ABSTRACT

JOHNSON, PAMELA MARTIN. Change in Classroom Practices of Technology Use by K-12 Teachers. (Under the direction of Bradley S. Mehlenbacher.)

The purpose of this longitudinal study was to investigate the sustained change of technology use in the classroom by K-12 teachers following a one-year professional program. The study investigated specific factors which influence change in technology use in the classroom. The factors investigated in this study include: a) years of teaching experience b) hours of professional development in technology d) presence of on-site hardware and technical assistance, e) ratio of computers to students in the classroom, f) number of Internet accessible computers for students, and g) perceived technology support by principal.

Additionally, this study aligned the Teaching with Technology Instrument – Revised with Welliver’s (1989) Instructional Transformation Model. The aligned Teaching with Technology Instrument – Revised has 23 questions covering technology skills determined by the North Carolina Technology Competencies for Educators. Each of the questions is placed on a 5-point Likert scale ranging from never to daily use. Welliver’s Instructional Transformation Model is a technology use model ranging from familiarization, which is when a teacher is first introduced to technology to evolution, which is where a teacher is creating classroom specific applications for software.

The study found a significant change in teachers’ use of technology in the classroom during the four years covered by the study. The variable, years of teaching experience, was significant on the total model score as well as on four of the five stages of the model (utilization, integration, reorientation, and evolution). Four additional variables were
significant at one stage of the model. These include, hours of professional development in technology integration at the familiarization stage, level of education completed by teachers at the reorientation stage, and teachers’ perception of principals’ knowledge of technology at the utilization stage and teachers’ perception of principals’ knowledge of instructional technology at the utilization stage.
CHANGE IN CLASSROOM PRACTICES OF TECHNOLOGY USE BY K-12 TEACHERS

by

Pamela Martin Johnson

A dissertation proposal submitted to the graduate faculty of North Carolina State University in partial fulfillment of the requirements for the Degree of Doctor of Education in Adult and Community College Education

Raleigh, NC

March 23, 2006

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Dedication

This is dedicated to my father and father-in-law who are no longer with us in person, but are with our families in spirit every day.

Harvey Jordan Martin, Jr.
September 23, 1930 – December 4, 1983

Harvey William Johnson
March 15, 1929 - September 18, 1996
Biography

Pamela Gail Martin Johnson was born at Fort Bragg, North Carolina but lived most of her childhood in Savannah, Georgia and later Hampton, Virginia. She earned a Bachelor of Science degree in Elementary Education in 1974 from Madison College in Harrisonburg, Virginia and a Master of Education degree in Counseling and Guidance from Campbell University in Buies Creek, North Carolina in 1980.

Her early work experience was in teaching courses in Army Education Centers at Fort Polk, Louisiana, Fort Benning, Georgia and Fort Bragg, North Carolina, teaching subjects ranging from typing and shorthand for Department of the Army civilian employees to General Educational Development and College Level Equivalency Program courses to soldiers. She also taught third grade at Fort Polk Elementary where she was selected as Teacher of the Year in 1977. She also taught 1st grade at Laurel Bay School in Beaufort, SC and then served as a guidance counselor for four elementary schools in Fayetteville, NC. After the birth of her second child, she stayed at home for ten years to raise her three sons. During this period she was actively involved in leadership roles with the United Methodist Church, Henderson County Public Schools and Boy Scouts of America. All three of her sons are Eagle scouts.

Mrs. Johnson returned to education in 1992 serving as an instructor in psychology at Brevard College in Brevard, North Carolina. In 1996, she became Brevard College’s first Placement Director as the college transitioned from a 2-year to a 4-year institution. In 1998, Mrs. Johnson began her doctoral studies as a member of the North Carolina State University, Adult and Community College Education’s Asheville Cohort. She was awarded the William Stanback Faculty Award in 1998 from Brevard College and the Esther Edwards Graduate
Scholarship in 1998 from the United Methodist Church. Mrs. Johnson received the Evelyn Sherrill Bunch Award for Outstanding Assistance to the Average Student in 1999.

In 2000, Mrs. Johnson was named Assistant Dean for Special Projects and assumed the role of Coordinator of Brevard College’s Adventure of the American Mind (AAM) program, a grant project funded by the Library of Congress. In this position, she mentored K-12 teachers from three counties, ran a summer institute and taught a graduate course in technology integration in conjunction with Montreat College.

In 2001, Mrs. Johnson left Brevard College to create and direct the AAM Home School Program for the Education Research Consortium (ERC) in Asheville, North Carolina. The ERC is the parent organization for the Adventure of the American Mind program. In 2005, the AAM Home School Program became the AAM Online Education Program. Mrs. Johnson serves as the director of this nationwide program that offers online project-based lessons using resources from the Library of Congress Website.

Mrs. Johnson is the daughter of Harvey Jordan (deceased) and Ann Love Martin, sister of Marty Martin, Mike Martin, Debbie Colleran and Mary Greenman, wife of Bob Johnson for 31 years and mother to Martin, Jeremiah and Spencer Johnson. She currently resides in Hendersonville, North Carolina.
Acknowledgements

First, I would like to say a special thank you to Dr. Brad Mehlenbacher for taking over as the chair of my committee during the middle of the dissertation process. Thank you so much for sharing your expertise and your guidance through the doctoral program. Words cannot say how much the encouraging e-mails meant during the many months of editing.

Second, I would like to thank Dr. Ellen Vasu, Dr. Saundra Williams, and Dr. Tim Hatcher for the many hours of review and support during the last six years. Thank you also to Dr. Carol Kasworm for serving as my chair during the initial months of my doctoral studies.

It was because of the encouragement and support of the faculty and staff of Brevard College that I began and continued in this program. I would like to thank Dr. Tom Bertrand, former President of Brevard College and Steve Martin, former Dean of Campus Life, for encouraging my studies through financial support and release time for attending coursework. I would also like to thank the General Board of Higher Education and Ministry of the United Methodist Church for their support of women in higher education administration through the Esther Edwards Graduate Scholarship.

Meeting the members of the North Carolina State University, Adult and Community College Education’s Asheville Cohort was one of the most valuable experiences during my doctoral studies. Many of them have provided words of encouragement and support during the past eight years that have enabled me to continue my studies and complete my dissertation. Specifically, I would like to thank Dr. Susan Fouts for her many hours of reading, listening and editing during this time as well as the countless quick meetings for emotional support. I would also like to recognize two members of the Cohort, Jeanette Staley
and Dwayne Crane, now deceased, who completed the coursework, but were not able to complete the dissertation.

My husband, Bob, has been an incredible inspiration to me during the last 37 years. His unwavering support of me during our lives together has been the anchor which has made it possible for me to achieve this lifetime goal. Bob and I have been very blessed to have three wonderful sons, Martin, Jeremiah, and Spencer, who constantly amaze us with their actions and abilities. Our sons have grown into wonderful young men who will be good husbands, fathers, and citizens. I greatly appreciate their support and encouragement when my doctoral studies took much longer than I originally anticipated.

Thank you, Bob, Martin, Jeremiah, and Spencer for being such a wonderful family.
# Table of Contents

<table>
<thead>
<tr>
<th>Table of Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF TABLES</td>
<td>xi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xii</td>
</tr>
<tr>
<td>CHAPTER I: INTRODUCTION</td>
<td></td>
</tr>
<tr>
<td>The Problem</td>
<td>1</td>
</tr>
<tr>
<td>Conceptual Framework</td>
<td>6</td>
</tr>
<tr>
<td>Purpose</td>
<td>11</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>13</td>
</tr>
<tr>
<td>Significance of the Problem</td>
<td>14</td>
</tr>
<tr>
<td>Limitations of the Study</td>
<td>15</td>
</tr>
<tr>
<td>Assumptions</td>
<td>16</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>16</td>
</tr>
<tr>
<td>CHAPTER II: LITERATURE REVIEW</td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>19</td>
</tr>
<tr>
<td>Introduction to Technology Integration</td>
<td>19</td>
</tr>
<tr>
<td>Change Models</td>
<td>20</td>
</tr>
<tr>
<td>Concerns-Based Adoption Model</td>
<td>20</td>
</tr>
<tr>
<td>Diffusion of Innovations</td>
<td>22</td>
</tr>
<tr>
<td>Apple Classroom of Tomorrow</td>
<td>23</td>
</tr>
<tr>
<td>Instructional Transformation Model</td>
<td>24</td>
</tr>
<tr>
<td>Familiarization Stage</td>
<td>25</td>
</tr>
<tr>
<td>Utilization Stage</td>
<td>26</td>
</tr>
<tr>
<td>Integration Stage</td>
<td>26</td>
</tr>
<tr>
<td>Reorientation Stage</td>
<td>27</td>
</tr>
<tr>
<td>Evolution Stage</td>
<td>28</td>
</tr>
<tr>
<td>Classroom Teaching Practices</td>
<td>30</td>
</tr>
<tr>
<td>Integration in Curriculum</td>
<td>36</td>
</tr>
<tr>
<td>Factors Affecting Change</td>
<td>38</td>
</tr>
<tr>
<td>Barriers</td>
<td>40</td>
</tr>
<tr>
<td>Institutional Support</td>
<td>42</td>
</tr>
<tr>
<td>Institutional Culture</td>
<td>43</td>
</tr>
<tr>
<td>Institutional Vision</td>
<td>44</td>
</tr>
<tr>
<td>Collaborative School Culture</td>
<td>44</td>
</tr>
<tr>
<td>Attributes of Administrators</td>
<td>45</td>
</tr>
<tr>
<td>Beliefs versus Practices</td>
<td>47</td>
</tr>
<tr>
<td>Systemic Change</td>
<td>49</td>
</tr>
<tr>
<td>Limited Budgets to Support Technology Personnel and Resources</td>
<td>50</td>
</tr>
<tr>
<td>Evaluation and Assessment Policies</td>
<td>50</td>
</tr>
</tbody>
</table>
Appendix Z: Sample of Teachers’ Report on Teaching with Technology
Instrument-Revised as Aligned with Welliver’s Instructional Transformation Model* .................................................................................170
## List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Definitions of Each Level of Welliver’s <em>Instructional Transformation Model</em></td>
<td>8</td>
</tr>
<tr>
<td>2.</td>
<td>Phases of Participation in Adventure of the American Mind Program</td>
<td>58</td>
</tr>
<tr>
<td>3.</td>
<td>List of Participating Schools with Montreat College Cluster: Year 3</td>
<td>60</td>
</tr>
<tr>
<td>4.</td>
<td>Characteristics of Sample</td>
<td>79</td>
</tr>
<tr>
<td>5.</td>
<td>Process for Placing TTI-R Questions on Welliver’s <em>Instructional Transformation Model</em> Using Panel of Experts (POE) and Factor Analysis</td>
<td>84</td>
</tr>
<tr>
<td>6.</td>
<td>Item Analysis of Questions from the Teaching with <em>Technology Instrument - Revised</em> as Placed on Welliver’s <em>Instructional Transformation Model</em></td>
<td>85</td>
</tr>
<tr>
<td>7.</td>
<td>Item Analysis of Questions Placed on Model by Panel of Experts</td>
<td>86</td>
</tr>
<tr>
<td>8.</td>
<td>Comparison in Teacher’s Use of Technology from Pretest to Posttest for the Model and Stages of the Model (n=35)</td>
<td>89</td>
</tr>
<tr>
<td>9.</td>
<td>Correlation Coefficients between Change in Teacher Use of Computers and Study Variables (n=35)</td>
<td>91</td>
</tr>
<tr>
<td>10.</td>
<td>Correlation Coefficients between Change in Teacher Computer Use and Teaching Experience of Teacher (n=35)</td>
<td>93</td>
</tr>
<tr>
<td>11.</td>
<td>Correlation Coefficients between Change in Teacher Computer Use and Level of Education Completed by the Teacher (n=35)</td>
<td>94</td>
</tr>
<tr>
<td>12.</td>
<td>Correlation Coefficients between Change in Teacher Computer Use and Hours of Staff Development in Technology Integration (n=35)</td>
<td>95</td>
</tr>
<tr>
<td>13.</td>
<td>Correlation Coefficients between Change in Teacher Computer Use and Presence of Hardware Assistance at the Teacher’s School (n=35)</td>
<td>96</td>
</tr>
<tr>
<td>14.</td>
<td>Correlation Coefficients between Change in Teacher Computer Use and Ratio of Computers to Students in the Classroom (n=35)</td>
<td>97</td>
</tr>
<tr>
<td>15.</td>
<td>Correlation Coefficients between Change in Teacher Computer Use and Number of Internet Computers for Student Use (n=35)</td>
<td>98</td>
</tr>
<tr>
<td>16.</td>
<td>Correlation Coefficients between Change in Teacher Computer Use and Teacher’s Perceived Support by their Principal (n=35)</td>
<td>99</td>
</tr>
</tbody>
</table>
List of Figures

1. Welliver’s *Instructional Transformation Model* ............................................................... 6

2. Welliver’s *Instructional Transformation Model* ............................................................... 76

3. The Conceptual Model of the Relationship of the Variables in Hypothesis Three .......... 92

4. Comparison of Individual Teachers’ Change Score on Welliver’s *Instructional Transformation Model* and Years of Teaching Experience (n=35) ........................................... 108
Chapter I: Introduction

The Problem

The introduction of technology in the classroom is one of many educational reforms made during the past sixty years. But unlike other reforms, technology has also had a significant impact on society at large and students are now expected to be exposed to technology in the classroom so they will be prepared to use it once they leave and enter the workplace. However, despite the dramatic growth in technology and Internet access in the past decade in society, the number of teachers using the Internet in their classrooms has not kept pace with this increase (Boyd, 1999; Colley, 2002; Hunter, 2002; Web-Based Education Commission, 2000). While computers are available in most classrooms in the United States, their use by instructors and students varies greatly. Connected to this, it is teachers, not students or administrators, who are likely to increase the integration of any new reform in the classroom (Bredeson & Scribner, 2000; Cuban, 1993; Fullan, 1995; Landgraf, 2001; Little, 1993).

Studies consistently report that in order for teachers to integrate technology into the classroom, adequate professional development must be provided (Bauer, 2002; Bronson, 2002; Colley, 2002). Administrators are now discovering that having the technology available in the classroom does not guarantee that the technology is integrated into daily classroom activities. As shown by Kim, Crasco, Smithson, and Blank (2001), changes in classroom practices do not occur because authorities mandate the change. Rather, only teachers can successfully incorporate technology in the classroom. Bauer’s (2002) investigation of 30 teachers in four schools that were identified as "technology-users" by
their administrators found that although teachers are trained in technology, they have not changed their classroom practices to reflect this training.

Initially, professional development that focused on technology use was skill-based, emphasizing applications at the expense of not demonstrating how teachers might use these applications in their educational contexts (Barnett, 2003; Hodgson & Kay, 2003; Peterman, 2003). Since this approach to technology preparation has not brought about the desired changes in classroom technology use by teachers, researchers have begun to investigate other factors that might deliver the desired changes in classroom practices by teachers.

One factor is to use the curriculum that teachers plan to use in the classroom in the professional development training. Dietrich (2003) found that this individualized “just-in-time” support was highly effective when used with a group of private high school teachers and brought about changes in their instructional practices.

A second factor is evaluating how teachers’ pedagogies impact their classroom practices. Hunter (2002) investigated how constructivist-oriented teachers used technology, reporting that, although these teachers understood the importance of using technology in their classrooms, they had limited knowledge of how to integrate it.

Rodriguez, with Knuth (2000), summarizing existing research on technology teacher preparation, have recommended thirteen components of an effective technology professional development program. These components include the following:

1. Connection to student learning
2. Hands-on technology use
3. Variety of learning experiences
4. Curriculum-specific applications
5. New roles for teachers
6. Collegial learning
7. Active participation of teachers
8. Ongoing process
9. Sufficient time, technical assistance and support
10. Administrative support
11. Adequate resources
12. Continuous funding
13. Built-in evaluation

Ideally, all of these components would be included in every professional development program. Researchers (Birman, Desimone, Porter & Garet, 2000; Dietrich, 2003; Gitomer & Latham, 2000; Peitenati, Giuli & Abou Khaled, 2001; Wenglinsky, 2001) have investigated various forms of professional development that combine several of these components to determine an effective training format for professional development in technology integration.

After surveying 1,000 math and science teachers in five states, Birman, et al. (2000) found that the characteristics of professional development which have the greatest impact on changing teachers’ instructional practices include content knowledge, a longer duration, and an alignment with school priorities and teacher responsibilities. Birman, et al. (2000) reported finding very few professional development activities which included components found effective by research. The challenge in providing quality professional development is planning and cost. Birman, et al. (2000) recommended offering either fewer teachers quality training or increasing the training budget.
Wenglinsky (2002) reported that one of the most underused training strategies for teachers was “hands-on” technology use. “Hands-on” does not occur during a three-day workshop, but over time, which is another of the components recommended by Rodriguez and Knuth (2000). “Hands-on” learning includes ongoing opportunities to observe other teachers modeling technology integration and the time to go through the learning cycle, so that the teacher could practice using technology in their classroom, be observed, review the observations and then revise their teaching practices (Corcoran, 1995; Corcoran, Shields, & Zucker, 1998; Garet, Birman, Porter, Desimone, Herman, & Yoon, 1999).

Additional changes in professional development activities include an increased emphasis on collaboration by teachers. Researchers reported finding a strong relationship between professional development and collaborative activities on teachers’ changes in practice (Birman, et al., 2000; Dexter, Seashore, & Anderson, 2002; Haycock, 2001). Birman, et al. (2000) also found collaboration of teachers within one school a factor in the change in practices by teachers. Nevertheless, there are few current studies addressing the influence of professional development on classroom practices.

Another change has been the growth of online professional development opportunities for teachers. Online professional development activities allow teachers to establish relationships with each other during the training sessions and to maintain these relationships through electronic means after completing training sessions. This extended collaboration provides teachers with the opportunity to work together on classroom-based problems utilizing the professional development training.

Sandholtz (2001) investigated teachers’ abilities to use what they learned during professional development training programs in technology by studying approximately 860
teachers involved in two teacher development programs. When barriers to using technology in the classroom, such as available time and access to training and on-site technical support, were reduced or removed, Sandholtz found that teachers changed their classroom practices and increased the level of technology use in the classroom following the professional development programs. Additionally, in situations where the level of support from school administrators and the surrounding community was high, the level of technology integration moved out of individual classrooms into school-wide projects.

Other studies have investigated school districts to determine which factors enhance teacher technology use. One factor studied is the comfort level of the teacher with technology. The Center for Information and Communication Sciences at Ball State University selected twelve outstanding school districts in the area of technology integration in the United States (Bossert, December 2001). A key to their selection was evidence of teachers who had changed their classroom practices and who had integrated technology into their daily activities. Administrators in the successful technology school districts reported that if teachers were not comfortable with technology or did not understand how to use it, they would not be able to make it a part of their classroom practices (Bossert, December 2001).

A second factor studied is the type of activities supported by technology resources. Technology integration joins a long list of teaching reforms. According to Vermette, et al. (2001), many reforms do not change practices in the classroom. However, technology integration is one reform that when implemented does change teaching practices. However, the types of activities supported by technology resources are not compatible with all teaching practices.
Conceptual Framework

Welliver’s (1989) *Instructional Transformation Model* (Figure 1) provides a framework to conceptualize and structure the technology use practices of teachers. This model was developed from a study of technology adoption behaviors of teachers and has been used to guide research (Marcinkiewicz & Welliver, 1993; Hooper & Reiber, 1995) as well as professional development training within school systems (Wang, 2000). Marcinkiewicz and Welliver’s (1993) research validated the model’s developmental and hierarchical stages of the adoption of computer usage by teachers while Hooper and Reiber (1993) redefined the model to allow for maturity in the teachers’ pedagogical use of computers.

![Figure 1: Welliver's Instructional Transformation Model](image-url)
Many of the models used to study computer use by teachers have been concerns-based models (Sherry, et al., 2000; Dooley, 1999; Cafolla & Knee, 1995). The *Instructional Transformation Model* follows the hierarchical format of the Concerns-Based Adoption Model (CBAM) of Hall, Wallace, and Dossett (1973). However, Welliver’s model is based on the activities of the teacher’s computer use in the classroom rather than the concerns of the teacher regarding the usage of the innovation (Table 1). The Apple Classroom of Tomorrow (ACOT) (Dwyer, 1994) model follows the stages in Welliver’s model by defining the five phases of a teacher’s computer use by their computer activities. The use of teachers’ computer activities rather than their concerns surrounding the innovation has been followed in multiple studies (Marcinkiewicz, 1994; Hooper & Rieber, 1995; Sandholtz, Ringstaff, and Dwyer, 1997).

Welliver’s model was designed specifically for technology integration and focuses on the changes in teaching practices during the technology integration process. Upon completion of the 10-year ACOT project of technology integration, Sandholtz, Ringstaff, and Dwyer (1997) developed the ACOT model, which is similar to Welliver’s model in that there are also five stages which focus on the activities of the teachers during the integration process. However, there have been other models that have been used to study technology integration, including Roger’s Diffusion of Innovations and Hall’s CBAM models which have evolved from change models. Roger’s Diffusion of Innovations model focuses on the process of the adoption of an innovation, rather than the application of the innovation. Hall’s CBAM model is different because it focuses on the technical and emotional integration of technology (Lane, 2000; Shotsberger & Crawford, 1996). Neither of these models addresses the stages
which teachers go through during technology integration, and therefore Welliver’s

*Instructional Transformation Model* was selected as the change model for this study.

Marcinkiewicz’s (1994) study of 170 elementary teachers supports the sequential and hierarchical format presented in the *Instructional Transformation Model* for change in computer use by classroom teachers. Marcinkiewicz finds the change from the utilization level (level 2) to the integration level (level 3) to be significant. A teacher’s level on Welliver’s model changes with the increase of technology use and the introduction of new technology. The presence of a reorientation level (4) and evolution level (5) in Welliver’s model acknowledges that learning to use technology is a continual process. The circular nature of the model proposes that teachers follow the same basic process when learning new technologies as they did when they first learned to use technology at all.

Table 1

*Definitions of Each Level of Welliver’s Instructional Transformation Model*

<table>
<thead>
<tr>
<th>Level</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Familiarization: Introduction to technology, such as “how-to” knowledge</td>
</tr>
<tr>
<td>2</td>
<td>Utilization: Teacher tries the technology, but can change the lesson if the technology fails</td>
</tr>
<tr>
<td>3</td>
<td>Integration: Technology is necessary. The lesson cannot be taught without technology.</td>
</tr>
<tr>
<td>4</td>
<td>Reorientation: Student becomes the center of the educational process with the technology integrated and the teacher facilitating the content but not the technology</td>
</tr>
<tr>
<td>5</td>
<td>Evolution: Teacher must change with the technology. This stage is never fully reached.</td>
</tr>
</tbody>
</table>
In 1992, Welliver’s model was adopted by the Grosse Point, Michigan school system to assist in professional development technology training. Since there was not an instrument aligned with the model, administrators in the Grosse Point School System created a “Staff Computer Skills Survey” to place teachers at the stages of the model. The reliability and validity of the “Staff Computer Skills Survey” was not reported in the literature.

Welliver’s model was also used by Marcinkiewicz (1995) in his research on the change in the levels of computer usage by teachers. Marcinkiewicz created and tested a questionnaire to place teachers on Welliver’s model but his research indicated the questionnaire would only place teachers on the utilization and integration stages of the model.

Nelson (1998) finds Welliver’s model helpful in establishing a “hierarchy through which teachers move” when learning technology skills for the classroom. Nelson (1998) uses this model in a qualitative study to help teachers recognize their “stage” of technology use and how it is defined. Nelson reports that a well-defined activity for each level on the model is necessary. Because a complete description of each level is central to aligning an instrument with the model, a further discussion of each level follows.

Teachers who are at the familiarization level (level 1) on Welliver’s model are in the initial stages of exposure to technology. A teacher at this level would attend "how-to" workshops covering new software or hardware technologies. However, a teacher at this level typically stops increasing their knowledge of technology once they leave the workshop. While the teacher would be able to discuss what was covered in the workshop, they would not be able to apply this knowledge in their classroom.
The *utilization level* (level 2) is the point when the teacher takes a risk and begins to use technology in the classroom. The teachers at this level use the computer for educational activities and classroom management but are not committed to using it as a standard tool in the classroom. If the technology does not work or the teacher is dissatisfied with the results of the usage, they will not be willing to use the computer for follow-up lessons. Teachers at this level frequently use drill and practice software or other basic software in isolated activities. According to Welliver and Marcinkiewicz (1993), most teachers are at this level of the model.

The *integration level* (level 3) occurs when technology and digitized documents are used to create lessons for students that are required as a part of a class curriculum. When the technology is disrupted by broken hardware, lack of access, or other reasons, the educational process cannot continue. At this level, the computer is as necessary to educational activities as chalk was to classrooms in the 1960s. According to Corwin and Marcinkiewicz (1998), teachers at the integration level also delegate tasks to the computer and are fully aware of changes in their classroom due to this delegation. Here, the role of the classroom teacher is beginning to shift and the teacher is aware of this shift.

The *reorientation level* (level 4) occurs when the teacher, convinced of the necessity of the computer as a resource in the classroom, requires their students to use the technology available through use of a computer, and begins to develop alternative activities for their students. A teacher at this level will have advanced software and troubleshooting competencies as well as the confidence to trust the technology. Additionally, teachers who are at this level have classrooms that are more student-centered than teacher-centered. These
teachers have changed their classroom practices to allow for student input and direction in determining the materials necessary to meet the curriculum requirements.

The *evolution level* (level 5) of the model is never fully reached because of rapidly changing technology and the transitional nature of this stage. As a result, teachers will return to the familiarization level (level 1) each time new technology is introduced. However, they will move more rapidly through the model because of their increased confidence in learning and using new technology. Level 5 is always fluid because teachers are constantly redefining their roles and practices in response to technology changes. Teachers at this level have interest in evaluating new technology and will collaborate with school administrators to acquire advanced hardware and software.

Central to the model is how technology has changed teaching practices in the classroom. At the familiarization (level 1) and utilization (level 2) levels, the teachers’ classroom practices do not look different than those in a non-technology enhanced classroom. However, beginning with the integration level (level 3), there is a dramatic difference in the learning activities and teaching practices used in the classroom.

*Purpose*

The purpose of this study is to investigate the change in classroom practices of technology use by K-12 teachers. The extent of these changes during the four-year period covered by this study was determined by comparing the teacher’s pretest and posttest responses to the 46-items on the *Teaching with Technology Instrument – Revised (TTI-R)*. The questions in this instrument cover the teacher’s usage of software and web-based resources in the classroom as well as general issues related to technology use, such as copyright.
This study examines which factors influence teachers’ changes in practice in technology use in the classroom. These factors include:

1. Years of teaching experience
2. Time span of the professional development activity
3. Hours of technology training
4. Presence of school software technical assistance
5. Ratio of computers to students in the classroom
6. Number of Internet-accessible computers for students
7. Perceived technology support by principal (Chiero, 1997; Guha, 2000; Wenglinsky, 2002)

Additionally, this study aligned Atkins (1997) TTI-R with Welliver’s (1989) Instructional Transformation Model to provide professional development trainers with a tool to place teachers in one of five stages in the model. This model was selected because it specifically targets the implementation of technology by teachers (Wang, 2000). The TTI-R (1998) consists of 46 questions covering technology skills determined by the North Carolina Technology Competencies for Educators. Each of the questions was placed on a 5-point Likert scale ranging from "never use" to "use daily." Welliver’s Instructional Transformation Model is a technology use model that ranges from "familiarization," which describes when teachers are first introduced to technology, to "evolution," which occurs when teachers create classroom-specific applications for software. See chapter 3 for a discussion of Atkins, Viersen and Frink’s (1995) instrument and Welliver’s (1989) theoretical model.
Hypotheses

This quantitative study compared the relationship of the teacher’s level on Welliver’s Instructional Transformation Model with seven variables using the following null hypotheses.

1. There is no significant change in the mean score of an individual teacher’s use of technology in the classroom as measured by the TTI-R on Welliver’s Instructional Transformation Model.

2. There is no significant relationship between the teacher’s score on Welliver’s Instructional Transformation Model as measured by the TTI-R and:
   a. Years of teaching experience
   b. Level of education completed
   c. Hours of staff development in technology integration
   d. Presence of hardware technical assistance at their school
   e. Ratio of computers to students in the classroom
   f. Number of computers available for student use in the classroom that were connected to the Internet
   g. Teacher’s perceived support for technology by the school principal

3. There is no significant relationship between the teacher’s score on each stage of Welliver’s Instructional Transformation Model as measured by the TTI-R and:
   a. Years of teaching experience
   b. Level of education completed
   c. Hours of staff development in technology integration
   d. Presence of hardware technical assistance at their school
e. Ratio of computers to students in the classroom
f. Number of computers available for student use in the classroom that were connected to the Internet
g. Teacher’s perceived support for technology by the school principal

Significance of the Problem

Due to the growing demands on teachers to use technology in their classroom, there is a need to investigate strategies and factors that will enhance technology use by teachers. This study focuses on the change in practices of computer use by classroom teachers subsequent to a series of professional development activities. The findings from this study may assist professional development planners in preparing future professional development training activities. This study placed teachers on the Welliver’s *Instructional Transformation Model* according to their score on the *TTI-R*. The ability to place teachers on Welliver’s model prior to professional development activities may help the professional development planner to group teachers according to their stage on Welliver’s model for training and to prepare training sessions which focus on specific needs of the participating teachers. By aligning Atkins, Viersen and Frink’s (1995) *TTI-R* with Welliver’s (1989) *Instructional Transformation Model*, specific technical skills and pedagogical practices can be identified at each stage. Defining teachers’ technical and pedagogical competencies may enable the professional development planner to plan a program specific to meet the teachers’ needs.

A second benefit of aligning Atkins, Viersen and Frink’s (1995) *TTI-R* with Welliver’s (1989) *Instructional Transformation Model* is that it may provide a tool for raising the teachers’ awareness of their stage on Welliver’s *Instructional Transformation Model*. This awareness is intended to help them to focus their professional development
activities and to encourage reflection on current classroom practices. Ertmer (2003) found that skills training provided teachers the technical knowledge for integrating technology into their curriculum, but reflection on classroom practices provided the ability to sustain these changes in technology use. It is hoped that as teachers become more aware of practices that reflect technology integration they may be able to incorporate these practices into their daily curriculum.

This study added to the research base of change in technology use practices by teachers. The seven factors investigated added to the research on factors which influence change in teachers’ practices in technology use in the classroom. Further discussion may also be beneficial for researchers and professional development planners in evaluating teachers’ stages of technology integration. The ability of the professional development staff to tailor teacher professional development activities to a specific stage of the model has the potential to increase the efficiency of a training session, thereby increasing effectiveness while reducing costs.

Limitations of the Study

1. The convenience sample (n=40) used in this study is representative of the teachers in the population. However, self-selection by the participating teachers may indicate a strong interest in technology.

2. Due to the longitudinal nature of the study, the research for the study was gathered over a four-year period. The research completed during this period may be dated and not applicable with the rapid changes in technology integration.

3. The teachers’ access to technology resources within their individual schools may impact the amount of change in their classroom practices.
4. Professional development training received outside of this study may impact changes in teaching practices.

5. Since participants volunteered for the study, they may have a higher level of motivation to learn the technology integration than other teachers in their schools.

6. The subject to item ratio is less than 1:1. The small sample (n=40) for this study may produce errors in the alignment of the TTI-R with Welliver’s *Instructional Transformation Model*.

7. The statistical power of the factor analysis conducted in aligning the TTI-R with the model may be compromised because of the small sample and the small number of questions at the sub-scales on Welliver’s *Instructional Transformation Model*.

8. The changes in technology over the period of this study are not reflected in the TTI-R. This lack of representation of current technology used in the classroom may weaken the usability of the TTI-R as a tool for evaluating teacher’s technology use in the classroom.

**Assumptions**

1. Teachers responded honestly to questions about their current practices.

2. The panel of experts will confirm questions from the TTI-R on the stages of Welliver’s *Instructional Transformation Model*.

**Definition of Terms**

*Classroom Practices.* Activities aimed at transferring knowledge from one person to another that is performed by classroom teachers in educational situations.

*Evolution.* A stage on Welliver’s (1989) *Instructional Transformation Model* that occurs when technology-using teachers become aware of new technology and create ways to
incorporate it into the classroom. This is the last stage in Welliver’s *Instructional Transformation Model*.

**Familiarization.** A stage on Welliver’s *Instructional Transformation Model* that occurs when an individual is first exposed to a new technology. This is the first stage in Welliver’s *Instructional Transformation Model*.

**Integration.** A stage on Welliver’s *Instructional Transformation Model* that occurs when a teacher’s curricula require that technology be used in the classroom. This is the third stage in Welliver’s *Instructional Transformation Model*.

**Professional Development.** Activities that enhance a teacher’s subject knowledge and classroom teaching practices.

**Reorientation.** A stage on Welliver’s *Instructional Transformation Model* that occurs when a teacher organizes classroom activities around resources available through technology. This is the fourth stage in Welliver’s *Instructional Transformation Model*.

**Teaching with Technology Instrument.** A 46-item instrument created by Atkins, Viersen and Frink (1995) which determines what technology-based activities a teacher uses in conducting classroom activities. This instrument was revised by placing each item on a 5-point Likert scale. Initially, the response for each item was “Yes” or “No”.

**Technology.** The use and knowledge of computer software, hardware, and telecommunications including the Internet.

**Utilization.** A stage on Welliver’s *Instructional Transformation Model* that occurs when a teacher uses technology, but technology is not required as a part of the daily classroom activities. This is the second stage in Welliver’s *Instructional Transformation Model*. 
Chapter II: Literature Review

Introduction

The purpose of the literature review is to clarify and further explore the process teachers go through when they change classroom practices in using technology in their curriculum. The literature review for this study is organized into three sections. The first discusses current research on change models used to evaluate technology integration by teachers. The second section is a review of the current research on change in classroom teaching practices. The final section presents studies on the influence of institutional culture on change in the classroom.

Introduction to Technology Integration

Pre-school through college students in technology-rich environments exhibit increased academic achievement, positive attitudes toward learning and a higher self-concept (Hale, 2002; Sivin-Kachala, 1998; Wenglinsky, 2002). The educators’ role is central to the efficacy of technology in the classroom. Studies have investigated the changing role of classroom teachers—from "sage on a stage" to "guide on the side"—when technology is integrated into the curriculum (Brees, 2002; Knutel, 1998; Roberts, 2002). However, this transition has not been an easy one for teachers. Most of the early research focused on the teachers’ attitudes toward technology while current research instead considers their technology practices (Amenta-Shin, 2000; Puckett, 1997). This review discusses several prominent change models that are used to define the changing practices of teachers.
Change Models

Concerns-Based Adoption Model

As a conceptual framework, the Concerns-Based Adoption Model (CBAM) has been used for more than twenty-five years to describe, explain, and predict changes in teacher behavior when adopting an innovation. The three areas used in this framework are the Stages of Concern (SoC), Levels of Use (LoU) and the Innovation Components (IC) (Horsley & Loucks-Horsley, 1998). The SoC measures the level of concern an individual has for an innovation. Results show that an increased level of concern decreases the implementation of an innovation by teachers (Ansah & Johnson, 2003). In this model, individuals are placed at one of seven stages of concern about an innovation. These stages are determined by their response to an interview and observation process.

Unlike in the past, researchers now see change as an ongoing process rather than an individual event. The CBAM model stresses researching, planning, and managing innovation adoption in an organizational setting (Hall, 1974; Wesley & Franks, 1996). This model addresses three primary factors:

1. The individual’s level of usage (LoU)
2. The stages of their concern (SoC) for the innovation
3. How these factors impact the ability of the individual to work with others to implement the innovation (Hall, 1974).

Determining the LoU is necessary in order for the professional development program planner to be able to match the training to the user so that they can achieve the highest results. It is important for the program planner to know the individual's SoC because it allows
them to address the teachers’ concerns during the training, allowing them to move on to another task.

The CBAM is also an appropriate model for integration of the Internet in the curriculum because of the developmental framework it provides in technical and emotional areas (Lane, 2000). There have been more than fifty studies that have utilized CBAM, covering multiple innovations and disciplines (Shotsberger & Crawford, 1996).

In the original CBAM, there were seven Stages of Concern (SoC). These were:

1. Awareness (No concern for the innovation)
2. Information (A desire to know about the innovation)
3. Personal (Effect of using the innovation on the individual)
4. Management (Handling the time required when using the innovation)
5. Consequences (Effect of the innovation on outcomes)
6. Collaboration (Interest in relationship of personal use of innovation with others use of innovation)
7. Refocusing (Idea of new uses of innovation or new innovations (Hord, Rutherford, Huling-Austin, & Hall, 1987)

The SoC has recently been changed to a five-stage model. The stages omitted, Awareness and Refocusing were merged into the remaining five stages (Shotsberger & Crawford, 1996).

One of the basic assumptions of the CBAM is the developmental sequence to change (Hord, Rutherford, Huling-Austin, & Hall, 1987, pp 5-7). This developmental sequence is identified by seven levels in the Levels of Use (LoU) model. These levels are:

1. Non-use (No action is being taken with regard to innovation)
2. Orientation (Seeking information about the innovation)
3. Preparation (Making preparations to use the innovation)
4. Mechanical (Initial use of the innovation with user-oriented changes)
5. Routine (Established pattern of use of the innovation)
6. Collaborative (Sharing use of the innovation with other user’s in the environment)
7. Renewal (Locating effective alternatives to use of the innovation in the user’s environment) (Hord, Rutherford, Huling-Austin, & Hall, 1987)

An individual’s LoU is determined through interviews and observations. In the interviews, teachers describe the classroom activities that involve the innovation being studied. During their observations, the behavior of the teachers is recorded relative to how they incorporate the innovation into classroom practices.

The Innovation Components (IC) defines what the environment will look like once the innovation is fully integrated into the setting. This includes a description of the necessary materials and conditions that would be present when the innovation is in place.

Diffusion of Innovations

This model was developed by Rogers in 1983 and is comprised of five stages:

1. Knowledge (exposure to its existence, and understanding of its functions)
2. Persuasion (the forming of a favorable attitude to it)
3. Decision (commitment to its adoption)
4. Implementation (putting it to use)
5. Confirmation (reinforcement based on positive outcomes from it) (Rogers, 1983)

The model is concerned with the manner in which technology migrates from creation to use.

The Diffusion of Innovation first describes the process an innovation undergoes as it becomes
a part of the society and then further breaks the individuals in that society into five types according to how they respond to innovation. These are:

1. Innovators (venturesome)
2. Early adopters (respectable)
3. Early majority (deliberate)
4. Late majority (skeptical)
5. Laggards (traditional) (Clarke, 1994)

This theory recognizes the importance of the opinion leader, change agent and change aide in the adoption of an innovation. The opinion leader is typically someone outside of the organization who influences the adoption of the innovation. The change agent is someone inside the organization who coordinates the adoption of the innovation. The change aide is the primary individual who brings the change to the organization. Since DoI's theory is primarily concerned with describing the process of adoption of an innovation, it is does not explain or predict the impact of the adopted innovation.

*Apple Classroom of Tomorrow*

*Apple Classroom of Tomorrow (ACOT)*, a 10-year project that began in 1985 and was funded by Apple, Inc., studied the implementation of technology into the classroom. From the findings of this project, Sandholtz, Ringstaff, and Dwyer (1997) developed the *ACOT* model. This model supports the *CBAM* model, but goes one step further by incorporating the ways teachers think and act when integrating technology use in the classroom. The five stages in the *ACOT* model are:

1. Entry
2. Adoption
3. Adaptation
4. Appropriation
5. Innovation

The researchers found that as teachers moved through the model, their teaching style shifted toward a student-centered environment where interdisciplinary, individualized, and cooperative project-based learning activities were prevalent.

**Instructional Transformation Model**

Reiber and Welliver (1989) developed another change model, the *Instructional Transformation Model* in 1989. This five-stage model was developed from a study of technology adoption behaviors of teachers. It follows the premise that Rogers’ *CBAM* model of technology adoption is a developmental process. Three observations by Reiber and Welliver (1989) highlight the developmental nature of this model. These observations are

1. “In order for the full potential of educational technology to be realized, it must be viewed more as a process rather than just the implementation of educational tools” (p. 24)

2. “There seems to be an innate desire on the part of educators to believe that there will exist one day a delivery medium which will enhance instruction and create superior learning environments by its mere delivery qualities” (p. 25)

3. “It seems that when a new technology becomes available, the most natural thing to do at first is to apply old techniques and methods to it” (p. 27).

This model includes the “Level of Use” approach where each stage describes the ways a teacher uses the technology at that stage. These stages are:

1. Familiarization
2. Utilization
3. Integration
4. Reorientation
5. Evolution (Reiber & Welliver, 1989, p. 21)

As in the ACOT model, Welliver’s *Instructional Transformation Model* also presents the evolution of teachers' thought processes as they become more experienced with the use of technology as a tool in the classroom (from http://www.apple.com/education/planning/profdev/index4.html). Each stage of Welliver’s *Instructional Transformation Model* is described in two ways, first by the practices exhibited by the teacher, and second by what the teacher thinks about the technology. Below is a review of these five stages according to these criteria.

**Familiarization stage.** The familiarization stage occurs when a teacher first encounters technology. At this stage the teacher focuses on how to use the hardware and software involved with the technology. Hardware items may include things as basic as turning on the computer, connecting a printer to the computer, and generally preparing the computer for use as a tool. Software items may include how to open, save, and retrieve as well as manipulate the appearance of documents. As the teacher moves through the familiarization stage, experience is gained by using additional hardware such as cameras, scanners, and LCD projectors. Additionally, the teacher learns new software programs that are used in the classroom, including presentation, database and subject specific software.

Teachers in the familiarization stage think of the technology as another task to be completed as a part of their job. They perceive it as a tool that provides them new ways to accomplish routine tasks that takes more time to accomplish than they did before they began
using the technology. They also see the training required to learn these new skills as a drain on their schedule that does not produce immediate results in the classroom (Reiber & Welliver, 1989).

Utilization stage. The utilization stage is the second stage in Welliver’s *Instructional Transformation Model*. The developmental activities exhibited by teachers in this stage are similar to the Adoption stage of the *ACOT* model. During this stage, teachers begin to apply technical skills to some of their current practices. Examples of teacher activities in this stage include maintaining a computerized grade book, using word processing for notes sent to parents, and creating class worksheets. Students of teachers in the utilization stage may use subject-focused computer games to reinforce learning. The key to this stage is the expendability of technology. If the technology does not work, the teacher can continue with the lesson or activity without it.

As teachers become more experienced with using technology, their comfort level increases and they begin to realize the added efficiency that it provides. Technologies serve as supplemental tools for student activities but are not the central focus of the lesson. Teachers at the utilization stage frequently have students use subject-specific software to reinforce concepts learned during class. They supplement their lessons by using the Internet for further research. During professional development, teachers in this stage focus on instructional strategies rather than on basic skills.

Integration stage. The integration stage is where teachers begin to see the impact technology has on student learning. Experiments such as letting students make small decisions regarding lessons and final products are a central part of teacher activities at this stage. Teachers move toward using project-based activities that require students to access the
Internet to complete assignments, while guiding the activities by specifying the resources and Internet sites that may be used. Teachers at the integration stage start to appreciate the diversity of activities available through the use of the Internet.

During the integration stage, the teacher moves from the role of instructor to co-learner. Students also take on different roles, such as that of a technical assistant for the class. Teachers in this stage are more likely to collaborate with colleagues for student projects while still using textbooks as a guide for instructional topics. Teachers are sold on the value technology adds to the classroom and find that technology is a required tool in their instruction.

Reorientation stage. The reorientation stage is where teachers view learners and learning tasks in new ways. The classroom physical layout is not directed toward a central point for lecture purposes but into a series of sections designed to support group work by students. Students direct their learning path and control lesson goals and final products. Teachers move from planning and presenting lessons to co-planning them with students and guiding them to identify and accomplish goals. This new role involves collaboration not only with colleagues, but also with other stakeholders in the educational process, including the community, parents, and school administrators. Support from the school administration is necessary because classes led by teachers in the reorientation stage do not at first glance appear to be productive. This is because the classroom is noisy and appears to be disjointed when compared to traditional classrooms.

Teachers in the reorientation stage see technology as a necessary part of the classroom and students as central to defining the role of technology in it. The teacher values increased classroom participation and critical thinking by students. The teacher in this stage
serves as a technology leader in their school and encourages administrators to support technology through incentives such as additional planning time, training and technical support.

*Evolution stage.* The evolution stage, the fifth and final stage of the *Instructional Transformation Model*, is critical because of the fast-changing nature of technology. This is important because teachers begin to transform technology, finding solutions in diverse and unlikely places. As teachers look to use technology in new ways, collaboration with educators outside of their immediate school or district becomes an important tool.

Teachers also take a larger, more assertive role in incorporating new technologies in the educational setting, serving as technology advocates to their colleagues. Additional roles within their schools or districts may include technology peer coaches and mentors. School administrators also look to teachers in the evolution stage as advocates for creating and spreading the technology vision within the school system.

A key component for each stage in the model is that teachers must have time to explore, reflect, collaborate, and apply technology tools learned to subject specific activities (Sandholtz, Ringstaff, & Dwyer, 1997). According to Hooper and Reiber (1995), it is important that teachers focus on the pedagogy rather than the technology innovation. They addressed this issue in redefining the *Instructional Transformation Model* to allow for maturity in a teachers’ pedagogical use of computers. Their redefinition of the model maintained the same stages but placed more emphasis on the activities performed by the teacher at each stage. As an example, they discovered that there must be on-going support for teachers to progress beyond the utilization stage (Hooper & Reiber, 1995, p. 158).
Additionally, they learned that teachers who progress to the integration stage often still do not adopt the constructivist pedagogical practices that exist in a technology-rich classroom.

Reiber and Welliver (1989) developed the *Levels of Computer Use (LCU)* questionnaire that is used with the *Instructional Transformation Model*. This instrument measures teacher computer usage in the classroom by placing them in one of five stages in the *Instructional Transformational Model*. Reiber and Welliver found the *LCU* ineffective because the items on the *LCU* did not establish unique activities for each of the stages and were only able to differentiate between the utilization and integration stage. The *LCU* questionnaire used Nunnally’s paired-comparisons technique to establish the reliability of the *LCU* in determining the difference between the utilization and integration stage. In the utilization stage, teachers are able to continue with a lesson if the technology fails because the technology is supplemental to the lesson. Teachers in the integration stage are not able to continue with the lesson without the technology because it is an integral part of the lesson. The key criterion is that at this level, according to Reiber and Welliver (1989), “the computer technology cannot be taken away without disrupting the educational process” (p. 28).

Marcinkiewicz and Welliver (1993) used the *LCU* with 170 elementary teachers to determine their level of computer usage between the utilization and integration stages. Their results show the instrument to be highly reliable in placing teachers into one of these two stages. Marcinkiewicz (1994) suggested, “the adoption of computer use may occur incrementally or hierarchically as described by instructional transformation” (Marcinkiewicz, 1994, p. 232). This supported the premise that the *LCU* validated the developmental and hierarchical stages of the adoption of computer usage by teachers.
Wang (2000) used the *Instructional Transformation Model* with action research in conducting technology-focused professional development. The first three stages of the model—familiarization, utilization, and integration—formed the conceptual framework for a one-year professional development program at an elementary school in Guam. Wang (2000) designed the training to take the teachers from the familiarization to the integration stage after one year of training with specific activities taught during each stage. While other researchers found that the integration process typically took longer than a year, Wang (2000) found evidence of integration in classrooms after only one year and cited quality professional development as the reason for the quick integration.

*Classroom Teaching Practices*

There is a rich collection of literature on the change process for teaching practices. Most relate that changing teaching practices is a slow and difficult process (Amenta-Shin, 2000; Bossert, 2001, Sheingold & Hadley, 1990). Historically, most classrooms have been teacher-centered where information was delivered to students. Research has shown that teachers who have fully integrated technology into their classroom have student-centered classrooms where students decide which material to use to complete assignments (Hale, 2002; Sandholtz, Ringstaff, & Dwyer, 1997). Whether a classroom is student-centered or teacher-centered is determined by the teacher’s pedagogical beliefs.

Cheney-Cullen and Duffy (1998) investigated six math teachers to find factors that change their pedagogical beliefs. The teachers in this study participated in a site-based program to encourage the integration of technology into mathematics. One of the major influencing factors was peer support during the change process. Researchers reported that change in behavior was easy to measure while change in belief was more difficult to
document, as it occurred gradually. Positive student response encouraged change in practices by the teachers. Ongoing site-based support was found to be a significant factor in facilitating change in classroom practices. Even though teachers were motivated to change, change did not occur because teachers only partially incorporated student-centered activities into their teacher-centered classrooms.

Pierson (2001) investigated sixteen elementary school teachers who were selected by their principal as the strongest technology users in the school. After a three- to six-hour observation of each teacher, the researcher selected three teachers who demonstrated the highest teaching and technology skills for further study. Pierson (2001) discovered that the operational definition of technology integration in the literature is very different from the understood definition by the educators in the study. According to Pierson (2001), the literature defines “exemplary technology-using teachers” (p. 427) as those that use “student-centered learning, viewing computers in terms of function, and using project-based activities” (p. 427). The vagueness of this definition of technology integration made it is difficult for teachers to determine their level of integration. Pierson (2001) recommended defining technology integration within each school system using national standards and research models.

Ross, Hogaboam-Gray, and McDougall (2002) investigated three elementary school teachers for their implementation of technology in mathematics reform. These teachers were recognized as strong technology users in their respective schools and were highly motivated to integrate technology into the math curriculum. Ross, et al. (2002) found that all three teachers had created mathematical communities within their schools. Their efforts also resulted in increased student-to-student interaction within the classrooms. However, Ross, et
al. (2002) also discovered that these teachers were hindered by hardware problems, such as computer crashes and school network inaccessibility. Additional problems included software difficulties and inability to have whole class activities because of the poor quality of the audiovisual equipment. These factors reduced the computer’s effectiveness as an instructional tool and, as Ross, et al. (2002) describe, “none of the teachers studied realized the potential of the computer to support student to student constructions” (p. 98). As a result, teachers prepared non-technology based materials in anticipation that the technology would likely fail. According to Ross, et al. (2002) the teachers were encouraged by the technology to continue using the mathematics reform because it matched their pedagogical beliefs.

Suh (February 23, 2004, from http://203.246.105.157/upload/eti/3-1/ssuh.pdf) investigated the relationship between four predictor variables of technology use and a college faculty’s usage of web-based instruction. These variables were:

1. Relative advantage
2. Compatibility
3. Subjective norm
4. Environmental support

Suh developed a *Levels of Web Usage (LoWU)* model following Reiber and Welliver’s *Instructional Transformation Model* and investigated these variables’ ability to predict a faculty member’s placement on the *LoWU* model. In this study, sixty-two randomly selected faculty members at Florida State University who had experience with web-based instruction completed a forty-item survey. Suh’s findings supported Reiber and Welliver’s (1989) conclusions that there were more teachers at the utilization stage than at the integration stage. Additionally, the subjective norm (the expectation by others) and relative
advantage (the individuals’ perception of the value of the technology) were positive predictors of computer usage by faculty members.

According to Cradler (2002), when teachers are included in the school- and district-based planning activities, they are better able to understand their role in integrating technology into the classroom. Not including the teachers in the collaboration process often resulted in teachers failing to use the technology skills learned during professional development activities. Cradler’s (2002) recommendations included:

1. A stronger emphasis on planning
2. Involving all of the stakeholders
3. Using current resources
4. Ensuring that the curriculum is driving the technology, not the technology driving the curriculum.

Technology makes learning more effective for students and instruction more efficient for teachers (Colon & Simpson, 2003; Cradler, 2002; Lamb, 2003). As teachers use technology to enhance their instruction, students develop into learners who now know where to find the answers rather than just ‘know’ the answers. Besalel (2004) also found that teachers who use computers for administrative tasks become more comfortable with technology.

Westhoff (2003) interviewed 138 K-16 teachers in public school, community college and university settings regarding their pedagogical practices in the distributed learning environment. Westhoff found that teachers in the K-12 public school setting were adapting their practices to integrate technology better than post-secondary teachers.
Amenta-Shin (2000) evaluated teachers from five schools who were participating in a professional development program to determine their perception of their instructional practices and use of technology in the classroom. During the program, teachers created technology-rich units for their classrooms. Upon returning to their schools, several reported a reduction in district-level technology support, which discouraged the use of the technology-rich units. The five most reported areas that impacted the teachers’ use of technology in the classroom were:

1. Administrative support
2. Access to resources, including equipment
3. Connectivity and software
4. Opportunities to collaborate with colleagues
5. Time to plan, collaborate and learn

However, during the next two years, Mouza found improvement in the integration of technology in the classroom. In one study, Mouza (2002) interviewed eight elementary teachers regarding their knowledge, practices and beliefs about technology. Findings indicated that as teachers increased their technology competency, they also increased their understanding of using technology in the classroom. Teachers who saw the positive impact of technology-rich lessons on student interest and learning changed their beliefs about the value of technology in the classroom. Mouza (2002) concluded that a teacher's change in practices brought about a change in beliefs. This is contrary to the conclusions of many of the early change research studies that thought individual beliefs about the value of an innovation had to be addressed before adopting the innovation (Messmer, 1996; Rogers, 1995).
Oliver (2003) used the CBAM’s Stages of Concern Questionnaire to gather quantitative data from elementary school teachers about their concerns for technology use in the classroom. Findings revealed that the concerns about technology were similar across all seven CBAM’s stages. Oliver found that teachers with more experience had less concerns at the Informational, Management, and Refocusing stages, the last three in the CBAM.

Baylor and Ritchie (2002) studied the actions taken by school districts that led to technology integration into classrooms. They did this in an attempt to discern patterns supportive of technology integration. The researchers used interviews with administrators and teachers, surveys of teachers and reviewed the district’s technology plan. The seven factors considered were:

1. Planning
2. Leadership
3. Curriculum alignment
4. Professional development
5. Technology use
6. Teacher openness to change
7. Teacher non-school computer use

School districts with technology plans that included a blueprint for change as well as the supporting philosophy and details on how the plan would improve learning were the most successful at technology integration. The two variables that predicted positive technology integration by teachers were openness to change and the percentage of technology activities. In addition, student-centered classrooms and the degree of teacher openness to change positively impacted students’ higher order thinking skills (Wenglinsky, 2002).
Mills and Tincher (2003) conducted a professional development program that prepared teachers to change their technology use in classroom practices. In this study, they investigated teachers’ abilities to use what they learned during professional development programs when integrating technology into their curriculum. They proposed that teachers go through stages in using technology, just as individuals go through stages in becoming an expert in any field. These stages were:

1. Novice technology operators
2. Technology facilitators
3. Expert technology integrators

Knowledge and skills were identified for each of the proposed stages of technology integration in order to measure a teacher’s progress toward becoming an expert technology integrator. Mills and Tincher (2003) found at the beginning of the study that teachers used computers extensively in preparation for teaching but not in the actual conduct of teaching. However, when specific technology integration practices were introduced, teachers began to meet these expectations.

Integration in Curriculum

The goal of technology integration is to teach students how to use technology to learn rather than to just use computers (Tapscott, 1999). As Muir (1994) argues, “learning to use the computer is only a secondary objective” (p. 30). When true integration occurs, the traditional disciplinary boundaries are significantly blurred or even lost (Lederman & Niess, 1998).

Teachers and students are “intrigued with technology and are willing to make an investment in their own development” (Thurlow, 1999, p. 9). Research shows that helping
teachers learn how to integrate technology into their math curriculum is a critical factor for the successful implementation of technology in schools (U. S. Congressional Office of Technology Assessment, 1995).

Research has shown that faculties are generally content with their methods of instruction (Mueller, 1999; Rogers, 1999; Wesley & Franks, 1996). One way to help teachers learn how to integrate technology into their content is by showing them how other teachers are using the Internet in their classrooms. This stimulates teachers to think of ways to incorporate Internet activities into their curriculum (Land, 1997). Mueller (1999) states that it is important to make sure faculty members are aware of the possibilities of technology integration before teaching them the technology. This is supported by the CBAM and Instructional Transformation Model discussed earlier.

As a teacher integrates technology into the classroom, the focus should be on the content area being studied rather than on the technology (Land, 1997; Wiburg, 1997). When meaningful curricular integration of technology occurs, teachers and students begin to use the computer to foster higher-level thinking skills (Means & Olson, 1994; Papert, 1993; Zeon, et al., 1999).

According to Peck & Dorricott (1994) the potential of the computer is lost if educators only use the computer to do the same things they were doing previously. Means & Olson (1995) assert that the best use of the computer is as a resource for information, communication and self-directed learning. Teachers who successfully integrated technology into their classrooms expand their classroom activities to include these areas (Lamb, 2003).

Historically, the traditional format for teaching has been linear, with the teacher presenting the material in an orderly fashion. The computer, however, encourages and
affords a “non-linear way of processing information” (Tapscott, 1999, p. 9). As such, it can accommodate a number of different capabilities and learning styles. Teachers and students are able to focus on the collection and analysis of data rather than on memorizing information (Land, 1997; Peck & Dorricott, 1994). Technology integration affects the teaching methods and relational roles of teachers and students (Wesley & Franks, 1996). The classroom shifts from being teacher-centered to student-centered (Peck & Dorricott, 1994; Rehmel, 1998; Tapscott, 1999).

In a student-centered classroom, teachers are still responsible for creating a focus and structure for students (Tapscott, 1999). Students in a student-centered classroom, in turn, learn how to navigate within that structure following the focus of the teacher (Tapscott, 1999). The Internet allows students to design their own path to gain desired knowledge. The teachers’ role changes to that of a facilitator of the learning process as well as a technical consultant (Means & Olson, 1994; Tapscott, 1999).

Factors Affecting Change

Goldenberg (2004) surveyed 357 K-12 teachers participating in the Adventure of the American Mind program, a grant from the Library of Congress. This program trained K-16 teachers to integrate technology into their curriculum through participation in a one-year program at one of the ten colleges participating in the grant. This research revealed that although teachers were using technology in their classroom the definition of “using” varied greatly from teacher to teacher. Four factors influenced technology “use” by teachers:

1. Subject taught
2. Grade level
3. Program emphasis
4. Readiness of teacher to connect three knowledge domains: technology, primary sources, and pedagogy (p. 53)

Bianchi (1996) surveyed eighty teachers selected through a random sampling of 132 elementary, middle and high school teachers to determine motivating factors for technology use. The researcher found three primary reasons that teachers wanted to use technology. These were:

1. To increase students’ interest in a subject
2. A personal interest in technology
3. A desire to improve teaching skills

Professional development, grade level taught, and experience were not found to be motivating factors. Ali (2003) reported that limited technology support, weak technology skills, and the change in teaching role as some of the primary barriers preventing technology use in the classroom by teachers. Ballard (2000) also found that teachers who lacked confidence in their technical skills to appropriately use technology in the classroom were themselves a barrier in the integration of technology.

Stein, McRobbie, and Ginns (2002) observed during an academic year the classroom practices of three experienced elementary school teachers who were using technology in their classroom for the first time. The researchers found that the limitations of these teachers’ conceptual and procedural knowledge of design and technology influenced their early experiences. The knowledge gained by these teachers during technology-based activities when supporting their students’ educational goals was measured by standardized tests. During the study only a small amount of change was noted in the teachers’ classroom practices. Stein, et al. (2002) recommended:
1. Assisting teachers in gaining confidence in their technology abilities
2. Training to establish a balance between the constructive teaching style and individual teaching style
3. Providing a teaching strategies database for teachers to use when creating technology-based projects

Cheney-Cullen and Duffy (1998) found administrative support to be a key factor in impacting change in teaching practices. Administrators in their study provided release time to investigate different teaching styles and reflect on their own practices.

**Barriers.** Tapscott (1999) reminds us that “the ultimate interactive learning environment is the Internet itself” (p. 9). Its capacity to be interactive, however, is one of the barriers because the Internet has no controls and many educators shy from the responsibility of monitoring their students’ web activities. While filtering programs have been added to overcome these problems, they in turn create additional problems, including sluggish performance and the filtering out of legitimate inquiry.

A second barrier is the “current atmosphere of financial cutbacks, low teacher morale, increased workloads, and reduced retraining budgets” (Tapscott, 1999, p. 11). While “businesses have been building electronic highways, education has been creating an electronic dirt road” (Peck & Dorricott, 1994, p. 11). Although the connectivity of schools to the Internet has improved greatly in many educational settings, lack of money allocated to training has continued to hamper the integration of technology into the classroom. Nevertheless, Internet connectivity in the classroom has grown from 77 percent in 2000 to 92 percent in 2002 (National Center for Education Statistics, 2003).
Teachers cited that the lack of time to plan and implement the resources available through the Internet was their main concern (Hubbard, 1998; Rogers, 1999; Schnackenberg, 1999; Thurlow, 1999; Wiburg, 1997). In addition to the time needed to plan, time is also needed for technology training. The Educational Testing Service (1997) reported that only 15 percent of teachers nationwide had received more than nine hours of training in educational technology. This same survey cited that nationally, public school districts spend approximately 15 percent of their technology budget on staff development (Coley, Cradler, & Engel, 1997). This is contrary to the U. S. Department of Education recommendation that school districts allocate 30 percent of their technology budget on staff development.

There is a strong correlation between the computer expertise of teachers and the value they place on including Internet activities in the curriculum (Becker, 1999). Studies have found that teachers who have Internet access at home are much more likely to integrate technology into their curriculum. “In terms of a teacher’s own professional Internet use, having a modem at home may be almost as important for teachers as having one in their classroom” (Becker, 1999, p. 9). Becker (1999) found that only 24 percent of teachers had a modem at home in 1998. At that same time, 90 percent of schools had Internet access, but only 39 percent of teachers had Internet access in their classrooms (Becker, 1999).

A third barrier is the sociocultural factors such as economics and geographic location (Bereiter, 1994) especially in rural areas where incomes typically are low and Internet connectivity is limited. This digital divide is further exacerbated in areas where education is not valued or considered essential to future employment. Pearson and Swain (2001) reported that student access to computers in schools is narrowing the digital divide. However, three
areas that also impact this divide are frequency of use, computer experience of students and technology training of teachers.

A fourth barrier is the personological factors such as age, gender, attitudes, and teaching philosophy (Marcinkiewicz & Grabowski, 1992). Recent findings have found that younger teachers have a higher usage rate of the Internet in their classes. This usage rate is expected to change as more staff development becomes available.

Full integration of the Internet in student-centered classrooms requires teachers to embrace the constructivist philosophy of education where learning occurs by doing rather than by simply listening (Tapscott, 1999; Peck & Dorricott, 1994; Novick & Grimstad, 1999; Wiburg, 1997). As a result, students participate in the planning of the curriculum to best utilize the Internet.

**Institutional support.** Sandholtz, Ringstaff and Dwyer (1997) found a supportive environmental culture as a necessary component in supporting teachers as they moved through the ACOT model. At each stage, teachers needed different forms of support from their colleagues. Teachers at the Entry stage only needed emotional support. While this need for emotional support continued throughout the model, later stages required additional support in the areas of technical assistance, instructional sharing and collaboration.

Technical assistance included professional development training as well as onsite hardware and software support. As teachers entered the Adaptation stage, they needed additional time to share their instructional success or failure stories with their colleagues. As teachers began to adapt their classrooms to integrate technology, the opportunity for collaboration with other teachers about instructional ideas and techniques became a necessary component.
Borrell (1992) and Piller (1992) discuss situations where classrooms have computers, but teachers do not have the training to use them. Administrators must be willing to provide the opportunity for teachers to develop adequate computer skills related to the content of their curriculum. “Many in-service models focus on equipping teachers with basic skills such as using hardware and productivity software rather than curriculum-based applications and strategies for integrating them in their instructional activities” (Benson, 1997, p. 18). Hurst (1994) frequently found that in-service technology training had a positive impact on technology integration but was too short in duration. “Appropriate training in the use of the Internet is critical. The trainer should be an individual who is skilled in the use of the Internet in teaching” (Land, 1997, p. 63).

A third aspect of institutional support is the quality of the support (Rogers, 1999). If a teacher does not have timely technical support, the likelihood of technology integration decreases. Since teachers place the goals of teaching and learning first (Rogers, 1999), if the technology becomes unreliable it will not be used.

**Institutional culture.** Sergiovanni (2000) describes culture as the “normative glue that holds a particular school together. With shared visions, values, and beliefs at its heart, culture serves as a compass setting, steering people in a common direction” (p. 1). Technology adoption models have historically focused on individual teacher change rather than on organizational change. As the research matured, it has become evident that variables within organizations have a greater impact on technology integration by teachers than was originally anticipated. These variables include:

1. Vision
2. Systemic change
3. Impact on student learning

According to Preskill and Torres (1999), an individual’s mental model is a set of opinions, perceptions and views of the world that guides their daily life. For change to occur, individuals must revise their mental model. These shared mental models define an organization’s culture and policies. The organization’s culture changes as individuals within that organization change their mental models. For these changes to be sustained, the organization’s stakeholders must also support the change. Recognition and discussion of existing individual and organizational mental models are the first steps in changing them (Senge, et al., 1994).

Institutional Vision

Vision is an important element of technology integration because it forecasts the direction that teachers and administrators will go as they plan for the future. Research has shown several key areas relative to the development of a technology vision for a school. These are:

1. Collaborative school culture
2. Attributes of administrators
3. Essential conditions for sustaining technology
4. Beliefs versus practices

A brief description of the research identifying these key areas follows.

Collaborative School Culture

Bober (2002) states that school policies are the result of interaction between politics, pedagogy, and values of that community. Research on the plurality of various groups found within a school or district allows us to better understand how change is sustained in a
complex school system. However, since schools are part of a larger social system with competing demands, many of the changes are outside of their control. As a result, technology integration remains challenging (http://www.eschoolnews.com/news/showStory.cfm?ArticleID=4177).

There is no set formula for building a learning community. Even so, there are four conditions present when learning communities are forming. These are “trust, shared ownership, learning together, and reciprocal support” (Higgins, 1999, p 218). Dixon (2000) states, however, this only happens in organizations with non-competitive cultures.

*Attributes of Administrators*

Through interviews with administrators and teachers, Baylor and Ritchie (2002) found that strong technology leadership positively impacted student learning. They also discovered that exceptional leaders served as role models for their schools while additionally reinforcing technology use by teachers through incentives, recognition and a focus on professional development. Both internal supports and external opportunities played a role in creating incentives for continuous professional growth.

Duffield, et al. (2004) researched five first-year middle and high school teachers as well as their principals. Duffield, et al. (2004) used the ACOT model to investigate the characteristics of principals that supported technology integration by teachers. The five teachers were placed on the model using questions on technology access, student-centered learning, and assessment from Kelly and McAnear’s (2002) ten essential conditions for sustained technology use in the classroom. One of the teachers was placed on the Adoption stage; two were placed on the Adaptation stage, and the remaining two on the Appropriation stage.
Duffield, et al. (2004) determined that only three of the five teachers’ principals had characteristics that supported technology integration by teachers. These characteristics included the principals’ value of new ideas, vision of technology use in the classroom, and use of technology in the classroom as a teacher evaluation standard.

Research has determined that principals alone do not provide the leadership necessary for technology integration within a school (The Teaching Commission, 2004; Jenkins, Zimmerman, & Jenkins, 2004; Jilks, 2004). A new concept, “parallel leadership,” has recently been observed. In this concept, teachers and other school staff serve as technology leaders by supplementing and enhancing the technology vision of the principal (Andrews & Crowther, 2002).

Osborne, et al. (2004) discovered that leadership affected the social dynamics and processes in a school. This was especially true in integrating instructional technology in innovative and supportive ways. A critical element of this was getting early acceptance of the technological changes by faculty and staff. Osborne, et al. (2004) also discovered that leadership style was important to the implementation of the changes. These changes would not only alter the life of the school, but also the lives of those who are part of the school.

Kelly and McAnear (2002) cite ten essential conditions for sustained technology use. These are

1. Shared vision
2. Technical assistance
3. Skilled educators
4. Professional development
5. Access
Of the ten conditions, Duffield, et al. (2004) felt four of these conditions were essential to the success of the five teachers in the study. These were shared vision, technical assistance, skilled educators and professional development. Duffield, et al. (2004) considered that access, content standards and curriculum resources and support policies were desirable conditions but not essential. Student-centered teaching was conducted by the teachers but not perceived as an essential component to the success of technology integration. Additionally, assessment and community support were not perceived as essential.

Beliefs versus Practices

Brown and Campbell (2002) cite the common perception of a “culture of technology” and how this culture affects the development of technology fluency. According to the authors, presenting access to technology does not acculturate an individual into the culture of technology but it is a first step. The identification of technology as a culture provides educators with a basis for discussion on the challenges of integrating technology into the curriculum. There are two perceptions of the culture of computing, that of inclusion, where anyone can be fluent and exclusion, where only technophiles can be fluent. This range of perceptions exemplifies the cultural boundaries in the K-12 setting (Brown & Campbell, 2002).
Stigler and Hiebert (1999) found that part of the difficulty in changing teaching practices come from the deep cultural roots of teaching. They felt that the art of teaching is largely learned through observation over a lifetime, beginning in childhood and continuing into adulthood. Individual teaching styles are developed from these observations and adapted to accommodate a teacher’s personality, school environment, and student needs.

Franklin (2004) surveyed 121 teachers who had recently graduated from college to determine how and when they used technology in their classrooms. Significant factors in determining technology use by these teachers were their educational philosophy of how people learn and the teachers’ content knowledge. In addition, leadership, access and availability, incentives, personnel support, and external constraints were variables that enhanced technology use. Most of the teachers in this study had a personal vision of technology integration but were not able to practice their vision because of external constraints such as the demands of their curriculum, daily schedule, and testing standards. A majority of the classrooms of these teachers were teacher-centered classrooms that did not support the Kelly and McAnear’s (2002) ten essential components of technology integration.

Levin and Wadmany (2004) investigated the educational beliefs, practices, and knowledge restructuring of six elementary school teachers in a 3-year case study. These teachers’ practices were placed in one of three patterns by measuring their flexibility in planning and presenting lessons, the amount of student interaction in the learning activities, and the diversity of their practices. The three patterns were partial change, significant change, and striking change. Levin and Wadmany (2004) found significant changes in the teachers’ practices, even though some teachers were not able to articulate their belief changes.
Some researchers view teachers as objects that can easily be molded to conform to recommended practices for technology integration. Heinich, et al. (1999) considered instructional practices created to utilize technology in classroom practices as soft technologies. As teachers integrate these soft technologies into their classroom, they create new classroom practices by combining their pedagogical beliefs and experiences to meet the needs, limitations, and issues-at-hand in the classroom. Squire, et al. (2003) found the classroom culture, “which is a culture nested with the broader school culture” (as cited in Banathy, 1991) remained stable even as new practices were implemented by teachers.

*Systemic change.* Throughout the study of technology integration in the classroom, researchers (Steelman, Vasu, & Foley, 2004) have moved from a focus on training the teacher to equipping the school and now to a focus on system-wide changes to support sustained technology use by teachers. Systemic change models such as the IMPACT model of technology integration address system components including teaching and learning, information access and delivery, program administration, and system-level leadership and support with indicators in each area to guide implementation. Collaboration, vision, and use of resources are central to the IMPACT model of technology integration.

Systemic change is difficult because of the fluidity of the implementation period, the continual changing leadership within the school system, and the need to measure progress (Grundy, 2002). According to Higdon (2003), during the implementation of an innovation, it is important to listen to the critics within an organization because they provide good feedback which is helpful in making mid-stream corrections. These mid-stream corrections however, are problematic, as noted by Grundy (2002), who felt they should be guided by an overarching framework for implementing the innovation.
Limited Budgets to Support Technology Personnel and Resources

Weatherholtz (2003) investigated postgraduate in-service teachers’ use of technology in the classroom. In this study, the teachers’ reported access to the technology was not supportive of technology integration into the classroom. This access is determined by the culture of the school and district.

According to Cradler and Bridgforth (2002), copy machines are the technology that has impacted the classroom the most, yet some teachers’ report their copy machine use is restricted by school administrators. This limited access to such a basic technology is an example of limited institutional support of technology use.

Evaluation and Assessment Policies

Cradler and Bridgforth (2002) found that an institution’s evaluation and assessment policies affected technology use by teachers. These policies included having a vision as well as a plan that uses technology to meet goals and staff development designed to directly support implementation of the school and classroom level plan.

Barton (2001) reports that many states have not developed standardized tests that measure the impact of technology integration on student learning. This has resulted in teachers placing more emphasis on preparing students for standardized tests rather than on technology integration. State level educational departments also need to systematically change the required curriculum to connect the “content standards, curriculum, technology and tests” (Barton, 2001, p. 28).

Fullan (1999) provides three reasons that innovations are not readily integrated into the educational system. First, many of the requirements of the innovation in practice are a part of tacit knowledge and the proponent of the innovation is often not aware of the
implications of the innovation. Second, the cultural conditions of the organization directly impact the success or failure of the innovation. Replicating the innovation is much easier than replicating the cultural conditions that made it successful. Third, the demands on limited resources created by several innovations occurring simultaneously, reduce the effectiveness of each innovation. This is exhibited in the conflict whereby teachers prepare their students for “end-of-year” tests while concurrently integrating technology into their curriculum. The students’ skills gained while using technology are not, however, measured by the “end-of-year” tests.

**Norms**

Chiero (1997) cites group norms as one factor that impacts computer usage by teachers. “For most innovations it is an S-shaped curve indicating that even successful innovations start out slowly and don't become widely adopted until a critical mass develops” (Surry, 2002). Researchers have discovered that stakeholders within the school will only take personal ownership in adopting technology in the classroom when they recognize the need for it to bring about change (Seels, et al., 2003).

According to Grundy (2002), the constant changing of leadership within the school is a factor in preventing systemic change. Research has shown change that is mandated by an administration is not sustainable (Becker & Ravitz, 2001). This is particularly important in the K-12 sector where the average tenure of the administrative staff is significantly less than the teaching staff.

Another area that makes systemic change difficult is the need for the stakeholders to see measurable progress (Grundy, 2002). According to Higdon (2002), cultural change takes place over an extended period of time and placing unreasonable timetables on the change
process is counterproductive. Additionally, changing teaching practices to integrate technology is a slow process because the change has to occur at many levels, including curriculum, state mandated standards, facilities, and funding supporting teachers’ change in pedagogy.

Wilson and Notar (2003) surveyed 118 teachers who had participated in multiple technology-based professional development programs. The survey revealed that the teachers’ primary use of computers was administrative with limited use for instruction and no embedding of student computer usage in their teaching practices. This was reflected by the requirement of the administration to submit grades electronically yet not requiring the application of technology into classroom instruction.

**Impact on student learning.** Two general areas within a school’s culture, the quality and substance of professional development efforts, have the greatest impact on student learning and teacher motivation. Professional development is reflective of a school’s culture in that key people in those organizations have a strong influence on what course or subject areas are to be taught. In making these choices, key planners have to be attuned to which classes would best motivate teachers to incorporate the technology into their classroom. Combining a positive school culture with targeted professional development results in a technology-rich environment for students (Morote, 2004; Seels, et al., 2003).

**Professional Development for Pedagogical Applications of Technology**

McEuen (2001) defines technology fluency as “convergence of information literacy, critical thinking skills, and computer literacy” (p. 9). This definition cites the importance of a teachers’ knowledge of available resources as well as applying those resources in the classroom. According to Barton (2001), computers without adequate software for classroom
instruction are “dumb machines” which don’t have the capacity to impact student learning. Teachers need to be aware of the appropriate software for their curriculum. This awareness often comes from professional development that focuses on curriculum needs.

Motivational Factors for Teachers to Integrate Technology

Sarason (1990, 1996) as cited in Franke, et al. (2001) states that a collaborative school culture is central to teacher change. Pugh and Zhao (2003) investigated the empowerment of twelve teachers’ use of technology when supported by a grant that provided monetary, technical, and personal support. These teachers were selected from 118 teachers participating in the grant through stratified sampling using “geographic location, grade level, subject matter, and school type (urban, suburban, rural)”. According to Pugh & Zhao, belief in equality is central to most school cultures. Pugh & Zhao (2003) found that “technology, like salary, is a concrete resource which easily differentiates teachers into the haves and have-nots” (p. 196). This grant provided technology for the haves, which alienated three of the ten teachers investigated from the have-nots because of this change in equality. The alienation experienced by these teachers was from peers as well as administrators.

Recent research has determined that an introductory instructional technology course can dramatically increase the use of technology in the classroom (Morote, 2004). In this study, twenty-seven teachers’ perceived motivation to use technology was measured through a pretest and posttest survey. During the course, the participants’ technology use changed from a pretest level of eighty-five percent not using technology to a posttest level of seventy percent using technology on a weekly basis. While these results demonstrate remarkable improvement, teachers still found frustration in two areas: lack of resources and lack of technology support.
Seels, et al. (2003) has shown that online learning environments positively impact the motivation of teachers to voluntarily participate in “communities of practice”. Teachers gain personal and instructional benefits from participation in these online communities. Those in negative school environments gain personal benefits, such as opportunities to share, reflect, and investigate current or future classroom practices with other professionals. Teachers in positive school environments, on the other hand, already have these needs met within their school and therefore focus on instructional benefits.

Duffield, et al. (2004) found that teachers who had a vision of how technology would help their students learn were motivated to dedicate time to integrate technology into the classroom. This occurred whether the vision was a school-wide vision or a personal vision. Albion and Ertmer (2002) determined that shared vision is an essential condition for technology integration.

**Conclusion**

A review of the literature regarding the integration of technology into the classroom indicates a need for an overarching model that will assist the professional development planner in providing targeted training for teachers. This model needs to include technology skills as well as motivation for pedagogical change. Of the various change models reviewed, Welliver’s (1989) *Instructional Transformation Model* is best suited for this study because it measures teachers’ practices as well as their beliefs about technology at each stage of the model.

A review of the literature also supports the importance of administrative support in reducing the barriers to technology integration (Amenta-Shin, 2000; Baylor & Ritchie, 2002; Besalel, 2004; Cradler, 2002). The literature also shows that as teachers increase their
confidence level in using technology through training, reflection, and collaboration, they also integrate technology at a higher rate (Ballard, 2000; Bianchi, 1996; Stein, et al., 2002). This increase in technology integration has resulted in increased student learning and student-to-student interaction as well as better accommodation of different learning styles (Mouza, 2002; Ross, et al., 2002; Tapscott, 1999).

Also found in the literature is discussion about how institutional culture affects the integration of technology into the classroom. Areas of interest that support this study were vision, collaboration, attitudes of administrators and beliefs versus practice (Albion & Ertmer, 2002; Bober, 2002; Dixon, 2000; Duffield, et al., 2004; Kelly & McAnear, 2002; Osborne, et al., 2004).

Systemic change, another factor in this study, is supported by the literature through discussions of limited budgets to support technology, evaluation and assessment policies. Additionally, norms and motivational factors, also important to this study, are well covered by the literature (Chiero, 1997; Morote, 2004; Pugh & Zhao, 2003).
Chapter III: Method

Introduction

This quasi-experimental longitudinal study investigated the change of computer usage by K-12 teachers in classroom practices following a series of professional development activities. A quasi-experimental research design was used to determine the relationship between seven variables and these changes. This design was selected because of the non-randomized selection of the convenience sample used in the study (Campbell & Stanley, 1981). This chapter presents a discussion of the research setting for the subjects in the study. A detailed description of the instrument used and the process for selecting a panel of experts to align the instrument with the conceptual model of the study were provided. In addition, the research design, hypotheses, data collection procedure, and the framework for the data analysis are explained in this chapter.

The Research Setting

The professional development activities in this study are part of An Adventure of the American Mind, a federal program offered to school systems in Western North Carolina. A discussion of the Adventure of the American Mind program follows.

Adventure of the American Mind

The Adventure of the American Mind (AAM) is a four-year grant from the Library of Congress whose mission is to train K-12 educators to be able to integrate Library of Congress Internet resources into their classroom practices. When the grant started in October, 1999, it was offered at three colleges in Western North Carolina. This grant has expanded and is currently offered at five colleges in North Carolina, and one college each in South Carolina, Arizona, and Illinois. The AAM grant provides funding for a coordinator, an
instructional technologist, and an administrative assistant at each college. Each college is assigned school districts that include all public, private, and charter schools in nearby districts. Every K-12 school in the assigned districts is offered an opportunity to participate in the grant but individual schools may choose to not participate. Once a school district has agreed to participate in the grant, the AAM coordinator and the technology directors of the school districts select twenty K-12 schools for participation. The AAM coordinator notifies each school principal of their selection to participate in the grant and presents the benefits and requirements of participation to the school (Appendix A). The principal invites the AAM coordinator to a faculty meeting to share the opportunity with the teachers. Interested teachers complete an application (Appendix B) and submit it to the AAM office. The AAM coordinator uses information from the application, the principal’s recommendation, and an essay of the teacher’s vision of technology integration in the classroom to select the teachers.

There are three phases of participation in the Adventure of the American Mind grant (Table 2). Phase I is completion of a three semester-hour graduate class titled “Multi-Media Integration into the Classroom.” Phase II is completion of a twenty-one hour workshop conducted by the coordinating college at either the college campus or the Library of Congress in Washington, D. C. This workshop covers technology and curriculum integration skills. Phase III includes a semester of mentoring another teacher at their school. During this phase, both teachers create lesson plans that integrate technology and the Internet into the classroom curriculum (Appendix C).
Table 2

Phases of Participation in Adventure of the American Mind Program

<table>
<thead>
<tr>
<th>Phase</th>
<th>Requirements</th>
<th>Benefits</th>
</tr>
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<tbody>
<tr>
<td>Phase I</td>
<td>· A letter grade of B- or better in the 3-semester hour graduate course titled “Multi-Media Integration into the Classroom” · Agree to mentor another teacher during Phase III</td>
<td>· Free laptop computer · Free tuition for the graduate class · Free technical support</td>
</tr>
<tr>
<td>Phase II</td>
<td>· Participation in a 21-hour technology integration in the curriculum training workshop · Encourage mentored teacher to attend a summer workshop</td>
<td>· Free three-day technical integration training workshop · Free technology integration training workshop for mentored teacher · Free technical support</td>
</tr>
<tr>
<td>Phase III</td>
<td>· Mentor the teacher selected during Phase I in technology integration for one semester · Actively use technology in their classroom · Create lessons that integrate technology · Assist another teacher in creating lessons that integrate technology</td>
<td>· Additional knowledge gained from teaching another. · Free technical support · Copy of all teachers’ and mentors’ technology based lessons.</td>
</tr>
</tbody>
</table>

Population and Sample

The potential population (N=940) for this study is K-12 teachers at twenty-two schools in four school districts in three counties in Western North Carolina. Every teacher at these twenty-two schools had an opportunity to apply to participate in the Adventure of the
American Mind (AAM) grant. The AAM program normally selected twenty schools with two teachers selected from each school to participate in the AAM program, but in this case, twenty-two schools were selected because of the small number of teachers at several of the selected schools. The sample (n=40) for the study was a convenience sample representing four percent of the teachers from the potential population (N=940) who applied and were accepted to participate in the AAM grant. Two of the counties were rural and one was a mix of rural and urban. Buncombe, Rutherford and McDowell counties were selected because of their mix of school settings and technology status. Some of the schools used in this study are among the poorest in the state and therefore receive federal assistance to increase technology support. Other schools in this study do not qualify for this support yet their systems are not able to bring them to the same level as those receiving extra federal assistance. This variation in available technology may impact a teacher’s access to technology and thus the ability to integrate it into the classroom.

*Participating School Districts*

The Montreat College cluster was selected for this study because the grant proposal originated at Montreat College and they had the most experience of any of the participating institutions in conducting the grant. Additionally, the technology directors generally selected their most technology-enabled schools for participation with the grant during the first year. However, this study used schools participating in the third year of the grant (2001-2002) because these schools are more representative of non-technology focused schools than the schools that participated during the first two years of the grant.

The conceptual model for the grant is “train-the-trainer” (Appendix D). In this model a small number of individuals from each school are selected to receive training. Two teachers
from each K-12 school received intense training and became the trainers for their school. The
training for this study included a three semester-hour graduate course in “Technology
Integration in the Content Areas” and a twenty-one hour workshop on technology integration
in the curriculum. The forty teachers selected for year three of the Montreat College cluster
are the trainers for their schools. Phases I and II of the grant prepared them to serve as
trainers (Table 3). This model is significant because Haycock (2001, October) found greater
change in classroom practices when teachers were provided an opportunity to collaborate.
The train-the-trainer model provides teachers the vehicle for collaboration.

The twenty-two schools participating in year three of the grant were selected by the
Montreat College AAM Cluster Coordinator with the assistance of the technology directors
of the participating school districts (Table 3). The participating school districts in the
Montreat College Adventure of the American Mind cluster are Buncombe County, Asheville
City, McDowell County and Rutherford County School Systems.

Table 3

*List of Participating Schools with Montreat College Cluster: Year 3*

<table>
<thead>
<tr>
<th>School District</th>
<th>Number of Schools</th>
<th>Teaching Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asheville City</td>
<td>2</td>
<td>44</td>
</tr>
<tr>
<td>Buncombe County</td>
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<td>McDowell County</td>
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<tr>
<td>Rutherford County</td>
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<td>265</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>940</strong></td>
</tr>
</tbody>
</table>
Instrumentation

The application the teachers completed for the class (Appendix B) included home and school contact information as well as academic and technology information about them and their academic setting. The academic information included their certification area, highest degree completed, years of teaching experience, grade and subjects taught as well as class size. The technology information included questions about the ratio of classroom computers to students, Internet access of these classroom computers, and availability of an LCD projector in their classroom (Appendix B).

An additional questionnaire (Appendix E) was available online with the posttest to gather information about the availability of factors that have been found to impact integration of computers in the classroom (Sandholtz, 2001). These areas are as follows:

1. Hours of staff development outside of the parameters of the grant
2. On-site technical assistance with hardware
3. Teacher’s perceived support of technology integration by the school principal.

This study used a revised version of the Teaching with Technology Survey (Appendix F) that was developed by Atkins, Frink, and Viersen (1995) to assess the three areas of the Technology Staff Development model (Atkins, et al., 1995). This version outlines broad goals for technology professional development and was created to fit the North Carolina technology standards for students and teachers. Atkins, et al., (1995) Teaching with Technology Survey was published in Integrating Technology and Multimedia in the Classroom (Robyler & Edwards, 2000) as the Teaching with Technology Instrument and is listed in that text as a “copy me” instrument by the International Society of Technology for Educators (ISTE) (Appendix F). Publication and acknowledgement by ISTE of this
instrument as a tool for professional development trainers validates its usefulness in evaluating technology integration practices by teachers. Correlating the skills evaluated by the *Teaching with Technology Instrument (TTI)* with the stages on Welliver’s *Instructional Transformation Model* provide professional development trainers a model to evaluate change in teachers’ technology integration skills.

The *TTI* is a technology integration instrument originally scaled to fit a model of Technology Staff Development. This model included three general areas to determine how much teachers knew about technology as well as how they applied that knowledge to their classroom practices (Atkins & Vasu, 1998). These three areas were:

1. Writing and communication
2. Information access and management
3. Construction and productivity

A total of 46 questions were assigned to one of the three areas. Teachers were required to indicate *Yes* or *No* responses relative to their self-assessment of their knowledge in these areas. The instrument was validated with 155 middle school teachers. This instrument was also published in Atkins (1997) dissertation, a journal article by Atkins and Vasu (1998), and as a “Copy Me” instrument in Robyler and Edwards (2000). The areas focused on by Atkins (1997) were writing and communication, information access and management, and construction and multimedia. The questions were aligned with the North Carolina Standard Course of Study for technology and were ordered from simple to complex with a *Yes* or *No* response to each question.

Since the study used with the *TTI* did not address the constructs of the five stages of Welliver’s *Instructional Transformation Model*, the researcher revised the *TTI*. The *Yes* or
No responses were changed to a 5-point Likert scale. This change created the *Teaching with Technology – Revised (TTI-R)* (Appendix G). The transition to the Likert scale rating was established to enable participants to be assigned a score on each stage of Welliver’s model. “One” was assigned the label of “Never” and “Five” was assigned the label of “Always”. Scores from each question determined the participant’s placement on Welliver’s model.

The *TTI* was developed as a practitioner’s instrument and the development did not include the academic rigor needed in research to establish validity and reliability. This study used a confirmatory factor analysis to establish construct validity. Questions with eigenvalues of 1.0 or higher were retained in each sub-scale. These sub-scales for the *TTI-R* should align with Welliver’s *Instructional Transformational Model*.

The reliability of the *TTI-R* was not reported in the literature discussing the establishment of the instrument. To insure the accuracy, consistency, and stability of the *TTI-R*, a confirmatory factor analysis was conducted using the pretest scores (n=40) of the study’s participants. The questions on the *TTI-R* were divided into five sub-scales that aligned with the five stages on the *Instructional Transformation Model* by the panel of experts. A discussion of the selection process for this panel follows this discussion. A confirmatory factor analysis of the items on each sub-scale of the instrument was conducted. Since the sample size (n=35) for this study was small, questions with factor loadings higher than .65 were retained in the study for additional analysis.

*Panel of Experts*

The *TTI-R* was created to fit the Technology Staff Development model (Atkins, et al, 1995) and did not fit the stages of Welliver’s *Instructional Transformation Model*. A panel of experts (Appendix H) was used to align the questions on the *TTI-R* with the Welliver’s
model. Currently there is no instrument to place teachers on Welliver’s model. The panel provided content validity. A panel of experts in technology integration confirmed the ability of the instrument to measure technology integration. This panel consisted of twelve professors who teach technology integration at the college or university level and have been published in current technology integration refereed journals. These journals included *Action in Teacher Education*, *Journal of the American Society for Information Science and Technology*, the *International Journal of Technology and Design Education*, the *Journal of Technology Education*, *Journal of Technology and Teacher Education* and the *Educational Technology Research and Development*. Requests for participation on the panel were e-mailed to fifty-nine published professors of technology integration in these journals (Appendix H). The goal of the researcher was to have twelve professors participate in the panel of experts. Each professor assigned the questions on the *TTI-R* to a stage of Welliver’s model or state that the question did not fit the model.

An electronic copy of *TTI-R* was placed on a web page (Appendix I). Each question had six choices, the five stages of Welliver’s model and a “Not Fit model” choice. There were two sections at the end of the survey for the experts to comment on the questions within the survey and make suggestion for additional questions. Each expert was e-mailed a request (Appendix J) to participate as a member of the panel of experts for this study with a link to the web page (Appendix I). A brief description of each stage of Welliver’s model (Appendix K) was attached to the e-mail as well as be available as a link on the web page. Each question was placed at a stage on the model when there was eighty percent agreement by the panel of experts.
Twenty-one professors completed the survey and had the required 80% agreement on only one question of the model (Table 5). Possible reasons for the lack of agreement by the panel members were:

1. The survey was not created to follow the model. The questions on the stages of the model were spread throughout the survey.
2. The online survey required the panel to refer to a separate web page to identify a teacher’s activities at each stage of the model (Appendix K). This additional effort may have contributed to the panel members’ misunderstanding of a teacher’s actions at each stage on the model.
3. The criteria for being a panel member did not include the area of expertise of the panel members or the date of their doctoral degree.

These findings led the researcher to the conclusion that the requirements of the first panel of experts was not detailed enough to ensure they would be experts in the field of technology integration. Using the findings and the advice of methodology experts, the researcher created a second panel of experts which was divided into two groups.

The first group consisted of three recent graduates with Educational Doctorates in Curriculum and Instruction from North Carolina State University who are currently working with teachers in the field of technology integration. A request to participate as a member of this panel of experts in technology integration was sent by e-mail (Appendix L) to each potential member. Once they agreed to participate as a member of the panel of experts, an e-mail (Appendix M) was sent with a link to a revised online survey that had each question on the TTI-R (Appendix N) placed at one of the stages on Welliver’s Instructional Transformation Model. The panel members were asked to confirm the placement of
questions on Welliver’s *Instructional Transformation Model* (Appendix O). Each question receiving 67% agreement by the panel of experts was included for review by the second group.

The second group consisted of five technology specialists from University of North Carolina System institutions. An e-mail request (Appendix P) to participate as a member of this panel of experts in technology integration was sent to the potential members. The e-mail included a link to the *TTI-R* (Appendix N). The *TTI-R* included 44 questions confirmed as aligning with the *Instructional Transformation Model* by the first group in second panel of experts. The second group of panel members was asked to confirm the placement of questions on Welliver’s *Instructional Transformation Model*. Questions receiving 80% agreement by the panel of experts were placed on the model.

*Research Design*

This study used a quasi-experimental design to investigate change of teaching practices in using technology in the classroom of forty K-12 teachers. These teachers are members of a cohort selected for participation with the technology integration grant, An Adventure of the American Mind. According to Campbell and Stanley (1981), the quasi-experimental design is appropriate when there is a lack of randomization on the group used for the study. The pretest/posttest design was used to measure change over the 44 months covered by the study. During the first year of the study, the teachers completed a graduate course in technology integration in the classroom, post course training in technology integration in the classroom, and mentored another teacher in technology integration in the classroom.
Due to the length of the study and rapid changes in technology, there are many factors that may impact change in teaching practices in using technology in the classroom, which are not controlled by the study. Some of these factors include: (a) additional technology training by teachers (b) available of access to the internet in the classroom, (c) availability of on-site technical support, and (d) changing staffing of administrators within the teacher’s school. A supplemental questionnaire addressing each of these factors was given with the posttest.

Hypotheses

This quantitative study compared the relationship of the teacher’s level on Welliver’s Instructional Transformation Model with multiple variables using the following null hypotheses.

1. There is no significant change in the mean score of an individual teacher’s use of technology in the classroom as measured by the TTI-R on Welliver’s Instructional Transformation Model.

2. There is no significant relationship between the teacher’s score on Welliver’s Instructional Transformation Model as measured by the TTI-R and:
   a. Years of teaching experience
   b. Level of education completed
   c. Hours of staff development in technology integration
   d. Presence of hardware technical assistance at their school
   e. Ratio of computers to students in the classroom
   f. Number of computers available for student use in the classroom that were connected to the Internet
   g. Teacher’s perceived support for technology by the school principal
3. There is no significant relationship between the teacher’s score on each stage of Welliver’s *Instructional Transformation Model* as measured by the *TTI-R* and:

   a. Years of teaching experience
   
   b. Level of education completed
   
   c. Hours of staff development in technology integration
   
   d. Presence of hardware technical assistance at their school
   
   e. Ratio of computers to students in the classroom
   
   f. Number of computers available for student use in the classroom that were connected to the Internet
   
   g. Teacher’s perceived support for technology by the school principal
Data Collection

The researcher received permission from the AAM Project Director to use the participants from year three of the Montreat College cluster in this study. Permission was granted as well from the Montreat College AAM Cluster Coordinator (Appendix Q).

The proposal narrative (Appendix R), Informed Consent Form (Appendix S) and the TTI-R (Appendix G) were submitted to the North Carolina State Institutional Review Board (IRB). Permission was granted on September 25, 2001 and was renewed several times during the course of the study.

The TTI-R (Appendix G) pretest was administered on September 25, 2001 by the Montreat College AAM Cluster Coordinator to determine a base for each participant on Welliver’s model. This was during the fifth class of a fifteen-meeting class. The participants had received nine hours of training prior to taking the pretest. The pretest consisted of a data packet that included an Informed Consent Form (Appendix S), TTI-R (Appendix G), and a Scantron©. Each participant turned in a completed Informed Consent Form and Scantron© with their name and responses from the TTI-R to the Montreat AAM Cluster Coordinator during the class. The AAM Cluster Coordinator then hand delivered the packets to the researcher. The participants included their name on the Scantron© to allow the researcher to identify changes in their practices in computer use in the classroom from the pretest to the posttest.

The researcher distributed an Application Information Request Form (Appendix T) during classes on November 6 and 13, 2001. Permission to access the information on the AAM Application was granted by all AAM participants present on those dates. Four students were not in class on those two dates. The researcher requested permission through e-mail for
access to the application information. All four participants responded to the e-mail request and gave permission for the researcher to access the information on the AAM Application. The Montreat AAM Cluster Coordinator also provided the researcher with a hard copy of each participant’s application. This information was keyed into a database by the researcher.

The *TTI-R* (Appendix G) was administered (posttest) upon approval of the study by the researcher’s doctoral committee. The *TTI-R* was given as a web-based survey for the posttest to reduce the cost of data collection and to increase the accessibility to survey participants (Smither, Walker, & Yap, 2004). A review of the literature comparing pencil and paper surveys with web-based surveys shows that these modes of testing are very comparable regarding their means, reliability, and item analysis (Cole, MacIsaac, & Cole, 2001; Mertler & Earley, 2002; Sun & McClanahan, 2003). A link to the web-based survey was e-mailed to both the teacher’s school and personal e-mail address. Each e-mail included: a letter requesting their continued participation in the study (Appendix U), a link to the web site with the online version of the *TTI-R* (Appendix V) with a password to the site. The password maintained the security of the data, identify the teacher in the database and only allow the teacher to take the posttest once. A follow-up e-mail (Appendix W) was sent after two weeks to each teacher who had not completed the questionnaire. Two weeks after this email, teachers who have not completed the questionnaire were called with a request to participate in the study. If this did not provide an eighty percent return rate, or thirty-two responses, the researcher planned to visit the teacher’s school and request that they complete the questionnaire. Once the questionnaires had been completed, the data was imported into the computer database with the pretest scores.
Data Analysis

Atkins (1997) conducted a face validity test of the Teaching with Technology Survey using North Carolina technology standards and evaluation by staff development and technology professionals. Each of the three concerns for internal validity is addressed below.

One internal validity concern was that the teachers would become test-wise because of the test/retest method used in this study. This was reduced slightly because there were approximately 44 months between the pretest and posttest. On September 6, 2001, 25 of the Brevard College Adventure of the American Mind participants took the TTI-R to establish internal reliability. The test took 25 minutes to complete. Atkins (1997) established the reliability for the Teaching with Technology Instrument – Revised using Cronbach’s alpha (.49).

A second internal validity concern was differential selection. This was because of the selection of the schools by the AAM Cluster Coordinator and the self-selection of the teachers to participate in the study. The researcher argues that schools selected by the technology directors to participate during the first year of the grant would not be representative of the average technology using schools in the district because technology directors would select their best technology performing schools. To guard against this, the researcher used schools participating during the third year of the grant. The self-selection of the teachers for participation was a limitation of the study.

Selection maturation as the third internal validity concern was controlled by including years of experience as a variable in the study. Teachers in different stages of their career have been found to respond differently to professional development (Guskey, 2000, Lieberman & Miller, 2001).
The target population for the study was all teachers at public and private K-12 schools in Buncombe, McDowell, and Rutherford Counties in Western North Carolina. The accessible population for this study was all of the teachers from the twenty-two schools in these counties that were selected to participate in year three of the project (Table 3). All teachers in the accessible population were invited to apply for participation in the AAM program. All teacher participants volunteered for the program. Each volunteer completed an application that included an application form (Appendix B), an essay on their vision of technology integration into their classroom, and their principal’s recommendation. These materials were submitted to the Montreat College AAM office and two teachers from each of the twenty schools were selected from the applicant pool. Considerations in the selection process included the subject and grade taught by the volunteer, their technology integration vision essay and their principal’s recommendation. The teacher’s subject and grade was considered because technology integration in subjects such as English and history is more common than in math and science. This is because of the limited number of math- and science-related digitized resources available at the Library of Congress during the period covered by this study. The vision essay was considered because it provided insight into the applicant’s plans for integrating technology into their classroom. The principal’s recommendation was considered because of the importance of the “train-the-trainer” conceptual model that requires that the participant be capable of training additional staff in their own school. This selection process created a convenience sample of forty teachers for this quasi-experimental longitudinal study.

There are 46 questions on the TTI-R. Thirty-seven of the questions were aligned with one of the five stages on Welliver’s model by a panel of experts. Teachers’ responses to the
instrument were scored to determine a score for each stage on the model for both the pretest and the posttest. Each teacher’s aggregated response scores were determined for each stage of the model. The lower the score, the lower the technology integration, while the higher the score the higher the technology integration. The difference between the pretest and posttest score provided a change score for each stage on Welliver’s model. A total of the change scores for each stage on Welliver’s model provided a model change score. Each teacher’s responses were scanned into the database by a Scantron© machine to eliminate human error.

The purpose of this study was to investigate the change in practices of technology usage in the classroom by K-12 teachers following a series of professional development activities. The changes were measured by the difference in the teachers’ scores on the pretest and posttest of the TTI-R as assigned to each stage of Welliver’s model. Content analysis of each item within the stages was included to discover potential patterns of change. The stage the teacher is on in the model is an ordinal variable. A correlated $t$-test was used to test the differences between the scores of the pretest and the posttest for each teacher’s model and stage scores at a significance level of $\alpha = .05$. Due to the number of stages within Welliver’s model, the Bonferroni Adjustment were used to maintain $\alpha = .05$.

A correlation coefficient was used to compare the relationship of seven variables in hypothesis two and hypothesis three with each teacher’s change score for the model and for each stage within the model. Three of the variables consider the teacher’s educational training and four variables consider the support provided to the teacher by their school. The internal variables include

1. Number of years teaching

2. Highest degree completed
3. Additional hours of staff development training in technology integration.

The four external variables include:

1. Presence of hardware technical assistance at their school
2. Ratio of computers to students in the classroom
3. Availability of computers with Internet connectivity
4. Teacher’s perceived support by their principal
Chapter IV: Findings

Introduction

This study investigated the sustained change in technology use by teachers in the classroom over a four-year period following participation in an activity funded by a technology grant. The need for longitudinal studies in this area is frequently recommended for additional research (Doppen, 2002; Nanjappa, 2003). The purpose of the study was to investigate sustained increase in use of technology by classroom teachers. A quasi-experimental research design was used to determine the extent that seven variables shown in a review of the relevant literature impacted change in technology use in the classroom (Ali, 2003; Baylor & Ritchie, 2002; Birman, et al., 2000; Cheney-Cullen & Duffy, 1998; Kelly & McAnear, 2002; Pierson, 2001; Ross, et al., 2002; Stein, et al., 2002; Wenglinsky, 2002; Wilson & Notar, 2003). These variables are:

1. Years of teaching experience
2. Level of education completed
3. Hours of staff development in technology integration
4. Presence of hardware technical assistance at their school
5. Ratio of computers to students in the classroom
6. Number of computers available for student use in the classroom that were connected to the Internet
7. Teacher’s perceived support for technology by the school principal

A review of the literature also indicated the need for a model that would identify technological and pedagogical change (Wang, 2000). This study used Welliver’s (1989) Instructional Transformation Model because it addresses a teacher’s technological beliefs
and practices (Hooper & Reiber, 1995; Marcinkiewicz & Welliver, 1993; Wang, 2000).

Welliver’s model (Figure 2) is composed of five stages of development for teacher’s to fully integrate technology into the classroom. These stages are familiarization, utilization, integration, reorientation, and evolution. Teachers who are at the familiarization stage focus on basic skills during professional development. Some of these basic skills include turning on the computer; creating, saving, and retrieving documents; manipulating graphics and fonts in documents; learning terminology used with computers; and becoming aware of how digitized documents can be used to enhance learning.

Figure 2: Welliver’s Instructional Transformation Model
At the utilization stage of the model, teachers use technology for administrative requirements of the job, but not in the classroom. At this stage, if the technology does not work, the teacher can complete the activity without access to the technology. Teacher activities at this stage include the use of peripheral hardware such as cameras, scanners, etc.; supplemental curricula with Internet resources; and the use of subject focused computer games. At the utilization stage, technology is not a required tool in the classroom.

At the integration stage, a teacher plans activities taken from existing curricula based on access to technology. If the technology fails, the lesson cannot be completed. A teacher who has moved to this stage allows students to make some decisions in their learning, moves toward project based activities for lessons, specifies resources and Internet sites for students to use in the learning process, collaborates with colleagues to achieve educational goals, and requires students to have access to the Internet to complete assignments.

The fourth stage of the model, reorientation, is when the teacher has become the guide rather than the sage to their students. Classroom activities are organized around resources available through technology. The classroom layout for teachers at this stage of the model is not directed toward a central point. Additionally, students have a central role in learning decisions and teachers collaborate with stakeholders as well as colleagues to achieve educational goals. Students’ technical skills are required but not central to the curriculum.

In the last stage of the model, evolution, a teacher is exploring new technologies and ways to use them in the classroom. The teacher focuses on a more global vision of education rather than their own classroom. Teachers at this stage apply technology tools learned to subject specific activities, focus on the pedagogy rather than the technology innovation, advocate for creating and spreading the technology vision within the school system,
collaborate with educators outside of their immediate school or district, and take a larger, more assertive role in incorporating new technologies in the educational setting.

**Overview**

**Description of Sample**

Subjects in this study were selected through a convenience sample of the members of a graduate class in technology integration that was offered through participation in An Adventure of the American Mind (AAM) Program at Montreat College. AAM is a four-year technology focused grant from the Library of Congress that started in October 1999 and has been extended through September 2007. Its mission is to train K-12 educators to integrate Library of Congress digital resources into their classroom practices. Originally, the AAM program was offered at three colleges in Western North Carolina but has since been expanded to five colleges in North Carolina plus additional colleges in South Carolina, Arizona, Illinois, Pennsylvania, Indiana, Virginia, Colorado, and Nevada for a total of 25 colleges currently participating in the program (as of January 2006).

The 40 teachers in this study volunteered for participation in the Montreat College AAM program and represented 22 schools from four school systems in Western North Carolina. Thirty-five of the 40 teachers responded to the posttest and are included in this study (Table 4).
Table 4

**Characteristics of Sample**

<table>
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<td>Rutherford County</td>
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Method

The instrument used with the study was Teaching with Technology Instrument, a practitioner-developed instrument used with a technology integration staff development model. This instrument included 46 questions on technology use in the classroom. This study aligned the instrument with Welliver’s Technology Integration Model through the use of a panel of experts. This alignment allowed the researcher to identify a teacher’s score for each stage of the model. The process for the panel of experts is presented in the next section of this chapter.

The pretest was administered on September 25th, 2001 to the sample of 40 teachers. The teachers completed the informed consent form required by the North Carolina State University Institutional Review Board and gave permission for the researcher to obtain personal information from the program application form. In May, 2005, a link to an online copy of the TTI-R (Appendix V) and a supplemental survey (Appendix E) on factors found in the literature to impact change in teaching practices in using technology in the classroom was e-mailed to each teacher with a request for continued participation in the study (Appendix U). Between May and August, 2005, the posttest was completed by 35 of the 40 teachers.

Descriptive statistics are provided on the sample and school systems they represent (Table 4). For hypothesis one, the means of the pretest and posttest were compared for each teacher’s model and stage score.

A correlation study was performed and correlation coefficients were reported to compare the relationship of the seven variables in hypothesis two and hypothesis three for each total model change score and each stage score within the model.
Panel of Experts

A panel of experts was used to align the TTI-R with Welliver’s Instructional Transformation Model. Challenges presented by the results of the initial panel of experts necessitated the creation of a second panel of experts. A discussion of the membership requirements of each panel, the collection procedures, and problems encountered during the alignment process follows.

The criteria for members on the first panel of experts included being published in a refereed journal on technology integration and teaching technology integration at the college or university level. Individuals (N=59) who met these criteria were contacted by e-mail with a request to serve on this panel (Appendix J). Twelve professors were required for the panel of experts. Each professor was asked to assign the questions on the TTI-R to a stage of Welliver’s model or state that the question does not fit the model (Appendix I).

Twenty-one of the professors contacted agreed to serve on the panel of experts and completed the online survey aligning the TTI-R with Welliver’s Instructional Transformational Model (Appendix V). However, the panel of experts had 80% agreement on only one question of the model (Appendix X). The investigator began to look for possible reasons for the lack of agreement by the panel members. First, the survey was not created to follow the model. This caused the stages of the model to be spread throughout the survey rather than broken into sections that followed the model. This illogical order may have caused some confusion.

Another possible reason for this lack of agreement could have been the panel members’ misunderstanding of a teacher’s actions at each stage on the model. The survey required the panel to refer to a separate web page to identify a teacher’s activities at each
stage of the model (Appendix K). This additional effort required of the panel may have been awkward, thereby contributing to the lack of agreement.

Third, the criteria for being a panel member did not include the area of expertise of the panel members. A closer review of the placement of the items on the panel showed that those panel members who held doctorate’s in Curriculum and Instruction placed ten questions on the model with 80% or more agreement while those with doctorates in other fields had the required 80% or more agreement on only one question.

These findings led the researcher to the conclusion that the requirements of the first panel of experts was not detailed enough to ensure they would be experts in the field of technology integration. Using the findings and the advice of methodology experts, the researcher created a revised panel of experts to confirm the placement of the TTI-R questions on the model.

The second panel of experts was divided into two groups (Appendix H). The first group consisted of three recent graduates with Educational Doctorates in Curriculum and Instruction from North Carolina State University who are currently working with teachers in the field of technology integration. A request to participate as a member of this panel of experts in technology integration was sent by e-mail (Appendix L) to each potential member. Once they agreed to participate as a member of the panel of experts, an e-mail (Appendix M) was sent with a link to a revised online survey that had each question on the TTI-R (Appendix N) placed at one of the stages on Welliver’s Instructional Transformation Model. The panel members were asked to confirm this placement. Each question receiving 67% agreement by the panel of experts was included for review by the second group. Each of the members responded. Of the 46 questions on the TTI-R, 37 questions received 100%
agreement, seven questions received 67% agreement, and two questions received 33% agreement (Table 5). The 44 questions with 67% or higher agreement were included for review by the second group of this panel of experts.

The second group consisted of five technology specialists from University of North Carolina System institutions (Appendix H). A request to participate as a member of this panel of experts in technology integration was sent by e-mail (Appendix P) to each potential member. This e-mail included a link to the revised online survey (Appendix O) that had 44 questions from the TTI-R placed on Welliver’s Instructional Transformation Model as confirmed by the first group in this panel of experts. This second group of panel members was asked to confirm this placement. Each question receiving 80% agreement by the panel of experts was placed on the model. This placement was used to group the questions for an item analysis.
Table 5

Process for Placing TTI-R Questions on Welliver’s Instructional Transformation Model

Using Panel of Experts (POE) and Factor Analysis

<table>
<thead>
<tr>
<th>Questions</th>
<th>First POE</th>
<th>Researcher POE Group 1</th>
<th>Second POE Group 2</th>
<th>Factor Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzed</td>
<td>46</td>
<td>46</td>
<td>45</td>
<td>37</td>
</tr>
<tr>
<td>Placed on Model</td>
<td>1</td>
<td>45</td>
<td>44</td>
<td>23</td>
</tr>
<tr>
<td>Placed on Stages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familiarization</td>
<td>0</td>
<td>8</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Utilization</td>
<td>1</td>
<td>13</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Integration</td>
<td>0</td>
<td>9</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Reorientation</td>
<td>0</td>
<td>11</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Evolution</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

1. 80% or higher agreement (N=59, n=21)
2. 67% or higher agreement (N=3, n=3)
3. 80% or higher agreement (N=5, n=5)
4. Factor loadings >.65 and eigenvalues >1

Item Analysis

The TTI-R was developed as a practitioner’s instrument and the reliability or validity of the instrument was not reported in the literature. To ensure the accuracy, consistency, and stability of the TTI-R, a factor analysis was conducted using the study participants’ pretest scores (n=35) of the 37 questions placed on the model by the revised panel of experts. A factor analysis of the items on each sub-scale of the instrument was conducted (Table 6). Questions on each sub-scale with high factor loadings and Eigenvalues above 1 were retained on the model (Table 7). The recommended factor loading for retaining an item is between .40 and .70 (Costello & Osborne, 2005). Since the sample size was small (n=35), this study retained items with factor loadings above .65.
Table 6

*Item Analysis of Questions from the Teaching with Technology Instrument-Revised as Placed on Welliver’s Instructional Transformation Model*

<table>
<thead>
<tr>
<th>Model Stage</th>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Component Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarization</td>
<td>21</td>
<td>3.46</td>
<td>1.09</td>
<td>.725</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>3.83</td>
<td>.89</td>
<td>.809</td>
</tr>
<tr>
<td>Utilization</td>
<td>15</td>
<td>3.34</td>
<td>1.35</td>
<td>.713</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>2.97</td>
<td>1.29</td>
<td>.710</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>2.97</td>
<td>1.38</td>
<td>.716</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>3.09</td>
<td>1.40</td>
<td>.865</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>3.40</td>
<td>1.09</td>
<td>.747</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>2.77</td>
<td>1.40</td>
<td>.801</td>
</tr>
<tr>
<td>Integration</td>
<td>24</td>
<td>3.80</td>
<td>.96</td>
<td>.767</td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>3.29</td>
<td>1.20</td>
<td>.821</td>
</tr>
<tr>
<td></td>
<td>42</td>
<td>3.51</td>
<td>1.12</td>
<td>.791</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>3.06</td>
<td>1.16</td>
<td>.736</td>
</tr>
<tr>
<td></td>
<td>44</td>
<td>3.43</td>
<td>1.09</td>
<td>.726</td>
</tr>
<tr>
<td></td>
<td>46</td>
<td>3.37</td>
<td>1.21</td>
<td>.804</td>
</tr>
<tr>
<td>Reorientation</td>
<td>26</td>
<td>3.86</td>
<td>.85</td>
<td>.703</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>3.80</td>
<td>.90</td>
<td>.734</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>3.51</td>
<td>1.09</td>
<td>.843</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>3.43</td>
<td>1.04</td>
<td>.789</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>3.14</td>
<td>1.33</td>
<td>.759</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>3.37</td>
<td>1.09</td>
<td>.762</td>
</tr>
<tr>
<td>Evolution</td>
<td>5</td>
<td>4.17</td>
<td>.89</td>
<td>.758</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>3.97</td>
<td>.92</td>
<td>.734</td>
</tr>
<tr>
<td></td>
<td>39</td>
<td>3.60</td>
<td>1.19</td>
<td>.812</td>
</tr>
</tbody>
</table>
Reliability of the 23 questions retained on the model from the TTI-R was established using Cronbach’s alpha (.96). The reliability of the model sub-scales ranged from .58 for the familiarization stage to .82 or higher for the remaining four stages of the model (Table 7). The low reliability score of the familiarization stage is may be because there are only two items at this stage. According to Costello and Osborne (2005) factors with less than three items are weak and unstable. The placement of these 23 questions on the model were used to determine a stage score for each teacher on the pretest and posttest of the model and a total model score for the pretest and posttest (Appendix Z). The change score was determined by subtracting the pretest scores from the posttest scores.

Table 7

Item Analysis of Questions Placed on Model by Panel of Experts

<table>
<thead>
<tr>
<th>Stages on Model</th>
<th>Item Number</th>
<th>Alpha Values</th>
<th>Components</th>
<th>Eigenvalues*</th>
<th>% of Variance*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarization</td>
<td>2</td>
<td>.5778</td>
<td>1</td>
<td>1.415</td>
<td>70.743</td>
</tr>
<tr>
<td>Utilization</td>
<td>6</td>
<td>.9054</td>
<td>1</td>
<td>4.087</td>
<td>68.115</td>
</tr>
<tr>
<td>Integration</td>
<td>6</td>
<td>.8989</td>
<td>1</td>
<td>3.991</td>
<td>66.518</td>
</tr>
<tr>
<td>Reorientation</td>
<td>6</td>
<td>.8518</td>
<td>1</td>
<td>3.494</td>
<td>58.240</td>
</tr>
<tr>
<td>Evolution</td>
<td>3</td>
<td>.8156</td>
<td>1</td>
<td>2.208</td>
<td>73.616</td>
</tr>
<tr>
<td>Total Model</td>
<td>23</td>
<td>.9610</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Rotation sums of squared loadings
Hypotheses

This study consisted of three hypotheses covering the change of technology use in the classroom by K-12 teachers. To investigate this change, the study compared the relationship of the teacher’s self assessment score on Welliver’s Instructional Transformation Model with multiple variables using the following null hypotheses.

1. There is no significant change in the mean score of an individual teacher’s use of technology in the classroom as measured by the TTI-R on Welliver’s Instructional Transformation Model.

2. There is no significant relationship between the teacher’s score on Welliver’s Instructional Transformation Model as measured by the TTI-R and:
   a. Years of teaching experience
   b. Level of education completed
   c. Hours of staff development in technology integration
   d. Presence of hardware technical assistance at their school
   e. Ratio of computers to students in the classroom
   f. Number of computers available for student use in the classroom that were connected to the Internet
   g. Teacher’s perceived support for technology by the school principal

3. There is no significant relationship between the teacher’s score on each stage of Welliver’s Instructional Transformation Model as measured by the TTI-R and:
   a. Years of teaching experience
   b. Level of education completed
   c. Hours of staff development in technology integration
d. Presence of hardware technical assistance at school

e. Ratio of computers to students in the classroom

f. Number of computers available for student use in the classroom that were
   connected to the Internet

g. Teacher’s perceived support for technology by the school principal

_Hypothesis One_

Hypothesis one investigated the change in a teacher’s use of technology in the classroom between the two administrations of the TTI-R, September 2001 and summer 2005. Welliver’s conceptual model proposes five stages teachers go through as they integrate technology into the classroom is illustrated in Figure 2. The null hypotheses stated there was no significant change of technology use by teachers as measured by the teacher’s score on each stage of the model.

Hypothesis one was answered by comparing the means of the teachers’ pretest scores with the means of the posttest scores on Welliver’s _Instructional Transformation Model_ (Table 8). There was a significant change in the teachers’ use of technology in the classroom from the pretest to the posttest (p > .001).
Table 8

Comparison in Teacher’s Use of Technology from Pretest to Posttest for the Model and Stages of the Model (n=35)

<table>
<thead>
<tr>
<th>Model Stage</th>
<th>Score Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>T</th>
<th>Sig.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Model</td>
<td>23 - 115</td>
<td>19.58</td>
<td>-4.646</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>76.00</td>
<td>23.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>91.37</td>
<td>17.81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familiarization</td>
<td>2 - 10</td>
<td>1.61</td>
<td>-4.423</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>7.26</td>
<td>1.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>8.46</td>
<td>2.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilization</td>
<td>6 - 30</td>
<td>5.66</td>
<td>-3.555</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>18.23</td>
<td>6.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>21.63</td>
<td>5.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration</td>
<td>6 - 30</td>
<td>5.02</td>
<td>-4.342</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>20.11</td>
<td>5.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>23.80</td>
<td>4.68</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reorientation</td>
<td>6 - 30</td>
<td>3.88</td>
<td>-5.531</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>20.69</td>
<td>4.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>24.31</td>
<td>4.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evolution</td>
<td>3 - 15</td>
<td>2.42</td>
<td>-3.919</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>11.57</td>
<td>2.64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>13.17</td>
<td>2.82</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at the .01 level (2-tailed).
Hypothesis Two

Hypothesis two investigated the impact of seven variables found in the review of the literature to impact the teacher’s use of technology in the classroom (Figure 2) (Ali, 2003; Baylor & Ritchie, 2002; Birman, et al., 2000; Cheney-Cullen & Duffy, 1998; Kelly & McAnear, 2002; Pierson, 2001; Ross, et al., 2002; Stein, et al., 2002; Wenglinsky, 2002; Wilson & Notar, 2003). The seven independent variables included:

1. Years of teaching experience
2. Level of education completed
3. Hours of staff development in technology integration
4. Presence of hardware technical assistance at school
5. Ratio of computers to students in the classroom
6. Number of computers available for student use in the classroom that were connected to the Internet
7. Teacher’s perceived support for technology by the school principal

To measure the impact of these variables, a correlation between the variable and the model change score is reported (Table 9). Years of teaching experience was the only variable to show a statistically significant impact on the teachers’ change in technology use score.
Table 9

Correlation Coefficients between Change in Teacher Use of Computers and Study Variables
(n=35)

<table>
<thead>
<tr>
<th>Teacher Characteristic (Independent Variables)</th>
<th>Change in Teacher Computer Use</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Experience</td>
<td></td>
<td>.532*</td>
<td>.001</td>
</tr>
<tr>
<td>Level of Education</td>
<td></td>
<td>.223</td>
<td>.198</td>
</tr>
<tr>
<td>Hours of Technology Staff Development</td>
<td></td>
<td>.272</td>
<td>.113</td>
</tr>
<tr>
<td>Hours of On-site Hardware Assistance</td>
<td></td>
<td>.025</td>
<td>.886</td>
</tr>
<tr>
<td>Ratio of Students to Computers</td>
<td></td>
<td>-.176</td>
<td>.312</td>
</tr>
<tr>
<td>Number of Internet Classroom Computers</td>
<td></td>
<td>.234</td>
<td>.175</td>
</tr>
<tr>
<td>Teacher’s Perception of Principal support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology Knowledge</td>
<td></td>
<td>-.156</td>
<td>.371</td>
</tr>
<tr>
<td>Knowledge of Instructional Technology Use</td>
<td></td>
<td>-.077</td>
<td>.662</td>
</tr>
<tr>
<td>Financial Support of Technology Use</td>
<td></td>
<td>.032</td>
<td>.853</td>
</tr>
</tbody>
</table>

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

Hypothesis Three

Hypothesis three investigated the relationship between the teachers’ change score at each stage on the model and each of the seven variables as possible factors that impacted teachers’ use of technology in the classroom (Figure 3).
The teachers’ years of teaching experience significantly impacted the change in computer use in the classroom at four of the five stages of the model (Table 10). The sample had a range of teaching experience from one to 25 years with 54% having 11 or more years of teaching experience.
The teachers’ level of education completed was found in the literature to impact the teacher’s use of technology in the classroom (Kelly & McAnear, 2002; Morote, 2004). This finding was confirmed by this study at the reorientation stage of Welliver’s model (Table 11). The study found a significant relationship at the .05 level between the teachers’ educational level completed and the reorientation stage of Welliver’s model. Teachers at the remaining four stages in the model did not show any significant relationship between the change in the use of technology in the classroom and the teachers’ level of education completed.
Table 11

*Correlation Coefficients between Change in Teacher Computer Use and Level of Education

Completed by the Teacher (n=35)

<table>
<thead>
<tr>
<th>Model Stage</th>
<th>Pearson Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarization</td>
<td>.292</td>
<td>.089</td>
</tr>
<tr>
<td>Utilization</td>
<td>.021</td>
<td>.906</td>
</tr>
<tr>
<td>Integration</td>
<td>.272</td>
<td>.114</td>
</tr>
<tr>
<td>Reorientation</td>
<td>.354*</td>
<td>.037</td>
</tr>
<tr>
<td>Evolution</td>
<td>.024</td>
<td>.890</td>
</tr>
</tbody>
</table>

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

The hours of staff development in technology integration was found in the literature to impact the teacher’s use of technology in the classroom (Birman, et al., 2000; Dexter, Seashore, & Anderson, 2002; Haycock, 2001). This finding was confirmed by this study for teachers who are at the familiarization stage on the model (Table 12). Teachers at the remaining stages on the model did not show any significant relationship between the use of technology and the teachers’ hours of staff development in technology integration.
Table 12

*Correlation Coefficients between Change in Teacher Computer Use and Hours of Staff Development in Technology Integration (n=35)*

<table>
<thead>
<tr>
<th>Model Stage</th>
<th>Pearson Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarization</td>
<td>.491*</td>
<td>.003</td>
</tr>
<tr>
<td>Utilization</td>
<td>.139</td>
<td>.427</td>
</tr>
<tr>
<td>Integration</td>
<td>.198</td>
<td>.254</td>
</tr>
<tr>
<td>Reorientation</td>
<td>.287</td>
<td>.094</td>
</tr>
<tr>
<td>Evolution</td>
<td>.186</td>
<td>.285</td>
</tr>
</tbody>
</table>

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

The presence of on-site school staff to provide hardware support and technical assistance to teachers was found in the literature to impact the teacher’s use of technology in the classroom (Ross, et al., 2002; Ali, 2003). This finding in the literature was not supported by this study (Table 13). Teachers at each of the stages did not show any significant relationship between the use of technology and the teachers’ perceived presence of hardware support and technical assistance at school.
### Table 13

*Correlation Coefficients between Change in Teacher Computer Use and Presence of Hardware Assistance at the Teacher’s School (n=35)*

<table>
<thead>
<tr>
<th>Model Stages</th>
<th>Pearson Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarization</td>
<td>.097</td>
<td>.578</td>
</tr>
<tr>
<td>Utilization</td>
<td>-.012</td>
<td>.946</td>
</tr>
<tr>
<td>Integration</td>
<td>-.028</td>
<td>.874</td>
</tr>
<tr>
<td>Reorientation</td>
<td>.121</td>
<td>.488</td>
</tr>
<tr>
<td>Evolution</td>
<td>-.016</td>
<td>.928</td>
</tr>
</tbody>
</table>

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

The number of computers in the classroom available for student use impacted the teachers’ use of technology in the classroom according to the literature (Pierson, 2001). This finding was not supported by this study (Table 14). Teachers at each of the stages did not show any significant relationship between the teachers’ use of technology and the students’ access to computers in the classroom.
Table 14

**Correlation Coefficients between Change in Teacher Computer Use and Ratio of Computers to Students in the Classroom (n=35)**

<table>
<thead>
<tr>
<th>Stage on Welliver’s Model</th>
<th>Study Variable</th>
<th>Pearson Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarization</td>
<td></td>
<td>-.108</td>
<td>.538</td>
</tr>
<tr>
<td>Utilization</td>
<td></td>
<td>.012</td>
<td>.944</td>
</tr>
<tr>
<td>Integration</td>
<td></td>
<td>-.233</td>
<td>.179</td>
</tr>
<tr>
<td>Reorientation</td>
<td></td>
<td>-.207</td>
<td>.232</td>
</tr>
<tr>
<td>Evolution</td>
<td></td>
<td>-.187</td>
<td>.283</td>
</tr>
</tbody>
</table>

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

The literature indicated that student’s access to the Internet through classroom computers impacted the teachers’ use of technology in the classroom (Franklin, 2004; Steelman, Vasu, & Foley, 2004). This finding was not supported by this study (Table 15). The relationship between the teachers’ use of technology and the students’ access to computers in the classroom was not significant.
### Table 15

*Correlation Coefficients between Change in Teacher Computer Use and Number of Internet Computers for Student Use (n=35)*

<table>
<thead>
<tr>
<th>Model Stages</th>
<th>Pearson Correlation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarization</td>
<td>.114</td>
<td>.513</td>
</tr>
<tr>
<td>Utilization</td>
<td>.030</td>
<td>.865</td>
</tr>
<tr>
<td>Integration</td>
<td>.319</td>
<td>.062</td>
</tr>
<tr>
<td>Reorientation</td>
<td>.289</td>
<td>.092</td>
</tr>
<tr>
<td>Evolution</td>
<td>.198</td>
<td>.253</td>
</tr>
</tbody>
</table>

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

The teachers’ perception of the principals’ support of technology was investigated in three areas. These included the principals’ knowledge of technology, knowledge of instructional use of technology and financial support for the teachers’ use of technology. The principals’ knowledge of technology and instructional technology was found to have an impact on the teachers’ use of technology in the classroom (Table 15). This significance was only found in teachers who were at the utilization stage on Welliver’s model. The principals’ financial support of the teacher’s use of technology was not statistically significant in the teachers’ sustained use of technology in the classroom.
Table 16

*Correlation Coefficients between Change in Teacher Computer Use and Teachers’ Perceived Support by their Principal (n=35)*

<table>
<thead>
<tr>
<th>Model Stages</th>
<th>Principals’ Knowledge</th>
<th>Principals’ Financial Support</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Technical</td>
<td>Instructional</td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td>Sig.</td>
</tr>
<tr>
<td>Familiarization</td>
<td>-.056 .748</td>
<td>-.037 .834</td>
</tr>
<tr>
<td>Utilization</td>
<td>-.387* .022</td>
<td>-.377* .025</td>
</tr>
<tr>
<td>Integration</td>
<td>-.012 .947</td>
<td>.118 .500</td>
</tr>
<tr>
<td>Reorientation</td>
<td>.004 .980</td>
<td>.076 .665</td>
</tr>
<tr>
<td>Evolution</td>
<td>-.019 .915</td>
<td>.060 .732</td>
</tr>
</tbody>
</table>

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

**Summary of the Findings**

When comparing the stages of change on Welliver’s model to the variables in this study the correlation was significant in the following areas:

1. Years of teaching experience and the total model
2. Years of teaching experience and the utilization, integration, reorientation, and evolution stages of model
3. Level of education completed and the reorientation stage of model
4. Teachers’ perception of support for technology by the school principal and the utilization stage on teachers’ perception of the principals’ knowledge of
technology and utilization stage on teacher’s perception of the principals’ knowledge of instructional technology.

There was no significant correlation in the following areas:

1. Presence of hardware technical assistance at school and the total model change score on any of the stages on the model.
2. Ratio of computers to students in the classroom and the total model change score on any of the stages on the model.
3. The level of education completed by teacher and the familiarization, utilization, integration and evolution stages of the model
4. The hours of staff development in technology integration and the utilization, integration, reorientation, and evolution stages of the model.
5. The number of computers available for student use in the classroom that were connected to the Internet and the total model change score on any of the stages on the model.
6. The teachers’ perception of the principals’ knowledge of technology and the familiarization, integration, reorientation, and evolution.
7. The teachers’ perception of the principals’ knowledge of instructional technology and the familiarization, integration, reorientation, and evolution.
8. The teachers’ perception of the principals’ financial support of the teachers’ use of technology and all stages of the model.

Hypothesis one investigated the change in an individual teachers’ use of technology in the classroom as measured by Welliver’s Instructional Transformational Model. By comparing the pretest and posttest means for each teacher, the study found a significant
difference (p < .001) in the change in technology use in the classroom by the study participants as measured by Welliver’s *Instructional Transformation Model*. This finding allowed the researcher to reject the null hypothesis for hypothesis one.

Hypothesis two investigated the significance of the relationships between the teacher’s change score on Welliver’s *Instructional Transformation Model* and the seven independent variables. These variables included:

1. Years of teaching experience
2. Level of education completed
3. Hours of staff development in technology integration
4. Presence of hardware technical assistance at school
5. Ratio of computers to students in the classroom
6. Number of computers available for student use in the classroom that were connected to the Internet
7. Teachers’ perceived support for technology by the school principal

The correlation between each independent variable and the change score for the total model was measured. Using the two-tailed Pearson correlation, a significant relationship between the independent variable years of teaching experience (p < .05) was identified. There was no relationship found between the teachers’ change score on Welliver’s *Instructional Transformational Model* and any of the remaining six independent variables. This finding allowed the researcher to reject the null hypothesis for hypothesis two for the variable years of teaching experience, but retain the null hypothesis for the remaining variables.
Hypothesis three investigated the relationship between the teachers’ change score on each stage of Welliver’s *Instructional Transformational Model* and the following seven independent variables:

1. Years of teaching experience
2. Level of education completed
3. Hours of staff development in technology integration
4. Presence of hardware technical assistance at school
5. Ratio of computers to students in the classroom
6. Number of computers available for student use in the classroom that were connected to the Internet
7. Teachers’ perceived support for technology by the school principal

The null hypothesis was not retained for the variable, years of teaching experience, on four stages of the model. Three additional variables included one stage on the model that showed a significant difference. These included the reorientation stage for the level of education completed variable, the familiarization stage of the hours of staff development in technology integration variable, and the utilization stage of the principals’ knowledge of technology and the use of technology in the classroom variable.

This study was significant from the viewpoint that few longitudinal studies have been done on change in technology use in the classroom even though this is a common recommendation for further research (Doppen, 2002; Nanjappa, 2003). Longitudinal studies such as this may uncover information that may not be apparent in studies of shorter duration. In summary, this study found that there has been change by the study participants during this four-year period.
Chapter V: Summary, Conclusions, Implications and Recommendations

Introduction

This study examined the change of computer usage by K-12 teachers following a series of professional development activities. This quasi-experimental longitudinal study was conducted using a convenience sample of teachers from four school systems in Western North Carolina. Teaching with Technology Instrument - Revised (TTI-R), a technology integration instrument, was used to measure change in technology use in the classroom by K-12 teachers. Additionally, the TTI-R was aligned with Welliver’s Instructional Transformation Model (1989) that served as the foundation for this study. Welliver’s model identified five stages teachers go through as they integrate technology into the classroom. These stages are familiarization, utilization, integration, reorientation, and evolution.

The goal of the study was to reject three null hypotheses. These are

1. There is no significant change in the mean score of an individual teacher’s use of technology in the classroom as measured by the TTI-R on Welliver’s Instructional Transformation Model.

2. There is no significant relationship between the teachers’ score on Welliver’s Instructional Transformation Model as measured by the TTI-R and the seven variables identified in the research literature that influence technology use by teachers.

3. There is no significant relationship between the teachers’ score on each stage of Welliver’s Instructional Transformation Model as measured by the TTI-R and the seven variables identified in hypothesis two.

The seven variables investigated in hypotheses two and three are
1. Years of teaching experience
2. Level of education completed
3. Hours of staff development in technology integration
4. Presence of hardware technical assistance at school
5. Ratio of computers to students in the classroom
6. Number of computers available for student use in the classroom that were connected to the Internet
7. Teachers’ perceived support for technology by the school principal.

**Summary**

This four-year longitudinal study investigated the change in classroom practices of technology use by K-12 teachers following a number of universal training experiences as well as self-selected training. The universal experiences included a three-semester hour graduate class in technology integration, a summer institute in technology integration, and a semester-long period where each teacher mentored another teacher on integrating technology into the classroom. The self-selected training included supplemental technology workshops available through the teachers’ school systems as well as external educational opportunities. Focus on the teachers’ change was guided by the study’s conceptual framework originally developed by Welliver (1989). Welliver’s model of technology integration, “Instructional Transformation Model” (Figure 1) described the process teachers experience during the integration of technology into the curriculum (Welliver, 1989). Welliver identified five stages (familiarization, utilization, integration, reorientation, and evolution) that served as the foundation for investigating change in technology use by K-12 teachers. The teachers’
changes in technology use were determined by comparing the teachers’ pretest and posttest responses to the TTI-R.

The limitations identified in the study included:

1. The self-selection of the study participants may indicate a strong interest in technology and a higher motivation to learn technology integration.

2. During the four years covered by this study, there have been changes in the use of technology in the classroom which are not measured by the TTI-R. This may reduce the value of this instrument as a tool for evaluating teacher’s technology use in the classroom.

3. The small sample (n=35) and the small number of questions at the sub-scales of Welliver’s Instructional Transformation Model, may compromise the statistical power of the factor analysis of the teachers’ pretest scores on the TTI-R.

Panel of Experts

The study used a panel of experts to align the TTI-R with Welliver’s Instructional Transformation Model. The results of the first panel of experts revealed the need for redesigning the panel membership requirements and the online survey. This redesign included selection of a second panel of experts using stricter membership criteria and structural modifications to the online survey. The second panel rejected nine items on the TTI-R by having agreement at less that 80% (Appendix X).

A factor analysis of the study participant’s pretest scores of these 37 questions revealed that 23 questions fit Welliver’s model with factor loadings above .65. Reliability of these questions was established for the model using Cronbach’s alpha (.95). The reliability was also established with Cronbach’s alpha for the five sub-scales of the model. These
included familiarization (.58), utilization (.91), integration (.90), reorientation (.85) and evolution (.82). This research used 23 of the 46 questions from the TTI-R to assign each teacher a score on the five stages of Welliver’s model using the teachers’ responses to the TTI-R.

Conclusions

Teacher Change on Welliver’s Model

The teachers’ pretest and posttest scores were evaluated and showed a significant increase in overall technology use. This was determined by comparing the means of the teachers’ pretest and posttest TTI-R scores on Welliver’s Instructional Transformation Model. These findings support earlier research that suggest teachers increase the use of technology with increased exposure to technology (Becker, 1999; Besalel, 2004). Technology exposure can occur through job requirements, such as online communication and classroom management tools as well as through personal demands. Since 2001, there has been a dramatic increase of consumer-based technology such as online banking, shopping, and customer service. Technology influences outside of the classroom have readily led to increased interest and use of technology within the classroom.

During the four years covered by this study, the availability of computer-based educational resources has dramatically increased (National Educational Technology Plan, 2005). Faster connectivity and improved software has broadened online opportunities for teachers and students. Teachers are now able to join supportive online communities of educators as they integrate technology in the classroom. According to the literature, membership in a community of educators to share, reflect and develop a technology vision
with other professionals is central to technology integration in the classroom (Seels, et al., 2003).

The increased availability of online ready-made educational resources found in traditional tools such as textbooks and professional journals has made the role of integrating technology into the curriculum easier. For example, during the four years covered by this study the number of digital resources on the Library of Congress Website has grown from two million to 10 million. According to Morote (2004), added technology support, such as ready-made resources, increases the teachers’ ability to integrate technology into the classroom.

Teacher Change on the Stages of Welliver’s Model

The only variable investigated in this study that had significant change for the total model change score as well as at four stages of the model was a teacher’s years of teaching experience. The data suggest that the number of years of teaching experience is positively correlated with the integration of technology as measured by the TTI-R ($p < .05$). This was determined by identifying the correlation coefficient between the total model change score and the variable, years of teaching experience (.532). For most teachers participating in the study, the more years of experience the teacher had, the greater the teacher’s change on Welliver’s model (Figure 4).
Figure 4: Comparison of Individual Teachers’ Change Score on Welliver’s Instructional Transformation Model and Years of Teaching Experience (n=35)

These findings are supported by Oliver’s (2003) study where teachers with more teaching experience had less concerns in the last three stages of the Concerns Based Adoption Model. These findings are in contrast to previous studies which did not find teaching experience to be a significant factor for the use of technology in the classroom (Bianchi, 1996; Marcinkiewicz & Grabowski, 1992; Stein, McRobbie, & Ginns, 2002).

One reason for the significant relationship between years of teaching experience and change in technology use in the classroom may be that the more experienced teachers had weaker technology skills at the beginning of the study. Due to the rapid changes in
technology, more experienced teachers are further removed from the emphasis on technology integration by schools of education than newly graduated teachers (Day, Janus, & Davis, 2005). Eighty-one percent of the study participants had four or more years of teaching experience in 2001. This finding supports Mouza’s (2002) findings that as the teachers’ technology competency improved their understanding of using computers in the classroom increased.

Experienced teachers having more content knowledge and classroom management experience may be better able to focus on learning new technology. Previous studies reveal that teachers who have successfully integrated technology into the classroom focus more on the content than on the technology (Franklin, 2004; Land, 1997; Wiburg, 1997). Additionally, novice teachers may need to master classroom management and content knowledge while also attempting to integrate technology. On the other hand, experienced teachers may be better able to focus on integrating technology into the classroom than on classroom control and content, which they have already mastered.

Another factor allowing experienced teachers to integrate technology in the classroom may be the teachers’ teaching philosophy (Novick & Grimstad, 1999; Peck & Dorricott, 1994; Tapscott, 1999; Wiburg, 1997). While student-centered classrooms appear to be chaotic because of the individualized activities, experienced teachers can quickly shift the students to one focal point when necessary. In reality, these classrooms require teachers who have very strong classroom management techniques. Teachers in these classrooms tend to have a more constructive teaching style which has been identified in the literature to be central to technology integration in the classroom (Hale, 2002; Sandholtz, Ringstaff, & Dwyer, 1997).
Traditionally, classrooms have been more teacher-centered and the integration of technology requires teachers’ philosophy of how people learn and their role within the classroom to change. Cheney-Cullen and Duffy (1998) found support from other teachers a major factor in teachers moving toward a more student-centered classroom. The Adventure of the American Mind program had a teacher support component built into the program. Therefore each teacher had onsite peer support for creating a technology rich classroom. This added peer support might have enabled teachers to change their role from a sage to a guide, as required in a student-centered classroom.

Of the five stages on Welliver’s model, four of the seven variables investigated were significant in at least one or more of the stages. Teaching experience was the only variable found as a significant factor impacting technology integration by teachers on four stages on Welliver’s model. The significant correlation coefficients for each stage of Welliver’s model and the variable, teaching experience were utilization, (.472), integration (.460), reorientation (.417), and evolution (.403). The remaining variables with significant correlation coefficients are discussed below.

*Stage one: Familiarization.* Hours of staff development in technology integration, was the only variable found to be significant at the familiarization stage of Welliver’s model (.491). A possible reason for this finding may be that staff development typically only covers basic skills such as creating and editing documents and increasing comfort with technology. While the research has shown that the most effective staff development encompasses opportunities for teachers to observe, use, and reflect on effective technology use in the classroom, most staff development does not include these activities (Barnett, 2003; Birman et
al, 2000; Wenglinsky, 2002). This may be due to a lack of funding and allocation of resources.

The fast changing pace of technology forces professional development providers to constantly prepare teachers to use new software that support the curriculum rather than expanding the training to incorporate more sophisticated applications of the existing software. The literature has found, however, that professional development that focuses on only basic skills does not change technology use in the classroom (Birman, et al., 2000). This need to constantly train teachers in new software programs at the introductory level reduces the effectiveness of staff development as a tool for improving integration of technology in the classroom. The teachers in this study may have overcome this dilemma by using other means to advance their skills beyond the introductory level. These may include mentoring relationships, collaborative teams within schools, online support groups, and other self-selected training that would not be classified as professional development (Birman, et al., 2000; Dietrich, 2003; Gitomer & Latham, 2000; Peitenati, Giuli & Abou Khaled, 2001; Wenglinsky, 2001).

Stage two: Utilization. The teachers’ perceived support for technology by the school principals’ technical knowledge (.387) and instructional knowledge (.377) were variables found to be significant at the utilization stage of Welliver’s model. This may be because the primary technology activities of teachers at this stage are typically administrative in nature and include the development and management of electronic grade books and attendance records. While this minimal integration of technology into the classroom is generally mandated at the school district level and is beyond the control of the school principal, it is important to the principal that all of the teachers are competent at this level. However, it may
not be important to the principal for his or her teachers to advance beyond this stage of Welliver’s model at the expense of other competing priorities such as end-of-grade testing.

The teachers’ positive perception of the principals’ instructional knowledge may come from the principals’ overall support for increasing the teachers’ use of technology. The principals’ vision for instructional technology may raise the expectations for the use of technology by teachers as an educational tool. Studies have found that teachers meet the technology integration expectations of the principal when these expectations are clearly established (Mills & Tincher, 2003; Suh, date unavailable). The principals’ vision may also be demonstrated by the encouragement of lead teachers to fulfill the role of technology mentors within the school. This leadership may foster the establishment of a school-based community that encourages beginning technology users with a safe environment to observe, discuss, and apply different teaching practices which utilize technology in the classroom (Andrews & Crowther, 2002; Mills & Tincher, 2003).

Stage four: Reorientation. The variable, level of education completed by the teacher (.340) was found to be significant at the reorientation stage of Welliver’s model. The level of technology incorporated in the advanced degree by the teachers may be directly related to obtaining the degree after being comfortable with content as a classroom teacher and using technology as a student in an advanced degree program. In addition, teachers who have advanced degrees may have obtained these degrees while concurrently teaching in the classroom and use techniques modeled by faculty and peers in their graduate school coursework. Another factor may be that teachers who seek additional education might also be more likely to advance their computer skills within and outside of the formal coursework.
Studies report the openness to change, such as attempting an advanced degree, to be an important characteristic for successful technology integration (Wenglinsky, 2002).

Implications

1. The intention of this study was to align the TTI-R with Welliver’s Instructional Transformation Model. This alignment provides professional development trainers with a tool to place teachers on Welliver’s model (Appendix Y). This placement also allows professional development planners to prepare instruction that focuses on teachers’ specific needs as identified through the instrument.

2. Additionally, this study investigated teachers’ change in technology use in the classroom over four years. The study found that teachers increase their technology use in the classroom with increased exposure to technology through a three-semester hour graduate class in technology integration, a summer institute in technology integration, and a semester-long period mentoring another teacher on integrating technology into the classroom.

3. Seven variables identified in the literature to be significant in a teacher’s technology use in the classroom were investigated. Of these, years of teaching experience was found to positively impact teachers’ change in the use of technology in the classroom. This occurred for the total model and at four stages of the Instructional Transformation Model. This conclusion supports previous research concerning teacher experience.

4. The variable, hours of staff development, was significant only at the familiarization stage of Welliver’s model. The lack of significance at other stages on the model may be due to the changes that technology access has brought about in the availability of
staff development during the four years covered by the study. The variables, principals’ knowledge of technology and its use in the classroom were significant only at the utilization stage of Welliver’s model. The variable, level of education completed by the teacher was only significant at the reorientation stage of the model.

5. The variables, presence of hardware assistance at the teachers’ school, the ratio of students to computers in the classroom, and number of computers available for student use in the classroom that were connected to the Internet were not found to be significant at any stage on Welliver’s model. Additionally, the variable, principals’ financial support of the teachers’ integration of technology into the classroom was also not significant at any stage on the model.

Recommendations for Further Research

1. Further study is needed to determine what factors in teachers’ experiences increase the integration of technology in the classroom.

2. The study should be replicated with a random selection of teachers to confirm the value found in this study of the TTI-R as a tool for evaluation of technology integration. The teachers participating in this study volunteered and this may have affected their motivation to integrate technology into the classroom.

3. Further research is needed on the effects of non-traditional professional development such as mentoring, collaborative teams, on-line support groups and self-selected learning. The research did not find the hours of professional development to be a significant factor in technology integration by teachers, yet the teachers displayed significant change in technology use in the classroom.
4. This study did not find the principals’ support of technology to be a significant factor for technology integration into the classroom. Further investigation is suggested into the principals’ role in technology rich environments.

5. Additional research to identify which components of advanced degrees increase the use of technology in the classroom. This study found the teachers’ level of education a significant variable in technology integration at the reorientation stage on Welliver’s model, but was not able to explain this finding with the data gathered in the study.

6. Further research is needed to investigate the effect of serving as a technology mentor has on the change of technology use in the classroom by the technology mentor.

Recommendations for Practical Application

1. Encourage school administrators to use years of teaching experience when forming mentoring teams for technology professional development.

2. Use the TTI-R with the Instructional Transformation Model to determine professional development needs of teachers.

3. Focus staff development funds for technology integration on curriculum specific areas.
References


Atkins, N., & Vasu, E. (May, 1998). The teaching with technology instrument: Effectively measuring where teachers are and planning for staff development. *Learning and
Leading with Technology, 25(8), 35-39.

http://www.infotoday.com/mmSchools/nov00/ballard.htm


Research Association, Seattle, WA.


Cradler, J. (2002) Implementing technology in education: Recent findings from research and
evaluation studies. Retrieved July 21, 2002,
http://www.wested.org/techpolicy/recapproach.html

Cradler, J., & Bridgforth, E. (2002). Effective site level planning for technology integration.
WestEd: Technology Policy, Research & Planning, Information & Resources. Online:
http://www.wested.org/techpolicy/planning.html

Cuban, L. (1993). How teachers taught: Constancy and change in American classrooms,

Retrieved from U. S. Census Bureau website on March 15, 2005 from
http://www.census.gov/population/www/socdemo/computer.html

Dexter, S., Seashore, K., & Anderson, R. (2002). Contributions of professional community to
exemplary use of ICT. Journal of Computer Assisted Learning, 18(4), 489-497.

Dietrich, K. (2003). Professional experiences that impact teachers’ beliefs and practices
regarding technology integration: A case study. (Doctoral dissertation, Capella


Dooley, K.E. (1999). Towards a holistic model for the diffusion of educational technologies:
An integrative review of educational innovation studies. Educational Technology &
Society, 2(4), 35-45.

year teacher’s technology use: Three perspectives. Paper presented at Society of
Information Technology for Educators conference, Atlanta, GA.

Leadership, 51(7), 4–10.


Guha, S. (2000). Are we all technically prepared? Teachers' perspective on the causes of comfort or discomfort in using computers at elementary grade teaching. Paper presented at the Annual Meeting of the National Association for the Education of
Young Children (Atlanta, GA, November 8-11, 2000). (ERIC Document Reproduction Service No. ED456101)


Technology Use by K-12 Teachers

Teachers: Preparing Teachers to Use Technology. Eugene, OR: International Society for Technology in Education.


Information Technology for Educators Conference, Atlanta, GA.


http://www.nationaledtechplan.org


Available: https://etd.wvu.edu/etd/etdDocumentData.jsp?jsp_etdId=1302


Technology Use by K-12 Teachers

Technology and Teacher Education, 9(2), 153.


Technology Use by K-12 Teachers

curriculum and local culture: Acknowledging the primacy of classroom culture.  

*Science Education, 87*, 468-489.


Appendices
Appendix A: School’s Benefits and Requirements of Participation

Adventures of the American Mind: A Local Community Initiative
Integrating Technology and the Library of Congress “American Memory” Resources

Project Requirements:
Teachers:
♦ Attend a 3-semester hour graduate class (Education 504)
♦ Attend a 1-week summer institute
♦ Teach another teacher the technology skills for curriculum integration
during the 2002-2003 academic year
Schools:
♦ Select an assistant teacher to receive technology trouble-shooting training
♦ Internet access in selected teachers’ rooms

Project Benefits:
Teacher:
♦ Gateway Laptop computer
♦ Three hour graduate class (Education 504)
♦ One week Summer Institute
Schools:
♦ Two 3-hour technology-troubleshooting workshops for an assistant teacher
♦ Four teachers with improved technology skills for curriculum integration

Application Process:
Introduction:
♦ Inform faculty of opportunity (faculty meeting or information sheet)
Application:
♦ Submit completed application and one-page vision statement
♦ Mail in pre-paid mailer on or before November 1, 2001
Selection:
♦ Teachers are selected on principal’s recommendation
♦ Principal and selected teacher will be notified by November 15, 2001
♦ Selected teacher confirm acceptance on or before December 1, 2001

Course Description:
Education 504
A technology-centered course planned for study of instructional programs in
the content areas; objectives including but not limited to Library of Congress
primary resource application; materials; techniques; current research; and their
application in public school setting.
Appendix B: Teacher’s Application for Participation with Grant

Teacher Participation Application-Summer 2001

It is very important that you fill in ALL the information requested in the following table.

<table>
<thead>
<tr>
<th>Name:</th>
<th>School System:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certification Area:</td>
<td>School:</td>
</tr>
<tr>
<td>Grade Level:</td>
<td>Subject Area:</td>
</tr>
<tr>
<td>Years of Teaching Experience:</td>
<td>Highest Degree Completed:</td>
</tr>
<tr>
<td>Average Class Size:</td>
<td>Email:</td>
</tr>
<tr>
<td>Home Phone:</td>
<td>Home Address:</td>
</tr>
<tr>
<td>Work Phone:</td>
<td></td>
</tr>
</tbody>
</table>

Please complete the chart below pertaining to your classroom’s access to technology.

<table>
<thead>
<tr>
<th>Classroom Computer Information</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many computers with CD-ROMs are in your classroom?</td>
<td></td>
</tr>
<tr>
<td>How many ink-jet printers are in your classroom?</td>
<td></td>
</tr>
<tr>
<td>How many computers in your classroom are connected to the Internet?</td>
<td></td>
</tr>
<tr>
<td>Does your classroom have access to an LCD or multimedia projector?</td>
<td></td>
</tr>
<tr>
<td>How many of the computers in your classroom have Windows 95/98 or Microsoft Office?</td>
<td></td>
</tr>
<tr>
<td>Is your classroom connected to the Internet (circle one)?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Description of An Adventure of the American Mind Vision: Please attach a proposal (one page or less) describing your vision for using technology in your classroom, and how you are using technology now.

If you have any questions please contact the “An Adventure of the American Mind” project manager, or assistant project manager, at or text.
Appendix C: Summer Institute Syllabus

### Day 1

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>MG 118</td>
<td>Introduction</td>
</tr>
<tr>
<td>9:45</td>
<td>MG 102 &amp; 219</td>
<td>Microsoft Basics</td>
</tr>
<tr>
<td>10:30</td>
<td>Lobby</td>
<td>Break</td>
</tr>
<tr>
<td>10:45</td>
<td>MG 102 &amp; 219</td>
<td>Microsoft Basics (Continued)</td>
</tr>
<tr>
<td>12:00</td>
<td>Myers Dining Hall</td>
<td>Lunch</td>
</tr>
<tr>
<td>1:15</td>
<td>MG 219</td>
<td>Thematic Unit Overview</td>
</tr>
<tr>
<td>2:30</td>
<td>Lobby</td>
<td>Break</td>
</tr>
<tr>
<td>2:45</td>
<td>MG 102 &amp; 219</td>
<td>Creating Your Thematic Unit</td>
</tr>
<tr>
<td>4:45</td>
<td>MG 102 &amp; 219</td>
<td>Evaluation</td>
</tr>
</tbody>
</table>

### Day 2

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>MG 219</td>
<td>Use of Primary Resources</td>
</tr>
<tr>
<td>9:45</td>
<td>MG 102 &amp; 219</td>
<td>Scavenger Hunt in the Library of Congress</td>
</tr>
<tr>
<td>10:30</td>
<td>Lobby</td>
<td>Break</td>
</tr>
<tr>
<td>10:45</td>
<td>MG 219</td>
<td>Search Strategies on the Library of Congress</td>
</tr>
<tr>
<td>12:00</td>
<td>Myers Dining Hall</td>
<td>Lunch</td>
</tr>
<tr>
<td>1:15</td>
<td>MG 219</td>
<td>Spin City</td>
</tr>
<tr>
<td>2:30</td>
<td>Lobby</td>
<td>Break</td>
</tr>
<tr>
<td>2:45</td>
<td>MG 102 &amp; 219</td>
<td>Electrifying Your Thematic Unit</td>
</tr>
<tr>
<td>4:45</td>
<td>MG 102 &amp; 219</td>
<td>Evaluation</td>
</tr>
</tbody>
</table>

### Day 3

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>MG 219</td>
<td>Welcome and Goals for the Day</td>
</tr>
<tr>
<td>9:45</td>
<td>MG 102 &amp; 219</td>
<td>Electrifying Your Thematic Unit (Continued)</td>
</tr>
<tr>
<td>10:30</td>
<td>Lobby</td>
<td>Break</td>
</tr>
<tr>
<td>10:45</td>
<td>MG 102 &amp; 219</td>
<td>Electrifying Your Thematic Unit (Continued)</td>
</tr>
<tr>
<td>12:00</td>
<td>Myers Dining Hall</td>
<td>Lunch</td>
</tr>
<tr>
<td>1:15</td>
<td>MG 102 &amp; 219</td>
<td>Electrifying Your Thematic Unit (Continued)</td>
</tr>
<tr>
<td>2:30</td>
<td>Lobby</td>
<td>Break</td>
</tr>
<tr>
<td>2:45</td>
<td>MG 102 &amp; 219</td>
<td>Electrifying Your Thematic Unit (Continued)</td>
</tr>
<tr>
<td>3:30</td>
<td>MG 219</td>
<td>Presentations and Evaluation</td>
</tr>
</tbody>
</table>
Appendix D: Train-the-Trainer Model

Key

Library of Congress Support Staff  Support from the Library of Congress for training materials and financial resources

Adventure of the American Mind Support Staff  Organization of 4 Clusters with each training teachers in an assigned region and collaborating to provide professional development and programming

AAM Cluster Coordinator  Director of the AAM Program

AAM Trained Teachers  Completed a 3-semester hour graduate class and summer institute on technology integration

Teacher Trained Mentees  Trained by AAM teachers

Students Impacted  Students in the classrooms of AAM trained teachers and mentees
Appendix E: Supplemental Posttest Questionnaire

Select the response that best answers each of the following questions.

1. How many hours of staff development in technology integration have you received since January 1, 2002?
   
   1. 2. 3. 4. 5.
   8 or less 9-17 18-26 27-35 More than 35

2. How many computers available for student use in your classroom connected to the Internet
   
   1. 2. 3. 4. 5.
   1 or 2 3 or 4 5 or 6 7 or 8 9 or More

3. How many hours per week that you have technical assistance with hardware at your school
   
   1. 2. 3. 4. 5.
   1-5 hours 6-10 hours 11-20 hours 21-40 hours 41 hours or more

4. “Does your principal...”
   a. seem knowledgeable about technology?
      
      1. 2. 3. 4. 5.
      Not at All Somewhat Average Strong Very Strong

   b. seem knowledgeable about the use of technology in instruction?
      
      1. 2. 3. 4. 5.
      Not at All Somewhat Average Strong Very Strong

   c. support you in your efforts to integrate technology into your classroom by providing you with funds (when available) to attend conferences, purchase software, etc.? “(Atkins & Vasu, 1999)
      
      1. 2. 3. 4. 5.
      Not at All Somewhat Average Strong Very Strong


This survey is part of the graduate research for Pamela M. Johnson, a doctoral student in the Adult and Community College Program at North Carolina State University. Thank you for your participation.
Appendix F: Teaching with Technology

Part I Introduction and Background on Integrating Technology in Education

Figure 2.4 The North Carolina Teaching with Technology Instrument

**TEACHING WITH TECHNOLOGY INSTRUMENT**

Instructions: The purpose of these questions is to examine the current status of your task, understanding, and use of technology in your classroom. Please read each statement and indicate whether you possess that skill by placing a check mark in either the yes or no box to the left.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Use a word processor to enter text, edit, change the format of a document, save and retrieve documents, check spelling, print documents, and use graphics tools.</td>
<td>🔺</td>
</tr>
<tr>
<td>2. Use desktop-publishing software to import text, format text and layout, and import graphics by producing a class newsletter.</td>
<td>🔺</td>
</tr>
<tr>
<td>3. Demonstrate how using computers enhances the writing process.</td>
<td>🔺</td>
</tr>
<tr>
<td>4. Compose and send e-mail to support classroom projects.</td>
<td>🔺</td>
</tr>
<tr>
<td>5. Understand the social, legal, and ethical issues related to telecommunications use.</td>
<td>🔺</td>
</tr>
<tr>
<td>6. Use telecommunications technology in the discipline subject for learning.</td>
<td>🔺</td>
</tr>
<tr>
<td>7. Understand how telecommunications technology can be used to meet the learning needs of students.</td>
<td>🔺</td>
</tr>
<tr>
<td>8. Plan writing/communication activities for computer labs and classrooms with one or multiple computer resources.</td>
<td>🔺</td>
</tr>
<tr>
<td>9. Demonstrate knowledge of installation of writing and telecommunications hardware/software and appropriate troubleshooting techniques.</td>
<td>🔺</td>
</tr>
<tr>
<td>10. Explore how higher order thinking skills and problem solving can be enhanced by writing/communication technology.</td>
<td>🔺</td>
</tr>
<tr>
<td>11. Apply understanding of physical settings, organizational and classroom management strategies that support active student involvement, inquiry, and collaboration.</td>
<td>🔺</td>
</tr>
<tr>
<td>12. Apply understanding of the goals of the North Carolina Computer Skills Curriculum as related to writing and communication.</td>
<td>🔺</td>
</tr>
<tr>
<td>13. For the title of a document, I can vary the typeface and size (e.g., I can use 16-point times rather than 10-point harvard).</td>
<td>🔺</td>
</tr>
<tr>
<td>14. Explain how to insert a forced page break into a document.</td>
<td>🔺</td>
</tr>
<tr>
<td>15. Use a spreadsheet by accessing an existing spreadsheet and creating a new spreadsheet to manage and interpret information.</td>
<td>🔺</td>
</tr>
<tr>
<td>16. Create a bar graph on the computer that is linked to a spreadsheet.</td>
<td>🔺</td>
</tr>
<tr>
<td>17. Enter a function in a spreadsheet cell.</td>
<td>🔺</td>
</tr>
<tr>
<td>18. Use a database by sorting an existing database and creating a new database to manage and interpret information.</td>
<td>🔺</td>
</tr>
<tr>
<td>19. Use telecommunications by accessing bulletin boards, online services, and the Internet.</td>
<td>🔺</td>
</tr>
<tr>
<td>20. Access resources for planning instruction available through telecommunications (e.g., experts, lesson plans, authentic data, and curriculum materials).</td>
<td>🔺</td>
</tr>
<tr>
<td>21. Understand differences between public domain, freeware, shareware, and commercial sources of software and browse telecommunications.</td>
<td>🔺</td>
</tr>
<tr>
<td>22. Understand role of media in effective communication.</td>
<td>🔺</td>
</tr>
<tr>
<td>23. Understand social, legal, and ethical issues related to information access and management.</td>
<td>🔺</td>
</tr>
<tr>
<td>24. Demonstrate the use of information access and management in the discipline subject for learning and as a medium for communication.</td>
<td>🔺</td>
</tr>
<tr>
<td>25. Understand the characteristics, strengths, and weaknesses of multimedia tools and techniques.</td>
<td>🔺</td>
</tr>
<tr>
<td>26. Demonstrate effective and appropriate use of computers and other technologies to communicate information in various formats for student learning to colleagues, parents, and others.</td>
<td>🔺</td>
</tr>
<tr>
<td>27. Understand how information and management can be used to meet the various learning styles of students.</td>
<td>🔺</td>
</tr>
<tr>
<td>28. Plan information access/management activities for computer labs and classrooms with one or multiple computer resources.</td>
<td>🔺</td>
</tr>
<tr>
<td>29. Demonstrate knowledge of installation of writing/communication hardware/software and appropriate troubleshooting techniques related to information access and management.</td>
<td>🔺</td>
</tr>
<tr>
<td>30. Explore how information access/management technology can enhance higher order thinking skills and problem solving.</td>
<td>🔺</td>
</tr>
<tr>
<td>31. Explain what WWW and internet mean within the telecommunications context.</td>
<td>🔺</td>
</tr>
<tr>
<td>32. Demonstrate/analyze another person's research on how access an e-mail account.</td>
<td>🔺</td>
</tr>
<tr>
<td>33. Understand how to set up and manage a telecommunications project between schools in different geographical areas.</td>
<td>🔺</td>
</tr>
<tr>
<td>34. Effectively use distance learning, online conferences related to professional information needs, desktop telecommunications, and tele-teaching technologies.</td>
<td>🔺</td>
</tr>
<tr>
<td>35. Develop and demonstrate a lesson plan that requires students to locate and analyze information as well as draw conclusions and use a variety of media to communicate results clearly.</td>
<td>🔺</td>
</tr>
<tr>
<td>36. Apply understanding of the goals of the North Carolina Computer Skills Curriculum related to information access and management.</td>
<td>🔺</td>
</tr>
<tr>
<td>37. Demonstrate/analyse a knowledge of technology/telecommunication hardware/software and ability to use appropriate technology.</td>
<td>🔺</td>
</tr>
<tr>
<td>38. Demonstrate/analyse a knowledge of telecommunications that support active student involvement, inquiry, and collaboration.</td>
<td>🔺</td>
</tr>
<tr>
<td>39. Understand differences between public domain, freeware, shareware, and commercial sources of software and browse telecommunications.</td>
<td>🔺</td>
</tr>
<tr>
<td>40. Understand social, legal, and ethical issues related to multimedia production.</td>
<td>🔺</td>
</tr>
<tr>
<td>41. Use and understand the differences between linear multimedia presentation and nonlinear multimedia presentation. Understand terms such as media, multimedia, hypertext, and digital media.</td>
<td>🔺</td>
</tr>
<tr>
<td>42. Demonstrate multimedia use in the discipline subject for learning and as a medium for communication.</td>
<td>🔺</td>
</tr>
<tr>
<td>43. Understand how multimedia production can be used to meet various learning styles of students.</td>
<td>🔺</td>
</tr>
<tr>
<td>44. Plan multimedia activities for computer labs and classrooms with one or multiple computer resources.</td>
<td>🔺</td>
</tr>
<tr>
<td>45. Plan a lesson incorporating appropriate technology that includes use of productivity software, online resources, or both.</td>
<td>🔺</td>
</tr>
<tr>
<td>46. Explore how multimedia production can enhance higher order thinking skills and problem solving.</td>
<td>🔺</td>
</tr>
<tr>
<td>47. Apply understanding of the goals of the North Carolina Computer Skills Curriculum related to multimedia production.</td>
<td>🔺</td>
</tr>
</tbody>
</table>

An ISTE Copy Me Page

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Appendix G: Teaching with Technology – Revised

Teaching with Technology Instrument

Answer each item by darkening the appropriate number for that item on the attached Scantron®.

1 = Always       2 = Usually       3 = Sometimes       4 = Rarely       5 = Never

1. Use a word processor to enter text, edit, change the format of a document, save and retrieve documents, check spelling, print documents, and use graphics tools.
2. Use desktop-publishing software to import text, format text and layout, and import graphics by producing a class newsletter.
3. Demonstrate how word processing enhances the writing process.
4. Compose and send e-mail to support classroom projects.
5. Understand the social, legal, and ethical issues related to telecommunication use.
6. Use writing/communication technology in the discipline/subject for learning
7. Understand how writing/communication technology can be used to meet the learning styles of students.
8. Plan writing/communication activities for computer labs and/or classrooms with one or multiple computer resources.
9. Demonstrate knowledge of installation of writing and telecommunication hardware/software and appropriate troubleshooting techniques.
10. Explore how higher order thinking skills and problems solving can be enhanced by writing/communication technology.
11. Apply understanding of physical settings, organizational and classroom management strategies that support active student involvement, inquiry, and collaboration.
12. Apply understanding of the goals of the North Carolina Computer Skills Curriculum as related to writing and communication.
13. For the title of a document, I can vary the typeface and size (e.g., I can use 18 point Times rather than 10 point Helvetica).
14. Explain how to insert a forced page break into a document.
15. Use a spreadsheet by accessing an existing spreadsheet and creating a new spreadsheet to manage and interpret information.
16. Create a bar graph on the computer that is linked to a spreadsheet.
17. Enter a function in a spreadsheet cell.
18. Use a database by sorting an existing database and creating a new database to manage and interpret information.
19. Use telecommunications by accessing bulletin boards, online services, and the Internet.
20. Access resources for planning instruction available through telecommunications (e.g., experts, lesson plans, authentic data, and curriculum materials).
21. Understand differences between public domain, freeware, shareware, and commercial sources of software.
22. Understand the role of media in effective communication.
23. Understand social, legal, and ethical issues related to information access and management.
24. Demonstrate the use of information access and management in the discipline/subject for learning and as a medium for communication.
25. Understand the characteristics, strengths, and weaknesses of media-communication tools and techniques.
26. Demonstrate effective and appropriate use of computers and other technologies to communicate information in a variety of formats on student learning to colleagues, parents, and others.
27. Understand how information access and management can be used to meet the various learning styles of students.
28. Plan information access/management activities for computer labs and classrooms with one or multiple computer resources.
29. Demonstrate knowledge of installation of hardware/software and appropriate troubleshooting techniques as related to information access and management.
30. Explore how information access/management technology can enhance higher order thinking skills and problem solving.
31. Explain what WWW and Veronica mean within the telecommunications context.
32. Demonstrate or explain to another person how to access an e-mail account.
33. Understand how to set up and manage a telecommunications project between schools in different geographical area.
34. Effectively use distance learning, online conferences relevant to professional information needs, desktop teleconferencing, and tele-teaching technologies.
35. Demonstrate development of performance tasks that require students to locate and analyze information as well as draw conclusions and use a variety of media to communicate results clearly.
36. Apply understanding of the goals of the North Carolina Computer Skills Curriculum as related to information access and management.
37. Demonstrate knowledge of installation of hardware/software and troubleshooting techniques (i.e., CD-ROMs, laserdisc players, LCD panels, television monitors, video equipment, scanners, digital cameras, and teleconferencing equipment.
38. Understand differences between public domain, freeware, shareware, and commercial sources of software and review copyright laws to ensure compliance with copyright law, fair-use guidelines, security, and child protection.
39. Understand social, legal, and ethical issues related to multimedia production.
40. Use and understand the differences between linear multimedia presentation and nonlinear multimedia presentation. Understand terms such as media, multimedia, hypermedia, and clip media.
41. Demonstrate multimedia use in the discipline/subject for learning and as a medium for communication.
42. Understand how multimedia production can be used to meet the various learning styles of students.
43. Plan multimedia activities for computer labs and/or classrooms with one or multiple computer resources.
44. Plan a lesson incorporating appropriate technology that included use of productivity software, online resources, or both.
45. Explore how multimedia production can enhance higher order thinking skills and problem solving.
46. Apply understanding of the goals of the North Carolina Computer Skills curriculum as related to multimedia production.
Appendix H: Panel of Experts Membership

First Panel of Experts (n=21):

- College professors holding terminal degrees that were teaching technology integration and were published in a refereed journal on technology integration

Second Panel of Experts (n=8):

Group One (n=3):

- Recent doctoral graduates in the NCSU Curriculum & Instruction that are currently working with K-12 teachers on technology integration

Group Two (n=5):

- Technology Specialists from University of North Carolina System Universities who are knowledgeable of North Carolina certification requirements for technology integration in the K-12 schools
Appendix I: Snapshot of Online TTI-R for Alignment with Welliver’s *Instructional Transformation Model*

**Teaching with Technology - Panel of Experts**

Thank you for agreeing to serve as a subject matter expert for my doctoral research. As a member of the Panel of Experts, you will place each of the 46 questions on the Teaching with Technology Instrument on one of the 5 stages of Welliver’s Instructional Transformation Model.

Welliver's Instructional Transformation Model proposes that teachers go through 5 stages as they integrate technology into their classrooms. The Description of Stages on Welliver's Instructional Transformation Model will provide sample activities of teachers at each stage of the model.

The Teaching with Technology Instrument was created in 1995 by staff development personnel in a school system to be used as a tool during technology staff development. Due to the age of the instrument, some terms may be outdated. If you feel this would impact a teacher's understanding of the question, please select the choice "Does not fit model".

At the end of this survey, there is space provided for your comments on any questions in the survey as well as suggestions for additional questions which you feel have not been addressed in the survey.

Each question is followed by the five stages in Welliver's Instructional Transformation Model and a choice of "Does not fit model". The choices are:

- Familiarization
- Utilization
- Integration
- Reorientation
- Evolution
- Does not fit model

[Click here for a pdf copy of the Teaching with Technology Instrument](#)

[Click here for a pdf copy of the activities of teachers at each stage on Welliver's Instructional Transformation Model](#)

I greatly appreciate you taking the time to complete this survey. If you would like to know the results of this survey, please provide your e-mail in the last question of the survey.

This information is confidential and will only be used in completion of my doctoral research for North Carolina State University, Adult and Community College Education department.
Appendix J: E-mail Request to Serve on the Panel of Experts

Dear [FirstName] [LastName],

I am a doctoral candidate at North Carolina State University and need your assistance in conducting my study. You have been identified as an expert in the field of technology integration because of your recent publication in [CustomData].

As a part of my doctoral research, I need to have a panel of experts in technology integration place each question on the Teaching with Technology Instrument at a stage on Welliver’s Instructional Transformation model. This process should take around 20 minutes to complete.

If you are willing to serve on this panel, please go to [SurveyLink].
The password is: memory

On the survey, you will have directions for aligning the instrument with the model, a link to a pdf copy of the Teaching with Technology Instrument and a description of teachers’ activities at each stage on Welliver’s Instructional Transformation model.

I greatly appreciate your assistance and will be glad to notify you with the results of the panel of experts as well as the findings on this study.

Sincerely,
Pamela M. Johnson
Doctoral Student
North Carolina State University

Link to the survey: [SurveyLink]
Password: memory

Please note: If you do not wish to receive further emails from me, please click the link below, and you will be automatically removed from the Panel of Experts.

[RemoveLink]
Appendix K: Description of Stages on Welliver’s Model for Panel of Experts

<table>
<thead>
<tr>
<th>Stage</th>
<th>Skills Exhibited</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Familiarization</strong></td>
<td>A teacher at this stage:</td>
</tr>
<tr>
<td></td>
<td>• First exposed to a new technology.</td>
</tr>
<tr>
<td></td>
<td>• Focused on how to use the hardware and software. Hardware items may include things as basic as turning on the computer, connecting a printer to the computer, and generally preparing the computer for use as a tool. Software items may include how to open, save, and retrieve as well as manipulate the appearance of documents.</td>
</tr>
<tr>
<td></td>
<td>• Sees technology as another task to be completed as a part of their job</td>
</tr>
<tr>
<td></td>
<td>• Sees the training required to learn these new skills as a drain on their schedule</td>
</tr>
<tr>
<td></td>
<td>• Impressed with graphics and word processing capabilities</td>
</tr>
<tr>
<td></td>
<td>• Aware of the availability of digitized documents and how they can be used to enhance learning in the classroom</td>
</tr>
<tr>
<td></td>
<td>• Acquainted with computers and terminology</td>
</tr>
<tr>
<td></td>
<td>• Teachers in this stage focus on basic skills during professional development</td>
</tr>
<tr>
<td><strong>Utilization</strong></td>
<td>A teacher at this stage:</td>
</tr>
<tr>
<td></td>
<td>• Uses technology, but technology is not required as a part of the daily classroom activities.</td>
</tr>
<tr>
<td></td>
<td>• Begins to use of additional hardware such as cameras, scanners, and LCD projectors.</td>
</tr>
<tr>
<td></td>
<td>• Uses for educational activities – not committed to use.</td>
</tr>
<tr>
<td></td>
<td>• Begin to use the computer resources as supplemental material in the classroom. If the technology fails, the class will continue without problem</td>
</tr>
<tr>
<td></td>
<td>• Applies technical skills to some of their current practices</td>
</tr>
<tr>
<td></td>
<td>• Uses computers for classroom management needs</td>
</tr>
<tr>
<td></td>
<td>• Uses subject focused computer games to reinforce learning.</td>
</tr>
<tr>
<td></td>
<td>• Teachers in this stage focus on instructional strategies during professional development</td>
</tr>
<tr>
<td><strong>Integration</strong></td>
<td>A teacher at this stage:</td>
</tr>
<tr>
<td></td>
<td>• Uses curricula which requires that technology be used in the classroom</td>
</tr>
<tr>
<td></td>
<td>• Sees the impact technology has on student learning</td>
</tr>
<tr>
<td></td>
<td>• Requires technology for instruction</td>
</tr>
<tr>
<td></td>
<td>• Experiments letting students make small decisions regarding lessons</td>
</tr>
<tr>
<td></td>
<td>• Moves toward using project-based activities</td>
</tr>
<tr>
<td></td>
<td>• Requires students to access the Internet to complete the assignments</td>
</tr>
<tr>
<td></td>
<td>• Guides student activities by specifying the resources and Internet sites</td>
</tr>
<tr>
<td></td>
<td>• Appreciates the diversity of Internet activities</td>
</tr>
<tr>
<td></td>
<td>• Begins role change to co-learner with the students</td>
</tr>
<tr>
<td></td>
<td>• Collaborates with colleagues</td>
</tr>
<tr>
<td></td>
<td>• Uses textbooks as a guide for instructional topics</td>
</tr>
</tbody>
</table>
Appendix K: Description of Stages on Welliver’s Model for Panel of Experts (continued)

Reorientation  A teacher at this stage:
  • Organizes classroom activities around resources available through technology
  • Reorients relationship with technology
  • Views technical competencies as secondary to the curriculum
  • Changes learning responsibilities for students and self
  • Classroom activities are organized around resources available through technology
  • Views learners and learning tasks in different ways
  • Arranges classroom physical layout so it is not directed toward a central point
  • Collaborates with stakeholders as well as colleagues in the educational process
  • Classes appear to be noisy and disjointed
  • Technology as a necessary part of the classroom
  • Values the greater classroom participation and increased critical thinking
  • Serves as a technology leader to colleagues
  • Encourages administrators to support technology through incentives such as additional planning time, training and technical support.
  • Encourages student roles of directing their learning path and controlling lesson goals and final products

Evolution  A teacher at this stage:
  • Explores new technologies
  • Reflects ways to incorporate new technologies into the classroom
  • Collaborates with educators outside of their immediate school or district
  • Accepts redefinition of roles
  • Continuously refining roles of teachers and students
  • Begins to transform technology, finding solutions in diverse and unlikely places
  • Takes a larger, more assertive role in incorporating new technologies in the educational setting
  • Serves as technology advocates to their colleagues
  • Advocate for creating and spreading the technology vision within the school system.
  • Applies technology tools learned to subject specific activities
  • Focuses on the pedagogy rather than the technology innovation
From: Pam Johnson [XXXXXXXXXXXXXXXX]
Sent: Wednesday, November 02, 2005 4:02 PM
To: Dr. [Last Name], Dr. [Last Name], and Dr. [Last Name]
Cc: Dr. [Last Name], Dr. [Last Name]
Subject: Request to Serve as a Technology Integration Expert
Importance: High

Drs. [Last Name],

Dr. [Last Name] gave me your names and e-mails as technology integration experts. As a part of my dissertation, I am aligning the Teaching with Technology Instrument with a model. I have placed each question on the model and need to have a panel of technology integration experts confirm this placement. The entire process is online through surveymonkey.com should take less than 15 minutes to complete.

If you are willing to help me, please respond to this e-mail and I will send you a link to the survey through Survey Monkey for the purpose of security and identification.

I am hoping to finish this stage by Friday, November 4th.

Thank you for considering helping me with my study.
Sincerely,
Pam Johnson
Appendix M: E-mail Sent to Revised Panel of Experts (Group 1) with Link to Online Survey

Dear [FirstName] [LastName],

Thank you for agreeing to serve as a member of my panel of experts for my dissertation.

As a member of this panel you will be confirming the placement of questions from an instrument on a model. This process should take around 15 minutes.

The password for the survey is....... memory
The link to the survey is..... [SurveyLink]

Thank you for your help with my study.

Sincerely,
Pam Johnson

Pamela M. Johnson
Doctoral Student
North Carolina State University

If you are unable to assist me, please click the following link: [RemoveLink]
Appendix N: Snapshot of Online Version of TTI-R for the Second Panel of Experts

Page One

**Instructional Transformation Model**

**Introduction to Model**

Thank you for agreeing to serve as a subject matter expert for my doctoral research. As a member of this panel, you will confirm the alignment of Welliver's Instructional Transformation Model with the Teaching with Technology Instrument (TTI).

Welliver's Instructional Transformation Model proposes that teachers go through 5 stages as they integrate technology into their classrooms. The stages of the model are:

- Familiarization
- Utilization
- Integration
- Reorientation
- Evolution

Page Two

**Instructional Transformation Model**

**Directions**

The Teaching with Technology Instrument (TTI) was originally scaled to fit a model of Technology Staff Development. The researcher, with assistance from educators with expertise in technology integration placed questions on the TTI on one of the 5 stages of Welliver's Instructional Transformation Model. Your task is to confirm their placement.

Each page of this survey is focused on one stage of the model. At the top of each page is a description of teachers' activities at that stage. Below that will be list of the questions on the TTI that the researcher and additional technology experts have placed on this stage of the model. You will be given the opportunity to select AGREE or DISAGREE after each question to confirm or reject the placement of questions relative to this stage of the model.

I greatly appreciate you taking the time to complete this survey.

This information is confidential and will only be used in completion of my doctoral research for North Carolina State University, Adult and Community College Education.
Appendix N: Snapshot of Online Version of TTI-R for the Second Panel of Experts

Page Three

<table>
<thead>
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<th>Instructional Transformation Model</th>
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</thead>
<tbody>
<tr>
<td><strong>Stage 1: Familiarization</strong></td>
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</tbody>
</table>

Teachers at the **Familiarization** stage focus on basic skills during professional development. Some of these basic skills include:

1. Turning on the computer
2. Creating, saving, and retrieving documents
3. Manipulating graphics and fonts in documents
4. Learning terminology used with computers
5. Becoming aware of how digitized documents can be used to enhance learning

If you agree that teachers who can answer **Yes** to the questions below are using technology skills described above, please check **Agree**.

* **1. For the title of a document, I can vary the typeface and size (e.g., I can use 10 point Times rather than 10 point Helvetica).**
  
<table>
<thead>
<tr>
<th>Agree</th>
<th>Disagree</th>
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<tbody>
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* **2. Explain how to insert a forced page break into a document.**
  
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<th>Disagree</th>
</tr>
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<tr>
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<td></td>
</tr>
</tbody>
</table>
Appendix O: Text for Online Version of TTI-R used by Revised Panel of Experts

Instructional Transformation Model

Stage 1: Familiarization

Teachers at this stage focus on basic skills during professional development. Some of these basic skills include:

1. Turning on the computer
2. Creating, saving, and retrieving documents
3. Manipulating graphics and fonts in documents
4. Learning terminology used with computers
5. Becoming aware of how digitized documents can be used to enhance learning

1. For the title of a document, I can vary the typeface and size (e.g., I can use 18 point Times rather than 10 point Helvetica).

2. Understand differences between public domain, freeware, shareware, and commercial sources of software.

3. Understand the characteristics, strengths, and weaknesses of media-communication tools and techniques.

4. Demonstrate or explain to another person how to access an e-mail account.
Appendix O: Text for Online Version of TTI-R used by Revised Panel of Experts (continued)

Instructional Transformation Model
Stage 2: Utilization

Teachers at this stage use technology for administrative requirements of the job, but not in the classroom. When classroom activities are planned using technology, if they technology does not work, the teacher can complete the activity without access to the technology. Some activities of teachers at this stage are:

1. Beginning use of peripheral hardware such as cameras, scanners, etc.
2. Supplement curricula with Internet resources
3. Use of subject focused computer games
4. Technology is not a required tool in the classroom

Questions:
1. Use a word processor to enter text, edit, change the format of a document, save and retrieve documents, check spelling, print documents, and use graphics tools.
2. Use desktop-publishing software to import text, format text and layout, and import graphics by producing a class newsletter.
3. Demonstrate knowledge of installation of writing and telecommunication hardware/software and appropriate troubleshooting techniques.
4. Use a spreadsheet by accessing an existing spreadsheet and creating a new spreadsheet to manage and interpret information.
5. Create a bar graph on the computer that is linked to a spreadsheet.
6. Enter a function in a spreadsheet cell.
7. Use a database by sorting an existing database and creating a new database to manage and interpret information.
8. Use telecommunications by accessing bulletin boards, online services, and the Internet.
9. Access resources for planning instruction available through telecommunications (e.g., experts, lesson plans, authentic data, and curriculum materials).
10. Demonstrate knowledge of installation of hardware/software and appropriate troubleshooting techniques as related to information access and management.
11. Apply understanding of the goals of the North Carolina Computer Skills Curriculum as related to information access and management.
12. Demonstrate knowledge of installation of hardware/software and troubleshooting techniques (i.e., CD-ROMs, laserdisc players, LCD panels, television monitors, video equipment, scanners, digital cameras, and teleconferencing equipment.
13. Use and understand the differences between linear multimedia presentation and nonlinear multimedia presentation. Understand terms such as media, multimedia, hypermedia, and clip media.
Appendix O: Text for Online Version of TTI-R used by Revised Panel of Experts (continued)

Instructional Transformation Model
Stage 3: Integration

At this stage, the teacher plans activities taken from existing curricula based on access to technology. If the technology fails, the lesson cannot be completed. A teacher in this stage would:
1. Provide students some decisions in learning decisions
2. Move toward project based activities for lessons
3. Specifies resources and Internet sites for students to use in the learning process
4. Collaborates with colleagues to achieve educational goals
5. Require students to have access to the Internet to complete assignment

Questions:
1. Demonstrate how word processing enhances the writing process.
2. Compose and send e-mail to support classroom projects.
3. Use writing/communication technology in the discipline/subject for learning
4. Apply understanding of the goals of the North Carolina Computer Skills Curriculum as related to writing and communication.
5. Demonstrate the use of information access and management in the discipline/subject for learning and as a medium for communication.
6. Demonstrate multimedia use in the discipline/subject for learning and as a medium for communication.
7. Understand how multimedia production can be used to meet the various learning styles of students.
8. Plan multimedia activities for computer labs and/or classrooms with one or multiple computer resources.
9. Plan a lesson incorporating appropriate technology that included use of productivity software, online resources, or both.
10. Apply understanding of the goals of the North Carolina Computer Skills curriculum as related to multimedia production.
Appendix O: Text for Online Version of TTI-R used by Revised Panel of Experts (continued)

Instructional Transformation Model
Stage 4: Reorientation

At teacher at this stage has become the guide rather than the sage to their students. Classroom activities are organized around resources available through technology. This is apparent through the following:

6. Classroom layout is not directed to a central point
7. Students have a central role in learning decisions
8. Collaborates with stakeholders as well as colleagues to achieve educational goals
9. Technical skills are required by not central to the curriculum

Questions:
1. Understand how writing/communication technology can be used to meet the learning styles of students.
2. Plan writing/communication activities for computer labs and/or classrooms with one or multiple computer resources.
3. Apply understanding of physical settings, organizational and classroom management strategies that support active student involvement, inquiry, and collaboration.
4. Demonstrate effective and appropriate use of computers and other technologies to communicate information in a variety of formats on student learning to colleagues, parents, and others.
5. Understand how information access and management can be used to meet the various learning styles of students.
6. Plan information access/management activities for computer labs and classrooms with one or multiple computer resources.
7. Explore how information access/management technology can enhance higher order thinking skills and problem solving.
8. Understand how to set up and manage a telecommunications project between schools in different geographical area.
9. Effectively use distance learning, online conferences relevant to professional information needs, desktop teleconferencing, and tele-teaching technologies.
10. Demonstrate development of performance tasks that require students to locate and analyze information as well as draw conclusions and use a variety of media to communicate results clearly.
11. Explore how multimedia production can enhance higher order thinking skills and problem solving.
Instructional Transformation Model
Stage 5: Evolution

A teacher at this stage is exploring new technology and ways to use in the classroom. This focus is not just on the teacher’s classroom but a more global vision of education in general. This is exhibited through:

1. Applies technology tools learned to subject specific activities
2. Focuses on the pedagogy rather than the technology innovation
3. Advocate for creating and spreading the technology vision within the school system.
4. Collaborates with educators outside of their immediate school or district
5. Takes a larger, more assertive role in incorporating new technologies in the educational setting

Questions:

1. Understand the social, legal, and ethical issues related to telecommunication use.

2. Explore how higher order thinking skills and problems solving can be enhanced by writing/communication technology.

3. Understand social, legal, and ethical issues related to information access and management.

4. Understand social, legal, and ethical issues related to multimedia production.
Dear Dr. [LastName],
Dr. [LastName], from Name of University, gave your name and e-mail to me as a technology integration expert. If at all possible, I need you to serve on a panel of experts for my dissertation. If you have about 15 minutes to spare, please consider serving on this panel.

As a member of this panel you will be confirming the placement of questions from an instrument on a model. This process should take around 15 minutes.

The password for the survey is....... memory
The link to the survey is..... [SurveyLink]

Thank you for your help with my study.

Sincerely,
Pam Johnson

Pamela M. Johnson
Doctoral Student
North Carolina State University

If you are unable to assist me, please click the following link.
[RemoveLink]
Appendix Q: Letters from AAM Program Staff Granting Approval to Use AAM Program Participants in Graduate Study

RE: Permission to Use the 2001 Montreat AAM Cluster in a Study

From: [Name]
To: [Name]
Cc: [Name]

Subject: RE: Permission to Use the 2001 Montreat AAM Cluster in a Study

Pam,

Your request to use the AAM Montreat Cluster for your study with your doctoral program at NC State is approved.

Good Luck!

AAM Program Director

-----Original Message-----
From: [Name]
Sent: Tuesday, August 16, 2001 11:44 AM
To: [Name]
Subject: Permission to Use the 2001 Montreat AAM Cluster in a Study

I would like to use the 2001 AAM Montreat Cluster for a study for my dissertation. In order to do this, I need your approval, Wendy's approval, and each teacher's approval to have access to their files. I will coordinate obtaining the individual teacher's approvals from Wendy. Wendy will have each teacher take the Teaching with Technology Instrument (attached). At a later date, I will attend class and discuss my study with the teachers. I will obtain their permission to use the information on their application to participate with the AAM program.

If you have additional questions, please don't hesitate to call.

Pam

<<TeacherPermissionForm>>  <<TeachingWithTechnologyInstrument>>
Appendix Q: Appendix Q: Letters from AAM Program Staff Granting Approval to Use AAM Program Participants in Graduate Study (continued)

---Original Message------
From: 
Sent: Tue 10/12/2004 11:36 AM
To: 
Cc: 
Subject: RE: AAM 2001 Cohort

My chair has finally approved my proposal and I am sending it out to my committee. Somehow in all of the moving, I cannot locate the permission form from you or your office to use the 2001 AAM Cohort.

Would you please send an e-mail confirming that permission to use the members of the 2001 AAM Cohort from the Montrest College Cluster. I initially visited your class on September 25 and then again on November 5.

I also need an e-mail to get similar permission granted statement from her. Do you by chance have it or have the name of the school where she is teaching.

I hope this isn't too much trouble and I greatly appreciate you doing this.

Thanks,

Pam
Appendix R: Proposal Narrative

North Carolina State University
Institutional Review Board for the Use of Human Subjects in Research
PROPOSAL NARRATIVE

A. INTRODUCTION
   a. The proposed study will be evaluating the change in the integration of technology in the classroom by K-12 educators during a graduate class on technology integration in the classroom. This study is important because it is investigating change in the educator’s use due to a professional development experience. Current research reports a lack of adequate research on technology integration training for in-service K-12 educators.

B. SUBJECT POPULATION
   a. There will be 40 K-12 educators involved in the proposed study.
   b. The educators are enrolled in a graduate class at Montreat College.
   c. Each subject will be asked to read and sign the informed consent form and complete the questionnaire twice, once as a pretest and once as a posttest. This will take approximately 45 minutes total.
   d. The subjects are all current educators of K-12 classrooms. They were nominated to participate in this class by their principals.
   e. This group was not achieved through sampling.
   f. The principal investigator will be teaching the graduate class, so the relationship will be teacher/student.
   g. There are no vulnerable populations included in study.

C. EXPERIMENTAL PROCEDURES
   a. The subjects will be mailed the informed consent prior to the first class meeting with a letter requesting participation in the proposed study.
   b. Each subject will receive a pencil and a questionnaire.
   c. The subject will be asked to place a letter on the top right corner of the questionnaire to denote the level of education currently teaching.
      The levels are:
      
      E  - Grades K-5
      M  - Grades 6-8
      H  - Grades 9-12
   d. The subject will then be asked to complete the questionnaire.
   e. The principal investigator will collect the questionnaires.
   f. Steps b through e will be repeated during the last class meeting.

D. POTENTIAL RISKS
   a. There are no potential risks (physical, psychological, financial, social, legal, or other) connected with the proposed study.
   b. The information requested in the proposed study is not considered to be personal or sensitive information.
   c. The material presented in the proposed study is not considered to be offensive, threatening, degrading, or causing stress or anxiety.
   d. Only the level of education he/she is currently teaching will identify the subject. The proposed data will be gathered following distribution and stored in a lock filing
Appendix R: Proposal Narrative (continued)

cabinet in the principal investigator’s office. An aggregate report as well as a report by level of education will be compiled.

e. There will not be any audio or videotaping done for the proposed study.
f. There is no deception of human subjects involved in the proposed study.

E. COMPENSATION
a. The subject will be participating in a graduate class funded by a grant from the Library of Congress. The subject will receive the credit for this class, a $1,875 laptop computer, an opportunity to attend a weeklong workshop at the Library of Congress, and technical support during the semester following the graduate class. The subject will receive these items whether he/she participates in the proposed study or not.
b. There is no penalty to a subject for withdrawing from the proposed study.
c. The 3-semester hours of credit will be given without regard to the study.

F. COLLABORATORS
a. Professor Robbie Pitman, Western Carolina University is currently teaching SPSS to the Adult and Community College Education Asheville Cohort. I am a member of this class and will ask him for assistance with the analysis of the data.

G. ADDITIONAL INFORMATION
a. The questionnaire is attached.
b. A copy of the informed consent form is attached.
Appendix S: Informed Consent Form Submitted to North Carolina State Institutional Review Board

North Carolina State University
INFORMED CONSENT FORM

Title of Study: Integration of Technology in the K-12 Classroom

Principal Investigator: Pamela M. Johnson  Faculty Sponsor: Carol W. Kasworm

You are invited to participate in a research study. The purpose of this study is to investigate the change in the integration of technology in the classroom by K-12 educators during a graduate class on technology integration in the classroom.

INFORMATION
If you agree to participate in this study, you will be asked to complete the following tasks:

1. Read this form carefully and return it to Pam Johnson on February 5, 2001.

RISKS
There are no risks involved with this study.

BENEFITS
This research will benefit future professional development experiences for K-12 educators in technology integration in the classroom.

CONFIDENTIALITY
The information gathered during this study will be kept strictly confidential. Data will be stored securely and will be made available only to persons conducting the study unless you specifically give permission in writing to do otherwise. No reference will be made in oral or written reports that could link you to the study.

COMPENSATION
There will be no compensation for participating in this study.

CONTACT
If you have questions at any time about the study or the procedures, you may contact the researcher, Pamela M. Johnson, at street address, city, state zip or e-mail address or phone number (work) or phone number (home). If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact name, Chair of the NCSU IRM for the Use of Human Subjects in Research Committee, Box 7514, NCSU Campus (phone number – e-mail address) or name, Assistant Vice Chancellor, Research Administration, Box 7514, NCSU Campus (phone number – e-mail address).

PARTICIPATION
Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed your data will be destroyed.

CONSENT
I have read and understand the above information. I have received a copy of this form. I agree to participate in this study.

Subject’s signature __________________________ Date __________________________

Investigator’s signature __________________________ Date __________________________
Appendix T: Participant Application Information Request Form

November 6, 2001

I give XXXX XXXXXX permission to share the information I provided on the application for the Montreat College - Adventure of the American Mind Project with Pam Johnson for use in her doctoral study at North Carolina Statue University.

Name: _____________________________________________

Date:   _____________________________________________
Appendix U: Letter Requesting Participation in the Posttest

Dear [FirstName],

In the fall of 2001, I gave a 46-question survey on the use of technology in the classroom to your AAM class. This was done as a part of my doctoral research. I am in the final stages of my doctoral studies and need to have everyone in the AAM class take the same 46-question survey.

The survey is now available online at [SurveyLink]
The password is: memory

It should take about ten minutes to complete the survey.

Please consider taking time from your busy schedule to complete this survey. If you would like to receive the results of the survey, please be sure to check the box requesting this at the end of the survey.

Thank you so much for assisting me with this stage of my research.

Sincerely,
Pam Johnson

The survey is now available online at [SurveyLink]
The password is: memory

A duplicate of this request was sent to your personal e-mail account. Please disregard the duplicate.
[RemoveLink]

Pamela M. Johnson
Appendix V: Snapshot of Online Version of Teaching with Technology Instrument – Revised

This survey includes 52 questions.

Questions 1 - 46 are about your use of technology for teaching or preparing for teaching.

Questions 47 - 52 are about the technology support in your school.

This information is confidential and will only be used in completion of my dissertation.

I greatly appreciate you taking the time to complete this survey. If you would like to know the results of this survey, please provide your e-mail in the last question of the survey.

Each question is followed by five choices. These are:

- Always
- Usually
- Sometimes
- Rarely
- Never

Click here for a pdf copy of the Teaching with Technology Instrument.

This information will be used in completion of my doctoral research for North Carolina State University, Adult and Community College Education department.

* 1. Use a word processor to enter text, edit, change the format of a document, save and retrieve documents, check spelling, print documents, and use graphics tools.

* 2. Use desktop-publishing software to import text, format text and layout, and import graphics by producing a class newsletter.

* 3. Demonstrate how word processing enhances the writing process.

* 4. Compose and send e-mail to support classroom projects.
Appendix W: Follow-up E-mail Requesting Participation in the Study

Date

Dear [Study Participant],

In the fall of 2001, I gave a 46-question survey on the use of technology in the classroom to your AAM class. This was done as a part of my doctoral research. I am in the final stages of my doctoral studies and need to have everyone in the AAM class take the same 46-question survey.

A few weeks ago, I sent an e-mail requesting your continued participation in my study. If you have not had a chance to complete the survey, please consider taking a few minutes from your busy schedule.

This survey is now available online at [link to survey]. Full instructions are available on the web site.

I greatly appreciate your willingness to assist me with my research.

Sincerely,
Pam Johnson

Pamela M. Johnson
Appendix X: Stages of Aligning Teaching with Technology Instrument with Welliver’s Instructional Transformation Model

<table>
<thead>
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<th>Item Number Placed at this Stage</th>
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<tr>
<td>Evolution</td>
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<td>Placed on model by Researcher</td>
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</table>

* 80% Agreement  
** 67% Agreement  
*** Factor Loading >.65 and Eigenvalues >1
Appendix Y: Teaching with Technology Instrument - Revised Aligned with the Instructional Transformational Model

Answer each item by darkening the appropriate number for that item on the attached Scantron®.

1 = Always 2 = Usually 3 = Sometimes 4 = Rarely 5 = Never

1. Understand differences between public domain, freeware, shareware, and commercial sources of software.
2. Understand the characteristics, strengths, and weaknesses of media-communication tools and techniques.
3. Use a spreadsheet by accessing an existing spreadsheet and creating a new spreadsheet to manage and interpret information.
4. Create a bar graph on the computer that is linked to a spreadsheet.
5. Enter a function in a spreadsheet cell.
6. Use a database by sorting an existing database and creating a new database to manage and interpret information.
7. Apply understanding of the goals of the North Carolina Computer Skills Curriculum as related to information access and management.
8. Use and understand the differences between linear multimedia presentation and nonlinear multimedia presentation. Understand terms such as media, multimedia, hypermedia, and clip media.
9. Demonstrate the use of information access and management in the discipline/subject for learning and as a medium for communication.
10. Demonstrate multimedia use in the discipline/subject for learning and as a medium for communication.
11. Understand how multimedia production can be used to meet the various learning styles of students.
12. Plan multimedia activities for computer labs and/or classrooms with one or multiple computer resources.
13. Plan a lesson incorporating appropriate technology that included use of productivity software, online resources, or both.
14. Apply understanding of the goals of the North Carolina Computer Skills curriculum as related to multimedia production.
15. Demonstrate effective and appropriate use of computers and other technologies to communicate information in a variety of formats on student learning to colleagues, parents, and others.
16. Understand how information access and management can be used to meet the various learning styles of students.
17. Plan information access/management activities for computer labs and classrooms with one or multiple computer resources.
18. Explore how information access/management technology can enhance higher order thinking skills and problem solving.
19. Demonstrate development of performance tasks that require students to locate and analyze information as well as draw conclusions and use a variety of media to communicate results clearly.
20. Explore how multimedia production can enhance higher order thinking skills and problem solving.
21. Understand the social, legal, and ethical issues related to telecommunication use.
22. Understand social, legal, and ethical issues related to information access and management.
23. Understand social, legal, and ethical issues related to multimedia production.
Appendix Z: Sample of Teachers’ Report on Teaching with Technology Instrument – Revised as Aligned with Welliver’s Instructional Transformation Model*

<table>
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<th>Participant Number</th>
<th>Date of Pretest</th>
<th>Date of Posttest</th>
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<th>Reorientation</th>
<th>Evolution</th>
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<td></td>
<td>79</td>
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<tr>
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<td>92</td>
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*Questions placed on stages by a Panel of Experts and confirmed through factor analysis with high factor loadings (> .65) and eigenvalues (> 1)
1-Questions from TTI - R included are 21 and 25
2-Questions from TTI - R included are 15, 16, 17, 18, 36, and 40
3-Questions from TTI - R included are 24, 41, 42, 43, 44, and 46
4-Questions from TTI - R included are 26, 27, 28, 30, 35, and 45
5-Questions from TTI - R included are 5, 23, and 39