EXAMINING THE ROLE OF VARIOUS FACTORS AND EXPERIENCES IN TECHNOLOGY INTEGRATION: A DESCRIPTION OF A PROFESSIONAL MODEL

by

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Examining the Role of Various Factors and Experiences in Technology Integration:
A Description of a Professional Model

A dissertation proposal submitted in partial fulfillment of the requirements for the degree
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DEDICATION

This is dedicated to all teachers, instructors, and professors who have committed or continue to commit their lives to helping and guiding others to the path of knowledge.
I would like to thank Priscilla Norton—who has been my guide and mentor from my portfolio reviews through the completion of this dissertation, Anastasia Kitsantas for her expert advice on research methodologies, and Kevin Clark for his generosity and offer of help in this academic undertaking. Special thanks to all my GMU professors especially Gary Galluzzo and Nada Dabbagh who were on my advising committee and to Janet Holmes of the Ph.D. Office for her constant support and advice. My memories of GMU will not be complete without Karrin Lukacs, Nancy Hollincheck, Anne Little, Dawn Hathaway, Barb Daniels, Robin Smith, John Baek, Amy Fulcher, Lisa Mistretta, Sue Ross, Zora Marschall and other classmates who have inspired me with their scholarly dedication and who have also shared their food, stories, and their lives. I would also like to acknowledge the support and continued friendship of Shannon Stone, Manuel Gancedo and Lakunle Lasebikan from my years at GWU and Bob Daniels, Joe Evans, Pat and Chris Cummins, and Christopher Brooks from Richmond.

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ABSTRACT

EXAMINING THE ROLE OF VARIOUS FACTORS AND EXPERIENCES IN TECHNOLOGY INTEGRATION: A DESCRIPTION OF A PROFESSIONAL MODEL

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George Mason University, 2008

Dissertation Director: Dr. Priscilla Norton

A mixed-design study investigated relationships among several factors and descriptions of particular experiences of graduates in a professional development program in technology integration. The quantitative aspect examined how demographic variables (age, gender, number of years as an educator, and length of time since graduating from the program) and attitudes (about technology and learning, technology tools, and instructional strategies) contribute to practice of technology integration. It also examined differences in attitudes, practices, and support on technology integration between early and recent graduates. The qualitative aspect explored participants’ thoughts on the program’s best and least helpful attributes and changes they think could make the program better.

Results showed that attitudes toward technology tools in addition to attitudes and use of technology-enhanced instructional strategies significantly contribute to the use of technology tools. Second, attitudes and use of technology tools as well as attitudes about
technology-enhanced instructional strategies significantly contribute to the use of technology-enhanced instructional strategies. Third, weak but significant differences were found between early and recent graduates on two aspects. Earlier graduates value technology-enhanced instructional strategies and take college or university courses to keep up-to-date slightly more than recent graduates. Qualitative analyses revealed that the use of authentic problems, collaboration, and hands-on approach were considered the best attributes of the program. The greatest challenges were time factor, readings, and lack of differentiation. In terms of changes to the program, the top answer was to have no changes, followed by more differentiation, and the learning of more skills and technologies.

This study confirmed the relative success of constructivist strategies in implementing professional development in technology integration. The conclusion includes recommendations for practice and further study.
1. Introduction

Need to Prepare Students and Teachers to Use Technology

We live in an age where having access to technology and knowing how to use it offers many advantages. So, preparing students to live and work in a technology-rich world has become the norm. "The business world demands that our schools prepare educated workers who can use technology effectively in the global marketplace" (Task Force on Technology and Teacher Education, 1997, p. 8). This, however, implies two things: first, technology resources must be made available in schools for both teachers and students to use; and second, teachers must be proficient in using and teaching with technology.

One of the initial barriers in preparing students to live and work in a technological world has been the scarcity of hardware resources in schools. As a result, there has been increased spending since the 90s for technology infrastructure. Internet connection in a sample of public schools, for example, dramatically increased from 35% in 1994, to 89% in 1998, and to 99% in 2002 (NCES, 1999; 2004). In a similar fashion, the ratio of public school students to instructional computers with Internet access decreased from about 12 students to 1 computer in 1998 to about 4 students to 1 computer in 2005 (NCES, 2005).

Having the equipment, however, is only one part of the equation. "In the early stage of computer adoption in the classroom we have too often faced the spectacle of
enormous resources being dedicated to hardware and software while neglecting the human part of the equation—teacher support and development” (Jenson, Lewis, & Smith, 2002, p. 482). Preparing our students for the 21st century also entails that teachers understand and use technology. In 1995, the Office of Technology and Assessment (OTA) was asked to look at several issues such as:

1. Do teachers use technology in their teaching?
2. What happens when they do?
3. Why don’t more teachers use technology?
4. How do teachers learn about technology and are prospective teachers being prepared to use technology before entering the classroom? (OTA, 1995, p. 6)

There has been great progress in improving technology resources in schools but having proficient teachers who use and model that technology still needs to be addressed just as well. One significant finding is that “teachers have little in the way of technology support or training available at their schools, although many teachers seek training on their own” (OTA, 1995, p. 25). The OTA report also divulged that schools spent 85% on hardware and software and only 15% on teacher education (OTA, 1995).

Background

A review of literature from the past 12 years revealed that there is a general consensus regarding the many benefits of technology for education. Federal and state governments, researchers, school administrators, teachers, and students generally agree that bringing technology into schools can be a vehicle for educational reform (OTA, 1995; Task Force on Technology and Teacher Education, 1997; Lewis, Parsad, Carey,
Bartfai, Farris, & Smerdon, 1999) and significantly increase the potential for learning most notably when used in conjunction with constructivist principles and strategies for learning (ACOT overview, 1996). This belief has helped boost federal and state spending on school technology. The same thing, however, cannot be totally said about preparing and educating teachers to use that technology.

A report by NCES in 1999 indicated that "relatively few teachers reported feeling very well prepared to integrate educational technology into their classroom instruction (20 percent)" (Lewis et al., 1999, p. 48). In terms of teacher education in technology, nothing much seems to have changed even at the turn of the century. “The capacity of teachers to use technology in classroom instruction has not kept pace with the increased access to technology in schools” (Sandholtz, 2001, p. 349).

On the other hand, there is evidence during the past decade that schools, colleges, and departments of education (SCDEs) have made an effort to integrate technology into their programs. A report by the Department of Education in 1999 entitled "Teacher Quality: A Report on the Preparation and Qualifications of Public School Teachers" showed that 78% of full-time public school teachers participated in some professional development program geared towards the integration of educational technology in the grade or subject they taught (Lewis et al., 1999). This was a significant increase from 51% taken from a 1993-1994 survey. However, "a core argument is that unless professional development programs are carefully designed and implemented to provide continuity between what teachers learn and what goes on in their classrooms and schools,
these activities are not likely to produce any long-lasting effects on either teacher competence or student outcomes (Lewis et al., 1999, p. 22).

Perhaps the comparison between technology resources and teacher technology integration is a bit unfair. The logic seems to be that more and better technology resources automatically results in greater teacher competence in the use of technology. It is relatively easy to allocate funds and procure the equipment. It is a much more daunting task to educate teachers on the use of technology. The human element often involves resistance. Teachers should subscribe to the idea that there are worthwhile advantages to the use of technology in education. On a more practical level, it is not always easy for current teachers to find the time from their already busy work and family or home schedules to devote to serious professional development. Another challenge is that teacher preparation and professional development programs should be designed and implemented in accordance with the latest from educational research.

Recent literature illustrated that there is no single philosophy, theory, model, or strategy to effectively design and implement a good educational program for teacher technology integration. It is interesting to note, however, that most of the research done during the past decade that reported relative success in this regard highlighted constructivist strategies (ACOT, 1996; Clemente, 2001; Sandholtz, 2001). The dominant themes that came out of the literature included: modeling (Norton, 1994; Howland & Wedman, 2004; Francis-Pelton, Farragher, & Riecken, 2000; Vannatta, 2000; Vannatta & Beyerbach, 2000; Ertmer, Johnson, & Lane, 2001; Franklin, Duran, & Kariuki, 2001; Matzen & Edmunds, 2007), collaboration (Norton, 1994; Rosean, Hobson, & Khan,

Statement of the Problem

One of the great challenges for schools today is the preparation of students in a technologically-rich society. Thanks to government and private funding, the technological infrastructure in schools has dramatically improved. However, teachers also need to be competent in the use of this technology. There is much room for improvement in understanding, designing, and implementing teacher education in technology integration.

This study hoped to gain a better understanding of the technology integration practices of teachers who have attended a 2-year graduate professional development program in the integration of technology in schools. The main problem involved investigating if certain factors such as number of years in the field, age, gender, attitudes about technology and learning, and support contribute in any way to their current practice of technology integration in their various work as teachers and if this practice of technology integration varies across graduates of the program. Practice of technology integration included both the use of technology tools (software, hardware, the Internet, etc.) and technology-enhanced instructional strategies (the design of instruction that
employs an appropriate use of technology and that promotes the use of authentic problems, higher order learning and collaboration). Moreover, the concept of practice of technology was not limited to what occurs in the classroom but included class preparation, time with students, assessment, and management. So, the primary question focused on the correlations between various variables and the current technology integration practices of the participants. Secondly, this study sought to learn more about participants’ particular experiences of the program—aspects of the program that greatly help and facets of the program that they consider challenges or obstacles to technology integration. The participants were also asked about suggestions as to how the program might be improved.

Research Questions

This study addressed the above problems by asking the following research questions of a sample of graduates from the Integrating Technology in Schools (ITS) professional development program:

1A. Do years of experience as an educator, length of time since graduating from the program, age, gender, attitudes about technology and learning, perceived value of technology tools, perceived value of technology-enhanced instructional strategies, use of technology-enhanced instructional strategies, availability of support, and quality of support predict use of technology tools by ITS graduates?

1B. Do years of experience as an educator, length of time since graduating from the program, age, gender, attitudes about technology and learning, perceived
value of technology tools, use of technology tools, perceived value of
technology-enhanced instructional strategies, availability of support, and
quality of support predict use of technology-enhanced instructional strategies
by ITS graduates?

2. Are there significant differences in attitudes about technology and learning,
perceived value of technology tools, use of technology tools, perceived value
of technology-enhanced instructional strategies, use of technology-enhanced
 instructional strategies, perceived support, and strategies on how to keep
current with technology by ITS graduates over time?

3. In terms of the participants’ experiences of the ITS program that may lead to
a better understanding of good professional development:

(a) What do participants identify as effective attributes of the ITS program?

(b) What do participants identify as obstacles or challenges in the ITS
 program?

(c) What additions or changes to their ITS experience do participants
 identify?

Significance of the Study

There are a number of ways teachers can learn and use technology. Teachers can
learn about technology on their own through various literatures or by doing research on
the Internet. Slightly more formal learning can involve short-term workshops or
seminars. Other programs extend to a year or more. Knowing what happens after—
whether teachers use technology or not and how they use it—can help us understand how to design and structure technology education.

This study sought to explore the breadth and frequency of technology use by graduates of ITS—a university-based, 2-year, cohort-style professional development program for teachers in the area of technology integration. This study hoped to learn what technologies graduate teachers now use, how often technology is used, and for what purposes technology is used. Again, it must be understood that technology integration was not limited to teachers’ direct contact with students in the classroom but included many other aspects of a teacher’s job such as “preparing materials, developing lessons, assessing student progress, enlisting parent participation, keeping up with advances in pedagogy and content, and participating in the professional community” (OTA, 1995, p. 8).

Findings from the research will help us learn more about and improve current professional development programs of a similar nature or understand, plan, design, and implement new ones. If factors such as years of experience as an educator, age, gender, attitudes about technology and learning, beliefs on tools and instructional strategies, and support have any bearing on current practices, this can lead to a greater understanding of prospective and current students and how best to provide help to those who need more support. In the same way, knowing if length of time after finishing the program has any effect on their current technology integration practice can help direct ITS staff or school administrators to be more supportive of either the newer graduates or those who graduated much earlier. The questions that deal with the participants’ identification of the
effective attributes of or challenges to the ITS program can provide recommendations to
the ITS staff in evaluating and redesigning the program as needed. Moreover, it can
inform other professional development programs concerning what strategies are or are
not effective. Finally, having an idea if and how participants keep current with
technology may help school administrators and ITS staff plan and implement support
options.

Theoretical Framework

The continuum of thought and practice between objectivism and constructivism
reveals a richness of history and the complexity of the human mind. Each epistemology,
type, or model highlights and values certain aspects of human behavior and learning.
Pavlov and Skinner focused on observable behavior. Coming from a more objectivist
epistemology, they did not venture into what goes on in the mind since this is neither
observable nor quantifiable. On the other hand, Atkinson and Shiffrin concentrated on
how the mind processes information that includes short-term and long-term memory—
cognitive information processing (Driscoll, 2000). Piaget, partly observing his children
growing up, proposed various stages of development and developmental processes. Still,
others, such as Bruner and Vygotsky, emphasized the role of culture and community in
cognitive development.

Each model has its inherent strengths as each also is not without its set of
weaknesses. The outcomes from the experiments on conditioning of Skinner, for
example, are still valuable in some forms of learning such as in rapid-response training in
the military or simple drill and practice for students. There is doubt, however, on how
conditioning can help develop higher order thinking skills. Another example would be how Piaget’s stages of development and developmental processes helped people understand how children learn but others also discovered that they did not easily carry over to children from other cultures as there were also certain inconsistencies in behavior within particular stages (Driscoll, 2000). Still, no one can deny the valuable insights these great thinkers contributed to our deeper understanding of learning and human behavior. Each theory or model, therefore, has its own valid claims. One can almost espouse any theory or model that best fits one’s values, needs, and objectives.

Paradigm and methodologies. Therefore, the pragmatic paradigm was chosen for this study as it employed both positivist (more accurately, postpositivist) and constructivist methodologies. Kornuta and Germaine (2006) explained that positivist/postpositivist and constructivist approaches may, in theory, be polar opposites but, in reality, some researchers see value in both. “Those who do so hold to the Pragmatic paradigm, and choose a methodology based on the nature of the questions they ask rather than asking the questions bound to a single paradigm” (Kornuta & Germaine, 2006, p. 42). This pragmatic approach can also be applied on two levels of this study: one level in answering the research questions and another level in understanding the context of the study.

On one level, the research questions involved looking at various quantifiable variables. The first and second research questions investigated the possible correlations among the variables using statistical procedures such as linear regressions and t tests. The third research question, though still partly quantitative as it involved frequencies, was
also qualitative in nature as the answers were derived and interpreted from open-ended questions.

So, in terms of the investigation of correlations and frequencies of variables that the research questions hoped to answer, the approach of this study was more postpositivist and quantitative. Creswell (1994) defined such a study as one “based on testing a theory composed of variables, measured with numbers, and analyzed with statistical procedures in order to determine whether the predictive generalizations of the theory hold true” (p. 2). In terms of extracting the participants’ understanding of and hopes for the program, the approach was more constructivist and qualitative. The participants were free to write what they thought were the best attributes of the program, the challenges of the program, and suggestions for the program to improve—using their own words and terms.

On a second level, the constructivist approach played a major role in understanding the context of the ITS program. The third research question examined participants’ experiences of and hopes for the program. It makes sense to understand at this point the constructivist framework from which (a) learning, (b) pedagogy, and (c) technology integration are commonly understood.

Learning. From a constructivist viewpoint, learning is defined as “the construction of meaning from activity and experience” (Dabbagh & Bannan-Ritland, 2005, p. 169). In this context, a learner is viewed not as a passive receiver of knowledge but as an active negotiator of meaning. The learner actively negotiates personal perceptions with the external world, making the learner a primary meaning maker and
taking ownership of the learning process (Dabbagh & Bannan-Ritland, 2005). The instructor, on the other hand, is viewed not as the fount of authoritative knowledge or expertise but one that guides, coaches, and mentors. The instructor paves the way for learning, creates the proper learning environment, and scaffolds the learner as necessary. These are the ways the instructor’s knowledge and expertise are put to use. Knowledge is acquired through “mediated forms of interaction and enculturation into a community of practice” (Dabbagh & Bannan-Ritland, 2005, p. 169). Hence, learning naturally goes beyond the instructor-learner relationship. This way of thinking is appropriate to this study as it involves teachers who attended a professional development program that has the creation of a thought community, the implementation of an integrated approach to inquiry, and the establishment of a vision of collaboration as its three main guiding principles (Norton, 1994).

**Pedagogy.** When it comes to pedagogical strategies that involve technology integration, Munkatchy (2003) asserts that “technology integration is evident when teachers are (a) developing and implementing technology-based learning experiences that promote collaboration and higher-level learning for students, (b) using authentic assessment to assess students’ learning experiences, (c) using technology to address the diverse learning needs of the students, (d) engaging in creating curriculum-based, interdisciplinary, and technology-enhanced learning experiences for their students, (e) ensuring that policies and procedures for responsible use of technology are followed, (f) experimenting with new instructional strategies as a result of use of technology, and (g) actively involved in ongoing professional development programs on technology
integration/infusion” (p. 18). All these strategies are in accord with a constructivist methodology.

*Technology integration.* Practicing technology integration in schools, therefore, is not just about teachers using technology in their actual teaching or time with students. A more constructivist understanding of technology integration would look at it as a much wider process. Hence, a more workable framework for technology integration in this study was based on the Educational Technology Standards and Performance Indicators of the National Educational Technology Standards for Teachers (NETS-T), which is under the International Society for Technology in Education (ISTE). The NETS-T Standards (ISTE, 2000-2005) contain six items which cover several important areas of technology integration. Within these six standards are performance indicators that can be translated into technology integration practices for the purpose of this framework (see Figure 1 for the list of performance indicators). Standard 1 or “technology operations and concepts” deals with basic knowledge and skills related to technology as well as continual growth in the knowledge of current and emerging technologies. Standard 2 or “planning and designing learning” covers the use of technology prior to time with students. Standard 3 which involves “teaching, learning, and the curriculum” encompasses the time or interaction with students. Standard 4, as its title suggests, deals with “assessment and evaluation.” “Productivity and professional practice” or standard 5 comprises the teacher’s professional development and use of technology in support of learning, teaching, and personal management. Finally, standard 6 deals with knowing and modeling the social, ethical, and legal aspects of the use of technology.
6. Social, ethical, legal, and human issues
- Model and teach legal and ethical practice.
- Enable and empower learners with diverse backgrounds, characteristics, and abilities.
- Promote safe and healthy use of technology resources.
- Facilitate equitable access to technology resources for all students.

5. Productivity and professional practice
- Engage in ongoing professional development and lifelong learning.
- Evaluate and reflect on professional practice.
- Apply technology to increase productivity.
- Use technology to communicate and collaborate with peers, parents, and the larger community.

4. Assessment and evaluation
- Apply technology in assessing student learning using a variety of assessment techniques.
- Use technology resources to collect and analyze data, interpret results, and communicate findings.
- Apply multiple methods of evaluation.

3. Teaching, learning, and the curriculum
- Facilitate technology-enhanced experiences that address content standards and student technology standards.
- Use technology to support learner-centered strategies that address the diverse needs of students.
- Apply technology to develop students' higher order skills and creativity.

2. Planning and designing learning environments and experiences
- Design learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.
- Apply current research on teaching and learning with technology.
- Identify and locate technology resources and evaluate them for accuracy and suitability.
- Plan for the management of technology resources within the context of learning activities.
- Plan strategies to manage student learning in a technology-enhanced environment.

1. Technology operations and concepts
- Demonstrate introductory knowledge, skills, and understanding of concepts.
- Demonstrate continual growth in technology knowledge and skills.

---

Figure 1. 2005 NETS-T standards and performance indicators.
A new set of NETS-T Standards were published in 2008 as this study was in progress. The new standards now list five areas modified and improved from the previous six areas: (a) student learning and creativity, (b) digital-age learning experiences and assessments, (c) digital-age work and learning, (d) digital citizenship and responsibility, and (e) professional growth and leadership. At first glance, the new standards look better organized and phrased. This study, however, used the previous standards because they were used simply to provide a framework for the question items relating to the importance and use of technology-enhanced instructional strategies. Moreover, the new standards still encompass all of the previous areas though they may be presented and worded in more meaningful ways. Finally, by the time the new standards were published, the questionnaire for this study had already been tested for validity and reliability.

Scope and Limitations of the Study

The data and analysis for this study was limited to participants from the Integrating Technology in Schools program at a large mid-Atlantic university. 318 graduates of the program were invited to participate. The database server’s logs showed there were a total of 232 survey responses. 77 were partial or abandoned surveys. After checking for duplicates, 155 questionnaires were considered complete for the purposes of this study.

A researcher-designed questionnaire composed of seven sections was used to gather data that included demographics, attitudes about technology, perceived value and use of technology tools, perceived value and use of technology-enhanced instructional strategies, availability and quality of support, personal thoughts and experiences of the
program, and how participants keep current with technology. The survey was
administered online during the academic year 2007-2008. Data were collected from
graduates of the program only. Validity and reliability testing of the survey instrument
was administered to current students of the program.

Definition of Terms

*Attitudes about technology and learning.* Attitudes would include beliefs,
feelings, values, and dispositions toward technology as related to learning and teaching.

*Collaboration.* Collaboration, in the context of learning, is the “interaction
between or among two or more learners to maximize their own and one another’s
learning” (Dabbagh & Bannan-Ritland, 2005, p. 326).

*Community of Practice.* Communities of practice (CoPs) are “groups of learners
or professionals with a common goal who congregate to share information and resources,
ask questions, solve problems, and achieve goals, and, in doing so, collectively build new
knowledge and evolve the practices of their community” (Dabbagh & Bannan-Ritland,

*Constructivism.* Constructivism is “an epistemology encompassing the following
assumptions: Reality is constructed by the knower, meaning is negotiated, and multiple
viable truths or viewpoints exist” (Dabbagh & Bannan-Ritland, 2005, p. 327).

*Integrating Technology in Schools program.* The Integrating Technology in
Schools (ITS) is a 2-year, cohort-style, university-based professional development
program at George Mason University for K-12 teachers in the area of technology
integration.
**Modeling.** “An instructional strategy that demonstrates the process of expert performance, including the making of and learning from mistakes… often accompanied by explaining” (Dabbagh & Bannan-Ritland, 2005, p. 331).

**Positivism.** Trochim (2006) summarizes positivism as a position wherein the goal of knowledge is simply to describe the phenomena that we experience and that the purpose of science is simply to stick to what we can observe and measure. Microsoft Encarta 2008 defines positivism as a “system of philosophy based on experience and empirical knowledge of natural phenomena, in which metaphysics and theology are regarded as inadequate and imperfect systems of knowledge.”

**Postpositivism.** Postpositivism was a radical offshoot from positivism. Trochim (2006) explains postpositivism by relating it to critical realism:

A critical realist believes that there is a reality independent of our thinking about it that science can study. (This is in contrast with a subjectivist who would hold that there is no external reality—we’re each making this all up!). Positivists were also realists. The difference is that the post-positivist critical realist recognizes that all observation is fallible and has error and that all theory is revisable. In other words, the critical realist is critical of our ability to know reality with certainty. Where the positivist believed that the goal of science was to uncover the truth, the post-positivist critical realist believes that the goal of science is to hold steadfastly to the goal of getting it right about reality, even though we can never achieve that goal!
**Problem-based learning.** Dabbagh and Bannan-Ritland (2005) defines problem-based learning (PBL) as “a pedagogical model that engages the learner in a complex problem-solving activity in which the problem drives all learning and no formal prior learning is assumed” (p. 171). More concretely, “students are introduced to a real-world problem that is complex and has multiple solutions and solution paths (is ill structured) and are provided with an iterative heuristic problem-solving model (a reasoning process) that supports reasoning, problem-solving, and critical thinking skills” (Dabbagh & Bannan-Ritland, 2005, p. 171).

**Professional development.** The Pennsylvania State System of Higher Education (2007) has the following interpretation of professional development:

Professional development involves the acquisition of knowledge and/or development of skills related to some aspect of the faculty member’s professional responsibilities. The learning may involve increasing knowledge in one’s discipline or a related discipline or of the inter-relationships among disciplines—or knowledge about how students learn, about issues facing colleagues in business or basic education or another professional field, or about national trends and issues in higher education. A faculty member may develop artistic skills, hone research skills, improve skills in organizing and integrating knowledge, develop pedagogical skills, sharpen performance skills, gain experience in using administrative skills, or learn how to use technology to enhance teaching and learning.
Support. The Encarta® Dictionaries (2007) define support as giving “active assistance and encouragement to, or an approving and encouraging attitude toward, somebody or something.” For the purposes of this study, support would be manifested by any technical, instructional, administrative, or peer assistance and/or encouragement given to teachers in terms of their use of technology.

Technology integration practices. In the context of this study, technology integration would include the use of technology tools and the technology-enhanced instructional strategies that go with them in the practice of teaching. Technology tools would include computer software and hardware as well as multimedia resources. Technology-enhanced instructional strategies would involve various ways of applying and infusing technology in the learning process. Pierson (2001) defines true technology integration as the intersection of multiple types of teacher knowledge that involves content knowledge, pedagogical knowledge, and technological knowledge. Finally, the practice of teaching would include “preparing materials, developing lessons, assessing student progress, enlisting parent participation, keeping up with advances in pedagogy and content, and participating in the professional community” (OTA, 1995, p. 8).
2. Review of Literature

Technology: In Society and in Education.

The advancement of science and technology notably during the latter part of the 20th century has permeated most aspects of our life. From the moment we wake up to when we eat, travel, work, communicate, and retire at night, we use various products of technology. Technology helps keep our lives organized. It simplifies often complicated—if not simultaneously tedious—tasks. It affords us greater leverage over our personal time and resources. Technology has become a part of our life, and most of us acknowledge its many benefits when used correctly and wisely. In terms of computers and information, “society has embraced computer technology and allowed it to reinvent the ways in which we create, find, exchange, and even think about information” (Pierson, 2001, p. 413).

Technology also offers many benefits to education. In the late 60s, “attempts to use computer technologies to enhance learning began with the efforts of pioneers such as Atkinson and Suppes” (Bransford, Brown, Cocking, Donovan, & Pellegrino, 2000, p. 206). One of the goals of the Apple Classrooms of Tomorrow (ACOT) project initiated in 1985 was to study “how the routine use of technology by teachers and students might change teaching and learning” (ACOT overview, 1996, p. 1). This research study showed that “the introduction of technology into classrooms can significantly increase the potential for learning, especially when it is used to support collaboration, information...
access, and the expression and representation of students’ thoughts and ideas” (ACOT overview, 1996, p. 1). Technology is seen by many as a catalyst for educational reform and improved student learning (Sivin-Kachala & Bialo, 1994; OTA, 1995; Apple Education, 1996; Task Force on Technology and Teacher Education, 1997; Lewis et al., 1999; Bransford et al., 2000)

The Goal and Challenge

“During the 1980s, computer technology has generally been credited with motivating students, aiding instruction for special needs students, improving student attitudes toward learning, and motivating teachers and freeing them from some routine instructional tasks, enabling them to better utilize their time” (Sivin-Kachala & Bialo, 1994, p. 6). In 1995, the Office of Technology and Assessment (OTA) report “Teachers and Technology: Making the Connection” acknowledged the promising benefits of technology in school districts throughout the country. Technology could be a “catalyst to support school reform, stimulate new teaching methods, and even redefine the role of teachers” (OTA, 1995, p. 8). A similar finding by the National Council for Accreditation of Teacher Education (NCATE) in 1997 stated that “the president and vice president of the United States, governors, state legislatures, and other policy-making groups are increasingly convinced that technology is a central element of educational reform and improved student learning” (Task Force on Technology and Teacher Education, 1997, p. 8). Still, another report two years later by the National Center for Education Statistics (NCES) reiterated the same assessment as it described that “many educators and policy
analysts consider educational technology a vehicle for transforming education" (Lewis et al., 1999, p. iii).

The Response

Educational reform and improved student learning are deeply related in that any reform in education is logically and ultimately for the benefit of the learners. One of the initial responses to this challenge was to devote funds and resources to school technological infrastructure. This investment is reflected in the growing amount of computers and Internet access in schools. In national surveys conducted in public schools by the U.S. Department of Education, instructional computers with access to the Internet rose from 8% in 1995 to 93% by 2003 as the ratio of student to computer decreased from 12.1 in 1998 to 3.8 by 2005 (NCES, 2005). The use of broadband Internet connection in public schools increased from 80% in 2000 to 97% by 2005 with wireless connections expanding from 32% in 2003 to 45% by 2005 (NCES, 2005). The investment in technology, of course, is not limited to computers and the Internet but includes all software and peripherals. This leaves little room to doubt that U.S. schools have some of the most advanced technologies available in the world.

However, technology by itself will not automatically enhance student learning. It is not a matter of simply having the best technology or of having a lot of it. “Although maintaining up-to-date hardware and software is a constant challenge, increased funding opportunities have enabled many schools, colleges, and departments of education to be technologically adequate, at least for the time being” but “the challenge of developing technology-using higher education faculty to prepare technology-using teachers remains”
In schools, the expectation is that both teachers and students know how to use technology appropriately. Teachers should model it. Moreover, it is not simply a matter of adding technology use into an existing lesson plan. “The mere ability to operate various hardware and software does not constitute an acceptable level of proficiency” (Otero, et al., 2005, p. 9). Otero et al. further argue that teachers must be able to “demonstrate an ability to use technology tools in their standards-based curricula to promote student learning, improve student achievement, and provide students with the skills they need in their future education and/or workspace careers” (Otero et al., 2005, p. 9). It is not a simple task.

On the other hand, contemporary understanding of learning can provide “important guidelines for uses of technology that can help students and teachers develop the competencies needed for the twenty-first century” which include “opportunities for creating learning environments that extend the possibilities of ‘old’—but still useful—technologies—books; blackboards; and linear, one-way communications media, such as radio and television shows—as well as offering new possibilities” (Bransford et al., 2000, p. 206). Thus, for technology to bring about improvement in education and student learning, having the technology is one requirement but having teachers who can use it to support instruction and enhance and extend student learning is another.

Teacher Professional Development in Technology

*Room for improvement.* After the acquisition of technology, the focus must shift to teachers and professional development. The 1995 OTA report and other similar national studies may have spurred more spending on technology resources but not enough
resources were funneled into teacher preparation or professional development in technology. In conjunction with the NCES survey done in 1999, a study of public school teachers by Smerdon et al. (2000) found that 13% reported feeling ‘not at all prepared,’ 23% reported feeling ‘well prepared,’ 10% reported feeling ‘very well prepared,’ and the rest reported ‘feeling somewhat prepared’ to use [these] technologies for instruction. It is not very promising that only one third of the teachers felt prepared and that a little more than half felt only somewhat prepared. The same study also revealed the various sources of preparation where, to a large extent, public school teachers resorted in order to teach with computers and the Internet: (a) 39% through independent learning, (b) 18% through some professional development, (c) 16% through colleagues, (d) 10% through college or graduate work, and (e) 4% through students (Smerdon et al., 2000).

In terms of teacher education in technology, nothing much seems to have changed even at the turn of the century. “The capacity of teachers to use technology in classroom instruction has not kept pace with the increased access to technology in schools” (Sandholtz, 2001, p. 349). Summarizing several points from various sources, Zhao and Cziko (2001) argue that “while evidence of the educational benefits of technology abounds (Bialo & Sivin-Kachala, 1995; Education Week, 1997; Fletcher, Hawley, & Piele, 1990; Garner & Gillingham, 1996; Kulik & Kulik, 1991; McKinsey Inc., 1996; Means, 1994; Office of Technology Assessment, 1982, 1995; Wenglinsky, 1998) and investment in hardware and software has dramatically increased (Mageau, 1991; Heaviside, Riggins, & Farris, 1997), relatively few teachers use technology regularly in their teaching (McKinsey, 1996; OTA, 1995) and the impact of computers on existing
curricula is still very limited (David, 1994; Education Week, 1997; Harper, 1987; OTA, 1995)” (p. 5).

**Need for a new vision, understanding, and skills.** The fact that technology continues to advance at a rapid pace further exacerbates the problem. There seems to be a constant chasm between then and now, the young and the not-so-young, the status quo and the new or emerging. Situations change. New needs and problems arise. New solutions emerge. NCATE’s Task Force on Technology and Teacher Education acknowledged these realities and how teachers must adapt to take advantage of technology for instruction: new understandings, new approaches, new roles, new forms of professional development, and new attitudes. So, in terms of successfully implementing technology use in education, one major problem involves teachers needing to have the vision, the understanding, and the skills to constantly learn new and emerging technologies. Simply undergoing professional development does not always guarantee effective use of technology in instruction.

**Teaching with technology, not about technology.** The 1995 OTA report concluded that "most technology instruction in colleges of education is teaching about technology as a separate subject, not teaching with technology across the curriculum" (OTA, 1995, p. 165). A report by the President’s Committee of Advisors on Science and Technology (PCAST) in 1997 submitted six recommendations which included: (a) focus on learning with technology, not about technology; (b) emphasize content and pedagogy, and not just hardware; and (c) give special attention to professional development. The first recommendation is also cited by Goss, Kinslow, and Welsh (2001) in their Teaching and
Learning with Technology program: “It is important to note that our program encourages teaching with technology rather than teaching about technology” (p. 857).

On a similar note, the International Society for Technology in Education conducted a survey of schools, colleges, and departments of education (SCDEs) in the US on how these institutions were preparing new teachers to use information technology. One significant finding was that "the number of hours of IT instruction integrated into other courses [had] a moderate correlation with other scores on the survey; however, the number of hours of formal IT instruction [did] not" (Moursund & Bielefeldt, 1998, p. 9). Similar to the findings of the 1995 OTA Report and the 1997 PCAST recommendations, this study suggested that SCDEs should focus more on the applied use of technology in their regular courses rather than having students take standalone technology courses.

*Content, pedagogy, and technology.* There is also a call to emphasize content and pedagogy, not just hardware. It is important to learn basic skills but it does not end there. Matzen and Edmunds (2007) noted from the 2000 NCES report that “frequently, teachers’ technology professional development experience is short term with a primary focus on computer skills” (p. 417). One of the problems with this approach is that teachers tend to fall back on technology uses that fit their old styles of teaching instead of being able to comfortably integrate technology effectively and use it in ways that emphasize more constructivist and learner-centered approaches (Matzen & Edmunds, 2007). Otero et al. (2005) reiterate that “teacher education programs are being called on to provide models of authentic teaching and to help teachers develop their knowledge of the content, discourse, and content-specific pedagogy” (p. 9). Technology, on the other
hand, has a lot to offer in this regard. Expounding how technology can support learning, Bransford et al. (2000) concluded:

What has not yet been fully understood is that computer-based technologies can be powerful pedagogical tools—not just rich sources of information, but also extensions of human capabilities and contexts for social interactions supporting learning. The process of using technology to improve learning is never solely a technical matter, concerned only with properties of educational hardware and software. Like a textbook or any other cultural object, technology resources for education—function in a social environment, mediated by learning conversations with peers and teachers. (p. 230)

According to Pierson (2001), true technology integration is practiced when three domains intersect: content knowledge, pedagogical knowledge, and technological knowledge. Pierson’s conclusion states:

Technology in the hands of a merely adequate teacher will lack the experienced [sic] and thoughtful motivation necessary to embed it within a context of sound teaching practice. Conversely, technology in the hands of an exemplary teacher will not necessarily result in integrated and meaningful use. Unless a teacher views technology use as an integral part of the learning process, it will remain a peripheral ancillary to his or her teaching (p. 427).

The conceptual framework for educational technology that is illustrated by the intersection of content knowledge (C), pedagogical knowledge (P), and technological knowledge (T) was the result of five years of work by Mishra and Koehler (2006) on a
program of research focused on teacher professional development and faculty
development in higher education (see Figure 2). Their conceptual framework was a
further development of Shulman’s concept of pedagogical content knowledge, which is
the intersection of content knowledge and pedagogical knowledge. As new technologies
are reshaping the classroom and learning, Mishra and Koehler explain:

What sets our approach apart is the specificity of our articulation of these
relationships between content, pedagogy, and technology. In practical terms, this
means that apart from looking at each of these components in isolation, we also
need to look at them in pairs: pedagogical content knowledge (PCK),
technological content knowledge (TCK), technological pedagogical knowledge
(TPK), and all three taken together as technological pedagogical content
knowledge (TPCK).

Figure 2. Technological pedagogical content knowledge.
Stages of Adoption

True technology integration requires a fair amount of both time and effort from teachers. Citing previous research, Hughes, Kerr, and Ooms (2005) argue that “benchmark research established that teacher learning about and integration of educational technologies in PK-12 settings is a lengthy process requiring a commitment, in some cases, of five years or more” (p. 367). There are several frameworks that can be used to study or understand how teachers adopt technology. One can use Rogers’ theory of diffusion of innovations which was first published in 1962. An innovation, such as technology integration, requires a decision on the part of the teacher. Rogers (2003) suggests five sequential stages in the innovation-decision process:

1. **Knowledge** occurs when an individual is exposed to a innovation’s existence and gains an understanding of how it functions;

2. **Persuasion** occurs when an individual forms a favorable or an unfavorable attitude towards the innovation;

3. **Decision** takes place when an individual engages in activities that lead to a choice to adopt or reject the innovation;

4. **Implementation** occurs when an individual puts a new idea into use; and

5. **Confirmation** takes place when an individual seeks reinforcement of an innovation-decision already made, but he or she may reverse this previous decision if exposed to conflicting messages about the innovation. (p. 169)

Another framework that can be used to understand the stages of incorporation of technology by teachers is one developed by Sandholtz, Dwyer, and Ringstaff based on
their ACOT research. They observed that teachers’ approach to the use of technology in
their classroom evolves through five orderly stages:

1. Entry: learning the basics of using the new technology;
2. Adoption: using new technology to support traditional instruction;
3. Adaptation: integrating new technology into traditional classroom practice where
   they often focus on increased student productivity and engagement by using word
   processors, spreadsheets, and graphic tools;
4. Appropriation: focusing on cooperative, project-based, and interdisciplinary
   work—incorporating the technology as needed and as one of many tools; and
5. Invention: discovering new uses for technology tools such as developing
   spreadsheet macros for teaching algebra or designing projects that combine
   multiple technologies. (Apple Education, 1996, p. 16)

In a study that sought to understand the value and impact of technology better,
Valdez, McNabb, Foertsch, Anderson, Hawkes, and Raack (2000) presented a model that
contains three stages. “We believe that to understand the value and impact of technology
in education, we must recognize that there have been three distinct phases in the
evolution of its uses and expectations: Print Automation, Expansion of Learning
Opportunities, and Data-Driven Virtual Learning” (p. 1). The role of the teacher in terms
of engaged learning and instruction progresses through these three stages as follows:

1. Phase 1 (Print Automation): Teachers have limits on structuring the learning due
to the closed-end design of the software; the quality of learning depends on the
intended learning outcomes set by software developers;
2. Phase 2 (Expansion of Learning Opportunities): Teachers use technology to access information, model problem solving, and develop simulations that provide greater understanding of how technology is used in the work world; and

3. Phase 3 (Data-Driven Virtual Learning): Teachers continue to use technology to guide and engage students in self-directed learning activities; they model problem solving that reflects real work but focuses on areas that are otherwise difficult to teach. (Valdez et al., 2000, p. 3)

Research Literature on Technology Education and Integration

Looking back at the past 15 years, it seems that research literature on teacher education and technology integration have been rather low-key—limited to some specialized journals, conference presentations, a few national reports, and other research articles. More high-profile and comprehensive works from the American Educational Research Association (AERA), for example, such as the latest edition of the Handbook of Research on Teaching (Richardson, 2001) or the report of the AERA Panel on Research and Teacher Education entitled Studying Teacher Education (Cochran-Smith & Zeichner, 2005) both do not contain any chapter on or references to technology.

The most comprehensive national study on technology and education may be the 1995 OTA report “Teachers and Technology: Making the Connection.” The OTA closed office that same year after 23 years of existence. In 1999, however, “the U.S. Department of Education established the Preparing Tomorrow’s Teachers to Use Technology (PT3) program to support organizational change in teacher education so that future teachers are able to use interactive information and communication technologies for improved
learning and achievement” (Otero et al., 2005, p. 9). PT3 research is regularly published by the Association for the Advancement of Computing in Education (AACE) in its *Technology and Teacher Education Annual* series. Most of the literature contained in this section have been gathered from various journals, proceedings, and reports dealing with teacher education and technology integration such as: Journal of Technology and Teacher Education, Journal of Research on Technology in Education (formerly Journal of Research on Computing in Education), Journal of Information Technology for Teacher Education, Proceedings of the Society for Information Technology & Teacher Education, and from the ACOT, NCES, and OTA reports.

*The Search for Best Practices*

There is no single, agreed upon way to design and implement effective teacher professional development in technology integration. It is possible to draw on any theory or model of learning that is deemed to be in accordance with a community’s values, answers their needs, and that can achieve their objectives. The following review of research literature, however, on both the proper use of technology in schools and the way to prepare teachers, indicated an overwhelming trend towards constructivist models. The dominant themes found in the research literature include constructivist strategies such as modeling and collaboration. These two were cited by many studies. Other constructivist practices, which ought not to be considered secondary although they may not have come out very pronounced in the literature include support, exploration, reflection, and problem-based learning.
Strengths and weaknesses. Each theory or model will always have its inherent strengths as it will also have its set of flaws. A study by Jenson, Lewis, and Smith (2002), for example, looked at three different models or approaches to professional development: university-based, school district, and a single school. Using case studies gathered from 30 schools and 18 school districts in five Canadian provinces in a span of two years, the researchers listed positive key areas that help teachers in IT professional development: “incentives, both financial and time; the importance of play and discovery; flexibility which makes for allowances for all levels of competency and interest; ongoing work, where teachers learn on the computers they will be using with their students; an activity-based emphasis—teachers don’t learn “stand alone” skills, but instead use computers in relation to the activities they design and will ask their students to do; and the importance of scalability and sustainability of any program (Jenson, Lewis, & Smith, 2002, p. 493). What makes this study particularly interesting is that the researchers also discovered some inconsistencies between the reports from the participants and those from the professional development organizers. Their counter-list as they call it includes: “‘self-motivation’ as ‘volunteerism’—teachers attend and pay for their own training and ‘upgrading’ of skills/knowledge; supporting innovation usually means supporting the one or two teachers who are already making use of technology, and does little to assist other teachers in the school; little or no recognition of ‘audience”—workshop facilitators often use technicist language that is not well understood by teachers who seek out and take IT professional development; self-display as a method of presentation—workshops which solely focus on demonstrating the technical knowledge of the presenter, who does little or
nothing to advance the technical know-how of his/her audience, epistemological
disparity—there is often a great difference between the proclamation of a certain
knowledge or skills-base (by workshop and program organizers) and its ‘uptake’ (actual
implementation and use) by teachers” (Jenson, Lewis, & Smith, pp. 493-494).

Constructivism. Most other studies that reported relative success in technology
integration reflect the same constructivist trends. When ACOT began in 1985, the staff
explored different ways to help teachers integrate technology in their teaching. More than
10 years later, they found that the following had the most impact: 1) involved small-
group collaborations among teachers, 2) took place in working classrooms, 3) built on
teachers’ existing knowledge about curriculum and practice, 4) provided opportunities to
experiment and reflect on new experiences, and 5) provided ongoing support to help
implement change and innovation (ACOT, 1996, p. 18).

In a study that compared ACOT as a teacher development program with a
technology professional development program implemented by a public school district in
southern California, key highlights of the two programs which were both considered
effective include: 1) teacher input into design, 2) teacher choice, 3) administrator
involvement, 4) situated teacher development, 5) participant collaboration, 6)
constructivist environment, 7) flexibility, and 8) adequate funding (Sandholtz, 2001).

In a pilot study that involved training preservice and inservice teachers as well as
K-12 students in the integration of technology in the classroom, Clemente (2001)
describes the next generation of professional development as characterized by a
“constructivist approach to learning that uses real-world problems, project-based curricula, and an active learning environment” (p. 1587).

Beyerbach, Walsh, and Vannatta (2001) made it clear from the beginning that “our School of Education’s conceptual framework is rooted in a constructivist view of teaching and learning that strives to support authentic learning for all students with a goal of achieving social justice” (p. 108). The researchers discussed how they designed the project:

We purchased software and designed Internet experiences that positioned learners (college faculty, teachers, preservice teachers, and K-12 students) as active constructors of knowledge who engaged in real world problem solving. Social discourse, authentic problems, teacher as facilitator, and student choice were key concepts in developing and assessing technology infusion activities… Finally, we drew from professional development literature calling for professional development to center on creating sustained learning communities where participants have an active voice in determining goals and activities for the project. Multiple strategies for professional development, acknowledgement and support for stages of development, hands on learning with peer support, and constant revision of plans were incorporated. (pp. 108-109)

**Modeling.** A theme or strategy that has often been cited in the literature is modeling. The discussion has so far been about teachers who need to learn how to appropriately integrate technology. Modeling takes us up a notch as it will involve education faculty who teach teachers who in turn will teach K-12 students. Several
research studies have highlighted the importance and use of modeling as a successful strategy.

In a two-year individualized and process-oriented professional development project involving 21 teachers in a large Research 1 university in the mid-west, one of the conclusions was that “the key to success may lie in modeling and infusing technology into preservice teachers’ curriculum through effective, pedagogically sound method” (Howland & Wedman, 2004, p. 259).

A preservice technology course taught at the University of Victoria in Canada focused on modeling as a successful strategy. Francis-Pelton, Farragher, and Riecken (2000) describe the summary of their findings is as follows:

The format of the course has been very successful. Students have the benefit of instructors with expertise in a subject area who can then model using technology in that subject. Participation in model activities allows students to become learners in the subject area while learning to use a variety of computer tools. Students completing evaluations consistently rate this course as one of the most useful in their preservice teacher education program. (p. 185)

In a study that looked at technology integration in a school of education, one of the recommendations was to have a Peer Mentor Program that “could provide faculty with opportunities for peer observation, through which faculty would observe skilled faculty integrate technology in the appropriate field of instruction” (Vannatta, 2000, p. 244).
Building on the model of *VisionQuest*©, Ertmer, Johnson, and Lane (2001) reiterate previous research studies in that “one of the most effective ways to help teachers move forward on their technology integration journeys is through the use of peer and exemplary models” (p. 836).

In trying to account for how teachers in a particular study increased their use of technology in more constructivist ways regardless of their broader instructional practices, Matzen and Edmunds (2007) hypothesize that “when teachers see technology modeled using constructivist compatible, student-centered approaches, they are likely to use it in that way” (p. 427).

Vannatta and Beyerbach (2000), describing the second year of a preservice technology infusion project to prepare higher education faculty, K-12 teachers, and preservice teachers wrote, “preservice teachers who (1) observed their instructors model technology integration, (2) were required to develop technology-rich lesson/unit plans, and (3) complete several assignments using technology were extremely positive about the use of technology and expressed the development of a constructivist vision of technology” (p. 134).

One of the barriers to successful technology integration is that teachers do not have a vision or model about how technology, such as a computer, can fit into the daily activities of the classroom. In an attempt to help teachers gain a vision and an exemplar of technology integration, a study focused on mentoring and modeling as a strategy. “Mentors modeled integration of the technology in the teacher’s classroom providing
opportunities for the teacher to observe how technology can be used and managed in their own setting” (Franklin, Duran, & Kariuki, 2001, pp. 848-849).

**Collaboration.** Collaboration as a key factor has been mentioned in several studies such as the ACOT project. Collaboration, in the context of learning, is the “interaction between or among two or more learners to maximize their own and one another’s learning” (Dabbagh & Bannan-Ritland, 2005, p. 326). Collaboration can be done in different ways. It can be practiced horizontally—such as among peers, or vertically—such as between instructor and student.

At Michigan State University’s Teacher Preparation Program, a collaborative approach was developed to support professional development of teacher candidates (Rosean, Hobson, & Khan, 2003). The collaborative aspect of the program involved the collaboration of teacher candidates, K-5 teachers, and the teacher educators. The process is described as follows (Rosean, Hobson, & Khan, 2003):

Course assignments, including those that required use of technology, were agreed upon by course instructors and collaborating teachers with whom teacher candidates worked, to increase the likelihood that the uses were authentic and connected to the classroom curriculum (e.g., drafting and sharing lesson plans; using the Internet to find high-quality teaching resources; seniors using a PowerPoint presentation to introduce themselves to students in the classroom; a classroom software appraisal; assisting [collaborating teachers] in using a variety of technologies). (p. 284)
Their data showed that “collaborating teachers who attended workshops regularly commented explicitly that their knowledge and uses [of technology] increased, as well as their confidence level and ability to trouble-shoot” (Rosean, Hobson, & Khan, 2003, p. 295).

Another study related to collaboration looked at an implementation of a graduate teacher education class that involved a combination of face-to-face meetings, web courseware, and interactive two-way video (Stallings & Koellner-Clark, 2003). Although this study talks about collaborative teaching, it can also give an insight on learning collaboratively. The researchers’ findings reveal that “collaborating gives the instructors more time to experiment with the new technologies and encourages reflection from two perspectives about how well teaching with those technologies work” (Stalling & Koellner-Clark, 2003, p. 513).

Collaboration in a master’s program that educate teachers to use technology can also be achieved through a cohort process. At a professional development school for educators in Long Beach, CA, 24 participants took courses as a cohort to facilitate group interaction and mutual support (Adams, 2005). In the summary of main findings, Adams (2005) cites

1. The most frequently cited method for further professional development in technology was learning from fellow teachers.

2. Teachers not only taught one another ways of integrating technology but also began applying many of the technological skills from the course to their own teaching.
Vannatta and Beyerbach (2000) noted in their study that after organizing technology-related assignments around group work, students noted how beneficial it was in terms of learning about technology integration when peers who have stronger backgrounds in technology help those with weaker backgrounds. One student participant in the study of Vannatta and Beyerbach (2000) commented:

I think collaboration was a key in the whole program since we did have limited time. Some people are more apt to get it quicker than others, and since we worked in groups it made it a lot easier for me to understand the program because there were some things that I got out of it that other people didn’t and vice versa. (p. 146)

In a similar study by the same researchers a year later, students noted that their classmates were willing to share tricks, shortcuts, and cool stuff like graphics and Internet sites—a collaboration which they observed was modeled by their instructors (Beyerbach, Walsh, & Vannatta, 2001).

Modeling and collaboration were definitely often cited by studies and at great length. Other constructivist practices such as support, exploration, reflection, and problem-based learning are just as effective and should not be thought of as secondary.

Support. Supporting teachers learning how to integrate technology into their teaching can come in various ways. Sandholtz (2001) cites four important areas: administrative support, technical support, collegial support, and funding. Any education or training should not just be a one-shot deal. Hornung and Bronack (2001) emphasize the importance of supporting teachers between workshops. In a study of a professional
development model for the integration of technology in an elementary school in British Columbia, Kitchenham (2001) lists as motivators: direct and indirect administrative support, support network within and outside of school, district support, federation support, and ministry support. Vannatta and Beyerbach (2000) mention providing adequate support for integration activities as a key element to an effective higher education faculty training program.

**Exploration.** There is so much to learn about technology that it is not possible to learn everything even with a two-year professional development program. Hence, one of the important lessons is that teachers should learn to explore and discover things by themselves. The ACOT project already mentioned providing teachers room for experimentation. The study by Jenson, Lewis, and Smith (2002) refers to it as “play and discovery” and “flexibility which makes for allowances for all levels of competency and interest” (p. 493). Ring, McCallister, and Ali (2001) described it as “tinkering” with software to discover what they are looking for.

**Reflection.** Reflection, a metacognitive process, can aid teachers in technology integration. The Integrating Technology in Schools (ITS) program is built around the dynamics of reflection, experience, modeling, planning, and a return to reflection (Norton, 1994). A study at the George Washington University investigated the professional growth of 11 teachers learning new technologies through journal writing (Kortecamp, 2001). The study found that “reflective journals allowed teachers the opportunity to (a) become more aware of what and how they were learning and make connections to broader educational issues, (b) transfer what they had learned to secondary
classrooms, and (c) examine how their experiences as learners revealed conditions necessary for effective technology implementation (Kortecamp, 2001, p. 918). The study by Goss, Kinslow, and Welsh (2001) also included knowledge of self as well as reflection in the conceptual framework that drives their teacher preparation program.

**Problem-based learning.** Based on the belief that the fast-pace life of the 21st century will demand adaptability, problem-solving, and continual learning, Lehman, Ertmer, Keck, and Steele (2001) designed a professional development approach to promote problem-centered uses of technology. Some of the features of this approach as outlined by the researchers are: (1) use of an ill-structured problem or driving question that provides opportunities for student investigations and problem-solving; (2) student analysis of the overarching problem or question to identify a specific problem for investigation; (3) student-conducted investigations or actions that typically result in the development of artifacts or products; and (4) collaboration among students, teacher, and community. Technology is believed to be able to help in all these aspects of learning.

The same problem-based and collaborative activities are also mentioned by Williams, Burns, and Oostenink (2001) in their innovative professional development model and by Clemente (2001) in what she calls the next generation of professional development.

**The Integrating Technology in Schools (ITS) Program**

**Background and summary.** The Integrating Technology in Schools program that leads to a Masters of Education in Curriculum and Instruction was developed in order to meet the need for teacher education responsive to the integration of new and emerging
technologies (Norton & Farrell, 2001). The program was originally developed by Norton (1994), and it uses several of the constructivist strategies that research literature reveals.

In summary:

The ITS program is structured around a cohort process that supports students finding common ground around a shared set of experiences, knowledge, readings, activities, and support systems. Each group shares a common area of inquiry—one that centers on models, methods, and processes that support the incorporation of technology into educational practice. As teachers enter the program, their most pressing goals center on learning to use the newer technologies. Participation in the ITS program, however, leads not only to technological expertise but to a consideration of the social, cultural, political, and epistemological impacts of these technologies. (Norton & Farrell, 2001, p. 959)

The program is grounded in three principles: (a) creating a thought community; (b) designing an integrated, transdisciplinary curriculum; and (c) promoting a vision of collaboration. One of the highlights of the program is precisely that student teachers come into the program at the same time and stick together for the next two years.

According to Norton (1994), “structuring graduate study as a cohort group plan allows for the creation of a group of students who share a common area of inquiry” without the demand for uniformity of interest (p. 167). Norton believes that this creates a “thought community” that “encourages hierarchical layers of expertise to coexist with horizontal systems of sharing, processing, and product completion” (Norton, 1994, p. 167).
Research on ITS. One of the earliest studies done on the ITS program involved the infusion of the narrative mode of thought as opposed to expository discourse, such as textbooks and research papers, in envisioning and understanding technology and educational change (Norton, 1995). The study involved a cohort of 48 graduate students in a nine credit hour seminar where the reading of eight books from nonfiction and trade market was integrated into their study of technology. “Students were then asked to brainstorm phrases that they might use if they were to write a story about today’s schools (Norton, 1995, p. 372). Results of the study showed that the narrative mode of thinking is not universally effective in promoting teacher-students’ ability to fashion an image of technology integration in schools although it served as an important strategy toward accomplishing that goal (Norton, 1995). The study, however, recommended two essential components for it to be effective:

1. Teacher-students must be guided through robust reading, reflecting, and modeling activities prior to attempting to create their stories.

2. Even though many of these teacher-students teach story writing themselves, they need significant support and instruction in the nature of story and story-telling before they are able to capture the power of narrative as a way of making sense of their emerging knowledge. (p. 375)

Another research study on the ITS focused on the cohort nature of the program. Using a two-round questionnaire, 51 students were surveyed on what aspects they found valuable about the cohort process, what aspects they found problematic, what difference they found learning in a cohort program, what they learned about themselves as learners
in a cohort program, and what they learned about teaching while participating in a cohort program. Norton and Sprague (1999) presented four salient conclusions:

1. Participants come to understand learning and educational change as a group effort that depends on shared responsibility, shared knowledge and vision, and the help and support of colleagues.

2. They learn to work with peers, developing and pursuing common goals and alternating between leadership and supportive roles.

3. They learn to cope with inequalities in expertise and effort.

4. The process of working with and within a group support the development of the skills and dispositions necessary for educational change whether personal, professional, or institutional. (p. 727)

A study by Norton and Farrell (2001) examined the relationship between changes in attitudes and changes in practice. A presurvey was administered to 24 ITS students at the beginning of the program in 1999 and a postsurvey was given 10 weeks before completion of the program in 2000. Both surveys consisted of question items relating to frequency of technology use and collegial interactions related to technology planning, and the Stages of Concern Questionnaire (developed by Hall, George, & Rutherford, 1998). The results of the study showed that the “positive relationship between changes in attitudes and changes in practice [was] not… as dramatic as one might hope” (Norton & Farrell, 2001, p. 964). The researchers found seeming evidence that there remain systemic or system-wide obstacles that impede more substantial transformations in education practice (Norton & Farrell, 2001).
A similar study, conducted by Norton and Schell (2001), included a comparison of a Master’s of Education degree program, such as the ITS, with a 12 graduate credit hour certificate program. 32 ITS students and 153 certificate program students responded to the same set of survey instruments used by Norton and Farrell (2001). The first set measured frequency of technology use and collegial interactions related to technology planning. The second set asked participants to complete the Stages of Concern Questionnaire. Norton and Schell summarize their findings in two lessons learned from the study:

1. Professional development activities designed to promote changes that fully integrate technology to support teaching and learning must be extensive, consistent, and long term.

2. [The participants’] ability to translate their learning into system-wide practices depend not only on what they learn or what they are able to implement in their practice but on the ways in which their learning and practice interact with broader, systemic issues. (p. 970)

In summary, the ITS program features a philosophy and design that reflect some of the best practices mentioned in recent research. The ITS goal of building a thought community, coupled with its cohort nature, provides the suitable environment for collaboration. The ITS program also highlights modeling and support between experts and students as well as among students. Readings and reflection are also an integral part of the program. All these manifest the constructivist approach of the ITS program that is also evident in the literature.
3. Methodology

Participants

The population consisted of graduates of a master’s program in teacher technology integration at a large mid-Atlantic state university. Out of 318 graduates, 232 responded. There was no remuneration of any kind for participating in the study. It was entirely voluntary. Participants were also treated in accordance with the “Ethical Standards for the Reporting and Publishing of Scientific Information” (American Psychological Association, 2001) and the “Ethical Principles and Guidelines for the Protection of Human Subjects of Research” (Office of Human Subjects Research, 1979). Some chose not to finish the survey while others did not complete certain required sections. After eliminating possible duplicates and incomplete surveys, this study had a final count of 155 participants ($N = 155$).

The participants comprised 124 women and 31 men who graduated between 1999 and 2007. Their ages ranged from 23 to 64 years with the mean age being 39 years. The participants’ number of years of experience as an educator ranged from 4 to 40 years, ($M = 14.15$). There were 87.1% from suburban settings ($n = 135$), 7.7% from rural areas ($n = 12$), and 5.2% from urban environments ($n = 8$).

Among the 155 participants, 89.6% were K-12 teachers while they were attending the program. The remaining 10.4% were composed of school based technology
specialists (SBTSs) or instructional technology resource teachers (ITRTs), an instructional assistant, a librarian, and an assistant principal. At the time when this study was conducted, 63.2% were in either full-time or part-time K-12 teaching positions. 20.6% were full-time school SBTSs or ITRTs. Others have become full-time mothers (5.2%) or principals/assistant principals (3.2%). 7.8% of the participants have become university instructors, went on to retire, or are involved with other kinds of work.

Survey Instrument

This study looked at a wide variety of variables: demographic information, attitudes, beliefs, experiences, and practices. The review of literature revealed that various researchers have developed surveys focusing on some aspects of this study such as attitudes about technology (Isleem, 2003), instructional strategies that make use of technology (Evans, 2006), and support (Becker & Anderson, 1998; Lebruto, 2001). This study could have used these developed and tested instruments. However, doing so would have meant asking participants to answer more than a hundred questions in order to address the many variables in this study. Second, using these developed surveys together did not necessarily satisfy validity and reliability requirements for this particular study. And third, this study called for other data not answerable by the developed surveys. Hence, this study needed a totally new instrument that could answer all three research questions at once.

Therefore, the Integrating Technology in Schools Program Survey (ITSP Survey) was developed with seven sections: (a) personal information; (b) attitudes about technology and learning; (c) beliefs about and frequency of participants’ use of
technology tools; (d) beliefs about and frequency of participants’ use of technology-enriched instructional strategies; (e) availability and quality of technical, instructional, administrative, and peer support; (f) questions about participants’ experiences of the ITS program; and (g) ways participants keep current with technology (see Appendix A). An online format was used since it was more convenient, and the participants were all familiar with computer technology and the Internet. There were a total of 56 items, with 26 of these items requiring two answers each. The whole survey, therefore, required 82 answers.

The test instrument was administered to 61 students who are currently in the program. This way, the target participants, the graduates of the program, were spared for the actual study. Second, the researcher chose to do the instrument test on current students because they best fit the profile of the graduates. Third, this allowed the researcher to test the instrument for reliability.

No item from the previously developed instruments was used as is. Nevertheless, acknowledgement is due to two research works that provided guidance in the development of certain sections of the instrument. The study by Isleem (2003) helped direct the types of questions one should ask about attitudes about technology. Evan’s work, on the other hand, helped provide a framework, using the NETS-T standards, to comprehensively design questions about teachers’ integration of technology (Evans, 2006).

Welcome and consent. Following APA and Institutional Review Board (IRB) protocols, the welcome page (see Appendix B) introduced the study to prospective
participants. It described the research procedures, risks (no foreseeable personal risks for participating in this study), benefits (no direct benefits to participants), confidentiality, participation, and contact information. It also served as an informal consent form where participants could click on a button if they agreed to the terms of the study. The IRB norm for online surveys is that the signing of a consent form is waived but a participant can opt for a written consent form. In this case, contact information was provided if one wished to have a consent form mailed to him or her.

Instructions. Each section of the questionnaire began with instructions. Some sections required simple instructions such as filling in information by typing their answers in textboxes or clicking on a checkbox on a Likert scale. Two sections called for a more complex set of instructions where each item required two distinct answers. The instructions for one section, for example, read

In this section, each item requires an answer on two columns. The second column (white) asks you to rate the importance of that item for teaching/learning. It uses a Likert scale where 1 = "Not at All Important" and 5 = "Very important." The third column (gray) asks how often you use that item for teaching. It uses a Likert scale where 1 = "Never" and 5 = "Very Often." (16 Items)

Section 1: demographics. The first section required eight basic personal, nonidentifying responses that included the year the participant graduated from the program, years of experience as an educator, job while attending the program, current job, grade level they teach (if applicable), gender, age, and geographic location.
Section 2: attitudes about technology as a tool for instruction. This section consisted of 10 items that gauged participants’ attitudes towards the use of technology in instruction and learning. Some statements expressed a more positive attitude towards technology and learning such as “I have access to so much more resources with the use of technology.” Other statements articulated a more negative attitude towards technology and learning such as “I feel very uneasy with technology tools I am not at all familiar with.” Each participant was asked to rate each item on a 4-point Likert-scale: 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree). Since some items were negative, the actual scoring had to be reversed for these items in such a way that a higher total score meant a more positive attitude towards technology and learning.

Section 3: technology integration tools. This section listed 16 technology tools. Some of these tools were taught to the graduates while they were in the program whereas a few others are emerging technologies they might have learned more recently. The list hoped to measure participants’ attitude about and practice of each item and was suggested by the director who designed the program. A sample of items included the Internet, word processor, skills software, WebQuests, e-mail, online discussion, podcasting, wikis, and others. For each of these items, the participants were asked two things. First, the participants rated how important they think the tool is. A Likert scale was used from 1 (not at all) to 5 (very important). Second, the participants were also asked to rate how often they now use it using the following Likert scale: 1 (never), 2 (seldom), 3 (sometimes), 4 (often), and 5 (very often).
Section 4: technology-enriched instructional strategies. This section contained 10 items that covered five of the six areas of technology integration and accompanying practices based on the NETS-T standards. The purpose of this study was to discover not only participants’ attitudes and practice of technology tools but, equally important, how they value and use various technologies in their lives as teachers. The majority of the items focused on the design of student learning activities. Some random sample items included: (a) design and implement learning activities that allow students to work collaboratively using various technologies, (b) design technology-enriched learning activities that incorporate and authentic problem, and (c) design learning activities that provide students with opportunities to use various technologies to connect with experts or resources for research and problem-solving. To cover the other areas of the NETS-T standards, there was one item about using technology to evaluate and assess student learning, one item about using technology for productivity and professional development, and one item about the ethical use of technology. There was no item related to the first standard since it simply deals with technology operations and concepts. Similar to the previous section, the participants were asked two questions for each item: how important the item was and how often they practice it. The same Likert scales as the previous section were also used for this section.

Section 5: support. This section was divided into two subsections. The first subsection aimed to measure participants’ perception of the availability of support in four categories: (a) technical support that includes software, hardware, troubleshooting, and repair; (b) instructional support that could help them integrate technology into their
lessons; (c) administrative support that provided them with opportunities for professional development; and (d) peer support. The Likert scale used was 1 (none), 2 (sometimes), 3 (frequently), 4 (mostly), and 5 (almost always). It would have been more logical to use always instead of almost always for the last one. However, the choice almost always seemed more realistically possible than always.

The second subsection was added to measure participants’ perception of the quality of support they receive in the same four categories: (a) technical support, (b) instructional support, (c) administrative support, and (d) peer support. This time, a 6-point Likert scale was used that included 0 (none), 1 (poor), 2 (fair), 3 (good), 4 (very good), and 5 (excellent).

Section 6: ITS experiences. This section contained three open-ended questions that asked participants about their experiences of and hopes for the program. Participants were first asked to list three aspects or features of the program that they consider as best practices in helping teachers integrate technology in teaching. Secondly, they were asked to list three aspects or features of the program that they consider as least helpful. Finally, they were asked to list any additions or changes they thought would make the program better.

Some participants chose not to answer some or all of these questions. Open-ended questions are more challenging and normally require more time to answer as participants need to think their answers over. A few suggested that it would have been easier if each question contained a list where they could simply have clicked on some choices. However, this study hoped to find out what each participant actually thought about their...
own personal experiences of the program without the questionnaire suggesting what they should be or limiting their choices, all in line with a constructivist approach. Hence, open-ended questions were the better choice, even if it meant putting off some participants.

Section 7: keeping up-to-date. This last section contained a list of six possible ways participants could keep up with the advancement of technology. Sample items included: journals and other related articles, collaboration with peers, workshops offered by school division, attendance at conferences, and taking community college or university courses. Four empty textboxes were added to allow participants to add other ways they keep current with technology.

Validity

Validity refers to “that quality of a data-gathering instrument or procedure that enables it to measure what it is supposed to measure” (Best & Kahn, 2006, p. 289). Fraenkel and Wallen (2009), on the other hand, point out that “in recent years, validity has been defined as referring to the appropriateness, correctness, meaningfulness, and usefulness of the specific inferences researchers make based on the data they collect” (p. 148). To ensure that the survey items measured the various constructs this study hoped to measure, the instrument was submitted to a panel of four experts in the field of educational technology for validity review. The experts scrutinized the items for possible construct underrepresentation which refers to the danger of having an assessment tool that is too narrow and that fails to include important dimensions of the construct (Ary, Jacobs, & Razavieh, 2002). All four independently commented that there was enough
content-related evidence of validity—that the items for each section of the survey were appropriate and sufficient to measure the constructs under investigation given the limitations of this study.

*Reliability*

Reliability, on the other hand, refers to the consistency with which an instrument or procedure measures a construct. Fraenkel and Wallen (2009) explain this concept by focusing more on the consistency of scores, such that an individual should get about the same results if administered the same test a second time. There are various ways to test for reliability such as the test-retest method and the equivalent-forms method (Fraenkel & Wallen, 2009). The latter is also known as alternate-forms or parallel-forms technique (Ary et al., 2002).

The instrument used in this study was tested for reliability using an internal-consistency method, specifically the alpha coefficient, also “frequently called Cronbach alpha after the man who developed it” (Fraenkel & Wallen, 2009, p. 158). Since the instrument being tested entailed approximately 80 answers, this method was favored because it neither required participants to take the same test a second time (test-retest method) nor did it require them to take a second different form of the test (equivalent-forms method).

“For research purposes, a useful rule of thumb is that reliability should be at least .70 and preferably higher” (Fraenkel & Wallen, 2006, p. 161). Table 1 summarizes the reliability test results of the four sections of the questionnaire that used Likert scales.
Table 1

*Reliability Coefficients of Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>( \alpha )</th>
<th>( n^* )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Attitudes about technology</td>
<td>.87</td>
<td>10</td>
</tr>
<tr>
<td>2. Technology tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Importance</td>
<td>.87</td>
<td></td>
</tr>
<tr>
<td>b. Use</td>
<td>.86</td>
<td></td>
</tr>
<tr>
<td>3. Technology-enhanced instructional strategies</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>a. Importance</td>
<td>.89</td>
<td></td>
</tr>
<tr>
<td>b. Use</td>
<td>.90</td>
<td></td>
</tr>
<tr>
<td>4. Support</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>a. Availability</td>
<td>.86</td>
<td>4</td>
</tr>
<tr>
<td>b. Quality</td>
<td>.85</td>
<td>4</td>
</tr>
</tbody>
</table>

*Note.* \( n \) refers to the total number of question items in that section.

In summary, the reliability coefficients based on the sample of this study showed very good results given the nature of the study. All alpha coefficients were well above the minimum .70 recommended by most authors (Ary et al., 2002; McMillan & Schumacher, 2001; Fraenkel & Wallen, 2009; Field, 2005).

The use of the option “Cronbach’s Alpha if Item Deleted” in SPSS also revealed that there was no significant increase in reliability statistics if any of the items were to be taken out. The Cronbach’s alpha coefficient for the section on attitudes about technology
would only have gone up to .89 from .87 if item 2 were deleted. If item 3 in the section on the use of technology use were taken out, reliability statistics also resulted in a Cronbach’s alpha coefficient of .87 instead of .86 which also is not a significant increase. Finally, the same increase in the Cronbach’s alpha coefficients of the two subsections on technology-enhanced instructional strategies were noted if item 9 were not included.

Description of the Program

All participants were graduates of the Integrating Technology in Schools program. The program has been offered for 10 years at the university from which the participants have graduated. In those 10 years, the program has naturally undergone some modifications in its implementation yet it has retained its intrinsic or fundamental attributes. The ITS experience is shaped by a particular philosophy, guided by three principles, and worked out within four domains of inquiry.

The ITS philosophy. The ITS experience is a graduate-level program for teachers in the area of technology integration that has its roots in the work of Norton (1994) at the University of New Mexico in the early 90s. The philosophy behind the ITS design employs the Hegelian dialectic. However, unlike Hegel who focused on ideas and Marx who applied it in terms of class struggle, Norton envisioned teacher technology integration as a “change within the dialectic of ideas and actions built around the dynamics of reflection, experience, modeling, planning, and a return to reflection” rather than “a plan of ‘right’ action imposed on an uncertain, changing educational system” (Norton, 1994, pp. 163, 174). In essence, “teacher education about technology is really teacher education for change and demands new approaches” (Norton, 1994, p. 163).
The ITS guiding principles. The ITS program is founded on three guiding principles: (a) the creation of a thought community; (b) the design of an integrated, transdisciplinary curriculum; and (c) the promotion of a vision of collaboration.

A thought community “creates a community of inquirers bound by a common question who then branch and recombine to share individual angles of vision” and who over time share “a set of experiences, knowledge, readings, activities, and support systems” (Norton, 1994, p. 167). Moreover, this thought community “encourages hierarchical layers of expertise to coexist with horizontal systems of sharing, processing, and product completion” such that academic study, within this frame, “supports the redefinition of roles where all participants become learners, students, and teachers transactionally” (Norton, 1994, p. 167).

In our modern world, there is a tendency for people to become experts in too narrow a field. Real life, on the other hand, is a complex web of interrelated domains. Norton believes that the proper approach to technology integration requires an integrated and transdisciplinary curriculum. “In the case of technology and the educational process, learning opportunities must be created that skim across psychology, sociology, history, philosophy, anthropology, science, and organizational theory, building toward complex systems of understanding applicable to complex problems” (Norton, 1994, p. 169).

Finally, Norton espouses a vision of collaboration that begins with an action plan that then seeks out collaborations as it evolves. “As a community of thinkers develops, explores, questions, challenges assumptions, and identifies needs, the group reaches out to a variety of communities for support, elaboration, resources, consultation, and field
experience” (Norton, 1994, p. 172). In the end, however, Norton believes that the most important collaborations are among the group members. This is also the reason why the program is designed as a two-year cohort program. No new members are introduced during the span of the two years.

**ITS and four domains of inquiry.** Four domains of inquiry direct the concrete efforts to design integrated and transdisciplinary curriculum of the ITS. Norton (1994) lists and explains each one:

1. *Technology Impacts on Social Contexts* through explorations of the history of technology, the role of technology in change, the social, global, economic, political, and psychological impacts of technology, technology integration as it impacts diverse cultures, and the implications of current changes for the design of educational practice;

2. *Technology Impacts on Knowledge Forms* through examination of the psychological and epistemological influences of technology on the nature of knowledge—on what we know and how we know it—by inquiring about the structure and implications of the various social and structural discourse arenas created by the electronic technologies;

3. *Technology Impacts on the Learning Process* through investigation of emerging definitions of learning environments consistent with larger social configurations and with newer visions of the learning, thinking, problem-solving, and creative process including the nature and role of instructional strategies and broader conceptions of learner attributes and characteristics; and
4. *Technology Impacts on Educational Goals* through the reassessment of traditional educational goals, rethinking what is to be learned, how it is to be learned, who the learner is, the nature of each learner’s cultural experiences, nature of knowledge, and learning and emerging literature on standards and goals for education as well as the role of technology in shaping these reassessments. (p. 170)

*Research Design*

This study employed a mixed-methods approach to answer the three research questions. Research questions 1 and 2 involved a quantitative approach whereas the third question entailed a qualitative analysis. The design of the study utilized two nonexperimental research methods: correlational and descriptive.

*Correlational.* The quantitative part of the study can be classified under correlational research as it investigated correlations between certain variables. Correlational methodology is just one example of associational research where “the relationships among two or more variables are studied without any attempt to influence them” (Fraenkel & Wallen, 2009, p. 328). This is what makes correlational studies different from experimental ones. The researcher does not introduce a control group and manipulate independent variables against it but merely extracts preexisting data by means of a survey, for example, for the various variables and investigates possible correlations. As such, correlational studies are sometimes referred to as a kind of descriptive research since they describe possibly previously unknown existing relationships between variables. However, more than simply describing relationships, “a correlational study
describes the degree to which two or more quantitative variables are related, and it does so by using a correlation coefficient” (Fraenkel & Wallen, 2009, p. 328).

**Descriptive.** Descriptive research, on the other hand, is another type of nonexperimental design that is primarily concerned with gathering and presenting information. There are no manipulations of independent variables nor are there causal inferences involved. “A descriptive study asks what is or what was; it reports things the way they are or were” but it “provides very valuable data, particularly when first investigating an area” (McMillan & Schumacher, 2001, p. 283). At the outset, a descriptive study may seem too basic or straightforward. From the initial data, however, other more important questions can be asked. Questions that explore development, differences, and relationships can be addressed once a phenomenon has been adequately described (McMillan & Schumacher, 2001).

Some research questions probed what participants thought were the high and low points of their experiences in the ITS program. It also asked participants for changes or additions they would like to see in the program. The descriptive research approach was the most logical choice to gather and present these data.

**Procedures**

**Institutional Review Board (IRB).** The abstract and protocol of the study, the proposed informed consent, the proposed e-mail invitation to participate in the study, and the proposed survey instrument were submitted to the Human Subjects Review Board (HSRB) for review. The HSRB is the official institutional review board (IRB) at George Mason University. Approval for this study commenced on December 11, 2007 with a
year’s validity (see Appendix C for the approval of the entire study, Appendix D for the approval of the consent form, and Appendix E for the approval of the e-mail advertisement).

Data Collection. The e-mail invitation to participate in the study was sent to 318 graduates whose e-mail addresses were on file. The e-mail was sent by Dr. Norton, the director of the ITS program. It was hoped that Dr. Norton’s e-mail would help “establish trust” and “sponsorship by legitimate authority” that could have increased survey response (Dillman, 2007). Unless the e-mail bounced back, there was no way of knowing how many still used those e-mail addresses. The first e-mail was sent during the first week of February 2008. Scheduling was prudently planned. Around that time, the participants would have had some time to settle down after the beginning of the spring term. Moreover, it was also hoped that it was not yet a hectic time for the participants as they were just beginning a new term.

Due to some unforeseen technical glitches in the initial online survey setup, however, some early participants were not able to finish the survey. The survey was relocated to a subscription-based commercial server. The survey did not ask for any personal identifying information so there was no way to track who had or had not answered the survey. Therefore, three carefully scheduled follow-up e-mails were sent to everyone to either remind them to take the survey or to try again—if their first attempt was unsuccessful. The online survey was officially put offline at the end of the second week of March 2008. Data from the two database servers were exported into an MS
Excel spreadsheet. They were then compared and checked for missing required data and possible double entries.

Statistical analyses. Research questions 1A and 1B required separate multiple linear regressions. There were a total of 11 variables: (a) number of years as an educator, (b) year graduated, (c) gender, (d) age, (e) attitudes about technology, (f) perceived value of technology tools, (g) use of technology tools, (h) perceived value of technology-enhanced instructional strategies, (i) use of technology-enhanced instructional strategies, (j) availability of support, and (k) quality of support. Each question looked at how 10 of the variables (predictors) predicted the outcome of the remaining variable (criterion). Except for the interchange of a couple of variables, these two questions were basically the same. In question 1A, the use of technology tools by participants was the criterion or dependent variable. The rest of the 10 were the predictor or independent variables. In question 1B, the use of technology-enhanced instructional strategies by participants was the criterion variable. Similarly, the rest of the 10 variables were the predictor variables. SPSS was used to compute for the statistical results.

Research question 2 involved comparing the means of two groups on seven variables. The participants were divided into two groups. Participants who graduated from 1999 to 2003 were categorized as early graduates while participants who graduated from 2004 to 2007 were categorized as recent graduates. Then, the following variables were compared between the two groups using t tests: (a) attitudes about technology and learning, (b) perceived value of technology tools, (c) use of technology tools, (d) perceived value of technology-enhanced instructional strategies, (e) use of technology-
enhanced instructional strategies, (f) perceived support, and (g) strategies on how they keep current with technology. SPSS was used to compute the statistical results. The last variable, strategies on how participants keep current with technology, required a separate t test because it contained a list of six unrelated items that used checkboxes instead of Likert scales that were used in the first five variables. So, for this part, t tests were conducted on each of the six items in the last variable. Moreover, the last variable also entailed qualitative analysis as it included optional open-ended answers. This open-ended section was included simply to discover what other ways participants keep up-to-date. No comparison of means was conducted on the results.

Qualitative analysis. The data for research question 3 contained short typed-in responses from participants. These were the answers from section 6 of the questionnaire. This section was divided into three categories: best attributes of the program, least helpful attributes of the program, and additions or changes to the program. Participants were asked to write three answers in each category in order, with the first answer being the most important. Qualitative analysis involved mostly categorizing strategies where the data were analyzed using organizational and substantive categories (Maxwell, 2005). The rest of the analysis entailed frequency counts more akin to a quantitative study.

The first step involved arranging the answers in each category according to the order they were written. The second step entailed reading the answers from beginning to end a few times to get a bird’s-eye view of the possible running themes or keywords. Organizational categories are broad areas or issues that a researcher establishes prior to gathering the data and that “function primarily as ‘bins’ for sorting the data for further
analysis” (Maxwell, 2005, p. 97). So, themes from the literature review in chapter 2 such as constructivism, problem-based learning, collaboration, modeling, and others provided a flexible framework for this step. The next step involved rearranging the answers by putting substantively similar items together. Similar items were grouped into three columns to preserve the order in which they were written by participants. That way, it was easier to calculate the frequency of an attribute first according to importance and then in totality. The grouped attributes were then analyzed for consistency, given labels, and subjected to scrutiny by an expert since it was not possible to conduct member checks to validate the reorganized data.
4. Results

This chapter presents the findings of the main research questions. It begins with a presentation of the descriptive statistics of all variables. This is followed by the results from the correlational studies involving research questions 1A, 1B, and 2. Finally, results from the more descriptive research question 3 are presented.

Descriptive Statistics Overview

The sample included the following number of graduates from the following years: 1999 ($n = 12$), 2000 ($n = 7$), 2001 ($n = 16$), 2002 ($n = 23$), 2003 ($n = 13$), 2004 ($n = 28$), 2005 ($n = 11$), 2006 ($n = 24$), and 2007 ($n = 21$). Table 2 provides an overview of the demographic data of the participants. The item group refers to whether they were categorized as early graduates (1999 – 2003) or recent graduates (2004 – 2007) from the program. The division was done in such a way that the participants were divided as close as possible into two groups. Among the 155 participants, 63.2% are currently part-time or full-time K-12 teachers. The others are ITRTs or SBTSs, administrators, or full-time mothers. A few have gone on to retire or have taken other jobs. Women outnumbered men by 4 to 1 which is typically the case in the teaching profession. The participants’ ages ranged from 23 to 64 years. The great majority of the graduates currently work in the suburbs (87.1%). Tables 3 and 4, on the other hand, show separate demographic data for early and recent graduates, respectively.
Table 2

*Descriptive Statistics of Demographic Data for Total Sample*

<table>
<thead>
<tr>
<th>Demographic</th>
<th>M</th>
<th>SD</th>
<th>N</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of years as an educator</td>
<td>14.15</td>
<td>7.98</td>
<td>155</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Group</td>
<td></td>
<td></td>
<td>155</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Early</td>
<td></td>
<td></td>
<td>71</td>
<td>45.8</td>
<td></td>
</tr>
<tr>
<td>b. Recent</td>
<td></td>
<td></td>
<td>84</td>
<td>54.2</td>
<td></td>
</tr>
<tr>
<td>3. Grade level</td>
<td></td>
<td></td>
<td>155</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. K1 – K2</td>
<td></td>
<td></td>
<td>11</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>b. K3 – K5</td>
<td></td>
<td></td>
<td>31</td>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td>c. K6 – K8</td>
<td></td>
<td></td>
<td>23</td>
<td>14.8</td>
<td></td>
</tr>
<tr>
<td>d. K9 – K12</td>
<td></td>
<td></td>
<td>33</td>
<td>21.3</td>
<td></td>
</tr>
<tr>
<td>e. Other or not applicable</td>
<td></td>
<td></td>
<td>57</td>
<td>36.8</td>
<td></td>
</tr>
<tr>
<td>4. Gender</td>
<td></td>
<td></td>
<td>155</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Female</td>
<td></td>
<td></td>
<td>124</td>
<td>80.0</td>
<td></td>
</tr>
<tr>
<td>b. Male</td>
<td></td>
<td></td>
<td>31</td>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td>5. Age</td>
<td>39.10</td>
<td>10.03</td>
<td>154</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Locale</td>
<td></td>
<td></td>
<td>155</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Rural</td>
<td></td>
<td></td>
<td>12</td>
<td>7.7</td>
<td></td>
</tr>
<tr>
<td>b. Suburban</td>
<td></td>
<td></td>
<td>135</td>
<td>87.1</td>
<td></td>
</tr>
<tr>
<td>c. Urban</td>
<td></td>
<td></td>
<td>8</td>
<td>5.2</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* One participant did not report age (n = 154).
Table 3  

*Descriptive Statistics for Demographic Data of Early Graduates*

<table>
<thead>
<tr>
<th>Demographic</th>
<th>M</th>
<th>SD</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of years as an educator</td>
<td>15.82</td>
<td>7.78</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>2. Grade level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. K1 – K2</td>
<td>2</td>
<td>2.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. K3 – K5</td>
<td>14</td>
<td>19.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. K6 – K8</td>
<td>9</td>
<td>12.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. K9 – K12</td>
<td>12</td>
<td>16.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Other</td>
<td>34</td>
<td>47.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Female</td>
<td>61</td>
<td>85.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Male</td>
<td>10</td>
<td>14.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Age</td>
<td>41.17</td>
<td>9.40</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>5. Locale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Rural</td>
<td>6</td>
<td>8.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Suburban</td>
<td>60</td>
<td>84.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Urban</td>
<td>5</td>
<td>7.04</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* One participant in this group did not report age (n = 70).
Table 4

*Descriptive Statistics for Demographic Data of Recent Graduates*

<table>
<thead>
<tr>
<th>Demographic</th>
<th>M</th>
<th>SD</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of years as an educator</td>
<td>12.74</td>
<td>7.92</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>2. Grade level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. K1 – K2</td>
<td>9</td>
<td>10.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. K3 – K5</td>
<td>17</td>
<td>20.24</td>
<td>17</td>
<td>16.67</td>
</tr>
<tr>
<td>c. K6 – K8</td>
<td>14</td>
<td>16.67</td>
<td>14</td>
<td>16.67</td>
</tr>
<tr>
<td>d. K9 – K12</td>
<td>21</td>
<td>25.00</td>
<td>21</td>
<td>25.00</td>
</tr>
<tr>
<td>e. Other</td>
<td>23</td>
<td>27.38</td>
<td>23</td>
<td>27.38</td>
</tr>
<tr>
<td>3. Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Female</td>
<td>63</td>
<td>75.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Male</td>
<td>21</td>
<td>25.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Age</td>
<td>37.37</td>
<td>10.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Locale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Rural</td>
<td>6</td>
<td>7.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Suburban</td>
<td>75</td>
<td>29.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Urban</td>
<td>3</td>
<td>3.57</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5 presents the descriptive statistics (means and SDs) of the other variables for all participants in this study. These are the variables that are related to technology integration.

Table 5

Descriptive Statistics of Other Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Attitudes about technology</td>
<td>1 – 4</td>
<td>3.46</td>
<td>.31</td>
</tr>
<tr>
<td>2. Value technology tools</td>
<td>1 – 5</td>
<td>3.91</td>
<td>.52</td>
</tr>
<tr>
<td>3. Use technology tools</td>
<td>1 – 5</td>
<td>3.26</td>
<td>.60</td>
</tr>
<tr>
<td>4. Value instructional strategies</td>
<td>1 – 5</td>
<td>4.56</td>
<td>.42</td>
</tr>
<tr>
<td>5. Use instructional strategies</td>
<td>1 – 5</td>
<td>3.73</td>
<td>.75</td>
</tr>
<tr>
<td>6. Availability of support</td>
<td>1 – 5</td>
<td>3.76</td>
<td>.97</td>
</tr>
<tr>
<td>7. Quality of support</td>
<td>0 – 5</td>
<td>3.85</td>
<td>.89</td>
</tr>
</tbody>
</table>

Note. The column Range refers to the range of the Likert scale for that section.

The data in Table 3 provides evidence that participants possess relatively positive attitudes towards technology and learning, $M = 3.46$. Secondly, the participants see the importance of technology tools ($M = 3.91$), but their use of these tools falls a bit short of their beliefs in them ($M = 3.26$). Thirdly, the same is true for their beliefs in technology-enhanced instructional strategies. They see the value of the instructional strategies ($M = 4.56$) but their practice of the strategies does not match ($M = 3.73$) their beliefs.
Correlational Findings

Correlations overview. This study looked at correlations among 11 different variables. The first four variables represented demographic data: (a) number of years as an educator, (b) *group* which referred to when they graduated from the program, (c) gender, and (d) age. The fifth variable measured participants’ general attitudes about technology and its role in education. The next four variables were related to participants’ beliefs about and use of technology tools and technology-enhanced instructional strategies. Finally, the last two variables measured participants’ perceived availability and quality of support. Table 6 provides a summary of the correlations among these variables.
Table 6

*Correlations among the Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of years as educator</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Group (early/recent)</td>
<td>-.19*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Gender</td>
<td>-.03</td>
<td>.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Age</td>
<td>.85**</td>
<td>-.19*</td>
<td>-.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Attitudes about technology</td>
<td>.07</td>
<td>-.15</td>
<td>.01</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Value technology tools</td>
<td>.01</td>
<td>-.03</td>
<td>-.08</td>
<td>-.02</td>
<td>.40**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Use technology tools</td>
<td>.20*</td>
<td>-.11</td>
<td>-.08</td>
<td>.16*</td>
<td>.34**</td>
<td>.58**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Value instructional strategies</td>
<td>.04</td>
<td>-.18*</td>
<td>-.19*</td>
<td>-.03</td>
<td>.40**</td>
<td>.61**</td>
<td>.44**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Use instructional strategies</td>
<td>.09</td>
<td>-.10</td>
<td>-.17*</td>
<td>-.04</td>
<td>.25**</td>
<td>.32**</td>
<td>.62**</td>
<td>.54**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Availability of support</td>
<td>.17*</td>
<td>-.01</td>
<td>-.03</td>
<td>.11</td>
<td>.21*</td>
<td>.18*</td>
<td>.30**</td>
<td>.09</td>
<td>.25**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Quality of support</td>
<td>.12</td>
<td>.04</td>
<td>-.01</td>
<td>.10</td>
<td>.30**</td>
<td>.25**</td>
<td>.31**</td>
<td>.12</td>
<td>.27**</td>
<td>.84**</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05. **p < .001.
Age naturally had a high significant correlation with number of years of teaching \( (r = .85, p < .001) \). The rest of the demographic variables did not correlate highly with all the other variables. Quality of support also had a high significant correlation with availability of support \( (r = .84, p < .001) \). This is also logical because any degree of quality of support would presuppose that it is available in the first place.

The group of variables that had relatively good correlations were: (a) use of technology tools with practice of technology-enhanced instructional strategies \( (r = .62, p < .001) \), (b) value of technology tools with value of technology-enhanced instructional strategies \( (r = .61, p < .001) \), (c) value of technology tools with use of technology tools \( (r = .58, p < .001) \), and (d) value of technology-enhanced instructional strategies with use of technology-enhanced instructional strategies \( (r = .54, p < .001) \).

Other significant although with slightly lower Pearson product-moment correlations include: (a) use of technology tools with value of technology-enhanced instructional strategies \( (r = .44, p < .001) \), (b) attitudes about technology with value of technology tools \( (r = .40, p < .001) \), (c) attitudes about technology with value of technology-enhanced instructional strategies \( (r = .40, p < .001) \), (d) attitudes about technology with use of technology tools \( (r = .34, p < .001) \), and (e) value of technology tools with use of technology-enhanced instructional strategies \( (r = .32, p < .001) \). It is interesting to note at this point that most of the correlations that yielded relatively high significant values have to do with participants’ attitudes about technology, value of technology tools, use of technology tools, value of technology-enhanced instructional strategies, and use of technology-enhanced instructional strategies.
Research question 1A. Do years of experience as an educator, length of time since graduating from the program, age, gender, attitudes about technology and learning, perceived value of technology tools, perceived value of technology-enhanced instructional strategies, use of technology-enhanced instructional strategies, availability of support, and quality of support predict use of technology tools by ITS graduates? Research question 1A investigated whether any of the 10 predictors statistically contribute to participants’ use of technology tools (dependent variable or criterion). A multiple linear regression was used to test the hypothesis.

In the execution of the regression in SPSS, the method used was hierarchical or blockwise entry. The 10 predictors were grouped into four blocks or models according to their relatedness to one another. The blocks were also entered according to their importance beginning with what the researcher considered most important. Model 1 included the value of technology tools, the value of technology-enhanced instructional strategies, and the use of technology-enhanced instructional strategies. In model 2, the predictor attitudes about technology and learning was added. In model 3, availability and quality of support were added. In the last model, all the demographic variables were added: number of years as an educator, group, gender, and age. The summary of the regression analysis is presented in Table 7.
Table 7

Four Regressions with Use of Technology Tools as the Outcome Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$F$</th>
<th>Sig $\Delta F$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1: Tools and Strategies</td>
<td>.56</td>
<td>.56</td>
<td>62.39</td>
<td>.001**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Value Technology Tools</td>
<td>.51</td>
<td>.51</td>
<td>7.47</td>
<td>.001**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Value Instructional Strategies</td>
<td>-.16</td>
<td>-.16</td>
<td>-2.11</td>
<td>.05*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Use Instructional Strategies</td>
<td>.54</td>
<td>.54</td>
<td>8.29</td>
<td>.001**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 2: Attitudes</td>
<td>.56</td>
<td>.01</td>
<td>47.42</td>
<td>.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Value Technology Tools</td>
<td>.49</td>
<td>.49</td>
<td>7.02</td>
<td>.001**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Value Instructional Strategies</td>
<td>-.18</td>
<td>-.18</td>
<td>-2.30</td>
<td>.05*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Use Instructional Strategies</td>
<td>.53</td>
<td>.53</td>
<td>8.24</td>
<td>.001**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Attitudes about Technology</td>
<td>.08</td>
<td>.08</td>
<td>1.29</td>
<td>.198</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 3: Support</td>
<td>.57</td>
<td>.01</td>
<td>32.24</td>
<td>.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Value Technology Tools</td>
<td>.48</td>
<td>.48</td>
<td>6.82</td>
<td>.001**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Value Instructional Strategies</td>
<td>-.17</td>
<td>-.17</td>
<td>-2.10</td>
<td>.05*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Use Instructional Strategies</td>
<td>.51</td>
<td>.51</td>
<td>7.67</td>
<td>.001**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Attitudes about technology</td>
<td>.07</td>
<td>.07</td>
<td>1.15</td>
<td>.252</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Availability of Support</td>
<td>.15</td>
<td>.15</td>
<td>1.43</td>
<td>.154</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Quality of Support</td>
<td>-.07</td>
<td>-.07</td>
<td>-.70</td>
<td>.485</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Model 4: Demographics

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Value Technology Tools</td>
<td>.49</td>
<td>7.01</td>
<td>.001**</td>
<td></td>
</tr>
<tr>
<td>b. Value Instructional Strategies</td>
<td>-.16</td>
<td>-2.04</td>
<td>.05*</td>
<td></td>
</tr>
<tr>
<td>c. Use Instructional Strategies</td>
<td>.51</td>
<td>7.66</td>
<td>.001**</td>
<td></td>
</tr>
<tr>
<td>d. Attitudes about technology</td>
<td>.05</td>
<td>.87</td>
<td>.388</td>
<td></td>
</tr>
<tr>
<td>e. Availability of Support</td>
<td>.12</td>
<td>1.13</td>
<td>.260</td>
<td></td>
</tr>
<tr>
<td>f. Quality of Support</td>
<td>-.06</td>
<td>-.56</td>
<td>.580</td>
<td></td>
</tr>
<tr>
<td>g. Number of years as educator</td>
<td>.08</td>
<td>.81</td>
<td>.422</td>
<td></td>
</tr>
<tr>
<td>h. Group</td>
<td>-.04</td>
<td>-.65</td>
<td>.517</td>
<td></td>
</tr>
<tr>
<td>i. Gender</td>
<td>.03</td>
<td>.48</td>
<td>.635</td>
<td></td>
</tr>
<tr>
<td>j. Age</td>
<td>.06</td>
<td>.54</td>
<td>.589</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05. **p < .001.

In the first model, the multivariable regression analysis shows that value of technology tools, value of technology-enhanced instructional strategies, and use of technology-enhanced instructional strategies account for a statistically significant amount of variance in the practice of technology tools, $R^2 = .56$, $F(3, 150) = 62.39$, $p < .001$.

Results of the part correlations indicate that the use of technology-enhanced instructional strategies had the most unique contribution (.45), followed by the perceived importance of the technology tools (.41). The addition of all other variables in the next three models did not result in any significant change in $R^2$. The addition of the predictor attitudes about
technology amounted to only a .01 change in $R^2$ in model 2. Moreover, this predictor did not have a significant contribution to the variance in the practice of technology tools, $\beta = .08$, $t = 1.29$, $p = .198$. The inclusion of the two predictors on support in model 3 added a mere .008 in $R^2$. Likewise, both availability of support ($p = .154$) and quality of support ($p = .485$) did not have any significant contribution to the variance in the practice of technology tools. Finally, in model 4, none of the demographic predictors likewise made a significant contribution to the variance in the practice of technology tools: number of years as an educator ($p = .422$), group ($p = .517$), gender ($p = .635$), and age ($p = .589$). The amount of change to $R^2$ with the addition of these four predictors was only .02.

In summary, the only variables that have a significant contribution to the variance in the use of technology tools are: (a) value of technology tools, (b) value of technology-enhanced instructional strategies, and (c) use of technology-enhanced instructional strategies. All other predictors were not significant.

Table 8 gives a summary of the correlations and collinearity statistics for model 1 of question 1A. The part correlations show the unique contributions of value of technology tools (.41), value of technology-enhanced instructional strategies (-.12), and use of technology-enhanced instructional strategies (.45) to the variance in the use of technology tools.
Table 8

Part Correlations and Collinearity Statistics for Question 1A: Model 1

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Correlations</th>
<th>Collinearity Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Partial</td>
<td>Part</td>
</tr>
<tr>
<td>1. Value Technology Tools</td>
<td>.52</td>
<td>.41</td>
</tr>
<tr>
<td>2. Value Instructional Strategies</td>
<td>-.17</td>
<td>-.12</td>
</tr>
<tr>
<td>3. Use Instructional Strategies</td>
<td>.56</td>
<td>.45</td>
</tr>
</tbody>
</table>

Note. Dependent variable: use of technology tools.

Collinearity statistics indicate if there are any multicollinearity problems in the regression model. Tolerance levels below .1 indicate serious problems while levels below .2 indicate potential problems (Field, 2005). Moreover, VIF values above 10 would indicate a cause for concern while an average VIF value substantially greater than 1 indicates that the regression may be biased (Field, 2005). The results for model 1 indicate no multicollinearity problems as the tolerance levels are well above .2, no VIF value is greater than 10, and the average VIF is not substantially greater than 1.

Research question 1B. Do years of experience as an educator, length of time since graduating from the program, age, gender, attitudes about technology and learning, perceived value of technology tools, use of technology tools, perceived value of technology-enhanced instructional strategies, availability of support, and quality of support predict use of technology-enhanced instructional strategies by ITS graduates? Research question 1B investigated whether any of the 10 predictors statistically
contribute to participants’ use of technology-enhanced instructional strategies (dependent variable or criterion). A multiple linear regression was also used to test the hypothesis.

Similar to the regression procedure used in research question 1A, the method used for question 1B was hierarchical or blockwise entry. The 10 predictors were grouped into four blocks or models according to their relatedness to one another. The blocks were also entered according to their importance beginning with what the researcher considered most important. This time, model 1 included the value of technology tools, the use of technology tools, and the value of technology-enhanced instructional strategies. In model 2, the predictor attitudes about technology and learning was added. In model 3, availability and quality of support were added. In the last model, all the demographic variables were added: number of years as an educator, group, gender, and age. The summary of the regression analysis is presented in Table 9.
Table 9

*Four Regressions with Use of Instructional Strategies as the Outcome Variable*

<table>
<thead>
<tr>
<th>Variable</th>
<th>( R^2 )</th>
<th>( \Delta R^2 )</th>
<th>( F )</th>
<th>Sig ( \Delta F )</th>
<th>( \beta )</th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1: Tools and Strategies</td>
<td>.51</td>
<td>.51</td>
<td>52.91</td>
<td>.001**</td>
<td>- .31</td>
<td>-3.85</td>
<td>.001**</td>
</tr>
<tr>
<td>a. Value of Technology Tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Use Technology Tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.59</td>
<td>8.29</td>
<td>.001**</td>
</tr>
<tr>
<td>c. Value Instructional Strategies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.47</td>
<td>6.53</td>
<td>.001**</td>
</tr>
<tr>
<td>Model 2: Attitudes</td>
<td>.51</td>
<td>.00</td>
<td>39.44</td>
<td>.84</td>
<td>- .31</td>
<td>-3.77</td>
<td>.001**</td>
</tr>
<tr>
<td>a. Value Technology Tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Use Technology Tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.59</td>
<td>8.24</td>
<td>.001**</td>
</tr>
<tr>
<td>c. Value Instructional Strategies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.47</td>
<td>6.42</td>
<td>.001**</td>
</tr>
<tr>
<td>d. Attitudes about Technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- .01</td>
<td>-2.1</td>
<td>.836</td>
</tr>
<tr>
<td>Model 3: Support</td>
<td>.53</td>
<td>.01</td>
<td>27.38</td>
<td>.13</td>
<td>- .32</td>
<td>-3.92</td>
<td>.001**</td>
</tr>
<tr>
<td>a. Value Technology Tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Use Technology Tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.56</td>
<td>7.67</td>
<td>.001**</td>
</tr>
<tr>
<td>c. Value Instructional Strategies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.49</td>
<td>6.65</td>
<td>.001**</td>
</tr>
<tr>
<td>d. Attitudes about technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- .04</td>
<td>-6.5</td>
<td>.519</td>
</tr>
<tr>
<td>e. Availability of Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.00</td>
<td>0.02</td>
<td>.987</td>
</tr>
<tr>
<td>f. Quality of Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.12</td>
<td>1.14</td>
<td>.255</td>
</tr>
</tbody>
</table>
In model 1, the multivariable regression analysis shows that value of technology tools, use of technology tools, and value of technology-enhanced instructional strategies account for a statistically significant amount of variance in the practice of technology-enhanced instructional strategies, $R^2 = .51$, $F(3,150) = 52.91$, $p < .001$. The results of the part correlations indicate that use of technology tools had the most unique contribution (.47), followed by perceived importance of technology-enhanced instructional strategies (.37) and perceived importance of technology tools (.22). Again, the three succeeding regression models revealed that all other variables do not significantly contribute to the variance in the practice of instructional strategies. The addition of attitudes about
technology ($p = .836$) in model 2 did not produce any change in $R^2$. The addition of availability and quality of support in model 3 do not statistically contribute to the variance, $R^2 = .53$. Finally, the full model with the inclusion of all demographic variables in model 4 also increased $R^2$ by only .01.

In summary, the only predictors that have statistically significant contributions to the variance in the use of technology-enhanced instructional strategies are (a) value of technology tools, (b) use of technology tools, and (c) value of technology-enhanced instructional strategies. Again, all other predictors were not significant.

Table 10 summarizes the correlations and collinearity statistics for model 1 of question 1B. The part correlations show the unique contributions of the variables to the use of technology-enhanced instructional strategies in order: (a) use of technology tools (.47), (b) value of technology-enhanced instructional strategies (.37), and (c) value of technology tools (-.22). The collinearity statistics indicate that there are no multicollinearity problems in the regression model. The results reveal that tolerance levels are well above .2, no VIF value is greater than 10, and the average VIF is not substantially greater than 1.
Table 10

*Part Correlations and Collinearity Statistics for Question 1B: Model 1*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Correlations</th>
<th>Collinearity Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Partial</td>
<td>Part</td>
</tr>
<tr>
<td>1. Value of Technology Tools</td>
<td>-.30</td>
<td>-.22</td>
</tr>
<tr>
<td>2. Use of Technology Tools</td>
<td>.56</td>
<td>.47</td>
</tr>
<tr>
<td>3. Value Instructional Strategies</td>
<td>.47</td>
<td>.37</td>
</tr>
</tbody>
</table>

*Note.* Dependent variable: use of technology-enhanced instructional strategies.

*Research question 2.* Are there significant differences in attitudes about technology and learning, perceived value of technology tools, use of technology tools, perceived value of technology-enhanced instructional strategies, use of technology-enhanced instructional strategies, perceived support, and strategies on how to keep current with technology by ITS graduates over time? Research question 2 investigated mean differences on seven variables between early and recent graduates of the program. The comparison between the two groups was done in three stages. First, independent *t* tests were computed for the first six variables. Second, the last variable, strategies on how to keep current with technology, required separate *t* tests on its six items (see Section 7 of the survey instrument in Appendix A). Third, the last variable also partly required qualitative analysis as the questionnaire included open-ended answers for this section.

Descriptive statistics were calculated for the first six variables according to group. Specifically, means and standard deviations for attitudes about technology, value of
technology tools, use of technology tools, value of technology-enhanced instructional strategies, use of technology-enhanced instructional strategies, and support were computed for each group. These first six variables used Likert scales. Figure 3 provides an overview of the differences in the means between groups.

![Bar chart](image)

**Figure 3.** Mean scores on six variables between early \( (n = 71) \) and recent \( (n = 84) \) graduates.

Independent-samples \( t \) tests were conducted to determine if there were statistically significant differences between early and recent graduates in any of the six variables. Field (2005) explains that one important assumption for an independent-samples \( t \) test is that variances in the populations are roughly equal (homogeneity of variance). Levene’s
Test for homogeneity of variances was used to check if equal variances should be assumed or not. A summary of the descriptive statistics (means and standard deviations) and $t$-test results, is presented in Table 11.

Table 11

*Independent-samples $t$ test on Six Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Early $(n = 71)$</th>
<th>Recent $(n = 84)$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Attitudes about Technology</td>
<td>3.51 .32</td>
<td>3.42 .30</td>
<td>1.81</td>
<td>.072</td>
</tr>
<tr>
<td>2. Value Technology Tools</td>
<td>3.92 .53</td>
<td>3.89 .51</td>
<td>.39</td>
<td>.696</td>
</tr>
<tr>
<td>3. Use Technology Tools</td>
<td>3.34 .56</td>
<td>3.20 .63</td>
<td>1.41</td>
<td>.160</td>
</tr>
<tr>
<td>4. Value Instructional Strategies</td>
<td>4.65 .35</td>
<td>4.50 .47</td>
<td>2.28</td>
<td>.05*</td>
</tr>
<tr>
<td>5. Use Instructional Strategies</td>
<td>3.82 .75</td>
<td>3.66 .74</td>
<td>1.30</td>
<td>.197</td>
</tr>
<tr>
<td>6. Support</td>
<td>3.79 .97</td>
<td>3.82 .83</td>
<td>-.21</td>
<td>.838</td>
</tr>
</tbody>
</table>

* $p < .05$, 2-tailed.

Equal variances were assumed for: attitudes about technology, value technology tools, use technology tools, use instructional strategies, and support. Equal variance was not assumed for value of instructional strategies, $p < .05$. In this case, the $t$-test values were taken from the *equal variances not assumed* row in the SPSS output.

The data revealed that only value of technology-enhanced instructional strategies had a statistically significant difference between the groups, $t(151.15) = 2.28, p < .05$. A
computation of the effect size on this variable showed $r = .18$. There were no statistically significant differences in means between groups in all other variables.

Separate $t$ tests were conducted for the variable *strategies on how to keep current with technology* because it contained six unique and unrelated items. Participants answered this section of the questionnaire by clicking on a checkbox next to six predetermined items: (a) journals and other related articles, (b) collaboration with peers, (c) collaboration with others who shared ITS experience, (d) workshops offered by school division, (e) attendance at local, state, or national conferences, and (f) taking community college and/or university courses (other than ITS). There were also four blank textboxes for participants to type in other ways they kept current with technology. For the first six items, a value of 1 was generated if a participant clicked on a particular item. Otherwise, the value was 0.

Means and standard deviations for the six items on how participants keep current with technology were calculated. Figure 4 provides an overview of the differences in means between groups.
Independent *t* tests were conducted to determine if there were statistically significant differences in any of the six items according to group. Again, Levene’s Tests were used to check for homogeneity of variances. Levene’s Tests were significant for two items: journals and other related articles (*p* < .05) and courses in community college or university (*p* < .001). For these two items, the *t* test values were taken from the *equal variances not assumed* rows in the SPSS output. In the *t* test results, only the item on community college or university courses had a statistically significant difference between groups, *t*(130.38) = 2.47, *p* < .05. Computation of the effect size for this item revealed *r* = .21. Descriptive statistics and results of the *t*-test analysis are summarized in Table 12.
Table 12

*Independent-samples t test on Keeping Current with Technology*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Early M</th>
<th>SD</th>
<th>Recent M</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Journals and Other Related Articles</td>
<td>.65</td>
<td>.48</td>
<td>.55</td>
<td>.50</td>
<td>1.27</td>
<td>.206</td>
</tr>
<tr>
<td>2. Collaboration with Peers</td>
<td>.85</td>
<td>.36</td>
<td>.89</td>
<td>.31</td>
<td>-.88</td>
<td>.380</td>
</tr>
<tr>
<td>3. Collaboration with ITS Peers</td>
<td>.61</td>
<td>.49</td>
<td>.56</td>
<td>.50</td>
<td>.58</td>
<td>.565</td>
</tr>
<tr>
<td>4. Workshops in School Division</td>
<td>.66</td>
<td>.48</td>
<td>.68</td>
<td>.47</td>
<td>-.22</td>
<td>.828</td>
</tr>
<tr>
<td>5. Conferences: Local, State, National</td>
<td>.48</td>
<td>.50</td>
<td>.39</td>
<td>.49</td>
<td>1.07</td>
<td>.284</td>
</tr>
<tr>
<td>6. Community College/University Courses</td>
<td>.32</td>
<td>.47</td>
<td>.15</td>
<td>.36</td>
<td>2.47</td>
<td>.05*</td>
</tr>
</tbody>
</table>

*p < .05, two-tailed. **p < .001, two-tailed.

Thirty-nine participants typed in other ways they keep up with the changes in technology. Using qualitative categorizing strategies, participants’ answers were grouped into six broad areas: (a) online resources such as blogs, podcasts, and wikis, (b) online collaboration, (c) online courses, (d) personal exploration, (e) others referring to other people such as students, mentor, TRT, and husband, and (f) professional development. Figure 5 provides a concept map of the six areas and the corresponding answers of participants. Numbers in parenthesis indicate the frequency of an answer if more than one participant mentioned it.
Figure 5. Other ways of keeping up-to-date.
Qualitative Findings

Research question 3. Research question 3 investigated participants’ experiences of and hopes for the program. It was divided into three parts: what participants considered the best attributes of the program, what participants felt were the greatest challenges in the program, and what changes or additions participants hope to see in the program. Participants’ answers ranged from a word to whole paragraphs. Some participants chose not to answer this section. Qualitative analyses of participants’ responses were conducted in three parts corresponding to the three subsections of the research question.

In terms of the best attributes of the program, 127 out of 155 participants (81.9%) chose to answer this subsection. Using the categorizing strategies described in chapter 3, the responses were coded and grouped according to substantive content.

The design of instructional materials that employ the use of authentic problems, sometimes referred to as problem-based learning in the literature, ranked first among the sample of participants. “Collaborative learning,” “cohort learning style,” “working with colleagues,” or “learning community” was a close second attribute listed by the participants. The third highly-ranked attribute was phrased in many and various ways: hands-on approach, hands-on experience, hands-on practice, hands-on work, or learning by doing, integrating technology, applying lessons learned, incorporating technology practical application, and many others.

Most of the other attributes are self-explanatory: learning technology tools, exploration or experimentation, higher-order thinking, modeling, use of portfolio,
research and search techniques, constructivist approach, and support. Some participants wrote down particular design strategies that they considered great attributes of the program. Some of the acronyms they wrote down include:

1. ACTS: a strategy for designing lessons that stands for authentic problem, clear outcome, thinking skills, and software skills;
2. FACTS: a strategy for designing learning units that stands for foundations, activities, content, tools, and system of assessment;
3. SCC: a strategy to teach students to be good information users that stands for search, sort, create, and communicate;
4. DEAPR: a design process for constructing a message that stands for design, encode, assemble, publish, and revise.

Some participants wrote down general attributes of the program such as the type of pedagogy that ITS espouses. Two participants, for example, noted that the program instilled in them the belief that learning is more about the process and not about the product. Others emphasized that, in the ITS program, technology must be seen as a tool to be used to enhance learning rather than as an end itself. Finally, the attribute differentiation referred to how participants felt the program was tailored to some of their needs and capabilities. Table 13 summarizes the top 14 categorized attributes and how participants ranked them according to importance (order).
Table 13

*Frequency Statistics on Best Attributes of the Program*

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Order</th>
<th>N = 127</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Use of Authentic Problem</td>
<td>45</td>
<td>54.3</td>
</tr>
<tr>
<td>2. Collaboration</td>
<td>14</td>
<td>52.0</td>
</tr>
<tr>
<td>3. Hands-on Approach</td>
<td>18</td>
<td>46.5</td>
</tr>
<tr>
<td>4. Learning Technology Tools</td>
<td>9</td>
<td>37.8</td>
</tr>
<tr>
<td>5. Exploration/Experimentation</td>
<td>3</td>
<td>8.7</td>
</tr>
<tr>
<td>6. Design Strategies</td>
<td>6</td>
<td>7.9</td>
</tr>
<tr>
<td>7. Higher-order Thinking</td>
<td>3</td>
<td>7.9</td>
</tr>
<tr>
<td>8. ITS Pedagogy</td>
<td>2</td>
<td>7.1</td>
</tr>
<tr>
<td>9. Modeling</td>
<td>4</td>
<td>6.3</td>
</tr>
<tr>
<td>10. Use of Portfolio</td>
<td>1</td>
<td>3.9</td>
</tr>
<tr>
<td>11. Research and Search Techniques</td>
<td>0</td>
<td>3.9</td>
</tr>
<tr>
<td>12. Constructivist Approach</td>
<td>3</td>
<td>3.1</td>
</tr>
<tr>
<td>13. Support</td>
<td>0</td>
<td>3.1</td>
</tr>
<tr>
<td>14. Differentiation</td>
<td>0</td>
<td>1.6</td>
</tr>
</tbody>
</table>

*Note.* Order refers to the order participants wrote that attribute, with 1 being most important.
In terms of the greatest challenges participants experienced in the program, 90 of the 155 participants (58.1%) had something to say. Time factor was the number one challenge for participants (21.1%). These participants felt there was not enough time to incorporate projects into the curriculum, to become experts in any program, to integrate projects, or to develop their plans.

After time factor, 17.7% of the participants wrote that they could not think of anything under this category. These participants wrote “none,” “NA,” or “can’t think of anything.” One described his or her difficulty in answering this section by writing down: “I really have a hard time with this because I found everything I learned useful.”

The next in rank on greatest challenges for the participants had to do with the readings (16.7%). Most of the participants who listed readings as a challenge said they were overwhelmed by the amount of readings while a few others commented that some of the readings were not related or applicable to what they would be doing.

The attribute *no differentiation*, which ranked fourth, referred to a perceived lack of tailoring of the program to individual needs. One participant wrote that “all were expected to do the same projects even if they [already] knew the tool.” Another commented: “Some aspects of what was covered were less relevant to me personally as an IT director.”

Other attributes considered challenging included LOGO programming, the research course, video editing, using online communications such as e-mail and online discussions or chats, and the leadership course. Table 14 summarizes the top 13 categorized attributes and how participants ranked them according to importance (order).
Table 14

*Frequency Statistics on Least Helpful Attributes of the Program*

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Order</th>
<th>N = 90</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1. Time Factor</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>2. None</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>3. Readings</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>4. Lack of Differentiation</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>5. Outdated Technology/Examples</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>6. LOGO/Programming Course</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>7. Video Editing</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>8. Research Course</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>9. Online Communications</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>10. Use of Authentic Problems</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>11. Getting Others Interested</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>12. Leadership Course</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>13. Lack of Match with School Division Expectations</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note.* Order refers to the order participants wrote that attribute, with 1 being most important.
In terms of changes or additions that participants want to see in the program, 88 participants (56.8%) opted to write down their suggestions. 34 participants (38.6%) said that the program was “great” and that they didn’t see the need for changes. One participant, on a more realistic note, wrote: “Looking back… what I thought was busy work… actually helped tremendously.” Similarly, another commented: “I am sure [there] were things I found unpleasant as I went through the process, but now that I am finished, nothing stands out in my mind as a negative… It was well-planned and well-executed.”

Nineteen participants (21.6%) suggested if there could be a way for the program to be able to differentiate among learners or be more tailored according to one’s needs and context. Some participants who had adequate computer literacy coming into the program found it frustrating to sit it out while the rest were trying to learn what the former already knew. They suggested screening applicants for prerequisite skills. On the other hand, one participant suggested having a “variety of elective courses available that an individual can choose to support their [sic] individual needs.” Some suggestions revolved around addressing specific needs such as having an instructor with primary level or special education experiences.

The next big set of suggestions was categorized as learning more skills, software, and technologies. Nine participants (10.2%) were interested in learning and developing lessons that make the most out of SMARTBoards, ActivBoards, and interactive white boards. One participant, noting that the learning of software tools was left mostly to participants’ initiatives, suggested that there should be a balance between integration and skill development in the program.
Six participants (6.8%) highlighted the need for the ITS program to be up-to-date in terms of the technology tools, reading materials, and assignments. One participant’s advice for the program was to “keep up with changing technology and, perhaps, focus more on emerging technologies.” On the other hand, most of these participants were aware how technologies come and go. So, one participant argued that “the concepts behind using the technologies were the most important.”

Other minor suggestions were to make the readings more relevant and have more feedback or assessment on their work. A summary of the categories for this subsection is presented in Table 15.
Table 15

*Frequency Statistics on Suggested Changes to the Program*

<table>
<thead>
<tr>
<th>Suggested Change</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. None</td>
<td>34</td>
<td>38.6</td>
</tr>
<tr>
<td>2. More differentiation</td>
<td>19</td>
<td>21.6</td>
</tr>
<tr>
<td>3. Learn more skills, software, technologies</td>
<td>9</td>
<td>10.2</td>
</tr>
<tr>
<td>4. Keep up-to-date</td>
<td>6</td>
<td>6.8</td>
</tr>
<tr>
<td>5. More relevant readings</td>
<td>4</td>
<td>4.5</td>
</tr>
<tr>
<td>6. More feedback or assessment</td>
<td>3</td>
<td>3.4</td>
</tr>
<tr>
<td>7. Better scheduling</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>8. Address SOLs</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>9. Others</td>
<td>9</td>
<td>10.2</td>
</tr>
</tbody>
</table>

This chapter described the findings of the linear regressions, the $t$ tests, and the qualitative analyses. The next chapter will provide a brief summary of this study, present conclusions based on the results of this study, discuss the results’ relationships with previous research, and offer recommendations for practice and further study.
5. Discussion

Summary

The research questions in this study were framed with the objective of finding ways to understand better and improve professional development of teachers in technology integration. Demographic variables such as number of years as an educator, age, gender, and group (early or recent graduate) were included to learn more about the wide variety of teachers who participate in technology integration and to see whether these demographic data have any bearing on beliefs and practices about technology and its integration with teaching and learning. Then, other variables such as attitudes about technology, beliefs about technology tools, beliefs about technology-enhanced instructional strategies, and support were included as the review of literature has shown that these variables are thought to be closely related to the adoption and practice of technology integration (ACOT, 1996; Rogers, 2003; Isleem, 2003; Beyerbach, Walsh, & Vannatta, 2001; Vannatta & Beyerbach, 2000; Sandholtz, 2001; Hornung & Bronack, 2001; Kitchenham, 2001, Blankenship, 1998).

This study included a correlational aspect (research questions 1 and 2) that investigated various relationships among several variables and a descriptive aspect (research question 3) that summarized participants’ views on attributes of the ITS program. The first part involved the use of statistical analyses, particularly multiple linear...
regressions and $t$ tests. The latter part involved qualitative categorizing strategies and frequency statistics.

**Conclusions from Statistical Analyses**

Research question 1A examined the relationship between the use of technology tools and 10 predictors (number of years as an educator, group, gender, age, attitudes about technology, value of technology tools, value of technology-enhanced instructional strategies, use of technology-enhanced instructional strategies, availability of support, and quality of support). The use of technology tools had moderate and significant correlations with use of technology-enhanced instructional strategies as well as value of technology tools. There was a marginal though significant correlation between the use of technology tools and value of technology-enhanced instructional strategies. The use of technology tools had weak though significant correlations with attitudes about technology, availability of support, quality of support, and number of years as an educator. Regression analysis showed that only value of technology tools, value of technology-enhanced instructional strategies, and use of technology-enhanced instructional strategies were significant predictors of participants’ use of technology tools.

Research question 1B examined the relationship between the use of technology-enhanced instructional strategies and 10 predictors (number of years as an educator, group, gender, age, attitudes about technology, value of technology tools, use of technology tools, value of technology-enhanced instructional strategies, availability of support, and quality of support). The use of technology-enhanced instructional strategies
had moderate and significant correlations with use of technology and value of technology-enhanced instructional strategies. It had weak though significant correlations with value of technology tools, quality of support, availability of support, attitudes about technology, and gender. Regression analysis showed that only value of technology tools, use of technology tools, and value of technology-enhanced instructional strategies have significant contributions to the variance in the use of technology-enhanced instructional strategies.

Research question 2 examined the differences between early and recent graduates in terms of their attitudes about technology, value of technology tools, use of technology tools, value of technology-enhanced instructional strategies, use of technology-enhanced instructional strategies, support, and ways of keeping up-to-date with technology. Results of the t tests on the first six variables showed that there is a significant difference between early and recent graduates on their perceived value of instructional strategies. The effect size, however, was small. The early graduates valued technology-enhanced instructional strategies slightly higher than recent graduates.

Results of the separate t tests conducted on the six ways participants keep current with technology revealed that there is a significant difference between early and recent graduates in terms of taking community college or university courses. The effect size for this item was also small. Earlier graduates were slightly more inclined to take courses in community colleges or universities to keep-up-date with technology.
Conclusions from Qualitative Findings

Research question 3 surveyed participants on their views of the best attributes and the greatest challenges of the program as well as suggestions to improve the program. The top five answers for the best attributes of the program were the use of authentic problem, collaboration, hands-on approach, learning technology tools, and exploration or experimentation. The greatest challenges for participants were time factor, readings, lack of differentiation, and outdated technologies or examples. The survey, however, also revealed that 17.8% of the participants did not find attributes of the program that they consider greatest challenges. This was actually the second top answer in this category. Finally, in terms of suggestions on how to improve the program, 37.8% of the participants said there was nothing to change. This was the top answer. The next five answers on the list were accommodating for more differentiation, learning more skills or technologies, keeping the program and the technologies up-to-date, choosing readings that are more relevant, and getting more feedback or assessment on their work.

Discussion of Results

Demographic information and technology integration practice. The results of this study showed that demographic variables (age, gender, early or recent graduate of the program, and number of years as an educator) do not predict technology integration (use of technology tools and use of technology-enhanced instructional strategies) by graduates of the ITS program. These findings partially confirm Blankenship’s (1998) conclusions where age and years before retirement were not consistent factors related to computer use. However, Blankenship’s study found gender to be a significant predictor of drill and
practice and over-all computer use for all classroom teachers but the researcher admits that, in other research literature, gender also had conflicting results with regard to being a predictor of technology use (Blankenship, 1998). In a study of computer anxiety levels, for example, Gordon (1993) found that no differences exist between males and females among secondary technical education teachers. On the other hand, Comber, Colley, Hargreaves, and Dorn (1997) investigated computer attitudes across gender and age groups and found males to have more positive attitudes toward computers as well as use of computers than females. Blankenship’s research, however, found the opposite.

This study also investigated whether length of time graduating from the program had any effect on technology practice. Are earlier graduates more adept at technology integration now that they have had the time to practice what they have learned? On the other hand, would their interest in technology integration have waned over the years and thus be doing less technology integration? These were the types of questions that prompted the addition of this variable. No previous research could be found correlating this variable with technology integration.

This study found no statistically significant differences in technology integration practice of early and recent graduates. On the one hand, this indicates that there is no increase in technology integration practice of early graduates over time. On the other hand, it also implies that there is no attrition in their practice of technology integration through time. And with well above average use of technology tools and use of technology-enhanced instructional strategies by all participants (see Table 5), this provides positive evidence on the consistency of the ITS program.
Isleem (2003) discovered that “the more instructional experiences that teachers have, the more likely they are to use computers for instructional purposes” (p. 116). This study, however, did not find number of years as an educator a significant predictor of technology practice, although a weak but significant correlation was found between the number of years as an educator and use of technology tools. Blankenship (1998) found conflicting results with regard to years remaining until retirement and computer use.

In summary, this study neither found strong significant correlations between demographic variables and technology practice nor statistically significant effects of demographic variables on technology practice. This suggests that, for ITS graduates, it does not matter whether one is 20 or 60 years old, male or female, a veteran or a rookie teacher, or an early or recent graduate. There are other stronger and more stable factors such as attitudes and beliefs that can predict technology integration practice.

*Attitudes and technology integration practice.* Previous research has been more consistent on attitudes being a predictor of use or practice (Rogers, 2003; Isleem, 2003; Blankenship, 1998; Munkatchy, 2003; Lebruto, 2001). This study, on the other hand, had slightly mixed results. In this study, beliefs or attitudes about technology were measured separately on three aspects: attitudes about technology and learning, beliefs about the importance of technology tools, and beliefs about the importance of technology-enhanced instructional strategies. Participants’ beliefs about technology tools and technology-enhanced instructional strategies were statistically significant predictors of their use. However, attitudes about technology and learning did not come out as a good predictor of use or practice. One reason for this discrepancy might be the separation of measurements
of multiple aspects of attitudes or beliefs. Another possible cause might be that the 10 question items measuring attitudes about technology and learning may not have been enough to adequately and accurately measure the construct. Still another explanation might be the separation of the measure of technology integration practice between the use of technology tools and the use of technology-enhanced instructional strategies.

The correlational statistics, on the other hand, did show weak though significant correlations between attitudes about technology and learning on the one hand, and the use of technology tools and technology-enhanced instructional strategies on the other. Hence, despite the slightly mixed results, there is ample evidence found in this study suggesting that positive attitudes about technology and learning, technology tools, and technology-enhanced instructional strategies play a significant role in technology integration practice.

Support and technology integration practice. Support has also been more consistently identified in the literature as an influential factor to practice (Blankenship, 1998; Munkatchy, 2003; Brown, 1999; Jacobsen, 1998). This study, however, did not find availability or quality of support to be a predictor of technology practice among ITS graduates. In the survey instrument, there were only four question items for availability of support and a similar set of four question items for quality of support. These may not have been adequate to measure the construct. Isleem (2003) found similar “insufficient evidence to support any multiple regression correlation between the two variates” among teachers in Ohio public schools (p. 114). Correlational statistics in this study, on the other hand, revealed weak but significant correlations between support and use of technology.
Differences in beliefs, practice, and support between groups. The research question that investigated the differences in beliefs, practice, and support between early and recent graduates was suggested, formulated, and added during the proposal defense of this study. There was interest in how beliefs, practice, and support increase, decrease, or remain the same over time. The results of the \( t \) test revealed that there was a weak but statistically significant difference between groups only on how they value the importance of technology-enhanced instructional strategies. Earlier graduates value these instructional strategies slightly more than recent graduates. A closer examination of the demographic information of the two groups could hint at some possible explanations. Earlier graduates had a slightly higher mean age compared to recent graduates. Earlier graduates also had a higher mean number of years as educators compared to recent graduates.

If one were to conjecture a plausible explanation for the difference in the two groups on how they value the importance of technology-enhanced instructional strategies taking into account the other demographic differences between them, one might hypothesize that the difference could be a function of time and experience with the instructional strategies. Perhaps it is not even so much a matter of difference in age as it is the difference in length of time as educators and time wherein earlier graduates had more opportunities of trying out in their schools what they have learned in the program that account for the difference in beliefs. In other words, the earlier graduates have had more time to design, implement, and evaluate the instructional strategies that incorporate technology and, as a result, possibly value them more than recent graduates. Perhaps
recent graduates are still more in the process of figuring out the potential of the
technologies they have learned. It would be interesting to conduct a separate study on
what graduates are currently more preoccupied with: the application of instructional
strategies or the learning and use of technology tools.

In terms of keeping up-to-date with technology, t-test results also showed that
there was a weak but statistically significant mean difference in taking community
college or university courses between early and recent graduates. Earlier graduates were
more likely to take courses to keep up with technology change compared to recent
graduates. As their group label indicates, recent graduates have recently just completed
five semesters of intense coursework and are understandably less likely to take
community college or university courses for now. The early graduates, on the other hand,
unless they have undertaken doctoral studies or pursued some other degree, have had five
to nine years of a break from course work since they attended something as rigorous as
the ITS program. If further studies can support timing as crucial, appropriate changes
should be made with regard to school and public policy. Policies should be made that
take into account the proper timing or scheduling of intensive professional development.
This study suggests that it is not beneficial for teachers to immediately move from one
professional development program to another. Teachers need time to digest and try out
what they have learned before being inundated with new material.

The lack of a comprehensive and highly significant difference between the groups
suggests that the length of time graduating from the program does not significantly
influence participants’ beliefs and practices in technology integration. The data in this
study revealed that in the 10 years the program has been in existence, various participants have the same relatively high positive levels of attitudes, beliefs, and practice (see Table 3 in chapter 4 for the descriptive statistics of these variables). One possibility would be that the program has been accepting a particular breed of students—educators who have generally more positive attitudes towards technology, technology tools, and technology-enhanced instructional strategies as well as more inclined to use technology. There is not enough data to statistically and unambiguously ascertain this claim as this study did not involve pre and post surveys.

One participant, however, wrote that non-ITS colleagues often ask about the ITS program and mention that they wished they would have gone through ITS rather than some other master’s program, in large part, because they see the confidence ITS graduates in their building have with technology. Whether ITS graduates were predisposed to have this confidence even before they participated in the program or if it were the result of the 2-year program can be debated and be the matter for further study. There is an indication, nevertheless, of a perceived advantage ITS graduates have in terms of technology integration. The following subsection that discusses the attributes of the program provides clues as to what could have given them this advantage.

Attributes of the program. It would have been easier for participants to simply choose among several choices what they thought were the best attributes of the program, the greatest challenges in the program, and the changes they would want to see in the program instead of using open-ended questions. One participant actually even suggested it by writing “I would rather [sic] this question be a list of choices.” Moreover, two
participants commented instead that they could not understand the question. Open-ended questions were favored to draw out what participants actually thought about the program without leading them with a prefabricated list of attributes. Understandably, this entailed more effort on the part of the participants as it required a fair amount of recall and reflection of events that for some occurred almost 10 years ago. From the researcher’s point of view, and thanks to the generosity and patience of some participants who took time to answer this section, this effort provided more genuine answers.

The list of best attributes summarized from participants’ written responses matched most of the best practices in the review of literature in chapter 2. Modeling (Howland & Wedman, 2004; Francis-Pelton, Farragher, & Riecken, 2000; Vannatta, 2000; Ertmer, Johnson, & Lane, 2001; Matzen & Edmunds, 2007; Vannatta & Beyerbach, 2000; Franklin, Duran, & Kariuki, 2001) and collaboration (Rosean, Hobson, & Khan, 2003; Stalling & Koellner-Clark, 2003; Adam, 2005; Beyerbach, Walsh, & Vannatta, 2001) were the most cited strategies in the literature review. With ITS participants, the top choices were the use of authentic problems followed closely by collaboration and the hands-on approach of the program. This clearly shows that the ITS program is in line with the best practices found in other studies. Surprisingly, modeling was only ranked 9th in a list of 14 best attributes. In an interview conducted with the director of the program after the study, she explained that modeling has always been an intrinsic component of the ITS program. It is possible, she explains, that participants failed to mention modeling as a best attribute because it has just so much been a constant element of their ITS activities that it was taken for granted.
On the opposite end, time was the greatest challenge for ITS participants. It is interesting to note that 17.8% wrote that they could not think of anything that they consider least helpful in the program. In other words, they were satisfied with most aspects of the program. The amount and choice of reading materials was the third top answer. It is reasonable to think that time and a fair amount of required reading materials will always be major concerns for students in any serious course of study especially graduate school. This might also explain why a good number of the answers on this question item revealed that participants could not find least helpful attributes. They must understand the rigors of good professional development. Moreover, the fact that there were fewer least helpful attributes cited by participants compared to best attributes says something good about the program. The top two best attributes were mentioned by more than a majority of the participants whereas the top least helpful attribute garnered only 21.1%.

Finally, in terms of additions or changes participants want to see in the program, 38.6% of those who answered this subsection said they could think of nothing to make the program better. This was followed by the suggestion that the program could be made more flexible and tailored to various needs and the context of the individual students. Again, with the top answer being no change in the program, this is an affirmation of the participants’ satisfaction with the program. On the other hand, the points raised by the participants provide insights as to how the ITS program can be made even better. Specific suggestions on having more differentiation include being able to choose from a variety of elective courses to support individual needs and offering more projects related to staff
development instead of just classroom projects. Participants who suggested learning more skills and technologies listed more experiences using interactive whiteboards and more opportunities to explore “hidden features, tricks, and applications in education.” In terms of better assessment, one participant suggested having evaluations of courses after each semester while another participant recommends having evaluations from self, peer, and teachers on projects.

Limitations of the Study

The following limitations were taken into account during the various stages of instrument creation, data collection, data analysis, and discussion of this study:

1. Data were collected using a researcher-designed survey instrument (ITSP Survey) that was tested for both validity and reliability. The instrument was composed of seven sections and 82 question items.

2. The data and analysis of this study were limited to the responses of 155 participants who are graduates of the Integrating Technology in Schools program at a large mid-Atlantic university.

3. The accuracy of this study was limited by the self-reported data from participants’ responses. It must be noted that what participants believe to be true may not necessarily be objective factual reality.

Educational Implications

This study has reaffirmed previous research that corroborates the relative success of mostly constructivist strategies in implementing a professional development program in technology integration such as the use of authentic problems, collaboration,
exploration, higher-order thinking, modeling, use of portfolio, and differentiation. Hence, the recommendation here would be the serious consideration of these strategies in the design and implementation of any technology integration program.

Statistical results of this study suggests that the use of technology tools by teachers can be improved by demonstrating and convincing teachers of the value and use of instructional strategies that employ technology as well as the value of the tools themselves (see Figure 6). The part correlations of the linear regression showed that the design and use of technology-enhanced instructional strategies as well as the perceived importance of the technology tools are the heaviest factors in the actual use of technology tools. In other words, if teachers value certain technology tools and are able to design lessons that incorporate those tools, their use of those technology tools will increase.

Figure 6. Significant factors that contribute to the use of technology tools.
Similarly, to make teachers design and use technology-enhanced instructional strategies more, they need to learn and use the technology tools and value those instructional strategies and tools (see Figure 7). It is logical to think that teachers will design and use instructional materials that employ the right technology if they see the value of the technology tools, know how to use those tools, and value the instructional strategies that can be designed using those tools that they deem important.

Figure 7. Significant factors that contribute to the use of technology-enhanced instructional strategies.

It makes sense to think that the converses of the two significant regressions are also true. Figure 7 already proves that the converse of one factor (use of technology tools) in Figure 6 is valid. A Hegelian dialectic between use and value could be applied here (see Figure 8). This study has affirmed that how teachers value tools and instructional
strategies positively affect the use of those tools and instructional strategies. The other part of the dialectic proposes that the use of tools and instructional strategies would also affect how participants value them. After teachers have tried and tested the tools and instructional strategies and have found them effective, it is logical and reasonable to think they would value them more.

Figure 8. Dialectic between value and use.

Finally, further professional development in technology integration must be planned in such a way as to give teachers some time to explore, implement, and evaluate the knowledge and skills they have just acquired. One cannot possibly learn everything during the course of a 2-year graduate study. Teachers, therefore, would still be figuring things out and learning other features of tools or nuances of instructional strategies as they continue their work in their schools. Staggered timing of professional development
will not only save schools dollars spent on professional development but will also provide valuable time for teachers to ruminate and imbibe what they have learned.

**Recommendations for Further Study**

Research on the relationship between the use of technology and demographic variables such as age, gender, and years of experience has not been consistent. It is, therefore, difficult to make more definitive conclusions if relationships do exist. Perhaps more studies on these relationships will shed light on more steady patterns. On the other hand, future research on this matter may possibly just lead to the conclusion that there really are no relationships. Still, any such study will not be useless.

Whereas other studies focused on a few select variables, this study ambitiously included a large number of variables that led to minimizing the number of question items measuring the various constructs so as not to overwhelm or put participants off with a very long questionnaire. A recommendation for further study would be the design of a better survey instrument or multiple in-depth instruments that can be given at different intervals in time. The latter suggestion would allow more rigorous and robust measurements of constructs without taxing or wearying participants. Perhaps there are aspects of technology attitudes and integration practices that have been neglected or have been too accentuated in the ITSP survey. The more recent NETS-T standards, for example, might be able to provide a better framework for constructing items dealing with technology integration. Another option would be to do a more qualitative study that investigates the same relationships between attitudes and technology practice.
Finally, this study was limited in scope to a particular program with a particular philosophy and a particular set of participants. It would be interesting to see the results of applying the methodology in this study to a similar or even a not so similar professional development program. Would a group with a slightly different set of demographics, such as younger participants or more male participants, radically change the results? How would a more rural context or one with less available technology impact the study? What if the program were not implemented in a cohort style? The permutations are limitless and the search for answers must continue.
APPENDIX A

Survey Instrument

Section 1: Demographics

Please fill in the required information.

1. Years of experience as an educator:
2. Year you graduated from ITS:
3. Job while attending ITS:
4. Current job:
5. Grade level you teach (if applicable):
   - K1 – K2
   - K3 – K5
   - K6 – K8
   - K9 – K12
   - Other
   - N/A
6. Gender:
   - Female
   - Male
7. Age:
8. Geographic location of your school:
   - Rural
   - Suburban
   - Urban
Section 2: Attitudes about Technology as a Tool for Instruction

Please rate the following items according to how you agree or disagree with each statement. (10 Items)

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I feel comfortable computers and other technology.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>I feel I can often do things better and faster without the use of technology.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Communication tools such as e-mail and instant messengers (Yahoo IM, Skype, AIM, etc.) give me easier access to colleagues and experts.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>The use of technology makes teaching and learning less personal.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>I have access to so much more resources with the use of technology.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>I feel very uneasy with technology tools I am not at all familiar with.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Some technology tools help represent and explain complex concepts and ideas.</td>
<td></td>
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<tr>
<td>8.</td>
<td>The use of technology can distract teachers or students from actual teaching or learning.</td>
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<tr>
<td>9.</td>
<td>I feel comfortable playing around with technology tools I am not familiar with.</td>
<td></td>
<td></td>
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<tr>
<td>10.</td>
<td>Technology can make learning more interesting and efficient.</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Section 3: Technology Tools

In this section, each item requires an answer on two columns. The second column (white) asks you to rate the importance of that item for teaching/learning. It uses a Likert scale where 1 = "Not at All Important" and 5 = "Very important." The third column (gray) asks how often you use that item for teaching. It uses a Likert scale where 1 = "Never" and 5 = "Very Often." (16 Items)

<table>
<thead>
<tr>
<th>Item</th>
<th>How important you think it is</th>
<th>How often you use it</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 = Not at all</td>
<td>5 = Very Important</td>
</tr>
<tr>
<td>1.</td>
<td>Internet/World Wide Web</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Word Processor</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>PowerPoint for Presentation</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>PowerPoint as Hypermedia</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Skills Software</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Simulation/Games</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>WebQuests</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>E-mail</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Online Chat/Instant Messengers</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Online Discussion</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Course Management Software</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BlackBoard, WebCT, etc.)</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Graphics</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Video</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Video Editing</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Podcasting</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Wikis</td>
<td></td>
</tr>
</tbody>
</table>
Section 4: Technology-enriched Instructional Strategies

Similar to the previous section, please answer each item on two columns. The middle column (white) asks you to rate the importance of that item for teaching/learning. It uses a Likert scale where 1 = "Not at All Important" and 5 = "Very important." The right column (gray) asks how often you use that item for teaching. It uses a Likert scale where 1 = "Never" and 5 = "Very Often." (10 Items)

<table>
<thead>
<tr>
<th>How important you think it is</th>
<th>How often you use it</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Not at all</td>
<td>5 = Very Important</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

1. Design technology-enriched learning activities that incorporate an authentic problem.

2. Design technology-enriched learning activities that promote student engagement and higher order thinking.

3. Design technology-enriched and learner-centered activities to address the diverse needs of students.

4. Design and implement learning activities that allow students to work collaboratively using various technologies.

5. Design learning activities that provide students with opportunities to use various technologies to connect with experts or resources for research and problem-solving.

6. Design technology-enriched learning activities collaboratively with colleagues.

7. Use technology to evaluate or assess student learning through electronic
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<tbody>
<tr>
<td></td>
<td>portfolios, digital projects, online quizzes, etc.</td>
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<tr>
<td>8.</td>
<td>Use technology as a means of professional development by connecting with peers and other experts (via e-mail, e-groups, listservs, webinars, online discussions, etc.).</td>
</tr>
<tr>
<td>9.</td>
<td>Use technology such as e-mail, chat or the Internet (i.e., school website) to communicate with parents or guardians.</td>
</tr>
</tbody>
</table>
Section 5: Support

Please rate the availability and quality of support according to the Likert scale provided. (8 Items)

| 1) How do you rate the availability of the following support in your school: |
|---|---|---|---|---|---|
| a. Technical support (software, hardware, troubleshooting and repair) | None | Sometimes | Frequently | Mostly | Almost Always |
| b. Instructional support (integrating technology into lessons) | | | | | |
| c. Administrative support (opportunities for professional development) | | | | | |
| d. Peer support (help from peers) | | | | | |

| 2) How do you rate the quality of the support you receive in your school: |
|---|---|---|---|---|---|
| a. Technical support (software, hardware, troubleshooting and repair) | None | Poor | Fair | Good | Very Good | Excellent |
| b. Instructional support (integrating technology into lessons) | | | | | | |
| c. Administrative support (opportunities for professional development) | | | | | | |
| d. Peer support (help from peers) | | | | | | |
Section 6: ITS Experiences

Please type in your answers in the corresponding text boxes. (7 Items)

List 3 attributes of the ITS program that you consider to be “best practices” in helping teachers integrate technology in teaching (in order with 1 being most effective):

1. 
2. 
3. 

List 3 attributes of the ITS program that you consider to be least helpful to good professional development in technology integration (in order with 1 being the biggest challenge):

1. 
2. 
3. 

In retrospect, list any additions or changes to your ITS experiences that would make it a better program for professional development in technology integration.
Section 7: Keeping Up-to-Date

Check a box if that item applies to you. You can type other items not listed below in the corresponding text boxes.

How do you keep current with technology and technology integration?

Check all that apply

<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>☐</td>
<td>Journals and other related articles</td>
</tr>
<tr>
<td>☐</td>
<td>Collaboration with peers</td>
</tr>
<tr>
<td>☐</td>
<td>Collaboration with others who shared ITS experience</td>
</tr>
<tr>
<td>☐</td>
<td>Workshops offered by my school division</td>
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<tr>
<td>☐</td>
<td>Attendance at local, state, or national conferences</td>
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<tr>
<td>☐</td>
<td>Taking community college and/or university courses (other than ITS)</td>
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<td>☐</td>
<td>Other: [ ]</td>
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<td>Other: [ ]</td>
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<td>☐</td>
<td>Other: [ ]</td>
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</tbody>
</table>
APPENDIX B

Consent Form

Research Procedures

This research is being conducted to investigate how certain factors and experiences affect technology integration practices of teachers who graduated from the Integrating Technology in Schools program at George Mason University. Factors include: number of years being an educator, number of years since graduating from the ITS program, age, gender, geographic location, attitudes about technology and learning, support, and ITS experiences. If you agree to participate, you will be asked to answer an online questionnaire that is divided into 7 sections. It will take approximately 15 - 20 minutes to complete.

Risks

There are no foreseeable risks for participating in this research.

Benefits

There are no direct benefits to you as a participant in this study but future ITS students or other teachers who will undergo professional development in technology integration may benefit from the results of this study.

This research hopes to contribute two things:

1. To learn more about and improve current professional development programs in technology integration, and

2. To help understand, plan, design, and implement new programs in technology integration

Confidentiality

The data in this study will be kept confidential. The data will be temporarily stored at SurveyGizmo, a commercial paid subscription-based online survey tool. Neither the survey nor the research includes names or other identifying information. The
researcher will have sole access to participants' responses. At the end of the study, all data will be deleted from the database.

While it is understood that no computer transmission can be perfectly secure, reasonable efforts will be made to protect the confidentiality of your transmission.

Participation

Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party.

Contact

This research is being conducted by Charlie G. Cenzon, a doctoral candidate at George Mason University. He may be reached at 202-939-1734 or ccenzon@gmu.edu for questions or to report a research-related problem. You may also contact his advisor, Dr. Priscilla Norton of the George Mason University Graduate School of Education, at 703-993-2015. You may contact the George Mason University Office of Research Subject Protections at 703-993-4121 if you have questions or comments regarding your rights as a participant in the research.

This research has been reviewed according to George Mason University procedures governing your participation in this research.

Consent

The George Mason University Human Subjects Review Board has waived the requirement for signing the consent form. However, if you would like to sign a consent form prior to beginning the survey, please contact Dr. Priscilla Norton at 703-993-2015 or by e-mailing her at pnorton@gmu.edu.

If you agree to participate in this study, you may proceed to the next page. Please note that there is no feature to save your survey if you decide to take a break. It will time you out. Please proceed only if you are free within the next 15-20 minutes. Thank you!
APPENDIX C

HSRB Approval of Study

TO: Priscilla Norton, College of Education and Human Development
FROM: Sandra M. Sanford, RN, MSN, CIP
Director, Office of Research Subject Protections

PROTOCOL NO.: 5625  Research Category: Doctoral Dissertation
TITLE: Examining the Role of Various Factors and Experiences in Technology Integration: A Description of a Professional Model
DATE: December 14, 2007
Co: Carlos Cenzon

On 12/11/2007, the George Mason University Human Subjects Review Board (GMU HSRB) reviewed and approved the above-cited protocol following expedited review procedures.

Please note the following:

1. A copy of the final approved consent document is attached. You must use the content approved in the consent form with the HSRB stamp of approval for your research.
2. Any modification to your research (including the protocol, consent, advertisements, instruments, etc.) must be submitted to the Office of Research Subject Protections for review and approval prior to implementation.
3. Any adverse events or unanticipated problems involving risks to subjects including problems involving confidentiality of the data identifying the participants must be reported to Office of Research Subject Protections and reviewed by the HSRB.

The anniversary date of this study is 12/10/2008. You may not collect data beyond that date without GMU HSRB approval. A continuing review form must be completed and submitted to the Office of Research Subject Protections 30 days prior to the anniversary date or upon completion of the project. A copy of the continuing review form is attached. In addition, prior to that date, the Office of Research Subject Protections will send you a reminder regarding continuing review procedures.

If you have any questions, please do not hesitate to contact me at 703-993-4015.
APPENDIX D

HSRB Approval of Consent Form

Consent Form

Exposing the Role of Various Factors and Experiences in Technology Integration: A Description of a Professional Model

As a graduate of the Integrating Technology in Schools (ITS) program at George Mason University, you have been selected to participate in this study.

Research Procedures: This research is being conducted to investigate how certain factors and experiences affect technology integration practices of teachers who graduated from the Integrating Technology in Schools program at George Mason University. Factors include: number of years being an educator, number of years since graduating from the ITS program, age, gender, geographic location, attitudes on technology and learning support, and ITS experience. If you agree to participate, you will be asked to answer an online questionnaire that is divided into 7 sections. It will take approximately 30 minutes to complete.

Risks: There are no foreseeable risks participating in this research.

Benefits: There are no direct benefits to you as a participant in this study. No future ITS students or other teachers who will undergo professional development in technology integration may benefit from the results of this study.

This research hopes to contribute two things:
- To learn more about and improve current professional development in technology integration, and
- To help understand, plan, design, and implement new programs in technology integration.

Confidentiality: The data in this study will be kept confidential. The data will be temporarily stored in one of George Mason University's database servers. Neither the survey nor the research includes names or other identifying information. The researcher will have sole access to participants' responses. At the end of the study, all data will be deleted from the database. While it is understood that no computer transmission can be perfectly secure, reasonable efforts will be made to protect the confidentiality of your transmission.

Participation: Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party.

Contact: This research is being conducted by Chetan G. Cenzo, a doctoral candidate at George Mason University. You may be reached at 202-599-1734 or cenzoc@pmail.gmu.edu for questions related to the research. You may contact the George Mason University Office of Research Subjects Protection at 703-590-6121 if you have questions or comments regarding your rights as a participant in the research.

This research has been reviewed according to George Mason University procedures governing your participation in this research.

Consent: The George Mason University Human Subjects Review Board has waived the requirement for signing the consent form. However, if you would like to sign a consent form prior to beginning the survey, please contact Dr. Priscilla Norton at 703-993-2015 or pmorton@gmu.edu.

I agree

Approval for the use of this document
EXPIRES

DEC 10 2008

Protocol # 5625
George Mason University

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APPENDIX E

HSRB Approval of Advertisement

Dear Graduate,

One of my students, Carlos Cenzon, is conducting a research study on the Integrating Technology in Schools (ITS) program as his doctoral dissertation. It investigates how factors such as age, gender, geographic location, attitudes on technology, support, number of years teaching, and length of time since graduating from the program have any effect on current technology integration practice.

As a graduate of ITS, you have been selected to participate in this study. There are no direct benefits to you as a participant in this study, but future ITS students or other teachers who will undergo professional development in technology integration may benefit from the results of this study.

This research hopes to contribute two things:

- To learn more about and improve current professional development programs in technology integration; and
- To help understand, plan, design, and implement new programs in technology integration

Participation involves answering an online questionnaire that is divided into 7 sections and that takes approximately 30 - 40 minutes to complete.

The data in this study will be kept confidential. Neither the survey nor the research includes names or other identifying information. The researcher will have sole access to participants’ responses. The data will be temporarily stored in one of George Mason University’s database servers. Again, only the researcher has access to the database. At the end of the study, all data will be deleted from the database.

Your participation is crucial to the success of the study and will be very much appreciated. If you agree to participate, please click on the following link: http://vhs.gmu.edu/itsresearch/consent.aspx.

Thank you very much in advance!

[Approval for the use of this document]
[EXPIRES]
[DEC 10 2008]
[Protocol # 5625]
[George Mason University]

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REFERENCES
REFERENCES


Schacter, J. (1999). *The impact of education technology on student achievement: What the most current research has to say.* (Available from Milken Exchange on Education Technology, Milken Family Foundation, 1250 Fourth St., Fourth Floor, Santa Monica, CA 90401-1353)


CURRICULUM VITAE

Carlos G. Cenzon, S.J. received his Bachelor of Arts in Philosophy at the Ateneo de Manila University, Philippines in 1987. In the same year, he entered the novitiate of the Society of Jesus. As a Jesuit in formation, he taught adult education at Miriam College, Quezon City, Philippines for a year in 1989 and high school at the Ateneo de Naga University also in the Philippines from 1992-1994. He received a Master of Arts in Pastoral Ministry from the Ateneo de Manila University in 1998 and a Master of Science in Computer Science from the George Washington University in Washington, DC in 2003.