphasis on integrating technology across the curriculum.

Not only did the professional development program in the present study focus on teachers' classroom needs for student learning, the technology initiative also focused on computer use aligned with current curricula and the promotion of computer use as a learning tool, promoting meaningful learning. Multiple barriers to teachers' use of computers include the report that many teachers feel unprepared to meet the challenge of technology integration into classroom instruction (Yepes-Baraya, 2000) and the present study met the challenge of providing practical and realistic professional development methods that teachers could easily implement into their classroom curricula. Many reported projects and initiatives are the results of large federal grants, and smaller scale technology integration initiatives are not widespread (Cuban, 2001). The present study presented a practical model that was implemented with existing technology and minimal resources with positive results school-wide.

#### *Implications for Practice*

Educational technology leaders, administrators, and policy makers will find the present study useful in that it provides a model for effective technology integration that did result in increased technology use by students. Other benefits of this technology initiative were teacher-reported increases in stage of technology adoption and technology integration. Because these positive outcomes are linked to increases in learning reported by other researchers, other administrators and teachers may be encouraged to develop similar models to promote an increased use of technology in the classroom.

The research in the present study supported goals that extended beyond providing technology access in the classroom. The investigation of teaching strategies to promote and enhance learning opportunities for all students and encourage administrative support of teacher professional development and school-wide technology innovation became a contextual part of this study. The professional development intervention represented an approach to meeting national, state, and local technology goals, with a focus on improving student academic achievement through the use of technology in elementary schools and striving to ensure that teachers in the initiative were able to integrate technology into their curricula to improve student achievement.

The support teachers received from the school administration and collaboration with other teachers were also important factors in the success of the technology initiative. The availability of resources and being sure that the technology was functional became important aspects of successfully promoting the technology initiative school-wide. Focusing on successful methods for promoting the use of technology in the classroom must consider all aspects of teaching and learning among teachers and students. The present study focused on the reinforcement of a school-wide technology initiative that considered the concerns of teachers in the use of technology in the classroom and the availability of resources for the teachers.

An increase in technology integration and stages of adoption of technology by teachers involved in the professional development intervention makes this study important to the community in which the study was conducted and may prove beneficial to the local school district and others in identifying best practices in technology integration and professional development. Integration of computer technology in the

classroom is a challenge across the nation's schools, and the model presented in the present study is one that could be replicated in other schools. The particular setting and design for this research served to illuminate the larger issues associated with conducting research on technology integration in the classroom. These issues include local, state, and federal accountability, and the necessity of providing open access to a potentially beneficial learning strategy in a real school setting.

The school site where this study was conducted has benefited from the climate of success within the school generated by the technology initiative and increased technology use by students in the classroom. The technology initiative design and research findings may benefit other elementary school technology specialists in the local school system as well. The initiative has received recognition by the local educational agency, and future adoption by other schools in the county is a possibility.

Accountability at the state and local levels for administrators and teachers and the effects of federal government legislation on technology initiatives are targeted to support specific initiatives in technology. Adopting technology standards at local, state, and federal levels and meeting performance indicators and reasonable goals for local education agencies, administrators and teachers were central to the conceptual framework of this study. The initiative examined in the present study involved the support of the principal and teacher leaders to promote a technology innovation through a school-based program to improve technology-integrated teaching and learning practices within the school promoting state and national technology goals as well as encouraging a collaborative learning community and school-based reform. Educational leaders should support and inspire teachers through a shared vision for comprehensive integration of

technology into the school, and this type of environment was established with this initiative. By fostering an environment and culture conducive to the realization of a technology vision our principal and teacher leaders were directly involved in a culture of responsible risk-taking in which we created and promoted a innovation with technology.

### *Conclusions and Recommendations*

The findings of the present study support conclusions and recommendations for practice and further research in professional development and computer technology use in the elementary school setting. Systemic education reform at the state and local levels; scientifically based research, development, and evaluation designed to improve student academic achievement; and rigid assessments following national standards is the climate for current educational reform in the United States. This study examined the implementation of a technology initiative that may be useful to school districts and individual schools and teachers striving to meet federal, state, and local educational goals. By creating a learning environment that utilized technology effectively in individual classrooms, the present research promoted the increased use of technology in a school-wide initiative that focused on preparing teachers to increase technology use by students in the classroom.

The initiative reported here was undertaken to meet a challenge that is present in all learning organizations today. The present study provided an opportunity for all teachers in the school to have access to technology, even if they were not directly involved in the professional development intervention. Preparing teachers to respond to the teaching demands through substantial and effective professional development to meet local, state, and national reform efforts related to technology standards was achieved in

this study by involving teachers in the professional development technology intervention as a hands-on experience of actively integrating technology in their construction of curriculum-based lessons.

The present study examined the effects of assisting teachers in creating lessons that could be used by students in the classroom or computer lab without teaching technology skills directly. It was hypothesized that teachers would improve their attitudes toward computer technology use with students and increase computer technology use with students for active learning. The focus of the professional development intervention was not increasing technology proficiency by teachers, but the development of technology-integrated lessons and using technology skills to create the lessons. Searching the Internet for information provided increased confidence and technology proficiency as it related to integrated applications of technology and increased technology use with students.

The present research holds the potential for influencing educational reform in the community in which it was conducted. The local education agency, other area schools, teachers at the research site not involved in the technology initiative, students, and parents throughout the community may benefit from the technology integration initiative on various levels. If schools are to promote the effective use of technology within the educational environment, teachers must be prepared to implement technology that directly engages students in learning. Teachers in the Professional Development Group (PDG) of this study did report increased use of integrated applications and increased stages of adoption of technology which supported technology use as it related to the core curriculum by students and encouraged technology literacy and technology integration by

these teachers. In addition, the school-wide technology initiative increased computer technology use by students of teachers in both groups, thereby increasing use of the computers on the research site and utilization of technology by students.

The present study was conducted in an elementary school setting and administrative support and teacher-perceptions of immediate supervisor expectations affected the contextual setting of the present study. The interactions of this school-wide technology initiative in the elementary school climate was also an important aspect of this study. This research setting provided the opportunity to investigate the complexities and processes of a real-life educational setting in which teachers interacted on a daily basis. A one-school setting provided an authentic complex environment where participants brought their thoughts, feelings, values and assumptions to the technology innovation (Marshall & Rossman, 1999).

The real-world setting of this study lends strength to the significance of findings in terms of their significance to similar elementary school settings and the possibility of creating a new climate of change. This study provides indirect evidence of more positive attitudes toward computer use by teachers with their students and an increased level of adoption of computer technology by the majority of the teachers within the school. Although the study utilized a small sample in one school, the behaviors and activities that promoted the diffusion of the initiative on the entire school culture built enthusiasm for this approach to integrating technology into the curriculum with existing hardware and no additional human resources except the teachers within the school who collaborated and developed lessons as a learning community. Teachers developed a resource of quality Internet resources to promote student learning with colleagues and created a peer support

network through the implementation and use of the school-wide websites for teachers and students to develop authentic learning environments for active, directed learning.

#### *Recommendations for Further Research*

Findings of this study support several recommendations for further research. First, the study could be strengthened by more accurate data collection on website use and types of use, as the hits on the website were approximate due to students returning to the home page or random hits by search engines. In addition, teacher-reported logs indicated that teachers in the Professional Development Group may have used the website for computer technology-integrated lessons more than the Web-Access Group, which used the website for more general reinforcing activities for statewide test preparation as opposed to a supplement to specific classroom curricula. This finding supports the need for a qualitative investigation to explore the climate of the elementary school setting and teacher epistemology concerning computer use and technology integration in the curriculum.

Further investigation of the technology initiative and professional development model examined in this research is needed to address limitations of the present design. Specifically, a research design that expanded model testing to additional schools would be useful. Additional schools would address the possible interaction effects of the treatment and comparison groups and would permit the use of a control group to which the results of the professional development intervention could be compared. The model should also be tested in schools with more diversity in the student and teacher populations.

On a broader scale, future research could promote implementation of this school-wide model across a school district or sub-district to investigate the effects on schools that are simply given access to the website, and compare use of the website to schools that have ongoing support and professional development interventions that promote the development of technology-integrated lessons that utilize Internet resources and current curricula. Investigating change theory and identifying factors that promote the use of computer technology into the classroom in the elementary school setting are research topics that may be examined.

### *Conclusion*

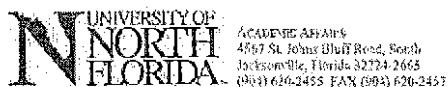
The professional literature strongly supports the importance of effective professional development for teachers in improving student learning outcomes. The teacher professional model implemented in the present study and the learning website developed by teachers in the treatment group were accomplished on-site in the elementary school using existing school technology resources. The model was found to be effective in advancing the technology proficiency of teachers and increasing the use of technology by students. Although no statistically significant changes in teacher attitudes toward technology were found through the survey instruments employed in this study, both treatment and comparison groups used technology more throughout the year providing indirect evidence of the efficacy of the model in changing teachers' attitudes toward instructional technology use in the classroom. This study adds to the growing body of literature on practical approaches to addressing state and national technology standards in schools.



## Appendices

## Appendix A

## Institutional Review Board Approval Form



Division of Sponsored Research and Training

MEMORANDUM

TO: Della Pass  
Department of Counseling and Educational Leadership

VIA: Dr. Joyce Jones  
Department of Counseling and Educational Leadership

FROM: James L. Collom, Institutional Review Board **Signature Deleted**

DATE: November 19, 2003

RE: Review by the Institutional Review Board #03-197  
"Effect of Constructivist Professional Development on Technology Integration  
in the Classroom"

This is to advise you that your project "Effect of Constructivist Professional Development on Technology Integration in the Classroom", has been reviewed on behalf of the IRB and has been declared exempt from further IRB review.

This approval applies to your project in the form and content as submitted to the IRB for review. Any variations or modifications to the approved protocol and/or informed consent forms as they relate to dealing with human subjects must be cleared with the IRB prior to implementing such changes.

If you have any questions or problems regarding your project or any other IRB issues, please contact this office at 620-2498.

eah

Attachments

c: Dr. Kenneth Wilburn

## Appendix B

Request for Approval for Research  
Local Education Agency (LEA)Cedar Grove Elementary  
354 Chaney Road  
Smyrna, TN 3716Delia R. Pass  
Doctoral Candidate  
University of North Florida  
Jacksonville, Florida 32224

September 7, 2003

Mr. Don Odom  
Assistant Superintendent of Curriculum and Instruction  
Rutherford County Schools  
2240 Southpark Blvd.  
Murfreesboro, TN 37128

Dear Mr. Odom:

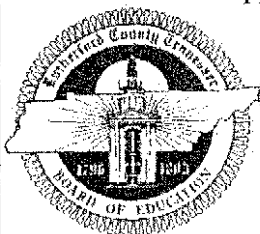
I am requesting permission to conduct research in the Rutherford County School System. I am a doctoral candidate at the University of North Florida in Jacksonville, Florida. The results of the research conducted will be submitted for the degree of Doctor of Education in Educational Leadership. The chair for this research is Dr. Joyce T. Jones, College of Education and Human Services/Educational Leadership. She may be contacted at 904-620-2990.

The following information is enclosed. A brief information form outlining the study, an abstract of the research, including the process by which the data will be obtained, a sample of the questionnaires to be used in the research, a consent form for participants in the study, and a signed statement that any data used will be treated in a confidential manner. Approval from my committee chair, Dr. Joyce T. Jones, will arrive via mail.

Sincerely,

Delia R. Pass  
Doctoral Candidate  
University of North Florida

Appendix C  
Approval Letter from Local Education Agency (LEA)



**RUTHERFORD COUNTY BOARD OF EDUCATION**

**Harry Gill, Jr., Director of Schools**

2240 Southpark Boulevard  
Murfreesboro, Tennessee 37128  
Phone (615) 893-5812 Fax (615) 898-7940

September 19, 2003

Delia R. Pass  
Cedar Grove Elementary  
354 Chaney Road  
Smyrna, TN 37167

Dear Ms. Pass,

Your research proposal, *"Effect of Constructivist Professional Development on Technology Integration in the Classroom"*, has been reviewed by the Curriculum and Instruction Department and the Legal Department. You have been approved to proceed with the study.

Study participants requesting inservice credit for participation will need to follow Rutherford County's guidelines for inclusion of inservice credit for non-system sponsored inservice activities. Introduction to the use of technology does fall within the parameters of approvable inservice activities.

I commend you in the pursuit of the Doctor of Education in Educational Leadership degree. If I can be of further assistance, please do not hesitate to contact me.

Sincerely,

**Signature Deleted**

Don Odom  
Assistant Superintendent  
Curriculum and Instruction

cc: Mr. Harry Gill  
Director of Schools

**Moving Beyond Excellence**

## Appendix D

Cedar Grove Elementary

Request for Participation

**To:** All teachers, K-5  
**From:** Delia R. Pass  
**CC:** Mrs. Kellye Goostree, Principal  
**Date:** 11/15/03  
**Re:** Interest in a technology initiative

---

I would like to organize a group of teachers who are interested in a technology initiative that may include collaborating on the building of a web site of links for student learning. I am setting up research for my dissertation, and I am inviting all of the teachers in the school to be involved in a project to promote computer technology as a learning tool in the classroom.

The teachers who volunteer will be divided into two groups. One group will be given access to a web site for learning, followed by an opportunity to participate in three two-hour professional development sessions the following term to work collaboratively on enhancing the web site project. The other group would participate first in three two-hour professional development sessions (at Cedar Grove) to work collaboratively on developing the web site project prior to student access to the site. For research purposes it will be necessary for me to randomly assign you to one of the two groups.

The group that attends the professional development sessions will receive six in-service credits through the county. The group that uses the web site will require a brief orientation and a minimal commitment of time. The use of the web site in the classroom or the computer lab will be at your discretion.

I would like to have the participation of the entire faculty in the school. This research project can have a positive effect on individual student achievement and may enable our school to receive financial support in the way of private or government grants in the future. The professional development activity will incorporate standards and benchmarks of a highly qualified teacher addressed by a part of No Child Left Behind and adopted by the state of Tennessee (National Educational Technology Standards for teachers). This project will promote our faculty as professionals who are highly qualified and leading the way toward adoption of these standards.

Your support in this project is deeply appreciated. I know that the difficult part of this request is that I cannot guarantee which group you will be assigned to, but all volunteers will have the opportunity for in-service development before the end of the project. I believe that this project will benefit our school and faculty. Please respond as soon as possible, as I will need a total of sixty participants. I am going to begin by only requesting volunteers from Cedar Grove.

I hope you consider participating in this project and I thank you in advance for your support.

I am \_\_\_\_\_ am not \_\_\_\_\_ interested in participating in this technology initiative.

Teacher Name \_\_\_\_\_

Grade level currently teaching \_\_\_\_\_

## Appendix E

*CONSENT FOR RESEARCH PARTICIPATION*

I hereby consent to participate as a subject in a research project entitled "**Effect of constructivist professional development on the integration of technology in the classroom**" conducted by Delia R. Pass, doctoral candidate attending the University of North Florida, Jacksonville, Florida. I can contact the initiator of this research at 904-716-2213 or by e-mail [drepass@charter.net](mailto:drepass@charter.net). I may also contact the chair for this research, Dr. Joyce Jones at (904) 620-2990 or by e-mail [jjones@unf.edu](mailto:jjones@unf.edu). For questions regarding the rights of research subjects, I may contact the IRB representative, Dr. James Collom at (904)620-2455.

**NOTE:** Participation is open to elementary teachers (K-5) of Rutherford County School System, regardless of computer expertise or teaching experience. I understand that I will receive county in-service points if I attend the professional development portion of this research, and that I will not receive this compensation if I am involved in the web site access portion of this research. I understand that for the professional development portion of this study, I will be required to attend three two-hour sessions to receive six in-service points, and that the purpose of this study is inquiry into the effectiveness of a professional development program on subsequent computer technology use by students in the classroom. I will be required to fill out a questionnaire before and after program implementation (eighteen weeks later) to assess the effect of the program only. This is in no way an evaluation of my teaching practices and all information collected will be anonymous. I will also be required to keep a weekly pre-formatted log of (approximate) computer use by students in the classroom. The control group in this study will only fill out pre and post questionnaires (eighteen weeks later).

I understand that my participation is completely voluntary, and that I am free to withdraw from the study at any time I choose. I have been given sufficient information about this research project and have had the opportunity to receive answers to any questions. I understand that this project is not expected to involve risks of harm any greater than those ordinarily encountered in daily life. I understand that the results of this project will be coded in such a way that my identity will not be physically attached to the final data that I produce.

I understand that the results of this research will be published as a doctoral dissertation and may be published or reported to government agencies, funding agencies, or scientific groups, but that my name will not be associated in any way with any published results.

---

 Participant Name (printed)

---

 Participant Signature

---

 Date

---

 Principal Investigator's (printed)

---

 Principal Investigator's Signature

---

 Date

## Appendix F

*Data Collection Instruments (Tac v 3.2a, Tpsa v.1.0, and Stages of Adoption)**To the Educator:*

*This questionnaire is a combination of several well-validated surveys that have been used with teachers in the past. There are three parts to this questionnaire. Please read each section carefully and respond with your first impression. Your answers will remain anonymous through color-coding of the questionnaire by groups. The responses in the questionnaire are in no way a part of your evaluation process and the identifier is for matching pre and post questionnaire responses only. Thank you in advance for your time.*

*Identifier* \_\_\_\_\_

***Please use the last four digits of your social security number (or another 4 digit number that you are not likely to forget)***

*Background Information*

*Grade level currently teaching* \_\_\_\_\_

**How would you rate your experience with computers? (Check all that apply)**

- I have never used a computer and I don't plan to anytime soon.  
 I have never used a computer but I would like to learn.  
 I use applications like word processing, spreadsheets, etc.  
 I use computers for instruction in the classroom.

**How often?**

- Daily  
 Weekly  
 Occasionally

Currently I use the computer approximately \_\_\_\_\_ hours per week in the classroom.

At the beginning of this school year, I used the computer approximately \_\_\_\_\_ hours per week in the classroom.

If you do use computers, what type of training have you received? (Check all that apply).

- No training  
 Basic Computer Literacy (on/off operations, how to run programs)  
 Computer applications (word processing, spreadsheets)  
 Computer integration (how to use in classroom curriculum)

Where did you receive your training? (Rank order all that apply).

- Self-taught  
 School district  
 College or university  
 Other- please specify \_\_\_\_\_

**Number of years since your first computer training:** \_\_\_\_\_

**Gender** \_\_\_ M \_\_\_ F

**Age** \_\_\_\_\_

**Years of teaching experience** \_\_\_\_\_

**Highest degree received** BA/BS \_\_\_\_\_ MA/MS \_\_\_\_\_ MA+45/ Specialty \_\_\_\_\_

EdD/PhD \_\_\_\_\_

**Do you have a computer at home?** No \_\_\_\_\_ Yes \_\_\_\_\_

**Do you have access to the World Wide Web at home?** No \_\_\_\_\_ Yes \_\_\_\_\_

### *Technology Proficiency Self-Assessment*

Instructions: Select one level of agreement for each statement to indicate how you feel.  
Fill in the circle for the appropriate response.

**SD = Strongly Disagree**

**D = Disagree**

**U = Undecided,**

**A = Agree,**

**SA = Strongly Agree**



I feel confident that I could...	SD	D	U	A	SA
1. send e-mail to a friend.	①	②	③	④	⑤
2. subscribe to a discussion list.	①	②	③	④	⑤
3. create a "nickname" or an "alias" to send e-mail to several people at once.	①	②	③	④	⑤
4. send a document as an attachment to an e-mail message.	①	②	③	④	⑤
5. keep copies of outgoing messages that I send to others.	①	②	③	④	⑤
6. use an Internet search engine (e.g., Infoseek or Alta Vista) to find Web pages related to my subject matter interests.	①	②	③	④	⑤
7. search for and find the Smithsonian Institution Web site.	①	②	③	④	⑤
8. create my own World Wide Web home page.	①	②	③	④	⑤
9. keep track of Web sites I have visited so that I can return to them later. (An example is using bookmarks.)	①	②	③	④	⑤
10. find primary sources of information on the Internet that I can use in my teaching.	①	②	③	④	⑤
11. use a spreadsheet to create a pie chart of the proportions of the different colors of M&Ms in a bag.	①	②	③	④	⑤
12. create a newsletter with graphics and text in 3 columns.	①	②	③	④	⑤
13. save documents in formats so that others can read them if they have different word processing programs (eg., saving Word, ClarisWorks, RTF, or text).	①	②	③	④	⑤
14. use the computer to create a slideshow presentation.	①	②	③	④	⑤
15. create a database of information about important authors in a subject matter field.	①	②	③	④	⑤
16. write an essay describing how I would use technology in my classroom.	①	②	③	④	⑤
17. create a lesson or unit that incorporates subject matter software as an integral part.	①	②	③	④	⑤
18. use technology to collaborate with other interns, teachers, or students who are distant from my classroom.	①	②	③	④	⑤
19. describe 5 software programs that I would use in my teaching.	①	②	③	④	⑤
20. write a plan with a budget to buy technology for my classroom.	①	②	③	④	⑤

*TPSA, v 1.0, created by and used with permission of Dr. Margaret Merlyn Ropp*

## ***Stages of Adoption of Technology***

***Instructions: Please read the descriptions of each of the six stages related to adoption of technology. Circle the number of the stage that best describes where you are in the adoption of technology.***

### **Stage 1: Awareness**

I am aware that technology exists but have not used it - perhaps I'm even avoiding it.

### **Stage 2: Learning the process**

I am currently trying to learn the basics. I am often frustrated using computers. I lack confidence when using computers.

### **Stage 3: Understanding and application of the process**

I am beginning to understand the process of using technology and can think of specific tasks in which it might be useful.

### **Stage 4: Familiarity and confidence**

I am gaining a sense of confidence in using the computer for specific tasks.  
I am starting to feel comfortable using the computer.

### **Stage 5: Adaptation to other contexts**

I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid.

### **Stage 6: Creative application to new contexts**

I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum.

**The stage that best describes where I am now is number \_\_\_\_\_.**

From: Christensen, R. (1997). Effect of technology integration education on the attitudes of teachers and their students. Doctoral dissertation, University of North Texas. Based on Russell, A. L. (1995). Stages in learning new technology. *Computers in Education*, 25(4), 173-178.

**Instructions:** Please read each statement and then circle the number which best shows how you feel.

**SD = Strongly Disagree    D = Disagree    U = Undecided    A = Agree    SA = Strongly Agree**

			SD	D	U	A	SA
1.	I enjoy doing things on a computer.	(1)	1	2	3	4	5
2.	I am tired of using a computer.	(2)	1	2	3	4	5
3.	I will be able to get a good job if I learn how to use a computer.	(3)	1	2	3	4	5
4.	I concentrate on a computer when I use one.	(4)	1	2	3	4	5
5.	I enjoy computer games very much.	(5)	1	2	3	4	5
6.	I would work harder if I could use computers more often.	(6)	1	2	3	4	5
7.	I think that it takes a long time to finish when I use a computer.	(7)	1	2	3	4	5
8.	I know that computers give me opportunities to learn many new things.	(8)	1	2	3	4	5
9.	I can learn many things when I use a computer.	(9)	1	2	3	4	5
10.	I enjoy lessons on the computer.	(10)	1	2	3	4	5
11.	I believe that it is very important for me to learn how to use a computer.	(12)	1	2	3	4	5
12.	I think that computers are very easy to use.	(13)	1	2	3	4	5
13.	I feel comfortable working with a computer.	(15)	1	2	3	4	5
14.	I get a sinking feeling when I think of trying to use a computer.	(16)	1	2	3	4	5
15.	Working with a computer makes me nervous.	(17)	1	2	3	4	5
16.	Using a computer is very frustrating.	(18)	1	2	3	4	5
17.	I will do as little work with computers as possible.	(19)	1	2	3	4	5
18.	Computers are difficult to use.	(20)	1	2	3	4	5
19.	Computers do not scare me at all.	(21)	1	2	3	4	5
20.	I can learn more from books than from a computer.	(22)	1	2	3	4	5

**Instructions:** Place an 'x' between each adjective pair to indicate how you feel about the object.

Computers are:

21. Unlikable	_____	Likable	(41)
22. Unhappy	_____	Happy	(42)
23. Bad	_____	Good	(43)
24. Unpleasant	_____	Pleasant	(44)
25. Tense	_____	Calm	(45)
26. Uncomfortable	_____	Comfortable	(46)
27. Artificial	_____	Natural	(47)
28. Empty	_____	Full	(48)
29. Dull	_____	Exciting	(49)
30. Suffocating	_____	Fresh	(50)

**Instructions:** Please read each statement and circle the number that best describes how you feel about that statement.

- 1 = Strongly Disagree (SD)  
 2 = Disagree (D)  
 3 = Undecided (U)  
 4 = Agree (A)  
 5 = Strongly Agree (SA)

		SD	D	U	A	SA
31. Computers do not scare me at all.	(51)	1	2	3	4	5
32. I would like working with computers.	(53)	1	2	3	4	5
33. Figuring out computer problems does not appeal to me.	(65)	1	2	3	4	5
34. I'll need a firm mastery of computers for my future work.	(66)	1	2	3	4	5
35. I don't understand how some people can spend so much time working with computers and seem to enjoy it.	(73)	1	2	3	4	5
36. I can't think of any way that I will use computers in my career.	(74)	1	2	3	4	5
37. I do not think I could handle a computer course.	(84)	1	2	3	4	5
38. I have a lot of self-confidence when it comes to working with computers.	(88)	1	2	3	4	5

		SD	D	U	A	SA	
39.	Knowing how to use computers is a worthwhile skill.	(94)	1	2	3	4	5
40.	A job using computers would be very interesting.	(101)	1	2	3	4	5
41.	Computer lessons are a favorite subject for me.	(102)	1	2	3	4	5
42.	I want to learn a lot about computers.	(103)	1	2	3	4	5
43.	A computer test would scare me.	(112)	1	2	3	4	5
44.	I see the computer as something I will rarely use in my daily life as an adult.	(123)	1	2	3	4	5
45.	Computers have the potential to control our lives.	(134)	1	2	3	4	5
46.	Our country relies too much on computers.	(135)	1	2	3	4	5
47.	I will use a computer in my future occupation.	(137)	1	2	3	4	5
48.	Computers dehumanize society by treating everyone as a number.	(138)	1	2	3	4	5
49.	I feel apprehensive about using a computer.	(141)	1	2	3	4	5
50.	Computers are changing the world too rapidly.	(142)	1	2	3	4	5
51.	Computers isolate people by inhibiting normal social interactions among users.	(144)	1	2	3	4	5
52.	If I had to use a computer for some reason, it would probably save me some time and work.	(147)	1	2	3	4	5
53.	Having a computer available to me would improve my general satisfaction.	(149)	1	2	3	4	5
54.	If I had a computer at my disposal, I would try to get rid of it.	(150)	1	2	3	4	5
55.	I sometimes get nervous just thinking about computers.	(153)	1	2	3	4	5
56.	I will probably never learn to use a computer.	(154)	1	2	3	4	5
57.	I sometimes feel intimidated when I have to use a computer.	(157)	1	2	3	4	5
58.	Computers will improve education.	(162)	1	2	3	4	5
59.	If there was a computer in my classroom it would help me to be a better teacher.	(163)	1	2	3	4	5
60.	Someday I will have a computer in my home.	(164)	1	2	3	4	5
61.	Computers could enhance remedial instruction.	(166)	1	2	3	4	5
62.	Computers can be used successfully with courses which demand creative activities.	(170)	1	2	3	4	5

		SD	D	U	A	SA	
63.	Computers can be a useful instructional aid in almost all subject areas.	(175)	1	2	3	4	5
64.	Use of computers in education almost always reduces the personal treatment of students.	(176)	1	2	3	4	5
65.	I feel at ease when I am around computers.	(177)	1	2	3	4	5
66.	Learning about computers is boring to me.	(180)	1	2	3	4	5
67.	I like learning on a computer.	(181)	1	2	3	4	5
68.	Working with a computer would make me very nervous.	(182)	1	2	3	4	5
69.	I think working with computers would be enjoyable and stimulating.	(186)	1	2	3	4	5
70.	Computers are not exciting.	(191)	1	2	3	4	5
71.	Studying about computers is a waste of time.	(192)	1	2	3	4	5
72.	I enjoy learning how computers are used in our daily lives.	(195)	1	2	3	4	5
73.	Computers would increase my productivity.	(202)	1	2	3	4	5
74.	Computers would help me learn.	(204)	1	2	3	4	5
75.	Computers improve the overall quality of life.	(207)	1	2	3	4	5
76.	The challenge of learning about computers is exciting.	(211)	1	2	3	4	5
77.	Learning to operate computers is like learning any new skill - the more you practice, the better you become.	(214)	1	2	3	4	5
78.	I am afraid that if I begin to use computers I will become dependent upon them and lose some of my reasoning skills.	(215)	1	2	3	4	5
79.	I dislike working with machines that are smarter than I am.	(218)	1	2	3	4	5
80.	If given the opportunity, I would like to learn about and use computers.	(224)	1	2	3	4	5
81.	I feel computers are necessary tools in both educational and work settings.	(226)	1	2	3	4	5
82.	Computers intimidate and threaten me.	(227)	1	2	3	4	5
83.	Working with a computer makes me feel tense and uncomfortable.	(230)	1	2	3	4	5
84.	Computers are difficult to understand.	(231)	1	2	3	4	5

		SD	D	U	A	SA	
85.	Working with computers makes me feel isolated from other people.	(241)	1	2	3	4	5
86.	I would like to learn more about computers.	(249)	1	2	3	4	5
87.	Working with computers means working on your own, without contact with others.	(251)	1	2	3	4	5
88.	Using a computer prevents me from being creative.	(257)	1	2	3	4	5
89.	You have to be a "brain" to work with computers.	(261)	1	2	3	4	5
90.	Not many people can use computers.	(262)	1	2	3	4	5
91.	I get a sinking feeling when I think of trying to use a computer.	(263)	1	2	3	4	5
92.	Computers frustrate me.	(264)	1	2	3	4	5
93.	I will use a computer as soon as possible.	(266)	1	2	3	4	5
94.	I enjoy computer work.	(270)	1	2	3	4	5
95.	I would never take a job where I had to work with computers.	(272)	1	2	3	4	5
96.	Electronic mail (E-mail) is an effective means of disseminating class information and assignments.	(274)	1	2	3	4	5
97.	I prefer E-mail to traditional class handouts as an information disseminator.	(275)	1	2	3	4	5
98.	More courses should use E-mail to disseminate class information and assignments.	(276)	1	2	3	4	5
99.	E-mail provides better access to the instructor.	(277)	1	2	3	4	5
100.	The use of E-mail creates more interaction:						
	a) between students enrolled in the course	(278)	1	2	3	4	5
	b) between student and instructor	(279)	1	2	3	4	5
101.	The use of E-mail increases motivation for the course.	(280)	1	2	3	4	5
102.	The use of E-mail makes the course more interesting.	(281)	1	2	3	4	5
103.	The use of E-mail makes the student feel more involved.	(282)	1	2	3	4	5
104.	The use of E-mail helps the student to learn more.	(283)	1	2	3	4	5
105.	The use of E-mail helps provide a better learning experience.	(284)	1	2	3	4	5

(END) Thank You!

*TAC, version 3.2a was created by and used with permission of Dr.Knezek and Dr.Christensen, University of North Texas.*

## Appendix G

## TAC v. 3.2a Seven Factor Form A

## Factor 1 (Enthusiasm/Enjoyment)

S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

No.	Item	S	SA	U	SD	D
1.	I think that working with computers would be enjoyable and stimulating.	1	2	3	4	5
2.	I want to learn a lot about computers.	1	2	3	4	5
3.	The challenge of learning about computers is exciting.	1	2	3	4	5
4.	Learning about computers is boring to me.	1	2	3	4	5
5.	I like learning on a computer.	1	2	3	4	5
6.	I enjoy learning how computers are used in our daily lives.	1	2	3	4	5
7.	I would like to learn more about computers.	1	2	3	4	5
8.	I would like working with computers.	1	2	3	4	5
9.	A job using computers would be very interesting.	1	2	3	4	5
10.	I enjoy computer work.	1	2	3	4	5
11.	I will use a computer as soon as possible.	1	2	3	4	5
12.	Figuring out computer problems does not appeal to me.	1	2	3	4	5
13.	If given the opportunity, I would like to learn about and use computers	1	2	3	4	5
14.	Computers are not exciting.	1	2	3	4	5
15.	Computer lessons are a favorite subject for me.	1	2	3	4	5



## TAC Seven Factor Form A

## Factor 2 (Anxiety)

S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

No.	Item	S	SA	U	SD	D
1.	I get a sinking feeling when I think of trying to use a computer.	1	2	3	4	5
2.	Working with a computer makes me feel tense and uncomfortable.	1	2	3	4	5
3.	Working with a computer would make me very nervous.	1	2	3	4	5
4.	Computers intimidate and threaten me.	1	2	3	4	5
5.	Computers frustrate me.	1	2	3	4	5
6.	I have a lot of self confidence with it comes to working with computers.	1	2	3	4	5
7.	I sometimes get nervous just thinking about computers.	1	2	3	4	5
8.	A computer test would scare me.	1	2	3	4	5
9.	I feel apprehensive about using a computer terminal.	1	2	3	4	5
10.	Computers are difficult to understand.	1	2	3	4	5
11.	I feel at ease when I am around computers.	1	2	3	4	5
12.	I sometimes feel intimidated when I have to use a computer.	1	2	3	4	5
13.	I feel comfortable working with a computer.	1	2	3	4	5
14.	Computers are difficult to use.	1	2	3	4	5
15.	Computers do not scare me.	1	2	3	4	5

## TAC Seven Factor Form A

## Factor 3 (Avoidance)

S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

No.	Item	S	SA	U	SD	D
1.	If I had a computer at my disposal, I would try to get rid of it.	1	2	3	4	5
2.	Studying about computers is a waste of time.	1	2	3	4	5
3.	I can't think of any way that I will computers in my career.	1	2	3	4	5
4.	I will probably never learn to use a computer.	1	2	3	4	5
5.	I see the computer as something I will rarely use in my daily life as an adult.	1	2	3	4	5
6.	Not many people can use computers.	1	2	3	4	5
7.	Learning to operate computers is like learning any new skill - the more you practice, the better you become.	1	2	3	4	5
8.	Knowing how to use computers is a worthwhile skill.	1	2	3	4	5
9.	I do not think that I could handle a computer course.	1	2	3	4	5
10.	I would never take a job where I had to work with computers.	1	2	3	4	5
11.	If given the opportunity, I would like to learn about and use computers.	1	2	3	4	5
12.	You have to be a "brain" to work with computers.	1	2	3	4	5
13.	Someday I will have a computer in my home.	1	2	3	4	5

TAC Seven Factor Form A  
Factor 4 (Email )

S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

No.	Item	S	SA	U	SD	D
1.	The use of E-mail makes the student feel more involved.	1	2	3	4	5
2.	The use of E-mail helps provide a better learning experience.	1	2	3	4	5
3.	The use of E-mail makes the course more interesting.	1	2	3	4	5
4.	The use of E-mail helps the student to learn more.	1	2	3	4	5
5.	The use of E-mail increases motivation for the course.	1	2	3	4	5
6.	More courses should use E-mail to disseminate class information and assignments.	1	2	3	4	5
7.	The use of E-mail creates more interaction between students enrolled in the course.	1	2	3	4	5
8.	The use of E-mail creates more interaction between student and instructor.	1	2	3	4	5
9.	E-mail provides better access to the instructor.	1	2	3	4	5
10.	Electronic mail (E-mail) is an effective means of disseminating class information and assignments.	1	2	3	4	5
11.	I prefer E-mail to traditional class handouts as an information disseminator.	1				

TAC Seven Factor Form A  
Factor 5 (Negative Impact on Society)

S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

No.	Item	S	SA	U	SD	D
1.	Computers are changing the world too rapidly.	1	2	3	4	5
2.	I am afraid that if I begin to use computers I will become dependent upon them and lose some of my reasoning skills.	1	2	3	4	5
3.	Computers dehumanize society by treating everyone as a number.	1	2	3	4	5
4.	Our country relies too much on computers.	1	2	3	4	5
5.	Computers isolate people by inhibiting normal social interactions among users.	1	2	3	4	5
6.	Use of computers in education almost always reduces the personal treatment of students.	1	2	3	4	5
7.	Computers have the potential to control our lives.	1	2	3	4	5
8.	Working with computers makes me feel isolated from other people.	1	2	3	4	5
9.	I dislike working with machines that are smarter than I am.	1	2	3	4	5
10.	Using a computer prevents me from being creative.	1	2	3	4	5
11.	Working with computers means working on your own, without contact with others.	1	2	3	4	5

## TAC Seven Factor Form A

## Factor 6 (Productivity)

S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

No.	Item	S	SA	U	SD	D
1.	Computers would increase my productivity.	1	2	3	4	5
2.	Computers would help me learn.	1	2	3	4	5
3.	I feel computers are necessary tools in both educational and work settings.	1	2	3	4	5
4.	Computers can be a useful instructional aid in almost all subject areas.	1	2	3	4	5
5.	Computers improve the overall quality of life.	1	2	3	4	5
6.	Knowing how to use computers is a worthwhile skill.	1	2	3	4	5
7.	Having a computer available to me would improve my general satisfaction.	1	2	3	4	5
8.	Computers will improve education.	1	2	3	4	5
9.	Someday I will have a computer in my home.	1	2	3	4	5
10.	I will use a computer in my future occupation.	1	2	3	4	5
11.	If I had to use a computer for some reason, it would probably save me some time and work.	1	2	3	4	5
12.	Computers can be used successfully with courses which demand creative activities.	1	2	3	4	5
13.	Teacher training should include instructional applications of computers.	1	2	3	4	5
14.	I'll need a firm mastery of computers for my future work.	1	2	3	4	5
15.	I believe that it is important for me to learn how to use a computer.	1	2	3	4	5

## Appendix H

**From:** Gerald Knezek [mailto:gknezek@tenet.edu] Gerald Knezek" <Knezek@unt.edu>  
**Sent:** Sunday, September 07, 2003 4:10 AM  
**To:** drepass@charter.net  
**Subject:** Request for instrument use/ Delia Pass

Hi Delia,

This is to grant permission to use the instruments listed below for your doctoral dissertation. Good luck on your research and please let us know the findings of your study. I am Ccing this to Dr. Rhonda Christensen who is first author in two of the instruments you mention.

Best Regards,  
Gerald Knezek

Date: Sat, 06 Sep 2003 11:47:03 -0500  
From: Delia R. Pass  
Subject: Request for instrument use/ Delia Pass

Dr. Knezek and Texas Center for Educational Technology,  
I am requesting permission to use the questionnaires Stages of Adoption of Technology(Stages v1.1), and Teachers' Attitudes Toward Information Technology (v.3.2a) and Teachers' Attitudes toward Computers (v. 4.0)  
I am working on research for the fulfillment of the requirements for the degree of Doctor of Education in Educational Leadership at the University of North Florida in Jacksonville, Florida. I would like to use these instruments as part of my study entitled "Effect of constructivist professional development on technology integration in the classroom". I will be using this instrument with elementary school teachers in a school system in Tennessee. I will begin this research Fall 2003, and approximate completion date of the dissertation will be Spring 2005.

Please let me know if I need to provide you with additional information. The use of this instrument will be for non-profit research activities only.

Thank you in advance for your consideration in this matter.

Sincerely,  
Delia R. Pass  
Doctoral Candidate  
University of North Florida  
Jacksonville, Florida  
Telephone: 904-716-2213  
E-mail: drepass@charter.net  
Chair for this research:Dr. Joyce Jones

**From:** Margaret M. Ropp [mailto:roppm@michigan.gov]  
**Sent:** Friday, September 12, 2003 12:48 PM  
**To:** drepass@charter.net  
**Subject:** Re: FW: request for permission to use The Technology Proficiency Self-Assessment

Hello Delia,

You certainly have my permission to use the instrument and I wish you the best of luck on your study! Please do let me know how your study turns out as I like to monitor the change in TPSA scores over time. Your study sounds very interesting!

Regards,  
Meg

-----Original Message-----

**From:** Delia R. Pass [mailto:drepass@charter.net]  
**Sent:** Tuesday, September 09, 2003 7:48 PM  
**To:** Margaret M. Ropp Ph. D  
**Subject:** request for permission to use The Technology Proficiency Self-Assessment

Dr. Ropp,

I am requesting permission to use the questionnaire The Technology Proficiency Self-Assessment.

I am working on research for the fulfillment of the requirements for the degree of Doctor of Education in Educational Leadership at the University of North Florida in Jacksonville, Florida. I would like to use this instrument as part of my study entitled "Effect of constructivist professional development on technology integration in the classroom". I will be using this instrument with elementary school teachers in a school system in Tennessee. I will begin this research Fall 2003, and approximate completion date of the dissertation will be Spring 2005.

## Appendix I

D. R. Pass

Identifier \_\_\_\_\_

*Weekly Log of Website use by teachers/students*

Circle the approximate number of minutes you and your students have used the web-based resources (Collaborate & Create Teacher and Student Websites) this week and turn in to my mailbox on Friday afternoon. Add any comments at the bottom or on the back of the form. I will provide a dated form for you weekly.  
**\*THANK YOU FOR YOUR TIME AND EFFORT\***

\*\*THIS INFORMATION WILL BE USED TO DETERMINE THE EFFECTIVENESS OF PROGRAM IMPLEMENTATION, AND IS IN NO WAY AN ASSESSMENT OF TEACHER PERFORMANCE.

**Dates: 5/17/04-5/21/04**

*Please circle the number by the typical or average minutes PER WEEK that:*

<i>you use the teacher</i>	1. None
<i>website as a resource</i>	2. < 15 minutes
(for information and to create supplementary technology lessons).	3. 15-45 minutes
	4. 46-90 minutes
	5. > 90 minutes
students use The Learning Page in the classroom or computer lab:	1. None
	2. < 15 minutes
	3. 15-45 minutes
	4. 46-90 minutes
	5. > 90 minutes
Comments:	
Do you sure TLP to supplement your curriculum ___ or for general Internet activities? ___ Both ___	



Appendix J

Rutherford County Board of Education  
Request for Approval of Independent In-service Activity

Date: 8-21-03 School/Department: Cedar Grove

Name: Dana K. Ross SSN: \_\_\_\_\_ Job Assignment: Teacher

Date/Location of Activity: October 21<sup>st</sup>, November 4<sup>th</sup>, November 18<sup>th</sup>

Title of Session: Collaborate and Create

Presenter: Dana K. Ross Hours Requested: 10

\*Focus: \_\_\_\_\_  
(See Centrapost for list of Current Objectives)

! Either Focus or Connection must be completed for approval.

or

\*Connection to School's Current School Improvement Plan: \_\_\_\_\_

Brief Description of Content: (Must support Focus or Connection) The proposed activity is a collaborative technology project for teachers. Through the development of a collaborative file of lessons and links for learning, teachers implement the use of computer technology as a tool across the curriculum, addressing content standards and covering standard 4. Student will use these resources to develop problem solving strategies; improve decision-making and apply real world applications (K-5) Computer Technology Literacy Usage Standards (attached)

**Signature Deleted**

Principal's Signature/Approval: \_\_\_\_\_ Date: 8-21-03

Date Received by Coordinator: 8-22-03  
Date Returned to School (and forwarded to Teacher Center): 8-22-03

Approved  Not Approved

Notes:

**Signature Deleted**

Coordinator's Signature: \_\_\_\_\_

Date Final Information Returned to Teacher Center: \_\_\_\_\_

Return this form with supporting documentation (agenda, program) and roster including SSN's, if appropriate, to Teacher Center upon completion of training activity.

Original Copy: Teacher Center Yellow Copy: Central Office Pink Copy: School

## Appendix K

**Rutherford County Schools/Technology Professional Development**

***Collaborate and Create: an interactive web site developed by and for elementary school teachers***

*Time Frame:*

Three 2-hour sessions of collaboration on lessons and links to integrate into the elementary school curriculum (six hours)

*Intended Audience:*

Elementary School Teachers

*Session 1: An Investigation into On-Line Projects and Collaborations**Workshop Description:*

Participants will learn about "Distance Technologies" and investigate various strategies for employing them in classroom settings. Demonstration lessons, techniques for navigating the web, classroom strategies, and evaluation techniques will be considered. Participants will be invited to participate in authentic projects and activities appropriate to his or her educational setting and grade level.

*Session Topics:*

- Tools and Tips for Searching the Web
- Techniques for Assessing Web-based Projects
- On-line Projects for Your Class to Join
- On-Line Collaborations: Extending the Classroom Walls
- Strategies that Work in a One, Two or Few Computer Classroom

*Materials/ Software Applications/ Skills:*

- Web-based research strategies
- Web-based student projects and activities
- Multimedia presentation strategies
- Word Processing

*Session 2: Technology and the Elementary Classroom**Workshop Description:*

Participants will learn how to integrate web links into their current elementary curriculum classroom and investigate an assortment of proven strategies for incorporating these recent technologies into their teaching and learning environments. Group work on a collaborative,

cooperative web-based lessons, and evaluation techniques will be considered as each participant develops hypertext, hyperlinks, images, and sound files in the creation of authentic projects and activities appropriate to his or her educational setting.

*Session Topics:*

- Developing Hotlists and Webliographies
- Tools and Tips for Searching the Web
- Techniques for Assessing Web-based Language Arts resources
- TrackStar and WebQuests devoted to the Language Arts curriculum
- On-line Projects for Your Class
- Technology and Literature Circles
- Using Multimedia to Enhance Student Presentations
- Strategies that Work in a One, Two or Few Computer Classroom

*Skills:*

- Web-based research strategies
- Web-based student activities including TrackStar, WebQuest, Knowledge Hunt; Scrapbook
- Multimedia presentation strategies
- Word Processing
- Drawing and Painting tools (brief introduction)
- Digital photography (brief introduction)

*Session 3 /Part 1: Desktop Publishing for Teaching and Learning*

*Workshop/ Seminar Description:*

Word processing and publishing can be a motivating strategy and authentic tactic for more deeply engaging students in their work. The focus of this workshop will be to explore methods for employing the latest technologies for publishing student as well as teacher's work. Participants will begin by learning how to create letterheads, banners, calendars, invitations, etc.-- all for educational uses. Classroom strategies and techniques for publishing brochures, flyers, and newsletters intended for various audiences will also be investigated as participants explore ways to connect publishing to the various content areas.

*Session Topics:*

- Intro Beginning/Intermediate Word Processing
- Brochures and Newsletters for all Audiences

*Materials/ Software Applications/ Skills:*

- Word Processing
- Desktop Publishing Software

## Session 3/Part 2: Working with Peripherals (Digital Cameras, Audio Files, Scanners)

### *Workshop Description:*

Participants will learn about the educational applications for those technologies that connect to their computers called "Peripherals". Peripherals have a variety of uses in the classroom from documenting student work to digitizing learning resources for student investigation. Demonstration lessons, classroom strategies, and evaluation techniques will be considered. Participants will be invited to participate in creating authentic and practical classroom activities appropriate to their educational settings.

### *Session Topics:*

- Scanning images and utilizing OCR
- Recording and saving audio files
- Capturing and saving images with digital cameras
- Extending and democratizing your classroom resources
- Strategies that Work in a One, Two or Few Computer Classroom

### *Materials/ Software Applications/ Skills:*

- Scanning and manipulating images
- Scanning documents and text with OCR
- Classroom activities employing audio and image files
- Importing digital images and audio files into multimedia presentations

## Appendix L

### Collaborate and Create Syllabus of Instruction Six hours of In-service Delia R. Pass, presenter

#### Course Goals:

The purpose of the Technology In-service, Collaborate and Create, is to promote technology integration into classroom curriculum through the creation of a technology integrated lesson based on current classroom curriculum and encourage collaboration through the building of a common web site for dissemination of these technology integrated lessons to encourage technology use by students in the classroom. The sessions will help learners become familiar with some of the basic technology skills and strategies needed to develop lessons and links for student learning, and the goal of the sessions are to promote an increased technology use in the classroom across grade levels and subjects.

#### Course Objectives:

At the end of this In-service teachers will be able to:

- Navigate the World Wide Web efficiently and strategically.
- Use acquired strategies to improve the quality of participation in an online learning community.
- Locate and identify effective technology resources for student use.
- Create lessons and hyperlinks to contribute to a resource of technology for learning for students
- Increase comfort level with the World Wide Web, computer technology and associated peripherals.

#### Target Audience:

This In-service is designed for teachers who are interested in developing interactive computer technology lessons for students but are unable to find the time to search and develop for lessons and/or develop the comfort level necessary for implementing technology for learning in the classroom.

#### Prerequisites:

To undertake these In-service, learners may have previous experience:

- Browsing the Internet.
- Navigating a Windows environment using a computer mouse.
- Using a word-processing program to compose your writing.

This experience will be helpful, but not required.

#### Course Schedule:

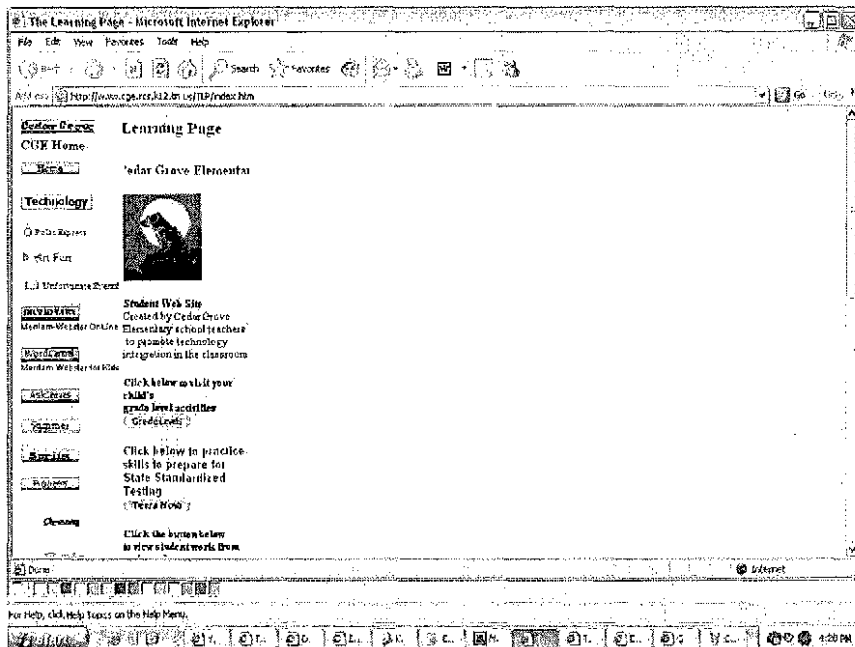
Module Part	Focus of Tasks for that Part	Amount of Time
<b>Part 1</b>	Intro to the WWW and Hypertext	One hour
<b>Part 2</b>	Classroom content: links and lessons	One hour
<b>Part 3</b>	Developing technology integrated lessons	One hour
<b>Part 4</b>	Copy and Paste hyperlinks/images	One hour
<b>Part 5</b>	Integrate lessons to classroom curriculum	One hour
<b>Part 6</b>	Complete technology integrated lesson	One hour
<b>Total</b>	Link the lesson to The Learning Page	<b>Six hours</b>

**Assessment Rubric:**

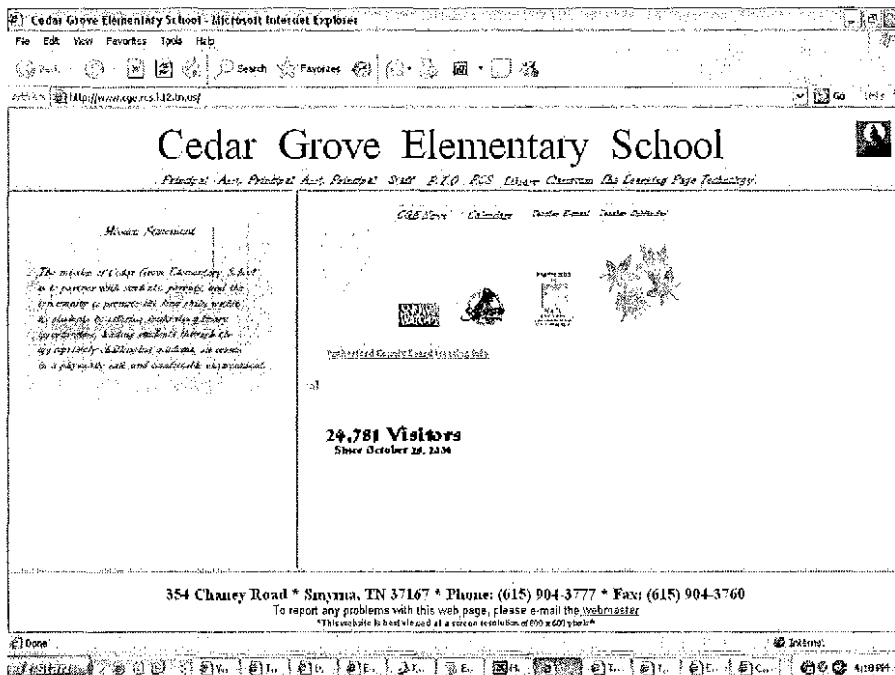
Activity	Does not meet expectations	Meets expectations	Exceeds expectations
<b>Part 1:</b> Reflect on personal schedule	Does not respond to searches and the organization of information from the WWW and the use of hypertext.	Searches the WWW and manages information relevant to content using hypertext.	Plan next steps to create lessons and link them to appropriate content and organizes information effectively to promote student achievement.
<b>Part 2:</b> Reflect on module tour and orientation	Does not demonstrate an understanding of how to locate module content quickly and efficiently.	Demonstrate an understanding of how to locate module content quickly and efficiently.	Connect and compare the strategies suggested here with others used during prior online learning experiences. - or - Make suggestions for additional strategies that help you move within a module efficiently.
<b>Part 3:</b> Post first time computer use story to the social forum in this module	Does not use suggested strategies to improve participation in an online community by including in the post a specific detail, some humor, or other elements that inspire peers to connect with other online peers.  Make at least one response to a colleague's story.	Use suggested strategies to improve participation in an online community by including in the post a specific detail, some humor, or other elements that inspire peers to connect with other online peers.  Make at least one response to a colleague's story.	Respond to a posted question with some thoughtful ideas and clearly communicated ideas/opinions. - or -  Pose additional questions that deepen the online discussion.  Use an intriguing title.  Spark a new discussion "thread" in this discussion forum.
<b>Part 4:</b> Post to the "Surviving and Thriving" Discussion in the Community Center	Does not include specific detail describing a challenge.  Does not take risks, by revealing personal mistakes or misconceptions.  Does not offer empathy in response to a colleague's post.  Does not suggest a strategy to one or more colleagues.	Include specific detail describing a challenge or adjustment you have faced. - or -  Take risks, by revealing personal mistakes or misconceptions.  Offer empathy in response to a colleague's post.- or -  Suggest a strategy to one or more colleagues.	Make connections and builds on others' ideas. -or -  Address a comment or question to the group, not just to one individual. - or -  Respond to a posted question with thoughtful ideas and clearly communicate ideas/opinions. - or -  Pose additional questions that deepen the online discussion.
<b>Part 5:</b> Take Self-Assessment Quiz and Write Journal Reflection	Does not demonstrate an understanding of personal strengths and readiness to proceed with online learning.	Demonstrate an understanding of personal strengths and readiness to proceed with online learning.	Offer specific, detailed reflections regarding personal readiness to proceed with online learning.  Plan next steps to take before beginning a TeacherLine module.
<b>Part 6:</b> Explore Station Schedule and TeacherLine	Did not explore resources.	Explored and identified 2-3 additional TeacherLine resources.	Explored and identified 4 or more TeacherLine resources.

Appendix M

The Learning Page Home Page



The School Website, with The Learning Page link



## Appendix N

## Third Grade Learning Page

Third Grade

*Third Grade Adventures Start Here*

Home

Comment Form

Reading

Language Arts

Math

Science

Social Studies

Terra Nova

Done

For Help, click Help Topics on the Help Menu.

## Third Grade Social Studies

Third Grade Social Studies

Home

Third Grade

[Constitution Day Treasure Hunt - New! 9/14/05](#)

[Chinese New Year](#)

[Pioneers in the Westward Movement-new Summer 2004!](#)

[Famous Americans-New Posting-Check it out!](#)

[Click Here to go to a web site about Famous American Icons](#)

[Click Here to learn about Famous American Landmarks](#)

Original: 11/07/01  
Phone: (615) 904-3777



## Third Grade Science Page

Third Science - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://www.ega.ncs.k12.tx.us/11P/ThirdScience.htm

### Third Grade Science

Home

ThirdGrade

[Flower Research New! September 28th!](#)

[Weather Information](#)

[Systems of the Human Body](#)

[Great Science Links-A new page about cool science things...check it out!](#)

[Check out this great lesson on types of energy](#)

[Rocks and Minerals](#)

[Plants](#)

[Eyes](#)

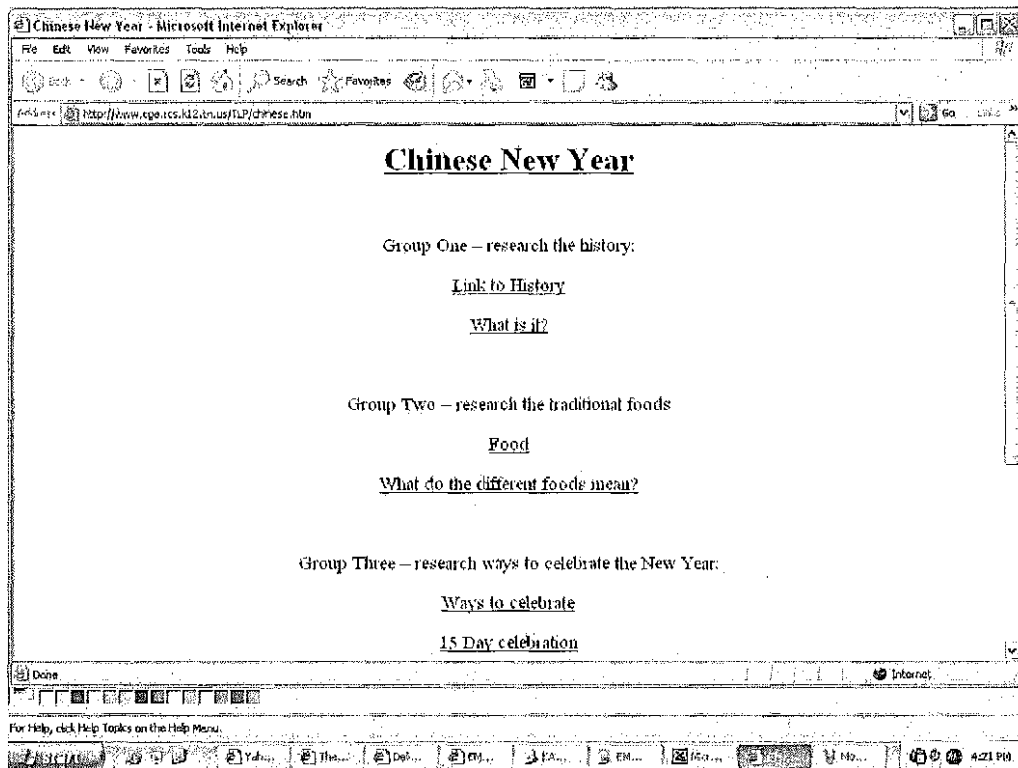
[Mammals of the Rainforest](#)

Internet

4:22 PM

## Appendix O

## Third Grade Technology Integrated Lessons (Social Studies)

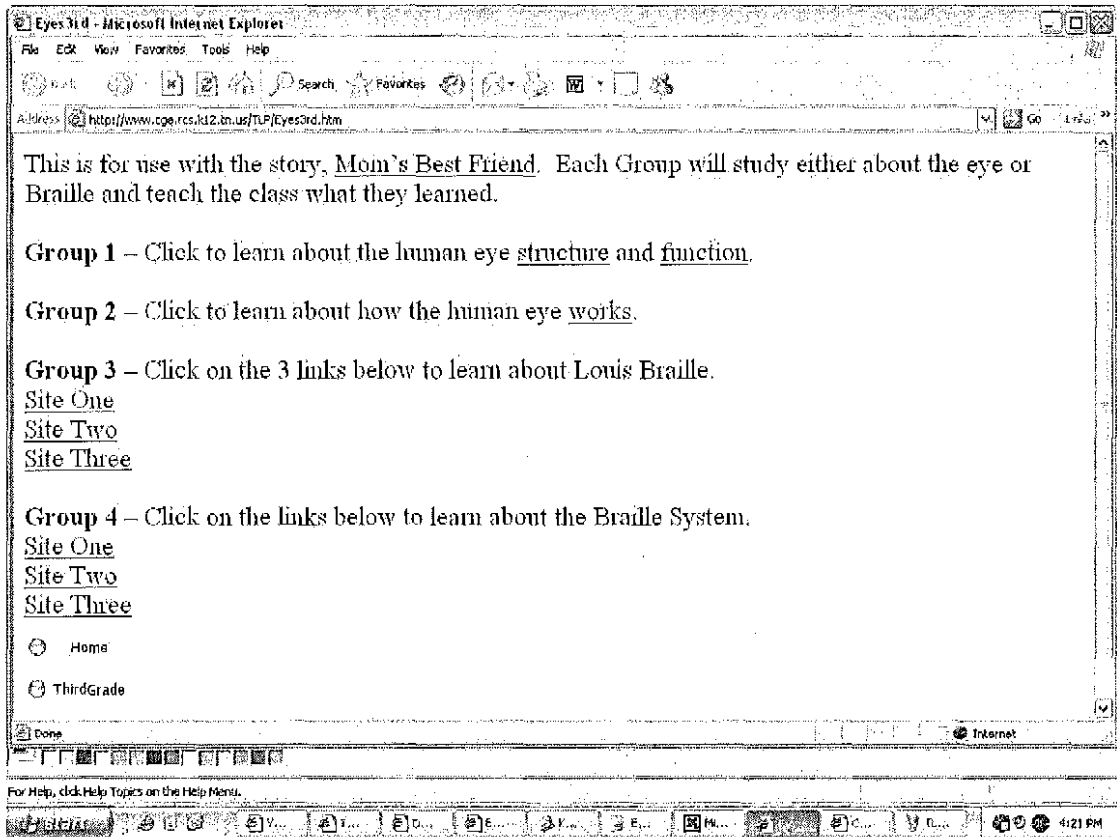


The screenshot shows a Microsoft Internet Explorer browser window. The title bar reads "Chinese New Year - Microsoft Internet Explorer". The address bar contains the URL "http://www.cpe.rccs.k12.ct.us/ILP/Chinese.htm". The main content area of the page is titled "Chinese New Year" and is divided into three sections for group research:

- Group One – research the history:**
  - [Link to History](#)
  - [What is it?](#)
- Group Two – research the traditional foods**
  - [Food](#)
  - [What do the different foods mean?](#)
- Group Three – research ways to celebrate the New Year:**
  - [Ways to celebrate](#)
  - [15 Day celebration](#)

The browser's status bar at the bottom shows "Done" and "Internet". The taskbar at the very bottom displays several open applications, including "Internet Explorer", "Word", "Excel", "PowerPoint", "Outlook", "Access", "Photoshop", "FireFox", and "H2O". The system clock in the bottom right corner shows "4:21 PM".

### Third Grade Technology Integrated Lessons (Science)



The screenshot shows a Microsoft Internet Explorer browser window titled "Eyes 3rd - Microsoft Internet Explorer". The address bar contains the URL "http://www.cge.rccs.k12.in.us/TUP/Eyes3rd.htm". The main content area of the browser displays the following text:

This is for use with the story, Mom's Best Friend. Each Group will study either about the eye or Braille and teach the class what they learned.

**Group 1** – Click to learn about the human eye structure and function.

**Group 2** – Click to learn about how the human eye works.

**Group 3** – Click on the 3 links below to learn about Louis Braille.  
[Site One](#)  
[Site Two](#)  
[Site Three](#)

**Group 4** – Click on the links below to learn about the Braille System.  
[Site One](#)  
[Site Two](#)  
[Site Three](#)

At the bottom of the page, there are two circular icons: "Home" and "ThirdGrade". The browser's status bar at the bottom shows "Done" and "Internet". The Windows taskbar at the very bottom displays the system tray with the time "4:21 PM".

## Appendix P

**Descriptive Statistics for Teachers' Attitudes Toward Computers version 3.2a (TAC  
3.2a), Pre-Program Questionnaire\***

	Minimum	Maximum	Mean	Std. Deviation
1	1.00	5.00	3.6	0.9
2	2.00	5.00	3.8	0.7
3	1.00	5.00	3.6	0.9
4	2.00	5.00	3.8	0.8
5	2.00	5.00	3.9	0.7
6	2.00	5.00	3.7	0.8
7	2.00	5.00	4.0	0.6
8	2.00	5.00	3.9	0.9
9	1.00	5.00	3.4	0.9
10	2.00	5.00	3.6	0.8
11	2.00	5.00	3.7	0.7
12	1.00	5.00	2.6	1.1
13	2.00	5.00	3.9	0.7
14	2.00	5.00	3.8	0.8
15	1.00	5.00	2.9	0.9
16	2.00	5.00	4.2	0.7
17	2.00	5.00	4.1	0.8
18	2.00	5.00	4.0	0.8
19	2.00	5.00	4.2	0.7
20	2.00	5.00	3.7	1.0
21	1.00	5.00	3.5	1.0
22	2.00	5.00	4.0	1.1
23	1.00	5.00	3.4	1.2
24	2.00	5.00	3.8	0.9
25	2.00	5.00	3.7	1.0
26	1.00	5.00	3.6	0.9
27	1.00	5.00	3.6	1.3
28	2.00	5.00	4.0	0.8
29	2.00	5.00	4.2	0.9
30	2.00	5.00	3.7	1.1
31	2.00	5.00	4.4	0.8
32	2.00	5.00	4.2	0.6
33	3.00	5.00	4.4	0.5
34	1.00	5.00	4.5	0.8
35	2.00	5.00	4.2	0.8
36	2.00	5.00	4.2	0.6
37	1.00	5.00	4.4	0.7
38	3.00	5.00	4.5	0.6
39	2.00	5.00	4.3	0.7
40	2.00	5.00	3.9	0.8

41	2.00	5.00	3.9	0.7
42	1.00	5.00	4.1	0.8
43	1.00	5.00	4.2	1.0
44	1.00	5.00	3.4	0.9
45	2.00	5.00	4.0	0.7
46	1.00	5.00	3.5	0.9
47	1.00	5.00	3.0	1.0
48	1.00	5.00	3.1	1.0
49	2.00	5.00	3.6	0.8
50	1.00	5.00	3.1	1.0
51	2.00	5.00	4.0	0.8
52	2.00	5.00	4.1	0.7
53	2.00	5.00	4.1	0.6
54	2.00	5.00	3.7	0.9
55	2.00	5.00	3.8	0.7
56	2.00	5.00	3.9	0.6
57	3.00	5.00	4.2	0.5
58	2.00	5.00	4.2	0.7
59	1.00	5.00	3.5	0.9
60	3.00	5.00	4.5	0.6
61	2.00	5.00	4.7	0.8
62	2.00	5.00	4.0	0.7
63	1.00	5.00	3.9	0.8
64	2.00	5.00	3.9	0.7
65	2.00	5.00	3.8	0.7
66	2.00	5.00	3.9	0.7
67	1.00	5.00	4.1	0.7
68	2.00	5.00	3.6	0.9
69	4.00	5.00	4.6	0.5
Factor1*	2.53	5.00	3.6	0.6
Factor2*	2.20	5.33	3.9	0.8
Factor3*	3.08	5.00	4.3	0.4
Factor5*	2.36	4.82	3.6	0.6
Factor6*	2.53	5.00	4.0	0.4

\*Note: Text of the TAC 3.2a items is presented in Appendix A, n=69. Subscales are: Factor1 (Enthusiasm/Enjoyment), Factor2 (Anxiety), Factor3 (Avoidance), Factor5 (Negative Impact on Society), Factor6 (Productivity).

## Appendix Q

**Descriptive Statistics for Teachers' Attitudes toward Computers version v. 3.2a  
(TAC 3.2a), Post-Program Questionnaire\***

	Minimum	Maximum	Mean	Std. Deviation
1	2.00	5.00	3.6	0.8
2	2.00	5.00	3.7	0.8
3	2.00	5.00	3.5	0.8
4	1.00	5.00	3.7	0.8
5	2.00	5.00	3.9	0.7
6	1.00	5.00	3.6	0.8
7	2.00	5.00	3.9	0.6
8	1.00	5.00	3.8	0.9
9	1.00	5.00	3.5	0.9
10	2.00	5.00	3.8	0.7
11	3.00	5.00	3.9	0.6
12	1.00	5.00	2.6	1.1
13	2.00	5.00	3.9	0.6
14	2.00	5.00	3.9	0.7
15	1.00	5.00	2.9	0.9
16	2.00	5.00	4.2	0.7
17	2.00	5.00	4.1	0.7
18	2.00	5.00	3.9	0.8
19	2.00	5.00	4.1	0.7
20	2.00	5.00	3.8	0.8
21	2.00	5.00	3.6	0.9
22	2.00	5.00	4.1	0.9
23	1.00	5.00	3.6	1.0
24	1.00	5.00	3.9	0.9
25	1.00	5.00	3.8	0.9
26	2.00	5.00	3.8	0.9
17	1.00	5.00	3.8	1.0
28	1.00	5.00	4.2	0.7
29	2.00	5.00	4.1	0.7
30	1.00	5.00	3.8	1.1
31	3.00	5.00	4.4	0.5
32	3.00	5.00	4.3	0.6
33	4.00	5.00	4.3	0.5
34	3.00	5.00	4.5	0.5
35	2.00	5.00	4.3	0.7
36	2.00	5.00	4.1	0.7
37	3.00	5.00	4.5	0.6
38	4.00	5.00	4.5	0.5
39	3.00	5.00	4.3	0.6

40	1.00	5.00	3.9	0.9
41	2.00	5.00	3.9	0.6
42	2.00	5.00	4.0	0.7
43	1.00	5.00	4.4	0.9
44	1.00	5.00	3.4	0.8
45	2.00	5.00	4.1	0.6
46	2.00	5.00	3.6	0.8
47	1.00	5.00	3.3	0.9
48	1.00	5.00	3.2	0.9
49	1.00	5.00	3.7	0.7
50	1.00	5.00	3.2	1.0
51	2.00	5.00	3.9	0.7
52	3.00	5.00	4.2	0.6
53	2.00	5.00	4.0	0.7
54	2.00	5.00	3.7	0.6
55	2.00	5.00	3.8	0.6
56	3.00	5.00	4.0	0.5
57	3.00	5.00	4.3	0.5
58	3.00	5.00	4.3	0.5
59	2.00	5.00	3.7	0.7
60	4.00	5.00	4.4	0.5
61	1.00	5.00	3.7	0.8
62	3.00	5.00	4.2	0.6
63	2.00	5.00	3.9	0.8
64	3.00	5.00	4.1	0.5
65	2.00	5.00	3.8	0.7
66	2.00	5.00	3.8	0.7
67	2.00	5.00	4.1	0.7
68	2.00	5.00	3.6	0.9
69	3.00	5.00	4.7	0.5
Factor1*	2.20	5.00	3.6	0.5
Factor2*	2.27	5.00	3.9	0.6
Factor3*	3.15	4.92	4.3	0.4
Factor5*	2.36	4.91	3.7	0.5
Factor6*	3.13	5.00	4.0	0.4

\*Note: Text of the TAC 3.2a items is presented in Appendix A, n=69. Subscales are: Factor1 (Enthusiasm/Enjoyment), Factor2 (Anxiety), Factor3 (Avoidance), Factor5 (Negative Impact on Society), Factor6 (Productivity).

## Appendix R

**Descriptive Statistics for Technology Proficiency Self-Assessment (Tpsa), v. 1.0, Pre-Program Questionnaire\***

	Minimum	Maximum	Mean	Std. Deviation
1	1.00	5.00	4.9	0.3
2	1.00	5.00	3.3	1.3
3	4.00	5.00	3.4	1.3
4	4.00	5.00	3.9	1.1
5	3.00	5.00	4.3	0.8
6	3.00	5.00	4.6	0.7
7	4.00	5.00	4.5	0.9
8	4.00	5.00	3.3	1.2
9	4.00	5.00	4.3	1.1
10	4.00	5.00	4.5	0.7
11	4.00	5.00	3.0	1.2
12	4.00	5.00	3.8	1.0
13	4.00	5.00	3.3	1.2
14	4.00	5.00	3.8	1.2
15	4.00	5.00	3.0	1.2
16	4.00	5.00	3.9	1.0
17	4.00	5.00	3.9	0.9
18	4.00	5.00	4.0	1.1
19	4.00	5.00	3.6	1.1
20	4.00	5.00	3.1	1.2
TpsaEmail	2.80	5.00	4.0	0.7
TpsaWWW	1.80	5.00	4.2	0.7
TpsaIntegratedApplication	1.00	5.00	3.4	0.9
TpsaTeachingW/Technology	1.00	5.00	3.7	0.9

\*Note: Text of the Tpsa items is presented in Appendix A, n=20. Subscales are: Tpsa Factor1 (Electronic Mail), Tpsa Factor2 (Worldwide Web), Tpsa Factor3 (Integrated Applications), Tpsa Factor4 (Teaching with Technology).



## Appendix S

**Descriptive Statistics for Technology Proficiency Self-Assessment (Tpsa), v. 1.0,  
Post-Program Questionnaire\***

	Minimum	Maximum	Mean	Std. Deviation
1	4.00	5.00	4.9	0.2
2	1.00	5.00	3.5	1.1
3	1.00	5.00	3.3	1.3
4	2.00	5.00	4.1	1.1
5	2.00	5.00	4.4	0.7
6	2.00	5.00	4.8	0.5
7	1.00	5.00	4.5	0.9
8	1.00	5.00	3.4	1.1
9	2.00	5.00	4.4	0.9
10	2.00	5.00	4.5	0.6
11	1.00	5.00	3.3	1.1
12	1.00	5.00	3.9	1.0
13	1.00	5.00	3.6	1.2
14	1.00	5.00	4.0	1.2
15	1.00	5.00	3.1	1.1
16	1.00	5.00	3.9	0.9
17	1.00	5.00	4.0	0.8
18	1.00	5.00	4.0	0.9
19	1.00	5.00	3.9	0.9
20	1.00	5.00	3.1	1.1
TpsaEmail	2.40	5.00	4.0	0.7
TpsaWWW	2.40	5.00	4.3	0.5
TpsaIntegratedApplication	1.00	5.00	3.6	0.8
TpsaTeachingW/Technology	1.00	5.00	3.8	0.8

\*Note: Text of the Tpsa items is presented in Appendix A, n=20. Subscales are: Tpsa Factor1 (Electronic Mail), Tpsa Factor2 (Worldwide Web), Tpsa Factor3 (Integrated Applications), Tpsa Factor4 (Teaching with Technology).

## Appendix T

**Stages of Adoption, single-item instrument, Pre and Post Program Questionnaires\***

	Minimum	Maximum	Mean	Std. Deviation
StagesPre	1.00	6.00	4.5	1.1
StagesPost	2.50	6.00	4.9	1.0

\*Note: Text of the Stages of Adoption item choices are presented in Appendix F, n=6

## References

- Albion, P. R. (1996). Student teachers' use of computers during teaching practice in primary classrooms. *Asia-Pacific Journal of Teacher Education*, 24(1), 63-73.
- Albion, P. (1999). Self-efficacy beliefs as an indicator of teachers' preparedness for teaching with technology. In J. Price et al. (Eds.), *Technology and Teacher Education Annual 1999* (pp. 1602-1608). Charlottesville, VA. Association for the Advancement of Computers in Education.
- Apple, Inc. (n.d.). Apple education K-12: Apple Classrooms of Tomorrow (ACOT). Retrieved September 27, 2003, from <http://www.apple.com/education/k12/leadership/acot/>
- Archer, J. (2000). The link to higher scores. In *The Jossey-Bass reader on technology and learning*. San Francisco: Jossey-Bass.
- Baker, E. L. (1999). Technology: How do we know it works? *Secretary's Conference on Educational Technology*. Retrieved July 26, 2003, from <http://www.ed.gov/Technology/TechConf/1999/whitepapers/paper5.html>
- Bandura, A. (1969). *Principles of behavior modification*. New York: Holt, Rinehart & Winston.
- Bandura, A. (1973). *Aggression: A social learning analysis*. Englewood Cliffs, NJ: Prentice-Hall.
- Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice-Hall.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman.
- Bandura, A., & Walters, R. (1963). *Social learning and personality development*. New York: Holt, Rinehart & Winston.
- Barron, A. E., Kemker, K., Harnes, C., & Kalaydjian, K. (2003). Large-scale research study on technology in K-12 schools: technology integration as it relates to the national technology standards. *Journal of Research on Technology in Education*, 35(4), 489-507.

- Barak, M., Maymon, T., & Harel, G. (1999). Teamwork in modern organizations: Implications for technology education. *International Journal of Technology and Design Education*, 9, 85-101.
- Barron, A. E., Kemker, K., Harmes, C., & Kalaydjian, K. (2003). Large-scale research study on technology in K-12 schools: Technology integration as it relates to the national technology standards. *Journal of Research on Technology in Education*, 35(4), 489-507.
- Barth, R. S. (1990). *Improving schools from within*. San Francisco: Jossey-Bass.
- Bebell, D., Russell, M., & O'Dwyer, L. (2004). Measuring teachers' technology uses: Why multiple-measures are more revealing. *Journal of Research on Technology in Education*, 37(1), 45-63.
- Becker, H. J. (1994). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Journal of Research on Computing in Education*, 26(3), 291-321.
- Becker, H. J. (1999). *Internet use by teachers*. Retrieved July 20, 2003, from <http://www.crito.uci.edu/TLC/FINDINGS/internet-use>
- Becker, H. J., & Riel, M. M. (2000). *Teacher professional engagement and constructivist-compatible computer use*. Retrieved June 20, 2003, from <http://www.crito.uci.edu/TLC/FINDINGS/REPORT4/>
- Bednar, A. K., Cunningham, D., Duffy, T. M., & Perry, D. J. (1992). Theory into practice: How do we link? In T. M. Duffy & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp. 17-34). Hillsdale, NJ: Erlbaum.
- Beyerbach, B., Walsh, C., & Vannatta, R. A. (2001). From teaching technology to using technology to enhance student learning: Preservice teachers' changing perceptions of technology infusion. *Journal of Technology and Teacher Education*, 9(1), 105-127.
- Bonk, C. J., Malikowski, S., Angeli, C., & Supplee, L. (2001). Holy COW: Scaffolding case-based "Conferencing on the Web" with preservice teachers [Electronic version]. *Ed at a Distance Magazine and Ed Journal*, 15(8).
- Bransford, J. D., Sherwood, R.D., Hasselbring, T. S., Kinzer, C. K., & Williams, S. M. (1990). Anchored instruction: Why we need it and how technology can help. In D. Nix & R. Sprio (Eds.), *Cognition, education and multimedia*(pp. 115-141). Hillsdale, NJ: Erlbaum.

- Bransford, J. D. et al. (Eds.). (1999). *How people learn*. Washington, D.C.: National Academy Press.
- Bransford, J. D., & Stein, B. S. (1993). *The ideal problem solver* (2nd ed). New York: Freeman.
- Brent, R., Brawner, C. E., & VanDyk, P. (2002). Factors influencing student teachers' use of technology. *Journal of Computing in Teacher Education*, 19(2), 61-68.
- Bruce, B. C., & Levin, J. A. (2001). Roles for new technologies in language arts: Inquiry, communication, construction, and expression. In D. Lapp, J. R. Squire, & J. R. Jensen (Eds.), *Handbook of research on teaching the English language arts* (2nd ed., pp. 649-657). Mahwah, NJ: Erlbaum.
- Bruce, B. C., & Peyton, J. K. (1999). *Literacy development in network-based classrooms: Innovation and realizations*. Retrieved April 29, 2002, from <http://www.ao.uiuc.edu/ijet/v1n2/bruce/index.html>
- Brookfield, S. D. (1983). *Adult learning, adult education and the community*. Buckingham, UK: Open University Press.
- Brookfield, S. D. (1986). *Understanding and facilitating adult learning: A comprehensive analysis of principles and effective practices*. San Francisco: Jossey-Bass and Buckingham, UK: Open University Press.
- Brown, J. S., Collins, A., & Duguid, S. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32-42.
- Bruner, J. (1966). *Toward a theory of instruction*. Cambridge, MA: Harvard University Press.
- Bruner, J. (1973). *Going beyond the information given*. New York: Norton.
- Bruner, J. (1990). *Acts of meaning*. Cambridge, MA: Harvard University Press.
- Bruner, J. (1996). *The culture of education*. Cambridge, MA: Harvard University Press.
- Bull, G., Knezek, G., Roblyer, M. D., Schrum, L., & Thompson, A. (2005). A proactive approach to a research agenda for educational technology. *Journal of Research on Technology in Education*, 37(3), 217-220.
- Burkholder, J. (1995). An annotated bibliography of the literature dealing with teacher training in the uses of the computer in education. (ERIC Document Reproduction Service No. ED260696)

- Bybee, R. W., & Loucks-Horsley, S. (2000). Standards as a catalyst for change in technology education. *The Technology Teacher*, 59(5), 14-17.
- Candy, P. C. (1991) *Self-direction for lifelong learning. A comprehensive guide to theory and practice*. San Francisco: Jossey-Bass.
- Carroll, J. M. (1998). *Minimalism beyond the Nurnberg Funnel*. Cambridge, MA: MIT Press.
- Chambers, J. M., & Carbonaro, M. (2003). Designing, developing, and implementing a course on LEGO robotics for technology teacher education. *Journal of Technology and Teacher Education*, 11(2), 209-241.
- ChanLin, L., Huang, R., & Chan, K. (2003). Web-based instruction in learning nutrition. *Journal of Instructional Psychology*, 30(1), 12-22.
- Chen, P., & McGrath, D. (2003). Moments of joy: Student engagement and conceptual learning in the design of hypermedia documents. *Journal of Research on Technology in Education*, 35(3), 402-422.
- Chou, L., & Moretti, F. (1992). *Teaching history in the context of hypermedia design*. New York: New Laboratory for Teaching and Learning.
- Christensen, R. (1998). *Effect of technology integration education on the attitudes of teachers and their students*. Doctoral dissertation, University of North Texas, Denton.
- Christensen, R., & Knczek, G. (1996, January). *Constructing the Teachers' Attitudes Toward Computers (TAC) questionnaire*. Paper presented to the Southwest Educational Research Association Annual Conference, New Orleans, LA.
- Clark, C. M. (1988). Asking the right questions about teacher preparation: Contributions of research on teacher thinking. *Educational Researcher*, 17(2), 5-12.
- Clark, C. M., & Peterson, P. L. (1986). Teachers' thought processes. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (pp. 255-296). New York: Macmillan.
- Clark, K. D. (2000). Urban middle school teachers' use of instructional technology. *Journal of Research on Computing in Education*, 33(2), 178-195.
- Cobb, P. (1999). Cognitive and situated learning perspectives in theory and practice. *Educational Researcher*, 28(2), 4-15.
- Cobb, T. (1999). Applying constructivism: A test for the learner-as-scientist [Electronic version]. *Educational Technology, Research and Development*, 47(3).

- Cognition & Technology Group at Vanderbilt. (1990). Anchored instruction and its relationship to situated cognition. *Educational Researcher*, 19(6), 2-10.
- Cognition & Technology Group at Vanderbilt. (1993). Anchored instruction and situated cognition revisited. *Educational Technology*, 33(3), 52-70.
- Cohen, V. L. (1997). Learning styles in a technology-rich environment. *Journal of Research on Computing in Education*, 29, 338-350.
- Craven, M., DiPasquo, D., Freitag, D., McCallum, A., Mitchell, T., Nigam, K., et al. (2000). Learning to construct knowledge bases from the World Wide Web. *Artificial Intelligence*, 118, 69-113.
- Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.
- Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal*, 38(4), 813-834.
- David, J. L. (1989). Synthesis of research on school-based management. *Educational Leadership*, 46(8), 45-53.
- David, J. L. (1994). Realizing the promise of technology: the need for systemic education reform. Retrieved on August 24, 2003, from <http://www.ed.gov/pubs/EdReformStudies/SysReforms/david1.html>
- Derry, S. (1992). Beyond symbolic processing: Expanding horizons in educational psychology. *Journal of Educational Psychology*, 84, 413-418.
- Derry, S. (1996). Cognitive schema theory in the constructivist debate. *Educational Psychologist*, 31(3/4), 163-174.
- Derry, S. J. (1999). A fish called peer learning: Searching for common themes. In A. M. O'Donnell & A. King (Eds.), *Cognitive perspectives on peer learning* (pp. 197-211). Mahwah, N. J.: Lawrence Erlbaum Associates.
- DeVellis, R. F. (1991). *Scale development*. Newbury Park, NJ: Sage.
- Dexter, S. L., Anderson, R. E., & Becker, H. J. (1999). Teacher's views of computers as catalysts for changes in their teaching practice [Electronic version]. *Journal of Research on Computing in Education*, 31(3).
- Duffy, T. M., & Jonassen, D. H. (1991). Constructivism: New implications for instructional technology? *Educational Technology*, 3(15), 7-12.

- Duffy, T. M., & Jonassen, D. H. (1992). Constructivism: New implications for instructional technology. In T. M. Duffy & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp. 17-34). Hillsdale, NJ: Erlbaum.
- Dupagne, M., & Krendl, K. A. (1992). Teachers' attitudes toward computers: a review of the literature. *Journal of Research on Computing in Education*, 24, 420-429.
- Dwyer, D. (1992). *ACOT: History, findings, impact*. Cupertino, CA: Apple Computer.
- Edwards, C. A. (2002). *Successful integration of internet technology in the K-12 classroom: Trends, perceptions, and successful practices*. Johnson City, TN: East Tennessee State University.
- Erickson, T. E. (1987, April). *Sex differences in student attitudes towards computers*. Paper presented at the Annual Meeting of the American Educational Research Association, Washington, DC.
- Ernest, P. (1995). The one and the many. In L. Steffe & J. Gale (Eds.), *Constructivism in education* (pp. 459-486). Hillsdale, NJ: Erlbaum.
- Fagan, M., Neill, S., & Wooldridge, B. (2003/2004). An empirical investigation into the relationship between computer self-efficacy, anxiety, experience, support and usage. *The Journal of Computer Information Systems*, 44(2), 95-104.
- Fosnot, C. (1992). Constructing constructivism. In T. M. Duffy & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp. 167-176). Hillsdale, NJ: Erlbaum.
- Fosnot, C. (1996). Constructivism: A psychological theory of learning. In C. Fosnot (Ed.), *Constructivism: Theory, perspectives, and practice* (pp. 8-33). New York: Teachers College Press.
- Francis, L. J. (1993). Measuring attitude toward computers among undergraduate college students: The affective domain. *Computers in Education*, 20(3), 251-255.
- Fullan, M., & Steigelbauer, S. (1991). *The new meaning of educational change*. New York: Teachers College Press.
- Fulton, K. (1997). *Learning in a digital age: Insights into the issues: The skills students need for technological fluency*. Retrieved September 5, 2003, from <http://www.mff.org/pubs/ME164.pdf>
- Fulton, K. (2001). From promise to practice: Enhancing student Internet learning. *Multimedia Schools*, 8(2), 16-24.



- Goddard, M. (2002). What do we do with these computers? Reflections on technology in the classroom. *Journal of Research on Technology in Education*, 35(1), 19-63.
- Gonzales, C., Pickett, L., Huper, N., & Martin, W. (2002). The Regional Educational Technology Assistance Program: Its effects on teaching practices. *Journal of Research on Technology in Education*, 35(1), 1-18.
- Gressard, C. P., & Loyd, B. H. (1986). Validation studies of a new computer attitude scale. *Association for Educational Data Systems Journal*, 18(4), 295-301.
- Griswold, P. A. (1983). Some determinants of computer awareness among education majors. *Association for Educational Data Systems Journal*, 16(2), 92-103.
- Halpern D. F., & Hakel, M. D. (2003). Applying the science of learning to the university and beyond: Teaching for long-term retention and transfer. *Change*, 35(4), 36-41.
- Halpin, R. (1999). A model of constructivist learning in practice: Computer literacy integrated into elementary mathematics and science teacher education. *Journal of Research on Computing in Education*, 32(1), 128-138.
- Handler, M. G. (1993). Preparing new teachers to use computer technology: Perceptions and suggestions for teacher educators. *Computers in Education*, 20(2), 147-156.
- Harel, I. (1990). Children as software designers: A constructivist approach for learning mathematics. *The Journal of Mathematical Behavior*, 9(1), 3-93.
- Hashweh, M. Z. (1996). Effects of science teachers' epistemological beliefs in teaching. *Journal of Research in Science Teaching*, 33, 47-63.
- Hazzan, O. (2002/2003). Prospective high school mathematics teachers' attitudes toward integrating computer in their future teaching. *Journal of Research on Technology in Education*, 35(2), 213-225.
- Heerman, B. (Ed.). (1986a). *Personal computers and the adult learner*. (New Directions for Continuing and Adult Education, 29), San Francisco: Jossey-Bass.
- Heinssen, R. K., Jr., Glass, C. R., & Knight, L. A. (1987). Assessing computer anxiety: Development and validation of the computer anxiety rating scale. *Computers in Human Behavior*, 3, 49-59.
- Honey, M., & Moeller, B. (1990). *Teachers' beliefs and technology integration: Different values, different understandings* (Technical Report 6). Center for Technology in Education.

- Howard, B. C., McGee, S., Schwartz, N., & Purcell, S. (2000). The experience of constructivism: Transforming teacher epistemology. *Journal of Research on Computing in Education*, 32(4), 455-462.
- Hughes, J. E., & Ooms, A. (2004). Content-focused technology inquiry groups: Preparing urban teachers to integrate technology to transform student learning. *Journal of Research on Technology in Education*, 37(4), 397-411.
- Hung, D. W. L., & Chen, D. (1999). Technologies for implementing social constructive approaches in instructional setting. *Journal of Technology and Teacher Education*, 7(3), 235-256.
- Johnston, J., & Toms Barker, L. (2002). *Assessing the impact of technology in teaching and learning: A sourcebook for evaluators*. Ann Arbor: University of Michigan Institute for Social Research.
- Jonassen, D. H. (1996a). *Computers in the classroom: Mindtools for critical thinking*. Englewood Cliffs, NJ: Prentice-Hall.
- Jonassen, D. H. (Ed.). (1996b). *Handbook of research for educational communications and technology*. New York: Macmillan Library Reference.
- Jonassen, D. H. (2000). *Computers as mindtools for school: Engaging critical thinking* (2nd ed.). Upper Saddle River, NJ: Prentice-Hall.
- Jonassen, D. H. (2003). Using cognitive tools to represent problems. *Journal of Research on Technology in Education*, 35(3), 362-381.
- Jonassen, D. H., Ambruso, D., & Olesen, J. (1992). Designing hypertext on transfusion medicine using cognitive flexibility theory. *Journal of Educational Multimedia and Hypermedia*, 1(3), 309-322.
- Jonassen, D. H., Howland, J., Moore, J., & Marra, R. M. (2003). *Learning to solve problems with technology: A constructivist perspective*. Upper Saddle River, NJ: Prentice-Hall.
- Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. Englewood Cliffs, NJ: Prentice-Hall.
- Jonassen, D. H., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments [Electronic version]. *Educational Technology, Research and Development*, 47(1).
- Kanaya, T., Light, D., & Culp, K. M. (2005). Factors influencing outcomes from a technology-focused professional development program. *Journal of Research on Technology in Education*, 37(3), 313-329.

- Knezek, G., Christensen, R., Miyashita, K., & Ropp, M. (2000). *Instruments for assessing educator progress in technology integration*. Denton: University of North Texas.
- Knezek, G., & Miyashita, K. (1991). *Computer-related attitudes of first and second grade students in the United States and Japan*. Invited paper presented at the American Educational Research Association Conference, Chicago. (ERIC Document Reproduction Service No. ED 336076)
- Knowles, M. (1984a). *The adult learner: A neglected species* (3rd ed.). Houston, TX: Gulf.
- Knowles, M. (1984b). *Andragogy in action*. San Francisco: Jossey-Bass.
- Knowles, M. S., Holton, E. F., & Swanson, R. A. (1998). *The adult learner: The definitive classic in adult education and human resource development* (5<sup>th</sup> ed.). Houston, TX: Gulf.
- LaJoie, S. P., & Derry, S. J. (Eds.). (1993). *Computers as cognitive tools*. Hillsdale, N.J.: Erlbaum.
- Larochelle, M., Bednarz, N., & Garrison, J. (1998). *Constructivism and education*. New York: Cambridge University Press.
- Lave, J. (1988). *Cognition in practice: Mind, mathematics, and culture in everyday life*. Cambridge, UK: Cambridge University Press.
- Lave, J., & Wenger, E. (1990). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.
- Little, J. W. (1993). *Teacher professional development in a climate of education reform*. Retrieved on September 12, 2003, from <http://e.gov/pubs/EdReformStudies/SysReforms/little1.html>
- Loucks-Horsley, S. (1998). The role of teaching and learning in systemic reform: A focus on professional development. *Science Educator*, 7(1), 1-6.
- Macgregor, S. K., & Lou, Y. (2004/2005). Web-based learning: How task scaffolding and web site design support knowledge acquisition. *Journal of Research on Technology in Education*, 37(2), 161-175.
- Marcinkiewicz, H. R. (1994). Computers and teachers: Factors influencing computer use in the classroom. *Journal of Research on Computing in Education*, 26(2), 220-237.

- Maurer, M., & Simonson, M. (1984). *Development of validation of a measure of computer anxiety*. Paper presented at the Annual Meeting of the Association for Educational Communications and Technology, Dallas, TX. (ERIC Documentation Reproduction Service No. ED 243428)
- McDonough, S. K. (2001). Way beyond drill and practice: Foreign language lab activities in support of constructivist learning. *International Journal of Instructional Media*, 28(1), 75.
- Merriam, S., & Caffarella, R. (1999). *Learning in adulthood: A comprehensive guide* (2nd ed.). San Francisco: Jossey-Bass.
- Milbrath, Y. L., & Kinzie, M. B. (2000). Computer technology training for prospective teachers: Computer attitudes and perceived self-efficacy. *Journal of Technology and Teacher Education*, 8(4), 373-396.
- Miller, N., & Dollard, J. (1941). *Social learning and imitation*. New Haven, NJ: Yale University Press.
- Mills, S. C., & Tincher, R. C. (2003). Be the technology: a developmental model for evaluating technology integration. *Journal of Research on Technology in Education*, 35(3), 382-410.
- Mouza, C. (2003). Learning to teach with new technology: implications for professional development. *Journal of Research on Technology in Education*, 35(2), 272-289.
- National Center for Education Statistics. (1999). *Teacher quality: A report on the preparation and qualifications of public school teachers* (NCES 1999-080). Washington, DC: U.S. Department of Education.
- National Educational Technology Standards (NETS) Project. (n.d.). Retrieved on September 14, 2004, from <http://cnets.iste.org/index.shtml>
- Newman, F., & Scurry, J. (2001). Online technology pushes pedagogy to the forefront. *The Chronicle of Higher Education*, 47, B7-B10.
- Nicaise, M., & Barnes, D. (1996). The union of technology, constructivism, & teacher education. *Journal of Teacher Education*, 47(3), 203-210.
- Nicaise, M., & Crane, M. (1999). Knowledge constructing through hypermedia authoring. *Educational Technology, Research and Development*, 47(1), 29-47.
- Niederhauser, D. S., & Fields, D. J. (1999). Exploring teaching, learning, and instructional reform in an introductory technology course. *Journal of Technology and Teacher Education*, 7(2), 153-172.

- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory* (3<sup>rd</sup> ed.). New York: McGraw-Hill.
- O'Bannon, B., & Judge, S. (2004). Implementing partnerships across the curriculum with technology. *Journal of Research on Technology in Education*, 37(2), 197-216.
- Olafson, L., & Quinn, L. (2003). Enlisting technology in instructional reform and teacher preparation. *Journal of Computing in Teacher Education*, 19(4), 107-112.
- Oliver, R. (1993). The influence of training on beginning teachers' use of computers. *Australian Educational Computing*, 8(1) 189-196.
- Papert, S. (1980, October). *Redefining childhood: The computer presence as an experiment in developmental psychology*. Paper presented at the 8th World Computer Congress: IFIP Congress, Tokyo, Japan and Melbourne, Australia.
- Papert, S. (1993). *Preface to the children's machine: Rethinking school in the age of the computer*. New York: Basic Books.
- Papert, S., & Harel, I. (1991). *Constructionism*. Norwood, NJ: Ablex.
- Pederson, S. L., & Liu, M. (2002-2003). The transfer of problem-solving skills from a problem-based learning environment: the effect of modeling an expert's cognitive processes. *Journal of Research on Technology in Education*, 35(2), 303-320.
- Pelgrum, W. J., Janssen Reinen, I. A. M., & Plomp, T. J. (1993). *Schools, teachers, students, and computers: A cross-national perspective*. Twente, Netherlands: I.E.A.
- Phillips, D. C. (1995). The good, the bad, and the ugly: The many faces of constructivism. *Educational Researcher*, 24(7), 5-12.
- Piaget, J. (1969). *The mechanisms of perception*. London: Rutledge & Kegan Paul.
- Poole, J. J., & Morgan, C. (1998). Schools have their computers, now what? *T.H.E. Journal*, 26(5), 60-61.
- Prain, V., & Hand, B. (2003). Using new technologies for learning: A case study of a whole-school approach. *Journal of Research on Technology in Education*, 35(1), 441-458.
- Provenzo, E. F., Brett, A., & McCloskey, G. N. (1999). *Computers, curriculum, and cultural change: An introduction for teachers*. Mahwah, NJ: Erlbaum.
- Pugalec, D. K. (2001a). Algebra for all: The role of technology and constructivism in an Algebra course for at-risk students. *Preventing School Failure*, 45(4), 171-176.

- Pugalee, D. (2001b) Writing, mathematics, and metacognition: Looking for connections through students' work in mathematical problem solving. *School Science and Mathematics, 101*(5), 236-245.
- Rakes, G. C., Flowers, B. F., Casey, H. B., & Santana, R. (1999). *An analysis of instructional technology use and constructivist behaviors in K-12 teachers*. Retrieved May 1, 2003, from <http://www.ao.uiuc.edu/ijet/v1n2/rakes/index.html>
- Raub, A. C. (1981). *Correlates in computer anxiety and college students*. Unpublished Ph.D. dissertation, University of Pennsylvania, Philadelphia.
- Reece, M. J., & Gable, R. K. (1982). The development and validation of a measure of general attitudes toward computers. *Educational and Psychological Measurement, 42*, 913-916.
- Ringstaff, C., & Kelley, L. (2002). *The learning return on our educational technology investment: A review of findings from research*. San Francisco, CA: West Ed Regional Technology In Education Consortium in the Southwest, U. S. Department of Education Office of Educational Research and Improvement.
- Roblyer, M. D., & Knezek, G. (2003). New millennium research for educational technology: A call for a national research agenda. *Journal of Research on Technology in Education, 36*(1), 60-71.
- Rogers, E. M. (1995). *Diffusion of innovations*. New York: Free Press.
- Rocap, K., Cassidy, S., & Conner, C. (1998). *Fulfilling the promise of technologies for teaching and learning: a summary and resource guide*. Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.
- Romiszwski, A. J. (1986). *Designing instructional systems: Decision making in course planning and curriculum design*. New York: Nichols.
- Ropp, M. M. (1999). Exploring individual characteristics associated with learning to use computers in preservice teacher preparation. *Journal of Research on Computing in Education, 31*(4), 402-416.
- Russell, A. L. (1995). Stages in learning new technology: Naive adult email users. *Computers in Education, 25*(4), 173-178.
- Saklofske, D. H., Michayluk, J. O., & Randhawa, B. S. (1988). Teachers' efficacy and teaching behaviours. *Psychological Reports, 63*, 407-414.
- Sandholtz, J. H. (2001). Learning to teach with technology: A comparison of teacher development programs. *Journal of Technology and Teacher Education, 9*(3), 349-374.

- Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1997). *Teaching with technology: Creating student-centered classrooms*. New York: Teachers College Press.
- Schacter, J. (1999). Does technology improve student learning and achievement? How, when and under what conditions? *Journal of Educational Computing Research*, 18(2), 183-196.
- Schrum, L. (2005). Editorial: A proactive approach to a research agenda for educational technology. *Journal of Research on Technology in Education*, 37(3), 217-220.
- Semple, A. (2000). Learning theories and their influence on the development and use of educational technologies. *Australian Science Teachers Journal*, 46(3), 21-28.
- Shunk, D. H. (2000). *Learning theories: An educational perspective* (3rd ed). Upper Saddle River, NJ: Prentice-Hall.
- Sivin-Kachala, J., & Bialo, E. (2000). *2000 research report on the effectiveness of technology in schools* (7th ed.). Washington, DC: Software and Information Industry Association.
- Smylie, M. A. (1988). The enhancement function of staff development: Organizational and psychological antecedents to individual teacher change. *American Educational Research Journal*, 25(1), 1-30.
- Song, S. H., & Keller, J. M. (2001). Effectiveness of motivational adaptive computer-assisted instruction on the dynamic aspects of motivation. *Educational Technology*, 49(2), 5-21.
- Spiro, R. J., Coulson, R. L., Feltovich, P. J., & Anderson, D. (1988). Cognitive flexibility theory: Advanced knowledge acquisition in ill-structured domains. In V. Patel (Ed.), *Proceedings of the 10th annual conference of the Cognitive Science Society*. Hillsdale, NJ: Erlbaum. Available at <http://www.ilt.columbia.edu/ilt/papers/Spiro.html>
- Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992). Cognitive flexibility, constructivism and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T. Duffy & D. Jonassen (Eds.), *Constructivism and the technology of Instruction* (pp. 121-128). Hillsdale, NJ: Erlbaum.
- Spiro, R. J., & Jehng, J. (1990). Cognitive flexibility and hypertext: Theory and technology for the non-linear and multidimensional traversal of complex subject matter. In D. Nix & R. Spiro (Eds.), *Cognition, education, and multimedia* (pp 164-205). Hillsdale, NJ: Erlbaum.

- Staples, A., Pugach, M. C., & Himes, D. (2005). Rethinking the technology integration challenge: Cases from three urban elementary schools. *Journal of Research on Technology in Education*, 37(3), 285-312.
- Steffe, L., & Gale, J. (Eds.). (1995). *Constructivism in education*. Hillsdale, NJ: Erlbaum.
- Stein, M. K., & Wang, M. C. (1988). Teacher development and school improvement: The process of teacher change. *Teaching and Teacher Education*, 4(2), 171-187.
- Stevens, D. J. (1982). Educators' perceptions of computers in education: 1979 and 1982. *Association for Educational Data Systems Journal*, 145(1), 1-15.
- Stiegelbauer, S. (1994). Change has changed: Implications for implementation of assessments from the organizational change literature. In R. J. Anson (Ed.), *Systemic reform: Perspectives on personalizing education*. Retrieved on August 24, 2003, from <http://www.ed.gov/pubs/EdReformStudies/SysReforms/stiegell.html>
- Strommen, E. F., & Lincoln, B. (1992). Constructivism, technology, and the future of classroom learning. *Education and Urban Society*, 24(4), 466-477.
- Summers, M. (1990). New student teachers and computers: An investigation of experiences and feelings. *Educational Review*, 42(3), 261-271.
- Tessmer, M. (1993). *Planning and conducting formative evaluations: Improving the quality of education and training*. Philadelphia: Kogan Page.
- Thomas, L., Knezek, D., & Porter, D. (2002). ISTE NETS on the digital edge: Accomplished teaching with technology. In C. Crawford et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2002* (pp. 1461-1462). Chesapeake, VA: AACE.
- Thompson, A. (2005). Scientifically based research: Establishing a research agenda for the technology in teacher education community. *Journal of Research on Technology in Education*, 37(4), 331-337.
- Trochim, W. M. (n.d.) *The research methods knowledge base* (2<sup>nd</sup> ed.) Retrieved on September 21, 2003, from <http://trochim.omni.cornell.edu/kb/>
- U.S. Department of Education. (2000). *E-learning: Putting a world-class education at the fingertips of all children* (The National Educational Technology Plan). Washington, DC: Author.
- U.S. Department of Education, Office of Educational Technology. (2004). *Toward a new golden age in American education: How the Internet, the law and today's students are revolutionizing expectations*. Washington, DC: Author.



- Vannatta, R. A. (2001). Evaluation to planning: Technology integration in a school of education. *Journal of Technology and Teacher Education*, 8(3), 231-246.
- Vician, C., Brown, S. A., & Murphy, L. (1997). The relationship among choice of participation mode, student characteristics, and student performance in technology supported learning environments. *Proceedings of the Third Annual Americas Conference on Information Systems*, 131-133.
- Venezkey, R. L. (2001). Procedures for evaluating the impact of complex educational interventions. *Journal of Science Education and Technology*, 10(1), 17-30.
- von Glaserfeld, E. (1989). Cognition, construction of knowledge, and teaching. *Synthese*, 80,(1), 121-140.
- von Glaserfeld, E. (1995a). A constructivist approach to teaching. In L. P. Steffe & J. Gale (Ed.), *Constructivism in education* (pp. 3-15). Hillsdale, NJ: Erlbaum.
- von Glaserfeld, E. (1995b). *Radical constructivism: A way of knowing and learning*. London: Falmer Press.
- Vygotsky, L. S. (1962). *Thought and language*. Cambridge, MA: MIT Press.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Wadsworth, B. (1978). *Piaget for the classroom teacher*. New York: Longman.
- Wang, F, & Wedman, J. (2001). eThemes: An Internet instructional resource service. *Information Technology and Libraries*, 20(4), 179-184.
- Watters, J. J., & Ginns, I. S. (1997, March). *Impact of course and program design features on the preparation of preservice elementary science teachers*. Paper presented at the Annual Meeting of the National Association of Research in Science Teaching, Chicago.
- Web-Based Education Commission. (2000). *The power of the Internet for learning: Moving from promise to practice*. Washington, DC: Author.
- Willis, J., & Cifuentes, L. (2005). Training teachers to integrate technology into the classroom curriculum: Online versus face-to-face course delivery. *Journal of Technology and Teacher Education*, 13(10), 43-63.
- Wolf, S. E., Brush, T., & Saye, J. (2003). Using an information problem-solving model as a metacognitive scaffold for multimedia-supported information-based problems. *Journal of Research on Technology in Education*, 35(3), 321-341.

- Yepes-Baraya, M. (2000). *Lessons learned from the evaluation of Alliance +: an Internet-in-education professional development program*. Princeton, NJ: Educational Testing Service.
- Zaichkowsky, J. L. (1985). Measuring the involvement construct. *Journal of Consumer Research*, 12(3), 341-352.
- Zemke, R. (1984). *Computer literacy needs assessment*. Reading, MA: Addison-Wesley.

## Vita

### Delia Raymos Pass

#### EDUCATION

Doctor of Education in Educational Leadership, University of North Florida,  
Educational Leadership, December 2005

Master of Arts in Teaching, Jacksonville University, May 1996

Bachelor of Arts, University of South Florida, Tampa, Florida, Fine Arts, 1981

Associate in Arts, Florida Community College in Jacksonville, Political Science, 1976

Nathan Bedford Forest High School, Jacksonville, Florida, H. S. Diploma

#### PROFESSIONAL EXPERIENCE

2003 to present. Elementary Technology Teacher, Cedar Grove Elementary, Smyrna,  
Tennessee, Rutherford School System, Murfreesboro, Tennessee

2000 to 2002. Computer Graphics and Art Teacher, Ridgeview High School, Orange  
Park, Florida, Clay County Schools, Green Cove Springs, Florida

1998 to 2000. Middle School Art Teacher, Orange Park Junior High School, Clay County  
Schools, Green Cove Springs, Florida

1997 to 1998. Junior High School Art Teacher, Wilkinson Junior High School, Clay  
County Schools, Green Cove Springs, Florida

1994 to 1996. Elementary Art Teacher, Tynes Elementary School, Middleburg, Florida,  
Clay County Schools, Green Cove Springs, Florida

#### CERTIFICATIONS

State of Tennessee teaching license K-12 Art

State of Florida teaching certificate K-12 Art

Intel Teach to the Future Master Teacher

#### PLACE OF BIRTH

Gainesville, Florida