

Middle School Teachers' Understanding of Technology Integration

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Abstract

M. LOVETTA JAMES: Middle School Teachers' Understanding of Technology Integration
(Under the direction of Barbara Wildemuth)

The purpose of this study was to examine middle-school teachers' understanding of technology integration. Three questions were addressed. 1) How do teachers define "technology integration"? 2) Is their definition of "technology integration" reflected in their teaching practices? 3) What factors affect their technology integration practices? Thirty-seven teachers from three school districts were observed and interviewed. Teachers were observed during class sessions for practices related to technology use. Observations were followed by semi-structured interviews. Initial questions were based on the four elements of information diffusion defined by Everett Rogers. These are innovation, communication channels, time and social systems.

The exploratory nature of the study provided reason to use an inductive approach for data analysis. Using the constant-comparative method, raw data from teacher observations and interviews were continuously analyzed against new data that was collected. In this way, links in the data were used to develop conclusions and answer the study questions.

Based on commonalities in their beliefs, motivations and practices, the teachers were categorized into five groups. These were Dynamic users (Group 1), Technology integrating users (Group 2), Knowledgeable intermittent users (Group 3), Limited

approach users (Group 4), and Non-users (Group 5). The teachers in Groups 1 and 2 integrated technology in ways similar to those described in the literature. They used rich, descriptive expressions to define the concept of technology integration. They overcame barriers within their environments and used technology in their teaching. They believed that using technology in the classroom benefited student learning and that technology fits well with their curriculum and teaching practices.

Dedication

This study is dedicated to my children, Samuel and Zachary.

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1. Introduction

Information technology impacts almost every part of our daily lives. From work to play, technology is more available and useful than ever before. Computer technology's ubiquity cannot be denied and a world without it is unimaginable. This world includes that of the K-12 environment. There is no question that schools have made considerable strides in terms of computer availability, functionality and variety. Schools have seen a steady rise in expenses towards hardware, software, technical support staff and professional development. During the early 1990s, two-thirds of the expenditure on educational technology was on building up the hardware infrastructure (i.e., computers, peripherals, and network connections). The mid-1990s saw expenses toward adding Internet access (Anderson & Becker, 2001). By the end of that decade, 99 percent of the public schools in the United States had computers, including Internet connectivity (Becker, 2000; Kleiner & Lewis, 2003; Smerdon, Cronen, Lanahan, Anderson, Iannotti, Angeles & Greene, 2000).

Research provides several reasons to use computers. Studies point to a number of specific positive effects when using computer technology with students. Students who used computer-based instruction scored higher on achievement tests, learned more in less time, and liked their classes more (Kulik, 1994). Technology training for teachers, and positive teacher attitude towards technology also led to student achievement gains (Schacter, 1999; Wenglinsky, 1998).

Along with the technological advances, increased expenditures on technology, and awareness of the benefits of computer use with students, has come greater expectations of teachers. Teachers are expected, by administrators and the communities in which they teach, to use the technology made available to them. They are expected to integrate them within their teaching practices. However, these expectations are unrealized and studies point to a number of reasons as to why. Some of the barriers considered in the research literature include teacher demographics (Hadley & Sheingold, 1993; Sheingold & Hadley, 1990), organizational guidance & support (Grove, Strudler & Odell, 2004; Pelgrum, 2001; Rogers, 2000); lack of technology resources (Russell & Bradley, 1997), training and comfort (Guha, 2001), time (Zhao & Frank, 2003), gender (Whitley, 1997), and teacher beliefs related to their role in the classroom (Sandholtz, Ringstaff & Dwyer, 1997).

The bulk of the studies examining this topic have used survey methodology. This has provided few new insights into why teachers continue to struggle to integrate computer technology even with the evidence of positive outcomes and greater availability of resources. Without meaningful inquiry into this challenge, meaningful solutions cannot be realized.

1.1. Purpose of the study

The purpose of this study was to examine middle school teachers' perceptions of the concept of "technology integration". Discussions and observations helped gain an understanding of their beliefs and practices as they relate to technology use for their curriculum goals. The study also identified factors that had contributed to these beliefs

and practices. Based on the beliefs and practices, teachers were identified as being either technology integrating or non-technology integrating.

To this point, little if any data on teachers and technology has examined this group's understanding of the term, "technology integration". Assumptions have been made and studies have discussed exemplary teachers, adopters of technology who use constructivist practices in the classroom (Cuban, 2001; Cuban, Kirkpatrick & Peck, 2001; Hadley & Sheingold, 1993; Zhao, Byers, Puge & Sheldon, 2002). Much of the research on teachers' use of technology has used survey methods. This study was of an exploratory nature and used an inductive qualitative approach to gain insight into why teachers continue to struggle in technology integration practices. By using this method and examining what patterns and themes emerge, new questions and answers may help in this endeavor. The practical implications of this study provide school and district administrators with suggestions for technology acquisition, distribution and professional development. Teachers also discussed the effects of their college technology experiences on their present day technology use.

1.2. Research questions

The study addressed the following questions:

1. How do teachers define "technology integration"?
2. Is their definition of "technology integration" reflected in their teaching practices?
3. What factors affect their technology integration practices?

These questions were selected to be studied as an introductory inquiry step to understanding why the lag in technology integration exists in the classroom practices of teachers.

1.3. Theoretical framework

The theoretical foundation for this research was Everett Rogers' Diffusion Theory (1995). Diffusion theory aims to explain the general spread of an innovation within a social network. The initial list of interview questions for this study was based on the four main elements of diffusion, as defined by Rogers. These are the perceived attributes of an innovation, communication channels, time, and the social system. Each element provided a different facet from which to investigate teachers and their technology beliefs.

Another theory relevant to the purposes of this study is Constructivism. The research literature has suggested that technology integration practices lend themselves to a constructivist teaching environment. When constructivist practices are present, there is a greater exchange and flow of ideas. Teachers have greater expectations of their students and feel that the needs of the students are being better met as a result of using technology. These teachers view the technology as the means to an end, instead of the end itself and see a connection between the technology and the curriculum (Cuban, 2001; Cuban et al., 2001; Hadley & Sheingold, 1993; Zhao et al., 2002).

Why and how teachers integrate technology needs to be examined from different perspectives. These two theories, Diffusion Theory and Constructivism, provided a basis for collecting and examining rich data about teachers' technology practices.

1.4. Significance of the study

According to the research literature, use of computers by teachers in the classroom is limited. This persists even though the field has made great strides in the availability of technology resources. It persists even though research points to the benefits of using technology in the classroom. One possible step in providing solutions to

the challenge is to examine technology integration from the perspective of the teachers. This study does exactly this by asking teachers directly about their understanding of technology integration and the issues they feel are relevant to the use of technology in the classroom.

2. Review of the Literature

Research on the use of technological innovations is easily found in the educational literature, going back several decades. On the footsteps of each new innovation (i.e., film, radio, and instructional television) came research and discussion on the innovation's role as the magic bullet aimed at what ails classroom teaching. When outcomes were not as expected, many researchers pointed to teachers for their failure to incorporate the innovation into their teaching (Cuban, 1986; Hannafin & Savenye, 1993). Cuban describes this sequence of events as the exhilaration-scientific credibility-disappointment-blame cycle.

Have computers followed this same cyclical pattern? The literature, both research and otherwise, suggests that they have. LOGO is an early example of the expectations and disappointments that followed the introduction of computers into the classroom (Papert, 1980; Tetenbaum & Mulkeen, 1984; Watt, 1982). LOGO, developed by Seymour Papert and his colleagues at the Massachusetts Institute of Technology (M.I.T.) in the late 1960s, uses simple English words as commands to control physical devices. As an educational tool, it provided a way to teach students about abstract algorithmic concepts. However, at the time of its introduction, computer technology in the classroom was a distant vision (Hammond, 1972). Computer Based Instruction (CBI), Computer Assisted Instruction (CAI) and other such computer dependent innovations have also

followed the path of exhilaration to disappointment (Clark, 1983; Salomon & Gardner, 1986).

Just as researchers in the 1980s centered their attention on the computer's role in education, the 1990s saw a significant number of studies on teachers and their role in the use of computers for teaching. Some, such as Cuban (2000), question the compatibility of computers and the teaching environment, where teachers are faced with barriers that make it difficult to incorporate regular computer use. However, other researchers, such as Becker (2000), point to the change in the past decade in the educational computing landscape, where now there is greater accessibility, functionality and variety. Teachers now have available to them electronic mail, documentation and presentation software, multimedia authoring environments, on-line databases and the World Wide Web.

2.1. Availability of computer technology

National surveys by the National Center for Educational Statistics (NCES) (Kleiner & Ferris, 2002; Kleiner & Lewis, 2003; Smerdon, Cronen, Lanahan, Anderson, Iannotti, Angeles & Greene, 2000) and large-scale surveys and studies by research organizations such as the Center for Research on Information Technology and Organizations (CRITO) (Becker, Ravitz & Wong, 1999) and the Pew Research Center (Levin & Arafeh, 2002) provide a panoramic view of the computer availability and use practices of teachers in the K-12 landscape. Similar surveys and studies at the state, district and school level provide a more focused impression of what is occurring in this environment (Barron, Kemker, Harmes & Kalaydjian, 2003; Cuban, 2000; Hart, Allensworth, Lauen, & Gladden, 2002). The national studies show that most teachers

have access to computers, but there is still disparity in who has and does not have access. The studies also point to needs voiced by teachers for technical support and training.

There is no question that the number of computers in schools has been increasing over the past decade. During the early 1990s, two-thirds of the expenditure on education technology was on building up the hardware infrastructure (i.e., computers, peripherals, and network connections). The mid-1990s saw investments in adding Internet access (Anderson & Becker, 2001). By 1999, a survey of public school teachers reported that almost all of them (99 percent) had computers available to them *somewhere* in their schools. Eighty-four percent had *at least one* computer available in their classrooms; 36 percent had one computer in their classroom, 38 percent reported they had two to five computers in their classrooms and 10 percent had more than five (Smerdon et al., 2000). Internet access in schools increased from 35 percent in 1994 to 99 percent in 2002 (Kleiner & Lewis, 2003). The percentage of public school classrooms connected to the Internet rose from 3 percent in 1994 to 87 percent in 2001 (Kleiner & Farris, 2002).

However, this increase in expenditure has not successfully met the needs of the teachers. A 2004 national survey of more than 1000 teachers found dissatisfaction with the number of computers available in the classrooms. Fifty-five percent reported that enough computers for students was an “extremely” or “very” serious problem. A dissection of the responses by region showed that teachers in the Northwest reported the greatest satisfaction by stating that they had “the right number” of classroom computers. Teachers in the Southeast and Texas reported that they needed “a lot more” computers (Rother, 2004).

What do surveys and studies, conducted at state and district levels, report about availability? In a 2001 study of Chicago schools, researchers found that availability either equaled or lagged behind the levels reported by teachers in similar settings nationally (city schools). Only half of Chicago high school teachers reported having a computer in their classroom, compared to three quarters of city teachers nationally. The numbers were especially low for Internet availability inside classrooms. Whereas, at the national level, 60 percent of elementary school teachers and 72 percent of high school teachers who had computers in their classrooms also had Internet access in their classrooms, Chicago school teachers reported that only a third had availability (Hart et al., 2002).

A 2002 survey of teachers at a Florida school district reported numbers comparable to those of the NCES survey (Smerdon et al., 2000). Eighty-seven percent of the district teachers reported having at least one computer in their classrooms (Barron et al., 2003). A 2002 study of Maryland schools found that 78 percent of teachers had at least one computer in their classrooms. Internet connection in the classroom was available to 69 percent of the teachers who had computers (Macro International, 2002). The reported data on availability of computers to teachers in the Florida school district and in Maryland schools are close to the NCES reported data; however, it should be noted that both the Florida and Maryland surveys were conducted three years after the NCES survey.

The 1999 NCES survey (Smerdon et al., 2000) also points to the disparity in computer availability based on certain school characteristics. Teachers were more likely to have computers available to them if they were in schools that were located in towns

(versus schools located in cities or on the urban fringe), or had less than 1000 students, or had less than 50 percent minority enrollment. Teachers in elementary grades were more likely, as well, to have computer availability than high school teachers. These same determining characteristics were true for Internet availability. The one difference was in class level. Secondary school teachers were more likely to have access to the Internet than elementary school teachers (Smerdon et al., 2000).

The survey results of teachers in the Chicago city school district are supported by the NCES report (Smerdon et al., 2000). The two significant school characteristics that negatively affected availability of computers for teachers in the district survey was the predominance of African-American students and low student achievement level (Hart et al., 2002).

2.2. Use of technology by teachers

Does computer availability equate to use? Cuban (2001) believes that use for classroom instruction is infrequent and limited. “E-learning” in public schools is word processing and Internet searches, far from the project-based teaching aspired to by researchers. Cuban, based on results of his study of schools in California, reports that teachers use the technology to communicate with parents and administrators, prepare syllabi, record grades and assign papers. Cuban’s view that use of computers by teachers is limited is supported by a report by Becker, Ravitz & Wong (1999). The report notes that the types of tasks that teachers ask students to perform with computers are trivial. Elementary school teachers used it mainly for skill-related drills and for educational games. In secondary schools, computer skills were taught by a computer specialist. As Cuban suggests, the jump from *access* to *instructional effectiveness* is lacking. The lag is

apparent in the frequency of use and the ways in which computers are used. Teachers use computers more for researching topics and preparing class materials. Use for class instruction, assigning work that requires technology use, and participation in online discussion groups or collaborative projects was minimal. A good number (75 percent) of teachers, even those who reported not having their students use computers at all, used it for their administrative needs. In schools and districts where there was a focus on providing teachers with technology and support, teachers are more active users (Hart et al., 2002; Smerdon et al., 2000). This is supported by the NCES surveys. Fifty-three percent of all public school teachers reported using computers for instruction during class time. Use for word processing, spreadsheet work and Internet research were the most common types of assignments given to students by teachers. Forty-one percent of teachers assigned work that used word processing and spreadsheets on a moderate to a large extent; 31 percent assigned work for Internet research on a moderate to a large extent. Similar statistics were reported in the study of computer use by teachers in the Florida school district and the Maryland schools (Barron, Kemker, Harmes & Kalaydjian, 2003; Macro International, 2002).

The Chicago survey relates that vocational, business and technology teachers reported the highest levels of availability and use (Hart et al., 2002). This is supported by a 1998 survey of 4th-12th grade teachers (Becker, 2001). Becker's study found that aside from computer education teachers, only one other group, business education teachers, reported using computers at least on a weekly basis. Of the core subjects, English classes were the most frequent users of the technology; math classes were the least likely users. Teachers reported some use of assistive technology for special education programs, such

as for students who are low achieving, limited-English-proficient, or those with disabilities (Becker et al., 1999; Hart et al., 2002; Macro International, 2002).

When looking at grade level, instructional use is higher among elementary and middle school teachers than high school teachers. This is supported by both the national and local surveys. Elementary school teachers assigned projects using the computer inside the classroom more than high school teachers, 60 percent versus 37 percent. This statistic is reversed for assignments involving the use of computers outside the classroom, 41 percent versus 64 percent. One reason suggested for this difference is the wider availability of computers in the elementary and middle school classroom and greater time flexibility for the teacher in these environments (Barron et al., 2003; Becker et al., 1999; Hart et al., 2002; Macro International, 2002).

NCES statistics report that nearly all teachers have a computer available to them somewhere in the school. However, two thirds do not have enough computers in the classrooms for use with students. These teachers have to go to a computer lab or media lab for access (Smerdon et al., 2000). The location and number of computers available is an indicator of frequency of use by teachers. In secondary schools, teachers who had five to eight computers in their classrooms were twice as likely to use them with students, than teachers who had one to four computers or teachers who shared a computer lab that had at least 15 computers (Becker, 2001).

2.3. Technology support and education for teachers

Technology support, in the form of access, training and assistance, is an important factor affecting computer use. Teachers in schools with higher quality support are more

likely to use technology with students than teachers in schools with lower quality support. They are also more likely to use technology for various professional uses (Ronkvist, Dexter & Anderson, 2000).

Most aspects of computer technology (i.e., Internet, e-mail, word processing, multimedia applications and databases) are used to some extent by teachers. However, in surveys, only 10 to 30 percent of teachers reported feeling well prepared to use the technology for instruction. The level of preparedness teachers report having, and their technical expertise, seems to translate to level of classroom use. Readiness to use was found to be a key factor in use in a study by Ward and Parr (2010), suggesting that teachers need to feel confident to integrate technology. The researchers state that professional development needs to be aimed at more than just skill development. It should help teachers understand the benefits of technology in the classroom. The importance of comfort in using technology can be seen with teachers who are technically knowledgeable. These teachers used a wider variety of software with their students and included student opportunities to present their work to an audience, such as with presentation software (Becker et al., 1999).

The NCES national survey (Smerdon et al., 2000) reported that teachers with fewer years of teaching experience were more likely to feel prepared to use computers and the Internet for instruction, than teachers with more years teaching. However, Cuban (2001), in his study of teachers in the Silicon Valley region of California, did not find a difference between veteran and novice teachers. Independent learning (70 percent), professional development (52 percent), colleagues (51 percent) and pre-service college

education (25 percent) are reported (Smerdon et al., 2000) as sources of computer preparation in a moderate to large extent.

In another study of both student teachers and experienced teachers, Smarkola (2008) found that there was a difference in computer use between the two groups. Student teachers focused more on lessons using the Internet. They believed their college-related technology education to be valuable, but they didn't feel prepared enough to develop computer-integrated lessons for their own classrooms. The experienced teachers, on the other hand, especially those who received support from the school, used a variety of software. They were dependent on both equipment and staff support from the school.

2.3.1. Pre-service training

Middle and high school students find the typical Internet-based assignment to be of "poor and uninspiring" quality. The types of assignments that require higher order thinking skills on the part of the students are rare. Students, frustrated and dissatisfied by a digital disconnect, because they are not given the full opportunity to take advantage of the Internet, believe teachers need assistance to effectively integrate computers into the curriculum. Teachers need training on how to use technology when teaching (Levin & Arafeh, 2002).

College does not seem to be providing the technology training most teachers need to prepare them for the classroom. One reason noted is that most pre-service teachers are taught by professors who themselves are not technologically proficient (Callison, 2004). Consequently, the pre-service teachers are not provided with enough, if any, opportunities to observe technology-rich possibilities. Those few who do observe

instructors modeling technology integration, are very positive about the use of technology, and can visualize technology use under different settings. In general, most pre-service teachers do not have this opportunity and do not move beyond drill-and-practice type computer use (Vannatta & Beyerbach, 2000).

Awareness of the need for standardization of teacher technology education is apparent in the efforts of educational associations. The American Association of Colleges for Teacher Education (AACTE) endorses standards for technology education, as does the International Society for Technology Education (ISTE), the Association for Educational Communications and Technology (AECT) and the National Council of Teachers of Mathematics (NCTM) (Davis & Eslinger, 2001; Thomas, 2002).

2.3.2. Professional development

Teachers who participate in professional development and increase their computer skill level are more likely to develop positive attitudes toward technology use in the classroom. Hands-on training, practice and attendance has shown to decrease inhibitions towards use and increased use in the classroom (Davis & Eslinger, 2001).

Teachers in the NCES survey reported a number of incentives for participation in professional development including course credit toward certification, release time and stipends. In general, those teachers with more years of teaching experience were more likely to have taken workshops in basic computer use. New teachers, on the other hand, were more likely to point to their college education as a source for their basic computer education. Teachers in schools with at least 50 percent minority or free or reduced-price school lunch reported less availability of computer related training (Smerdon et al., 2000).

2.3.3. Examples of computer use

In the 1980s, computers in the schools were used mostly for either drill-and-practice exercises or to teach programming skills (Becker, 1983). Emphasis on programming declined in the 1990s as the computer was used more as a tool (Becker, 1994). By the late 1990s, computer use was more for problem solving and learning content rather than for drill-and-practice and programming skills (Becker, 1999). Drill-and-practice and game type software applications are still commonly used in elementary grades for improving basic math and language arts skills. Word processing is the most used application among teachers and students at all grade levels (Becker et al., 1999).

However, whereas computers were supplemental to the curriculum in the 1990s, today teachers are asked to integrate technology into the classroom. The focus is on teachers' computer skills and their ability to integrate computers into their day-to-day teaching. Many schools have technology skills requirements for both teachers and students. Groups such as the National Council for the Teaching of Mathematics and the American Association for the Advancement of Science identify how technology should be integrated into specific subject areas and activities. Even with this interest, the responsibility of professional development for teachers lies mostly at the district level. As of 2004, only 15 states required incoming teachers to take technology courses (Rother, 2004; Soloway et al., 2000).

Beyond skills knowledge in the use of word processing and presentation type applications, teachers are asked, and in some cases required by school administrators, to use computer applications for administrative duties. Schools use student management

systems, such as PowerSchool, Star_Student and IDMS, to track attendance, disciplinary action, assignments, grades and overall performance. Applications such as InteGrade Pro, Easy Grade Pro and ThinkWave are specific to tracking student grades (Anderson, 2004; Associated Press, 2005; Bach, 2004). Examples of computer hardware that teachers with which are presented in their schools and classrooms include desktop computers, printers, scanners, interactive white boards and wireless computers (Kollali, 2004; Mollison, 2004; White, 2004).

The Internet is a valuable resource for those teachers who are familiar with it. School districts and educational organizations provide sites with lesson plans for different grade levels and by subject matter. Partnerships among educators, such as the WISE project (wise.berkeley.edu), provide valuable opportunities for teachers to instruct students using technology (Kent & McNergney, 1998). Using a WebQuest allows the teacher to focus the student's attention towards a particular goal by asking questions that can be answered by following links to websites provided by the teachers (Sena, 2005). Virtual field trips provide a plethora of learning opportunities. Via the Internet, teachers and students can, for example, visit historical sites, museums and distant cities (Lacina, 2004).

Becker, in his efforts to refute Cuban's (2000) argument that computers as a medium of instruction in the classroom are incompatible with the current requirements of teaching, comes to the conclusion that Cuban is partially correct. Becker agrees that the type of computer work assigned by teachers is typically word processing, and that most

classroom computer use is for skills-based instruction related to business and vocational education (Becker, 2000).

With the increase in technology expenditure, access is no longer a primary issue. The focus is increasingly of a pedagogical nature. In one study, 91 percent of middle and high school students themselves said that they wanted to learn from a teacher who was technology-competent. They wanted to use computers for web site development, creating presentations and for doing homework (Gulbahar, 2007). There are greater expectations for improvements in student academic accomplishments as a result of computer availability in schools, and teachers feel this pressure (Anderson & Becker, 2001; Myhre, 1998).

2.4. Barriers to and beliefs about technology use

As Rogers (1995) notes with his QWERTY typewriter example, even technological innovations with proven advantages are not always adopted. When appropriately integrated into the classroom curriculum, the potential for computer technology to assist and enhance learning can be significant (Kulik & Kulik, 1991; Wenglinsky, 1998). However, the data provided in this paper supports Cuban's conclusions that the vast efforts put into technology integration have not produced equally strong results (Cuban, 2001).

There is no question that expenditure for computer technology in schools has increased substantially in the last decade and that the computer-to-student ratio has increased during the same period. Computers in classrooms and media labs have made the technology much more accessible to students and teachers (Smerdon et al., 2000).

However, integration is limited. The current emphasis is to learn *from* technology rather than *with* technology. In the former, the technology is used to deliver content, which of course provides greater access and efficiency. However, it denies students the opportunity to expand, explore and create their own knowledge (Hooper & Hokanson, 2004).

There is a generous body of published research investigating the reasons for the sluggishness in the integration of technology in schools, and a good share of this research focuses on teachers, their environment and attitudes. Teachers frequently cite a number of “barriers” or obstacles to integration. These barriers are categorized using different terms, e.g. “external and internal sources”, “first and second order barriers”, but all reflect the same understanding of the types of barriers teachers face (Ertmer et al., 1999; Rogers, 2000). It is important to note that the barriers cited by teachers have basically remained the same despite the increase in the number of computers found in schools (Andrews, 1999; Pelgrum, 2001; Pelgrum & Plomp, 1993).

Pelgrum (2001) in his worldwide study of educational practitioners and their barriers to using technology, collected data from elementary school teachers, technology experts and administrators using surveys and case study methodology. Educators were asked to mark off, from a list provided, the “major obstacles affecting the realization of your school’s computer-related goals for students” (p. 173). The most frequently cited barriers are those cited by other researchers in the field. Barriers included are insufficient software and hardware, lack of knowledge and skills on the part of the teacher, inadequate technical support, lack of training opportunities, and insufficient teacher time.

Other studies point to teachers' attributes such as attitude and pedagogic beliefs. Understanding such *personal* barriers is also essential since the negative attitudes and apprehensive feelings teachers have associated with computers may be picked up by students and affect their learning (Andrews, 1999; Myhre, 1998; Sheingold & Hadley, 1990).

2.4.1. Organizational support

Organizational support is an important factor in promoting technology use (Pelgrum, 2001; Rogers, 2000). Lack of software and hardware, poor maintenance of equipment and lack of training and technical help create an impression of non-encouragement from administration (Dreyfus, Feinstein, & Talmon, 1998). Schools offer limited professional development to teachers, especially in subject specific areas (Bauer, Reese & McAllister, 2003; Smerdon et al., 2000). Providing bits and pieces of formal support is wasted. Stand alone training without follow-up support, such as additional training, collegial discussions and technical resources, provides no positive long-term results (Bauer et al., 2003).

Administrative guidance and support is important for the successful integration of technology (Grove, Strudler & Odell, 2004). Since administrators are ultimately responsible for implementing technology in their schools, their involvement is essential. However, their involvement is limited. States require little if anything from administrators as role players in establishing a technology integrated curriculum (Daniel & Nance, 2002). Opportunities for training in educational technology are limited for administrators, leading to uninformed decisions about the resources teachers need for integrating. The amount of training and type of training principals received influences the

level of integration in the schools' curricula. Many administrators are, however, not convinced of the role of technology in education and do not have a clear message in regard to its use (Dawson & Rakes, 2003; Shuldman, 2004; Thomas, 1998).

Principals who believe in the potential of technology to improve instruction are facilitators and guides for to their teachers and staff. They discuss technology in the context of the curriculum goals of the school. Those who do not play active roles in defining and communicating sensible goals fail to provide an environment where technology can have an enduring effect (Staples, Pugach & Himes, 2005).

Administrators face other obstacles such as budget constraints. In settings where funds are limited, regular hardware and software updates, staff development and other technology related activities may not be supported. Administrators also have to be sensitive to the expectations of the tax-paying public. Using public funds for teacher professional development, instead of direct student related activities, has been and is a sensitive proposition (Shuldman, 2004; Staples et al., 2005).

Other forms of organization support include providing release time to develop courseware and new skills, encouragement by administration, and funding for projects. Without time release programs, teachers cannot spend the time needed to learn the technology and incorporate it into their curriculum (Rogers, 2000). Teachers also need to be part of any new technology plan. When teachers are not involved in the change process, they adopt only that part of the innovation which least affects their established pattern of activity (Myhre, 1998). Also important is the promoting of innovations and publicly recognizing excellence. This provides support for teachers (Petersen, 1999). However, sensitivity to the implementation of innovations in parallel with technological

innovations is important, since the stresses of multiple challenges can impede adoption (Zhao & Frank, 2003). Another form of support is funding for specialists such as instructional technologists and grant coordinators (Staples et al., 2005).

2.4.2. Computer access and technical support

Unlike the business environment, where computers have moved into offices and onto the desks of individual workers, in the K-12 setting, computers occupy a special space: the technology lab. In some schools, computers can be found in the classrooms; however, usually there are only a small number. In the Apple Classrooms of Tomorrow (ACOT) project, classrooms were converted into multimedia environments with access and support. In this environment, teachers quickly overcame their initial negative feelings. However, when they returned to their own schools, where they faced limited access and lack of technical support, they quickly abandoned their plans to integrate computers into their practices (Dwyer, Ringstaff & Sandhotz, 1991).

An adequate number of computers, well maintained hardware and software, and a trained, technical support person are conditions necessary for a positive experience. Having a limited number of computers could mean use for limited drill and practice sessions. Also important is the physical location of computers. Teachers with computers in the classroom are more likely to use the technology than those who have computer access at a lab. The number of computers available is also relevant. For example, secondary teachers with one computer in their classroom for every four students are three times more likely to use the technology than those who have computer access at a lab (Becker, 1999). An inadequate number of computers can result in more drill and practice uses instead of discovery types of projects (Russell & Bradley, 1997).

Opportunities to play and experiment are critical to implementation (Zhao & Frank, 2003). Access to computer technology means greater opportunities for positive teaching experiences (Ross, Hogaboam-Gray & Hannay, 1999). For some teachers, access is a “critical prerequisite” to raising confidence and competence. As teachers have more experience with use of technology, they gain comfort and positive attitudes (Akbaba & Kurubacak, 1998; Andrews, 1999; Hadley & Sheingold, 1993; Rosen & Weil, 1995; Russell & Bradley, 1997; Yaghi, 1996).

Teachers with support in their schools are more positive about their use of computers than those who do not have such support. They are more confident, open to new possibilities, and less anxious when things work correctly (Andrews, 1999; Hadley & Sheingold, 1993). Having no computer support can be sufficient reason not to use the technology at all (Becker, 1994). Inadequate support could also lead to welcome or unwelcome expectations from teachers who are technology proficient (McGee, 2000). Frequent breakdowns that are not quickly fixed and frequent obsolescence of software create ambivalence among teachers. Confidence in the technology erodes, sustaining existing teaching practices (Cuban et al., 2001). When technical expectations are reduced, teachers have the opportunity to enhance the use of technology in their teaching (Sandholtz & Reilly, 2004).

2.4.3. Technology training

Training provides teachers with the experience needed to feel comfortable with computers. It is the opinion of administrators and teachers that computer training for teachers is a very important factor in being able to teach with computers (Yaghi, 1996). Without training, teachers feel “inadequate” and “frustrated” by their limited knowledge.

Since teachers interact with students regularly, they need to be comfortable with using computer technology. Their role as teacher assumes greater knowledge of the subject matter at hand than their learners (Guha, 2001). Teachers who are well-trained and comfortable using computers have positive attitudes towards computers and are positive role models for the learners, whereas those with inadequate training create an environment where negative attitudes are propagated (Gardner et al., 1993).

In general, the feeling among teachers is that they do not have sufficient training, either pre-service or during their tenure, to be at ease in incorporating computers into their teaching practices. Many teachers do not receive sufficient computer education during their pre-service training, yet they are expected to incorporate computers into their curriculum (Yaghi, 1996). Even when teachers are provided pre-service training, it is not modeled based on a real world educational setting. In their training environment, teachers are provided with equipment (probably a one to one student-computer ratio), information technology support, and little, if any, discussion of time constraints on developing a technology infused curriculum. Once in their professional environments, these teachers are met with a very different situation, one where there is limited technology, support, and time (Somekh et al., 1992).

The perception by teachers is that training is important if they are to incorporate the technology into their curriculum.(Guha, 2001; Russell & Bradly, 1997; Yaghi, 1996). This view is shared by district administrators as well. Administrators agree that professional development is important to technology integration. In addition, teachers need regular contact with professionals who are experienced in teaching with technology (Shuldman, 2004).

Teachers with pre-service technology training are more apt to describe themselves as being competent with computers and have more positive attitudes towards computers. These teachers use more computers within their educational programs. They use word processing packages and the Internet. Comfort with such uses has helped carry it into the classroom, where in recent years, drill-and-practice type of software is giving way to assignments using word processing and Internet related assignments (Becker et al., 1999).

However, more is necessary to integrate technology into the curriculum. Appropriate training goes beyond just instruction in software and hardware use. It provides teachers with strategies and activities to use computers in the classroom (Abbott & Faris, 2000; Russell & Bradly, 1997). Student teachers have a limited understanding of how computer technology can aid in their teaching practices (Smarkola, 2008). Observing teachers modeling technology integration in the classroom is critical to learning for the student teacher (Grove et al., 2004).

According to one longitudinal study, few schools had coherent strategies for professional development. Those teachers who had positive experiences related to training suggested that this was a result of collegiality among colleagues, rather than any official systematic plan put into place by administration (Andrew, 1999). Computer literacy was mostly self-taught. Few had formal coursework (Cuban, 2001). Those districts that did provide training opportunities provided generic skills that did not meet the specific needs of the teachers (Cuban et al., 2001).

2.4.4. Age, gender and experience

Studies related to age and gender issues are few. Age has not been shown to be a significant factor affecting computer use. Some suggest that gender has little or no

influence on teachers' attitudes toward computers (Harris & Grandgenett, 1999; Kristiansen, 1992; Marcinkiewicz, 1993-94; Migliorino & Maiden, 2004; Robin & Harris, 1998; Rosen & Maguire, 1990; Rosen & Weil, 1995). Studies that consider a multifaceted approach and examine gender along with other factors provide more varied results (Whitley, 1997).

A meta-analysis of studies on computer phobia (Rosen & Maguire, 1990) found women to be slightly more phobic than men. But differences were neither strong nor consistent. A sampling of college students found significant gender differences in experience and attitude. Among teachers, perceptions of usefulness and ease of use were found to be significant indicators of intention to use by females (Yuen & Ma, 2002). In regard to confidence, males reported more confidence than females in the use of computers (Russell & Bradley, 1997). Males also felt more competent (Robertson, Calder, Fung, Jones & O'Shea, 1995).

In a group of technology integrating teachers, more females than males were "enthusiastic" supporters, even though they did not have sophisticated knowledge of the technology and worked in environments that provided little support and had a number of barriers. Male teachers were dominant in environments with strong support services and minimum types of barriers (Hadley & Sheingold, 1993). However, in terms of use, the distribution of users between male and female teachers was nearly equal (Sheingold & Hadley, 1990).

The number of years that teachers have been in the profession has not been found to be a significant factor towards computer use for teaching practices. In one particular study, on the adoption of a grading application at two separate school districts, the

number of years of teaching experience and relative computer experience both showed a significant relationship to attitude. Further, the results showed that with more years of teaching, resistance to adoption increased (Migliorino & Maiden, 2004). Other studies have confirmed that number of years using a computer affects the use of computers in teaching (Dupagne & Krendl, 1992; Harris & Grandgenett, 1999; Robin & Harris, 1998).

2.4.5. Role of the teacher

Teachers are generally homogenous in their teaching practices. They are found to be authoritarian and didactic in their teaching style (Myhre, 1998). As such, they have definite preconceptions about their role in the classroom. These beliefs, common to teachers of different teaching specializations, are derived from their own learning experiences. They are brought into the classroom and are difficult to replace (Sadera & Hargrave, 1999; Sandhotz et al., 1997).

One such view is of their central role in the classroom, a teacher-centered approach (Sandhotz et al., 1997). They also have ideas about what the classroom environment should be like; perhaps that it should be a quiet, orderly place. The classroom will have rows of chairs and desks providing the teacher with easy viewing of the expanse in front. The teacher's desk is located in the front of the classroom near a chalkboard, underscoring the important role of the teacher in directing the classroom and those in it. Class routines for students include raising their hands to be recognized by the teacher, speaking only after the teacher's acknowledgement and not speaking out of turn, all of which provides a framework for the teacher within which to control the class and emphasize the importance of the teacher's role. Also, teaching the class as a whole provides a structured, time-efficient and convenient method of providing instruction.

Lectures and recitations pulled directly from text provide a direct and uncomplicated method of transmitting knowledge (Cuban, 1986).

These views conflict with the practices of using computers in the classroom. Technology infused instruction calls for a more student-centered approach, incorporating tasks that are more collaborative in nature, and require an active learning style rather than the traditional methods (Sandhotz et al., 1997). In the traditional classroom setting described above, students do not have the chance to explore computers and seek out computer resources (McGee, 2000). Integrating technology also requires a change in the way teachers view their role. It calls for a shift from the traditional, teacher-centered approach to a student-centered, constructivist method, where the teacher is more facilitator and the classroom setting is more informal (Cadiero-Kaplan, 1999; Dreyfus et al., 1998; Hannafin, 1999; Hannafin & Savenye, 1993; McGee, 2000; Sandhotz et al., 1997).

These beliefs about their roles in the classroom guide teachers' uses of computers with their students. Successes, in terms of student enthusiasm and motivation, may provide confidence to the teacher to temporarily break away from traditional methods. However, established beliefs can be hard to overcome (Sandhotz et al., 1997). When teachers try to apply traditional teaching methods to a curriculum incorporating computer technology, the results are not successful since their pedagogic beliefs are not consistent with the project at hand (Henry & Clements, 1999; Zhao et al., 2002;). Even teachers who are provided with training that has a deliberate bias towards technology and student-centered learning do not make the expected shift. Resistance to the philosophical shift hampers computer integration (Hannafin, 1999).

A teacher in a constructivist classroom organizes the classroom environment, gives clear directions, provides stimulating materials, raises stimulating issues and ideas, gives ample time for student responses, provides an arena for student discussion, teaches and models appropriate negotiating techniques, uses student ideas in posing new questions, reflects regularly on lessons, curriculum and teaching strategies, facilitates and coaches students in information gathering activities, and admits the possibility of several correct approaches (Cadiero-Kaplan 1999). A teacher who uses a constructivist approach for technology integration is willing to be open to technological innovations, to reflect on his or her teaching practices and to be a lifelong learner who cooperates and collaborates with the students and others in the community. Teachers, in general, are expected to take on the role of moderator and classroom manager and not the “omniscient” person of the traditional teaching methodology era (Wolff, 1994). Few teachers have made the shift from teacher-centered to student-centered instruction. A study by Palak and Walls (2009) found that the teachers in their technology-rich school had positive attitudes toward technology, adequate support and were comfortable with technology, but continued to hold a teacher-centered approach. No shift to a student-centered paradigm had occurred even with the technology support. As noted in other studies, most teachers just adapt the technology to their existing practices (Cuban 2001; Cuban et al., 2001).

2.5. Exemplary environments and exemplary teachers

Teachers, in most part, will use computers for activities that have minimum costs, maximum benefits, require little time to learn and can be adapted to their existing teaching practices (Cuban, 2001; Zhao & Frank, 2003). What this means is that

computers are used in limited and simple ways, i.e., word processing, internet searching, and e-mail.

However, there is a small fraction of teachers who integrate computers into their teaching practices. These early adopters of innovations differ from their colleagues in a number of ways. They understand their own teaching practices and goals and use the technology in ways consistent with their pedagogical beliefs. Such beliefs include the use of more constructivist practices (see the discussion of constructivism in Section 2.6.2) so there is a greater exchange and flow of ideas. They organize their classes differently, provide fewer lectures, use more than just the textbook as a resource and give the students more independence. They also have greater expectations of their students and feel that the needs of the students are being better met as a result of using technology. These teachers view the technology as the means to an end, instead of the end itself and see a connection between the technology and the curriculum (Cuban, 2001; Cuban et al., 2001; Hadley & Sheingold, 1993; Zhao et al., 2002).

Technology-embracing teachers take part in non-compulsory projects because of their personal interests. They remain because of their perceptions about the projects' contributions to the students; and they persevere even when they face barriers such as lack of support from the administration and inadequate facilities (Dreyfus et al., 1998; Hadley & Sheingold, 1993). Technology-adopting teachers are willing to expend unlimited time and effort to provide results. Even when there is inadequate support, these teachers are prepared with backup plans in case of system failure (Cuban et al., 2001; Henry & Clements, 1999; Rude-Parkins et al., 1993). Technology-integrating teachers are resourceful in their training practices. They are mostly self-taught, attend conferences and

workshops on their own time, seek out information about computers from multiple sources, and receive support from their community of teachers, computer coordinators and other computer specialists (Hadley & Sheingold, 1993).

Pre-service factors include programs that provide mentoring by teachers who use technology, opportunities to observe teachers modeling technology use in their teaching, having the opportunity to student teach using technology, and support from the schools' technology coordinators (Grove et al., 2004). Exemplary teachers have more formal training in using computers and more experience teaching with computers (Becker, 1994).

Environments supportive of exemplary technology use provide staff development that includes instruction in computer applications and training in using computers with specific subject matter. An organized support system, one which includes on-site computer coordinators, is associated with exemplary use. Exemplary teachers were found most often in environments where there is a vibrant and active use of computers. Such environments have more teachers using computers as well as more computers per user (Becker, 1994).

Administrators supportive of exemplary environments consider hiring teachers who are technology proficient, and provide release time to teachers with the opportunity to explore technology in formal and informal settings (Zhao & Frank, 2003). Becker (1994) found gender to be a strong predictor of exemplary computer-using teaching. Even though males comprised only one-fourth of the computer-using teachers in the sample, they were nearly one-half of the exemplary teachers. Some of this is explained by

the differences in the background and activities (i.e., education and non-school computer use) between males and females.

2.6. Theories

Theories and models permeate the K-12 research literature. Therefore, it is not surprising to find theories and models that explain, or attempt to explain, different aspects of computer use by teachers in this educational environment. Accepted ones, those showing successful outcomes and cited in research, include Everett Rogers' diffusion models (Fuller, 2000; van Braak, 2001), Albert Bandura's Social Learning Theory (Harris & Grandgenett, 1999; McGee, 2000; Ross et al., 1999) and Hall and Hord's Concerns-Based Adoption Model (Rakes & Casey, 2002; Marcinkiewicz, 1993-1994). Educational research specific to teachers and technology integration discusses constructivism and constructivist practices. Fred Davis' Technology Acceptance Model (TAM) is well known in the management information systems (MIS) field; however, it is barely visible in the K-12 educational environment. It is a well established model of technology acceptance and use.

2.6.1. Diffusion Theory

The most accepted of the innovation adoption theories is Everett Rogers' Diffusion theory (1995). Diffusion theory aims to explain the general spread of an innovation within a social network. Rogers' theory has been applied to research and practice in a number of disciplines including health communication, technology transfer and social behavior. It provides an understanding of the diffusion of innovation process

by detailing the stages of innovation adoption, the rate of adoption, affect of the attributes of the innovation on adoption, and the varying adopter categories.

The innovation-decision process, the process by which an adopter makes an innovation adoption decision, consists of five stages: 1) knowledge; 2) persuasion; 3) decision; 4) implementation; and 5) confirmation. The individual proceeds through these stages over a period of time while evaluating the new idea and deciding whether or not to adopt the innovation. At the *knowledge* stage, the individual becomes aware of an innovation, develops some understanding of its function, how it works, and determines whether the innovation is relevant to his or her needs. The need for an innovation precedes knowledge of the innovation. Thus, an individual's perception of the relevance of an innovation is colored by his or her belief about the need for the item. This perceived need is termed *selective perception*. In the *persuasion* stage, the individual forms an attitude, either favorable or unfavorable, towards the innovation. During this period, the individual actively seeks out information about the innovation, deciphering the information and determining its importance to self. Selective perception plays an important role in determining the person's behavior. Also at this stage, the individual will look to the opinions of his peers to see whether he or she is going down the right road. At the *decision* stage, the individual pursues activities that help to decide whether or not to adopt the innovation. Once an individual puts the item to use, he or she is at the *implementation* stage. With implementation, the innovation is put into practice. Implementation ends at the point when the new idea has become a part of the institution and part of the adopter's routine practices. At the *confirmation* stage, the final stage, the adopter looks for reinforcement of the decision made. A reversal of the decision can be

seen as well, when the individual rejects the innovation based on conflicting messages about the innovation.

Rogers identifies the following as important attributes of an innovation that influence the adoption decisions: *relative advantage* – degree to which the new idea is perceived to be better than the previous idea; *compatibility* – degree to which the idea is perceived as consistent with values, beliefs and needs of the potential adopter; *complexity* – degree to which an innovation is considered easy to understand and use; *trialability* – degree to which an idea can be experimented with; and finally, *observability* – degree to which the results of an innovation are observable to others.

Rogers also categorizes adopters based on when they first begin to use an innovation. The categories are: innovators, early adopters, early majority, late majority, and laggards. Rogers has identified some dominant characteristics for each of the adopter categories: innovators – a *venturesome* group that plays a gate keeping role by introducing new ideas into an organization/system; early adopters - a *respected* group of opinion leaders that provides subjective information about the innovation to their peers via interpersonal networks; early majority – *deliberate* in its decision making, this group makes up one-third of the adopters; late majority, also a third of the number adopters, this *skeptical* group follows group norms and thus, is motivated by peer pressure; and, finally, the laggards, a *traditional* group, is suspicious of innovations, mostly interacting with others of similar, traditional values. Beyond the dominant characteristics briefly mentioned here, Rogers further defines adopters by socioeconomic status, personality values, and communication behavior.

2.6.2. Constructivism

Constructivism is prevalent in the literature related to teachers and technology use. Those recognized as contributors to the development of constructivism theory include Immanuel Kant, John Dewey, William James, Jean Piaget, L. S. Vygotsky and Thomas Kuhn. There are different perspectives on constructivism, but for pedagogical purposes relevant to the study of teachers and technology practices in the classroom, constructivism is concerned with how learners construct their own knowledge (Kivinen & Ristela, 2003). Learners are identified as ‘active seekers’ who come into the learning environment with innate goals and interests. In such an environment, teaching-learning is no longer the traditional telling-listening relationship between the teacher and the students (Prawat, 1992). Rather, the focus is on the student, where fundamentals include discovery learning, teacher as facilitator and information provider, and students as agents of their own learning (Cadiero-Kaplan, 1999). Within the constructivism realm, some of the concepts the educational technology research examines are constructivist practices, student-centered classrooms, and critical and high-order thinking and learning.

Rice and Wilson (1999) are among a number of researchers who provide a description of a constructivist classroom. A teacher with constructivist practices provides a classroom where learning is collaborative among the teacher and students; the teacher tries to make the subject-matter relevant to the students' lives; lessons and activities encourage higher-order thinking and problem solving; the students construct their own knowledge; and the teacher is a guide or facilitator to student learning. Learning is through discovery and exploration.

Studies have suggested that, as teachers use computers in the classroom, their teaching practices reflect a constructivist orientation (Becker, Ravitz & Wong, 1999; Means, 1994). Becker, Ravitz and Wong (1999) examined whether teachers who use computers for more than transmission of instruction have changes in their teaching practices that are consistent with constructivist practices. The results suggested that such teachers a) are more willing to address new material and learn from their students; b) direct multiple activities during class time; c) assign extended and complex projects to students; and d) give students more choices for their activities and resources. From their findings, the researchers concluded that there was a causal relationship between technology use and pedagogic change. However, they note that their conclusions leave unanswered the question as to whether these teachers were already inclined to constructivist practices and just needed the right tools, or the use of computers and the Internet did really change their pedagogic beliefs.

Other studies examining the pedagogic beliefs of teachers and their classroom practices have shown mixed results (Lim & Chai, 2008; Wang, 2002a; Wang, 2002b; Windschitl & Sahl, 2002). Palak & Walls (2009) noted that the teachers in their study did not transform their practices to be student-centered. Their study was of teachers in a technology-rich school with minimal barriers. This conclusion reflected earlier findings that teachers in a technology-rich environment use the technology to support their existing practices.

Preservice teachers may have perceptions of engaging in student-centered teaching practices; however, once they are in the classroom, they use the computer as

more of a teacher-centered tool. Wang (2002b) suggests that teacher education does not provide the training that would help them view themselves as facilitators and partners. In a study that examined the differences between preservice teachers assigned to a classroom that had computers and preservice teachers in a classrooms with no computers, the computer-classroom teachers perceived their role to be neither student-centered or teacher-centered. The non-computer classroom teachers had a teacher-centered approach. The researcher suggested that preservice teachers need to reconstruct their basic beliefs about teaching and learning (Wang, 2002a).

Means and Olsen (1995) describe environments that support constructivist practices. These were classes where teachers were open to a project-based, student-centered approach. The school environment supported technology use by providing opportunities for the teachers to collaborate, giving them adequate technology access, technical assistance, and time to learn the technology. The environment also supported the teachers by recognizing and encouraging technology-supported projects. There are barriers to developing and maintaining constructivist practices. Ravitz, Becker and Wong (2000) suggest that the responsibilities of teaching an entire class of individuals at the same time, inadequate content knowledge, their own competing objectives, and external pressures can all interfere with following through on a constructivist philosophy.

3. Study Methods

This chapter discusses the research methods used in this study. First is a discussion of the rationale for using a qualitative approach. Next is a description of how the study sites and teachers were selected. Then follows a description of how the data was collected and analyzed followed by a discussion of trustworthiness issues.

3.1. Rationale for study methods

Studies using quantitative methods have provided a wealth of data on the availability and use of technology within the K-12 environment. These surveys and questionnaires, administered by government agencies at the federal and local level, are quick and cost-effective methods of collecting data, and are especially effective when the population size is large. The information that is collected via such methods is original, partial in that it is collected from a sample population, generally collected by mediators, self-reported, and standardized in the procedures used for data collection (Backstrom & Hursh-César, 1981).

There is also a plethora of teacher attitudinal studies, mostly from the 1980s and 1990s. These studies examine the perceptions and beliefs of teachers based on factors such as age, gender, their education level, pre-service and professional development experience, and computer use at home. Such studies are usually smaller in scope than studies conducted by the government. Such studies generally collected their data in either a professional development setting (Abbott & Faris, 2000; Hannafin, 1999; Kanaya,

Light & Culp, 2005; Loyd & Gressard, 1986; Lumpe & Chambers, 2001) or at a college-level teacher education course (Byrum & Cashman, 1993; Lowther & Sullivan, 1994; Shapka & Ferrari, 2003; Wang, 2002b). Variations on this approach included administration at conferences (Robin & Harris, 1998) and via an online educational website (Harris & Grandgenett, 1999). Instruments used for data collection were either developed by the researchers themselves (Byrum & Cashman, 1993; Hannafin, 1999; Wang, Ertmer & Newby, 2004), modifications of an existing measure (Czerniak et al., 1999; Guha, 2001; Migliorino & Maiden, 2004; Robin & Harris, 1998; Wang, 2002b; Woodrow, 1987), or a preexisting measure. However, as valuable as quantitative studies are to developing an understanding of teachers and technology, they focus on numbers and lack richness. Such studies, as helpful as they are, neglect to look at teachers and the processes they go through as they navigate their environment while trying to understand and use technological innovations (Zhao et al., 2002).

According to Berg (2001), qualitative research “refers to the meanings, concepts, definitions, characteristics, metaphors, symbols, and descriptions of things” (p. 3). It attempts to answer questions by studying different “social settings” (p. 6) and the individuals within these settings. Qualitative methods provide details and descriptions, directing attention to specific cases. The data are collected from natural settings and are of everyday events (Denzin & Lincoln, 1998; Miles & Huberman, 1994). Researchers who have used qualitative methods for studying issues related to technology adoption by K-12 teachers have done so because they felt the rich data gathered from such methods provided them with the best understanding of teachers’ views (Drenoyiani & Selwood, 1998; Evans-Andris, 1995). The focus of this study was teachers, how they define

“technology integration” and the factors that affect their technology use practices. Using a qualitative approach allows the researcher to “share in the understanding and perceptions” of the study participants (Berg, 2001).

A constructivist approach, as discussed by Lincoln and Guba (1985, p. 84), as well as Patton (p. 96, 2002), provided the study strategy. The constructivist view suggests that individuals derive meaning from their own experience and knowledge. It is the interpretation of their experience and knowledge that lends itself to what is real. The assumptions of “constructed reality” that were taken into consideration in the development of the study procedures include: 1) the concept exists only in the form recognized by the individual; 2) to “recognize” the concept, the individual has to have encountered the concept at least once in some form; 3) an infinite number of constructions of the concept are possible; and 4) a phenomenon can only make sense when studied within its own context (Lincoln & Guba, p. 84-5, 1985).

Teachers were observed within their own teaching environment. Follow-up interviews were also conducted within these settings. Interviews were directed towards gaining a better understanding of teachers’ interpretations of “technology integration”. Observations of teachers in the classroom were used to provide support for their words. Given the exploratory nature of this study, an inductive approach was used for analyzing the data. This proved appropriate given the changes in assumptions found during the course of the study. Initial assumptions were that teachers would provide descriptive evidence of their understanding of the term “technology integration” when asked the specific question, “What does technology integration mean to you?” However, as this

was not the case, an analysis of the complete interviews and observation data were used to approach the study of teachers' understandings of "technology integration".

3.2. Sampling procedures

3.2.1. Selection of sites

Data was collected using multi-stage sampling. In the first stage, three schools were selected, one each from three different school districts. In the second stage teachers were chosen from these schools. Middle-schools were selected as the sites for this study for two reasons. First, student achievement at this grade level, especially in math and science, has been of concern for some time (Beaton, Mullis, Martin, Gonzalez, Kelly & Smith, 1996; Cleary & Chen, 2009). Second, the middle-school environment is relatively homogenous, across districts, in terms of teachers' environment, schedules and materials. Theoretical sampling techniques were used as the approach for selecting the schools. Theoretical sampling, a purposeful sampling approach, selects from a population on the basis of their potential to represent the theoretical construct under study. In this sense, the sample is lucid and refined, providing variations in the meanings and manifestations of the data gathered (Patton, 2002). The 1999 National Center for Educational Statistics (NCES) survey (Smerdon et al., 2000) points to a disparity in computer availability and use based on certain school characteristics: size, percentage minority, and percentage receiving free/reduced lunch. Each of the schools selected for this study provided a different combination of these characteristic as described by the NCES study (see Table 1). Data on the school characteristics was collected from the New York Department of Education website (<http://www.nystart.gov/publicweb/>).

Table 1. School characteristics

School	Size	Percentage Minority	Percentage Free/Reduced Lunch
A	>1000	>50	>50
B	<1000	<10	<10
C	>2000	<25	<10

Initially, the Superintendent’s office for each school district was approached. A letter (Appendix E) detailing the research was either faxed or e-mailed to the Superintendent’s office. A follow-up call was made to each of the offices. In each case, the letter was passed on for review from the Superintendent’s office to the Principal of the individual school for which entry was being requested. Soon after, a meeting date was set for the Principal to discuss the research purpose and procedures. In each case, the discussion ended with approval from the administration to proceed with the study.

3.2.2. School characteristics

Resources in school A included several computer labs, some classrooms with several computers, a computer cart with laptops available through the school media center and interactive whiteboards in a number of classrooms. School A had pedagogic support-staff assigned; however, they had dual roles and could be called upon for other responsibilities. School A also had an “Instructional Technology Facilitator” who visited the school and provided assistance to teachers generally related to training, such as how to use the interactive whiteboard and other assistance. Teachers at this school expressed their needs and concerns, including technology, to their department chairperson. Each

department had a department chairperson. These were teacher-certified personnel who taught a minimal course load, but also had administrative authority.

School B had two labs, and at the time of data collection, was in-between administrators. If technical help was required, teachers expressed their need to the School Media Specialist, who notified the district office. There were department chairs in this school. In schools A and C, there was a district level administrator who managed and coordinated activities including purchase of hardware and software and providing professional development resources. These would be managed in conjunction with the school principal.

School C had several computer labs and several classes with interactive whiteboards. The principal at school C had written a grant and received funds within the year to purchase technology. Each lab at this school had a technical assistant who coordinated activities within the lab, including maintenance of equipment, assisting teachers and students, and scheduling of classes. Not all departments at this school had a department chairperson. The school was in the middle of eliminating such positions.

3.2.3. Selection of teachers

Initially, the approach for participant selection was to choose teachers using criterion sampling. Criterion sampling involves selecting samples that meet particular criteria. In this case, the criterion was to select teachers who had experience using computer technology for professional purposes. However, discussions with school administrators and teachers determined this selection criterion to be unnecessary since, in

all three schools, teachers were required to use either electronic attendance systems or a combination of both electronic attendance and electronic grading system. The electronic attendance and grading systems required teachers to use an Internet-based application, provided by the school district, to submit attendance and grades.

Teachers at each school became acquainted with the study in different ways. At school A, the teachers were not informed about the study prior to being approached by the researcher. The faculty meeting at which the researcher was invited to describe the research was cancelled and no follow-up opportunity was available. The principal did not inform any of the teachers. In this case, the researcher approached one of the technology staff for assistance. The staff member took it upon herself to acquaint the researcher with the school. At school B, the principal had announced to the faculty that a researcher would be conducting a study at the school. The researcher was invited to a faculty meeting and was listed by name on the meeting agenda handout. During the meeting, the researcher was given a few minutes to briefly introduce the study to the teachers. At school C, the principal provided the researcher with names of computer lab staff at the school. They were initially contacted by email and given a brief overview of the research study. Once at the school, the computer staff provided the researcher with information related to the physical layout of the school and technology resources available to the teachers. At schools A and C, the computer staff introduced the researcher to teachers as an initial beginning. At school A, the researcher was introduced to two teachers as we walked down the hall, and at school C, the researcher was introduced to a specific teacher as someone who used technology. Following participants were contacted by either the researcher walking into classrooms during the few minutes between class-sessions and

introducing herself to the teacher, approaching teachers in the school halls, and asking teachers who were already participants if they knew teachers who might be interested in participating.

At each school, the researcher was given the opportunity to approach any teacher during the school day and present them with the opportunity to participate in the study. There were no restrictions on who could or could not be approached. Teachers were approached randomly in classrooms and hallways. Teachers were approached with a standard speech, whether they were aware of the research study or not. If the teachers agreed to participate, a time was set on the schedule for the teacher to be observed and to be interviewed. Schedules were based on the school bell schedule. Teachers were also given a participant consent form to read and sign (Appendix A). The size of the sample in each school is shown in Table 2.

Table 2. Number of teachers from each school

School	Number of teachers
A	18
B	9
C	10

3.3. Data collection

The main method of gathering data was observations of teachers and their environments, and interviews of teachers. Field notes and lesson plans were also used to inform the findings. Data was collected over a three month period. There were 31 days of

actual teacher observations and interviews. On most of these days, the researcher spent full days at the school. All teachers were first observed and then interviewed. In all except for two cases, the teachers were observed and interviewed either on the same day or within three days of the observation. In those two cases, the interviews were conducted within two weeks of the observation.

3.3.1. Observations

With observation, the researcher can witness directly the phenomenon under study, without interference, and without any manipulation or stimulation of the participant/environment. It provides an in-depth “here-and-now” experience. Such observation lets the researcher see the world as the study participants see it. It also allows the researcher to see things that participants may take for granted or are unaware of (Adler & Adler, 1994; Lincoln & Guba, 1981; Patton, 2002). In this study, the researcher played the role of participant-as-observer. In this role, the researcher observes under both formal and informal conditions. The researcher interacts within the environment and builds relationships with the participants. However, all data collection was overt, in that teachers were aware that data was being collected and for what purpose. The researcher met with administrators, teachers, technicians and other staff members during the course of the study.

Teachers were observed either in their classrooms, computer labs, or the media center where computer technology was available. In all except for three cases, the observations were of pedagogic uses of computer technology by teachers. In two cases, the teachers did not use computer technology with students; and in the third case, the

computer network was not working during the class period. The researcher arrived before the start of the class, sat in the back of the room and took hand written notes or notes on a laptop. In two cases, the teacher introduced the researcher to the class as someone who would be observing. It is the researcher's experience that education students commonly observe classroom practices and so it is assumed that this was not an unusual experience for the classroom students to have an observer.

An observation protocol was used to standardize the information collected (Appendix B). The protocol was used as a guide to make notes related to the teacher and either the computer lab, media center, or classroom, depending on where the observation took place. As the study progressed, there was minimal variation in the protocol. Specific points of interest included:

- Types of technology available and whether they were in working condition;
- Is there availability for all students to use?
- Description of lesson
- Are teachers following a prepared lesson plan? If not, how is the class session structured?
- Is the teacher knowledgeable of the technology in use?
- What types of challenges did the teacher face during the lesson?
- Was there technical support in the lab?

Each observation lasted for one class period. Class periods were 42 to 46 minutes long, depending on the school.

3.3.2. Interviews

The second method of collecting data was interviews. Teachers who were observed were also interviewed. Interviewing provides context to observed behavior. People within organizations can be examined in a number of ways; however, to understand the meaning people give to their experiences, interviewing is a necessary mode of inquiry (Seidman, 2006). Since everything is not observable, such as feelings, thoughts, intentions, or behaviors that may have taken place at a previous time, an interview is the mechanism by which we can find out such things by asking people questions. It allows the researcher to enter another person's perspective. Qualitative interviewing assumes that what someone has to say is "meaningful, knowable, and able to be made explicit" (Patton, 2002, p. 341).

Previous studies in the field used interviews as a data collection tool because it allowed them to examine, in more detail, the beliefs that teachers held about the use of technology (Ertmer et al., 2001), to provide examples of technology innovations (Zhao et al., 2002), and for corroboration of data and reinforcement of conclusions (Cuban et al., 2001; Drenoyianni & Selwood, 1998). Other reasons for using this method are to better understand a particular event or how the event was interpreted, understand how a system works or why it failed, or to inform further quantitative investigation (Weiss, 1994).

This study used a semi-structured interview style. Semi-structured interviews use an interview guide, that provides questions and issues that are to be explored during the interview. The interview guide ensures that the same line of inquiry is used with each participant, but the interviewer is allowed some freedom to explore and ask questions that

may further clarify and reveal information. It allows the researcher to clarify responses, the participants to elaborate on their responses and to offer unexplored topics, and the researcher to summarize at the end of the interview. An advantage of the semi-structured approach is that the interviewer can make good use of limited time. It also allows a systematic and comprehensive way of limiting the issues to be explored (Patton, 2002). In this study, the outline of questions ensured that the same topics were introduced to each teacher.

The initial list of interview questions was developed based on the elements identified by Everett Rogers (1995). The four main elements of diffusion, as defined by Rogers, are the perceived attributes of an innovation, communication channels, time, and the social system. These provided an initial frame of reference in the development of the questions since they encompassed a variety of elements, within an environment, that could influence adoption. However, there were variations on questions based on the participants' responses and initial analysis of each previous interview and observation. A funneling technique was used for the questioning. This allowed the researcher to gather general information and then more specific details from the participants (Evan-Andris, 1995). As the interviews progressed, new questions were added to the guide, while others were removed (Appendix C).

Interviews were conducted in areas selected by the teacher; these interviews were located in areas where there was privacy. In most cases, this was the teacher's classroom during their lunch or free period. All interviews were conducted face-to-face during the school day, in the school building. An audio recorder was used during the interview when teachers permitted its use. Only one teacher asked that the interview not be recorded.

Three other interviews were not recorded because the researcher forgot her tape recorder on those days. In these cases, handwritten notes were taken.

Teachers also provided lesson plans and print outs of lessons they had created. These included materials created by some teachers during observed class sessions. However, since only a limited number of teachers provided such materials, these were gathered as data to support the individual teacher's classroom practices. Initially, it was considered that photographs of teachers' classrooms would enhance the data; however, teachers were uncomfortable with this, given that many classroom bulletin boards had student projects that identified them by their picture or name. So, instead, notes were taken on the physical aspects of the classrooms. These notes included descriptions of the types of technology available in the classroom and the ways in which teachers physically set-up their classrooms, including the way they decorated their walls and bulletin boards.

3.4. Data analysis

An inductive approach was used to analyze the data. This type of analysis moves from the specific to the general. (Patton, 2002). Glaser and Strauss (1967) offer the constant comparative method as a means for analyzing data and developing a grounded theory (Lincoln & Guba, 1985). With this method, the data are constantly being analyzed and compared as they are being collected. Each new instance of data collected is compared against existing data. In this way, new codes and concepts emerge, from which categories are created. Exceptions are noted as well. The relationships between categories are then linked to develop conclusions (Miles & Huberman, 1994).

Table 3. Concepts and questions of the “perceived attributes” category

Concepts	Questions
Relative Advantage: degree to which the new idea is perceived to be better than the previous idea	Are there any advantages to integrating technology? Are there any disadvantages? Could you have taught the lesson just as well without the technology?
Compatibility: degree to which the idea is perceived as consistent with values, beliefs and needs of the potential adopter	How well do you feel technology use fits in with the way you teach?
Complexity: degree to which an innovation is considered easy to understand and use	How complex or easy-to-use do you feel is the technology that is available to you?
Trialability: the degree to which an idea can be experimented with	Was the computer lab and software easily accessible?
Observability: degree to which the results of an innovation are observable to others	Was the lesson successful? Do your peers use technology?

In this study, initially, categories were based on Rogers’ elements of diffusion (1995). Table 3 is an example of some of the initial concepts from the “perceived attributes” category and the related question used to collect data on the topic. The interviews were collected and the raw data initially analyzed. With the progress of data collection and analysis, new codes and concepts emerged. From these codes and concepts, categories emerged. Codes and concepts were organized in tables using Microsoft Word. Each table represented a concept and included the teacher’s coded ID, the comments each teacher made that were relevant to the concept, and notes from observations that either supported or negated the particular incident. For example, technology training was a concept that emerged in the interviews. The concept name was

the file name. In the table, the columns identified the teacher ID, the teacher comments related to the concept and other related notes.

By the fifteen to twentieth teacher, most of the concepts had evolved. It was at this point that data at one particular school seemed to show that teachers were influenced in their technology practices by their department chairperson. In this particular case, the number of participants from the school was increased to examine the phenomenon and strengthen related findings. As data collection and analysis progressed at this second school, it was evident that data collection was not resulting in new patterns and themes. However, data collection continued at a third school to ensure saturation. The similarities in patterns provided the evidence that the number of participants in the study (37) was satisfactory to attain the goals of the study. By the end of the study, a number of concepts had been recognized. These were categorized and the information was then used to write the narrative format of this study and to develop conclusions.

3.5. Trustworthiness

Lincoln & Guba (1985) provide means by which the researcher can establish trustworthiness and credibility. In this study, the methods for establishing trustworthiness included prolonged engagement, triangulation, member checking, peer-debriefing, and negative case analysis. Prolonged engagement requires that the researcher is present at the data collection site long enough to be able to differentiate irregularities present in the data. For this study, the researcher collected data over a three month period of time. During periods when there were no observations or interviews scheduled, the researcher explored and interacted with staff throughout the school. As a non-classroom, certified teacher, the researcher was able to engage staff in conversation and build trust.

Triangulation is the use of multiple and different sources to improve accuracy of findings and interpretations. In this study, interviews and observations were the main source of data. However, documents provided by a number of teachers, as well as notes related to classroom descriptions, were also used to support the findings. The different sources either helped to confirm or question the findings regarding individual teachers and their technology integration practices.

Member checking provides the participants of the study with the opportunity to react to the data. In this study, member checking occurred in two ways. First, during the course of the interviews, teachers were asked to confirm data collected related to observations of their teaching practices. At the end of the interview, the researcher summarized parts of the interview comments to verify what was said. Second, teachers were asked to comment on some of the practices that were discussed by teachers who had been interviewed earlier.

With peer-debriefing, the researcher is given the opportunity to be probed by an outsider, someone indifferent to the conclusions of the study. It is to make the researcher aware of any biases that may exist and to ensure that conclusions are defensible. In this study, a professional peer, knowledgeable of research methods, was asked to assist. During the course of data collection, the researcher and debriefer had regular discussions regarding the collection process and initial analysis. As conclusions were drawn, the debriefer was provided with some notes from observations, all tables created during data analysis and a list of conclusions. The debriefer and researcher went over this material and discussed the conclusions.

Negative case analysis allows the researcher to re-examine assumptions and refine them until all cases are accounted for. As new data was collected, it also was checked against the existing categories. Instances that deviated from existing patterns were noted. In this way, the researcher actively searched for negating evidence.

Generalizability or external validity in a qualitative study is established by what Lincoln and Guba (1985) term transferability. In this study, transferability was established by providing “thick descriptions” of data, along with notes on observation practices and descriptions of teaching environments. These descriptions are meant to provide the study’s readers with a “data base” that makes it possible for them to make their own judgments.

An audit trail was created by keeping records including the following:

- raw data, including electronic recordings of teacher interviews, transcriptions and field notes
- instrument development, including interview schedule sheets, observation formats, and interview protocol
- data reduction and analysis instruments, including notes and tables on progress in development of categories.

3.6. Ethical issues

A main concern of the researcher, with this study, was confidentiality. Teachers were generally enthusiastically candid in their expressions. Given the small number of teachers, it was crucial that safeguards were in place to protect their identity and provide the teachers with the confidence to express themselves openly. Participants were given a consent form to read and sign. The consent form provided information about the study,

including its purpose, their role in the study, and privacy issues. The following were some of the steps taken to protect teacher identities:

- No school equipment was used at any time, i.e., computers to examine data.
- All electronic recordings were transferred to the researcher's home computer at the end of the day and deleted from the recorder. In this way, each visit to the site began with an empty recorder.
- Each school and teacher was assigned a code, which was then used in maintaining all data.

Teachers were assured that all information was confidential and no identifying data would be shared in any way or manner.

4. Results: Teachers' understanding of & reasons for technology integration

This chapter presents the study results related to teachers' understanding of and reasons for technology integration, in general. First, the demographic characteristics of the study participants are described. The data are limited in detail, in order to protect the identity of the participants, but provide sufficient relevant information to enhance understanding of the results. Next, "technology integration" is defined, as are those technologies included in the definition. The definition is based on the answers teachers gave to the questions, "What does *technology integration* mean to you?", and, "What types of technologies are included in this concept?" Next are the results identifying how teachers say they came to their understanding of technology integration, and the factors they say affect their use of technology.

4.1. Study Participants

There were 37 participants in this study. They were teachers from three different middle schools, in three separate school districts. All the participants were state certified teachers. There were seven males and 30 females. Table 4 provides a breakdown of the subject matter the participants taught. Almost 25 percent of the participants were English teachers, and close to 40 percent were science or math teachers.

Table 4. Number of participants by subject area

Subject	Number of teachers
English	9
Science	8
Math	6
Social Studies	4
Special Education	3
Other	7
TOTAL	37

Table 5 provides the educational and professional experience of the teachers. Teachers in New York State, where the participating schools are located, require a Masters degree for permanent teaching certification. Thirty-two of the 37 teachers have a Masters degree or more. Twenty-eight of the 37 teachers had been teaching for 15 years or less. Each of the teachers in the 25+ range has actually been in the profession for 30 to 40 years with more than 168 years of teaching between the five of them.

Table 5. Education and experience of participants

	Number of teachers
Education of participants	
Bachelor's degree	5
Master's degree	23
Master's degree plus	8
Ph.D. degree	1
Years of teaching experience	
0-7	13
8-15	15
16-24	4
25+	5

4.2. How teachers define 'technology integration'

4.2.1. Definition

Teachers in this study defined technology integration in terms of their use, or perceptions of expected use, of technology. To this group, technology integration meant the use of computers and computer-related software and hardware. Integration was specific to their pedagogic practices, directly involving the students they taught.

When asked the question “What does technology integration mean to you?” all teachers used terms and descriptions that were specific to computer technology. However, there was a mix of responses in their understanding of how “integration” of this technology happened. Teachers described specific projects and named specific software and hardware they used, or websites they visited. One teacher said, “Basically what we’re doing, like having them on the computer and looking up things. We’ve made pamphlets on the computer, made brochures and PowerPoint presentations” [A25]¹. Another teacher said, “OK, I’ll give you an example. I’ll give you a couple because I don’t know if they’re all the same,” [A17] and proceeded to give several examples of how she used technology with her students. One use was with an instrument to check the temperature of ice water over a period of time. The data were collected by the computer, to which the instrument was connected, and the students then analyzed the data. The students were involved in all parts of the data collection and analysis.

Frequency of use was relevant to many teachers when defining technology integration. As one teacher said, “Technology integration means being able to use technology in the classroom more on a regular basis, than just using it once or twice. It’s something you would try to use, incorporate into your class lesson almost on a daily basis” [A7]. Another teacher described technology integration as regular use, but

¹ Each teacher was assigned a code to protect his/her identity. Also, minor grammatical corrections have been made to make the teacher quotes easier to read.

“depending on what I’m doing. Trying to use it as often as I can, integrating it into my curriculum, into the content area” [A36].

There were a number of teachers who repeated the term in the definition. For example, one teacher said, “Technology integration means, (laughs) to integrate technology, to incorporate technology in the classroom as much as possible” [A11], and another said, “to integrate it into the classroom” [A28]. A third said “How well, how a teacher can integrate technology in the classroom” [A29].

Two teachers referred to technology integration as being “seamless”. A teacher said technology integration meant “using the tools of technology, whether it be computers or whatever else. That should be seamless. In other words, it shouldn’t be, ‘Ooh I have this giant project to do. I have to use the computer to do it. Oh no.’ ... Using the tool should be seamless” [A15]. Along the same lines, another teacher stated that technology integration “should be something seamless, that’s part of your curriculum. It shouldn’t be once. ‘Oh, today we’re going to do the show’ and take out a few tricks and show something. It should be something they’re used to all the time, that flows with the class work” [A9].

Other definitions included technology integration as an extension of teaching, or a tool for visual enhancement. As one teacher explained it, “The main thing the teacher has to teach them how to do on the computer, for me, will be an extension, but it’s not the primary tool” [A22]. Another teacher described technology integration as an enhancement. “I think just enhancement. I think it just enhances what you could do” [A2]. Another described it as an alternate method of presenting: “Basically, just being able to have visuals for the kids. ... Just basically, integration means another way of

presenting the information” [A23]. A teacher who used PowerPoint to summarize lessons and provide slides to students and parents as a review saw technology integration “as a tool to use for the students to finish up whatever you’re teaching them. But I don’t really see it as a means that they can go there and actually learn. I think computers are a tool to perfect and finish up what you’re working on” [A3].

Teachers spoke specifically of using computer technology with their students in the classroom. In their definitions, they did not describe uses that supported their other professional practices such as the use of the computer for taking class attendance, submitting grades, or searching for curriculum materials. However, in further discussions related to their technology practices, teachers said that they regularly used the Internet for ideas and, in fact, teachers in all three schools used the district software to submit grades.

4.2.2. Technology tools

Teachers understand the word “technology” in the concept “technology integration” to mean computer related tools. Teachers were asked, “What types of technologies are included in this concept?” All teachers who answered this question gave a response of either “the computer”, or provided names of specific computer applications or hardware that used computer connectivity, such as the interactive whiteboard. All 37 teachers, when discussing technology, spoke of computers and computer-related software and hardware. The Internet and the interactive whiteboard were the technologies mentioned most frequently. All three schools had at least one computer in each classroom with Internet access, Windows operating system and the basic Microsoft suite of applications, Word, PowerPoint and Excel. One English teacher explained the availability

of software this way: “We’re just going to be sticking with the Microsoft Office base, because that fits with what we do” [A30].

Two teachers, who regularly used computer technology with their students, included non-computer types of examples of technology in their list of technology types.

A Science teacher gave details of her first experience with technology.

“When I became a fish farmer, I won a \$10,000 grant and I raised fish in the basement of this school and I learned about plumbing and I learned about pipes and pumps. I had a small flood in my basement. I took a little pump out of my fountain. I took that little tiny fountain pump, I stuck it into the puddle and I opened up my drain and that was my invitation to like engineering technology. [A17]

For one teacher, technology included “computers, SmartBoard, also rulers, protractors, calculators, any tool used in the class” [A1].

Table 6 provides a list of the technologies teachers discussed in their interviews, including those they specifically said were included in their conceptualization of technology integration. The table is sub-divided by subject. Hardware common to teachers of all subjects were computers, laptops, and the interactive whiteboard which projects from the computer by way of an overhead projector. The Internet and e-mail were software technologies common to teachers of all subjects.

English and Social Studies teachers were more apt to mention the Microsoft applications. Three of the eight Science teachers included tools specific to their subject area, i.e., microscope, electrometric device, gel electrophoresis apparatus and GoTemp. One other Science teacher said, “We’ve used scales, we’ve used balances, we’ve used

Table 6. Technologies teachers consider part of “technology integration”

Subject	Hardware Technology	Software Technology
Technology common to all subjects	Computers Laptops Interactive whiteboard Overhead projector	Internet ² E-mail Microsoft PowerPoint
English	Television/VCR/DVD iPod ³	Microsoft Word, PowerPoint, Publisher and FrontPage Inspiration
Science	Video conferencing ⁴ Digital camera Class Performance System Microscopes GoTemp Electrometric device Gel electrophoresis apparatus Palm Pilot ⁵	Microsoft Excel
Math	Rulers, Protractors Calculators	Geometer’s Sketchpad Microsoft Publisher
Social Studies	TV/VCR DVD player iPod ⁶	Microsoft Publisher
Special Education	Tape recorder	Microsoft Word Literacy software
Other	Television/DVD	Microsoft Word, Publisher Literacy software

² This includes Internet-based subscriptions purchased by the school district, i.e. BrainPop, United Streaming, Marco Polo.

³ iPod was mentioned by one of the nine English teachers.

⁴ Video conferencing was available at one school.

⁵ Palm Pilot was mentioned by only one teacher who had experimented with the use of it for her classes.

⁶ iPod was mentioned by one of the four Social Studies teachers.

graduated cylinders, we've used spring scales, we've used as simple as a ruler", and that she considered them "scientific tools" as opposed to technology tools. Mathematics teachers included graphing calculators and specific Math software. Two of the six Mathematics teachers included rulers, protractors and calculators on their lists. Two literacy teachers who were required to use specific software with their students identified a literacy application. One teacher mentioned a failed experiment using the Palm Pilot and another said he used the iPod to store videos he had found on the Internet to later show them to his students in class. The overhead projector, used to project transparencies, and the television were mentioned by three teachers.

The answers teachers gave were reflective of the types of technologies found in schools today. These included equipment that has been available to them for decades, such as the television, to more recent ones such as an interactive whiteboard. All the teachers who responded to the question, "What types of technologies are included in this concept?" included computers in their answer. All 37 teachers in the study, when discussing the use of technology for their teaching practices, spoke of computers, whether it was the computer itself, computer software, hardware or peripherals connected to computers.

4.2.3. Summary

The term "integration" is one with which teachers are familiar. They are asked by administrators to integrate various concepts, ideologies and practices into their curriculum. "Curriculum integration" is a concept that is described in the education literature with such terms as *combine, jointly plan, involved, meaningful, enriched, critical thinking, collaboration, and flexibility* (Barefield, 2005). "Technology

integration”, like “curriculum integration” means to be more *involved* and *meaningful*, within a learning environment that is *enriched*. It promotes *critical thinking* and *collaboration*. Technology integration entails that teachers adopt (Rogers, 1995, p.21)⁷ technology, incorporating it readily and flexibly into their teaching practices and doing this on a regular basis to benefit students in achieving the teachers’ curricular goals.

However, the definitions that many of these teachers provided of technology integration did not convey these ideas and were lacking in depth. Many of the teachers in this study gave definitions of technology integration that reflect a limited understanding of the term. Based on the definitions of many of the teachers, someone who uses the interactive whiteboard to display daily “Do Now” assignments would be integrating technology, as would a teacher who displays daily classroom notes in Microsoft PowerPoint.

4.3. Sources of ideas about technology integration

When asked about the sources of their technology ideas, teachers in this study pointed to their interactions with their colleagues, administrators, and the Internet, as well as their own academic experiences.

4.3.1. Teachers/colleagues

Teachers looked to their peers for ideas. Twenty-seven of the 37 teachers in the study said that they got their ideas for technology use from other teachers. They shared ideas with other teachers who taught in their own subject area, as well as with teachers who taught other subjects at the same grade level. “There’s another teacher who teaches

⁷ Everett Rogers’ meaning of the term adoption, “to make full use of an innovation” is presumed here.

the same level I do in this building, and we're constantly sharing things. ... We meet and share things. 'I found this, I found this. Do you want to try this? Do you want a copy of this?' We do that a lot" [A9].

However, sharing in formal settings such as department meetings was minimal. The agendas for these meetings were at the discretion of the department chairperson and provided limited opportunities for sharing technology-related information. One teacher said that her department did not have regular department meetings. They were "relatively random. We get together on our own". More sharing was done during small informal meetings, for example, when grade-level teachers⁸ met. "So we work together as a cluster. In the past, we've done different technology units where we've incorporated every subject. Not formally, but we'll just talk about it, we'll discuss it" [A11]. At another school, a teacher noted that, if they wanted to share something, they "would let her [the department chairperson] know and she would kind of spread it because we don't come together in a school so big. A few of us here, a few of us there. ... A lot of e-mails and we just don't have the time to meet" [A2].

The exchange of ideas among teachers was, for the most part, informal. One teacher said they didn't share as much as she would like to at the formal meetings, "because I don't think we meet enough. So I share what I can when we discuss what we're doing. Or I'll put it on the T-share."⁹ She also shared products that she had created that her colleagues could also use, for example, "I just did Jeopardy [game she created using PowerPoint] yesterday. They took a test today and my colleague who also teaches seventh grade is finishing the unit, so I put it on T-share and I told her if she wants to

⁸ Grade-level teacher – teachers who teach the same grades, for example, 6th grade teachers

⁹ T-share – a common computer network drive for teachers was available in all three schools.

modify it she can because we cover slightly different information” [A21]. Ideas were discussed in passing conversations. Teachers also used e-mail. “We’ll send out an e-mail that, ‘Hey, this is a cool site’ or ‘Hey, this is something cool’” [A2]. They shared ideas at lunch when they met in classrooms and discussed work-related or other matters: “It would be in the hallway, passing, or in the classroom while we’re eating lunch” [A11].

All but one said they shared with teachers in their own schools. A small number said they also shared with others outside their school community. Teachers shared regardless of how long they had been teaching. Teachers who were new to the profession found the help of their colleagues valuable. A teacher who was new to the school and to the profession said, “The teachers here are so helpful. I would be lost without them. ...Pretty much every free period I have I go to another teacher and ask for advice, for help, for ideas, everything” [A32]. Another teacher new to the school said, “Another teacher showed me [how to use a particular software]. Any teacher in the wing would be willing to show me. ... I feel very comfortable going to the other teachers” [A36]. One teacher spoke of her positive experience with a mentor several years earlier when she first came to the school as a new teacher. The mentor had introduced her to the software package that she still used.

Two teachers, who were not provided with a curriculum for their classes, relied mostly on other teachers. One teacher said she teams herself with other teachers. Another teacher, whose curriculum is technology-based, said he knows someone who teaches the same subject in another school, so he has basically adapted the other teacher’s curriculum to his class.

Teachers also got ideas from observing their colleagues in common work areas such as computer labs and shared classrooms. The teachers browsed web pages created by other teachers as well as teacher files on shared networked drives. “I just happen to be in the computer lab one day and saw all the students working feverishly on this particular activity and I said, ‘What are you doing with that?’, and that’s how he was able to share that particular information” [A27].

Teachers in this study shared technology-related ideas with their colleagues. Most of these were in informal settings. Two teachers stated that they shared ideas with other teachers, but not from their own school. One of these teachers taught a subject unique to the school’s curriculum and said that the ideas were from a teacher in a different school district who taught similar content. The second teacher stated that she didn’t share with teachers in her school, but some of her comments suggested that she did not work in complete isolation. She related an activity she had learned of from observing another teacher in her department and mentioned that her administrator provided ideas as well.

4.3.2. Internet

Twenty-one of the 37 study participants said that they used the Internet as a source of ideas about technology use. On the Internet, teachers mostly performed general searches for curriculum ideas. “I use the Internet constantly. I’m always, always on the Internet, searching different things, subject areas, any topic that comes up. I’m always looking for different things to do” [A24]. Some teachers were aware of specific websites targeted at teachers. “A lot of times there are websites, like ReadWriteThink.org. It’s connected to some other websites” [A34]. Teachers were enthusiastic about this

resource. “There’s a lot of stuff on the Internet. . . .sometimes I’ll search online and there’s a lot of already made WebQuests for the subject that I teach” [A31].

4.3.3. District Staff

Of the 37 teachers in the study, 16 said that they got their ideas from the district. Specifically, they referred to their district administrators, school administrators or technical staff. They felt that district administrators provided ideas by way of the specific hardware and software that was adopted by the district. At one school, one department used specific literacy materials that included a website that the teachers used. At another school, two teachers were provided with specific software that they were required to use with their students. They also got ideas from their department chairs and the technical staff.

Only one of the three schools participating in the study had department chairs for each subject area. One school did not have department chairs, and the other was in the process of eliminating department chairs and so some teachers were part of a department and others had been without one for several years. Eight teachers in this study identified their department chair as a source for ideas. The eight teachers were all from the one school that had a chair for each subject area. Also, all eight teachers belonged to either the Mathematics or Science departments. The department chairs of these two departments were also certified teachers who continued to teach a limited number of classes.

The teachers pointed to the department chairs as not only providing them with ideas, but also providing instruction on use of specific computer hardware and software,. They communicated their ideas in a number of ways and the teachers felt the assistance was valuable. One teacher gave an example of a department chair observing the

teachers' efforts at using laptops in the classroom. The chairperson then provided feedback that was helpful with future use. About a software program introduced by the Mathematics Chair, one teacher said that "he had us trained" and "developed lessons" [A28]. About the Science Chair, a teacher said, "It's my chairperson. She'll give us a bunch of things" [A12]. About this same chairperson, another teacher said, "Well, the department chairperson tries to bring advantages to the department. We have a science newsletter and she's always putting stuff in the science newsletter. It's very helpful" [A13]. One teacher, who mentioned her graduate experience as playing an important role in her understanding of technology integration, went on to a job in a school district where there was no access to technology resources." She then moved to her current school district several years ago. Here, she said her understanding grew from "...my department chair, [who] was very much technology savvy. So I would ask her things. Often times she would show me how to do things. But it was knowing that it was important to her also. Because when she evaluated me, she did say she would like to see this". [A12]

4.3.4. Technical Staff

At one school where there were no department chairs, two teachers stated that they looked to the computer lab assistants for help. This went beyond the role of a lab assistant, which is to maintain the computer lab. These teachers said the lab assistants provided materials to support the individual teacher's curriculum needs. They found web sites on specific curriculum topics, created materials and, in one case, actually taught the class on how to use a specific software application. Most teachers, however, looked to the lab assistants only for technical help. One teacher suggested that a person to help guide them in their technology use would be helpful.

Well I got past that [discomfort using technology] by knowing that I have a technology person down the hall, so anything that happened I could rely on her. ... I think you need somebody that's like a coach in the building. ... We have people who work in the labs, but they're just lab facilitators. ... I don't feel that there is any guiding person. Because I think that would be helpful. If you had somebody you could turn to. [A12]

4.3.5. Education

Of the 37 teachers in the study, six referred to their college education as a source of ideas for technology use in their classroom practices. One teacher described her academic experience, where professors (outside the education school) used technology in their teaching.

The university had a lot of technology infused into it. ... We used things in class and that kind of gave me ideas, thinking back to then. I can modify it for these guys with the computers we have here. ... My professors, my sociology class for example, we used to bring it [laptop] every single week and we would do things online. Like he'd sometimes shoot us to a website and say read this and we're going to have a debate over this topic. Things like that. ... In Psychology courses that I took, we were always making PowerPoint out of topics. And then you would learn a lot about other topics that you didn't even research, from other people. [A37]

They also referred to classes where professors taught them specifically how to use technology for their own teaching practices. "I used a lot of technology [in college]. ... [The professors used technology] to teach us how to do presentations, showed us how to integrate it into our lesson plans, to do WebQuests, to do research" [A10]. One teacher created lessons in her graduate school classes that she used in her curriculum. "We had so many ideas given to us and shown to us. ... I created 4 to 5 different lessons while going for my Master's" [A11]. One teacher enthusiastically provided a list of technology practices that he learned from one of his classes and which he continued to use.

That was the first person to show me what United Streaming¹⁰ was, showed about PowerPoint, he showed about WebQuests, showed everything you can imagine. It was great.... We learned about websites, Rubricstar where you make your own rubrics on-line. Citation machine where you learn how to just type in the stuff and it'll make your citations for you. [A26]

There were also teachers who were dissatisfied with their technology experiences in higher education. Several teachers mentioned that their college professors did not use computers for teaching. As one student said, "They don't use it. The students use it. The professors don't use it" [A21]. When asked about how he had learned to use the technology, the same teacher replied, "I just taught myself. I really learned PowerPoint in college, obviously. I had to do it to do my thesis defense and to do projects. I just had to figure it out". Another teacher said, "They [professors] expected us to come in knowing it, I think" [A3].

One teacher expressed dissatisfaction with her overall computing experience in her graduate program. The teacher had taken courses in educational technology and "wasn't really happy with the program because I didn't really feel like I learned that much. There was one class where I had to make a Flash video which I use here and it ends up working perfect. Everything else that I ever did, it's like there's no need for me to know the rest of this stuff" [A2].

A new teacher wished her professors had used more technology to teach. "I think my professors could have used more technology, especially my education professors. ...I think I would have gotten more ideas. Or even if they just did a unit on it or spent a week just talking about it, I think that would have been helpful" [A32].

¹⁰ United Streaming, a web-based subscription database, owned by Discovery Communications, provides curriculum related multimedia.

4.3.6. Summary

Teachers in this study defined “technology integration” in terms limited to their uses of computers and computer-related technology. This same pattern was found when they were asked the question, “Where do you get your ideas for integrating technology?” They discussed where they got specific ideas for technology use. These ideas were limited to software and hardware use practices. Some examples included using Word to write letters, PowerPoint to write words and their definitions for presentation to other students in the class, and using the interactive whiteboard to play Jeopardy.

Teachers got most of their ideas for technology use from other teachers. The exchange of ideas was mostly on an informal level. They discussed ideas in casual conversations, or in self-organized meetings during lunch or other free time. They used e-mail or the common T-share server. The sharing of ideas was valuable to all teachers, but even more so for new teachers and teachers in need of curriculum ideas. Teachers were not hesitant to approach their colleagues for help.

The internet was frequently mentioned, but it was a source more for general curriculum ideas and not necessarily just technology-related ideas. A small number mentioned specific sites, other than Google, which was either another school’s website or an educational site such as www.ReadWriteThink.org¹¹. However, most often, they went to the Google website to conduct a broad Web search.

Administrators were another source for ideas. The software and hardware that administrators adopted, and the distribution of these materials within the school, influenced use practices. Department chairpersons, in schools that had such positions,

¹¹ www.ReadWriteThink.org was created as a partnership between the International Reading Association (IRA), the National Council Teachers of English (NCTE), and the Verizon Foundation.

were cited as particularly important sources. The department chairs identified by their teachers in this study provided support in a number of ways, including technology training and suggestions for use.

A small number of teachers identified their own undergraduate or graduate education as a source of ideas. One teacher described a technology experience in college as a curriculum that was “infused” with technology. The descriptions were of educators who used technology to enrich their teaching and provide students with opportunities for learning. Those few who do observe instructors modeling technology integration are very positive about the use of technology, and can visualize technology use under different settings (Vannatta & Beyerbach, 2000).

4.4. Factors that influenced technology use

Teachers pointed to a number of factors that influenced their technology use practices. The factors were either administrator-related or dependent on teacher beliefs. Administrators influenced their teachers by the decisions they made related to technology. These decisions were about what technology was purchased, who had access and received training, and the availability of technical help. State mandated testing also influenced technology use. Teacher beliefs that influenced use were their own views on teaching and their level of comfort with technology use. Each of these influences is discussed in this section.

4.4.1. Administrator-related factors

Administrators and their decisions on the purchase of technology, its distribution to teachers and placement in classrooms, and technology support were all factors

influencing the use of technology by teachers in this study. One factor not mentioned in previous studies was the effect of state mandated testing on technology use. The state mandated tests, a result of the No Child Left Behind Act of 2001 (NCLB) were cited as a factor influencing technology use.

Technology available in the classroom

The availability of technology is a necessary (but not sufficient) precursor to teachers' technology integration. All the participants in this study had at least one computer, with Internet access, in their classrooms. There were also computer labs in all schools. Teachers used a sign-in sheet for these labs. Many of the labs had regular classes, such as Technology, scheduled in them, which limited access for the teachers. All teachers used the Internet-based grading software that was provided by the school and, in two schools, they also used the Internet-based attendance software that was provided by the school. Eighteen of the 37 teachers had functioning interactive whiteboards available to them in their own classrooms. Nine teachers had several computers in their classrooms, including some rooms that were computer classrooms, with enough computers for all their students.

At one school, a technology grant had provided plasma televisions to a number of teachers, six of whom participated in this study. These televisions were connected to the classroom computer and used as a display panel. One teacher was regularly assigned to a computer lab. There were a number of computer labs in all three schools. In the two larger schools, teachers had to reserve time in these labs with the computer lab assistant. One of these schools had computer labs that were staffed during the school day. In the second school, the lab assistants had dual roles so were not in the labs through the entire

school day. The reservation book was on a desk and available for teachers when the assistants were not available. At the third school, there was no technology staff in the building. There was a reservation sheet in the rooms, and teachers filled in their names in the time slot for when the lab was available. All schools had a protocol for accessing technical help. In the schools with technicians, formal help was faster. In the one school with no technicians, teachers stated that technical help took one to two days, depending on the issue.

Administrative decisions

Teachers did not feel that they were included in the decisions administrators made regarding technology. These included decisions regarding purchase of hardware and software, which teacher was getting these materials, whether or not training was provided, the type of training, or the physical location of equipment within a classroom.

You come in the next morning and you say, ‘Oh look, I have a SmartBoard.’ Basically they don’t even tell you and you’re just like, ‘Ok, what am I supposed to do with this?’ I was just happy it was on wheels because they were telling me they were going to install it right in the middle and stick it right in the middle of my front boards. The one’s they had prior to this year, they are installed in the oddest places, like ‘Oh, there’s an open wall, let’s put a SmartBoard there’. But it’s awkward. The desks have to turn and the kids have to turn. [A2]

In one school, a technology grant was used to purchase plasma televisions for a number of classes. Six of the teachers who participated in the study had plasma televisions in their classrooms and all six conveyed similar views on having the equipment in their classrooms. As one teacher stated, “The plasma screens are nice but they’re small and they’re off center, hard to see” [A2]. Another teacher had these same thoughts. A third teacher said she used it everyday but more as a blackboard to display

information. “I usually use that on a daily basis but it’s more just for general information. Just to have it up there. I list at the start of class the topic for class. Their ‘do now’ and their homework is always listed on it” [A7]. A fourth teacher said, “I don’t use the plasma. It’s in a poor location. It’s not really conducive to learning because the screen is so small you can’t really put a lot of stuff up there” [A3]. A fifth teacher also used the plasma television to project her daily class objectives and “Do Now” assignments¹². The teachers who did use it had a very limited role for it in the classroom. They had not been aware that they would be getting the equipment and there had been no prior testing of it with these teachers to assess its usefulness to them.

Just as with hardware, teachers generally used whatever software was provided by their district. As one teacher explained, the software she was required to use was adopted by the district because of a senior administrator’s interest in the product. However, after use, the teacher felt the software was not appropriate for her students and pointed this out to her immediate supervisor. But no change was made and the teacher had to continue using the software until a recent change in administration.

In general, teachers expressed their disappointment at being left out of such decision making. They felt that, as a result, they did not receive the appropriate materials or training. As one teacher said, “They really need to re-think how they introduce technology” [A12]. She gave an example of a new piece of equipment that was brought into the school. “Like this [equipment name]. I can’t even imagine people beginning to use it because I don’t think anybody really understands how to use it yet themselves. So it’s hard.”

¹² “Do Now” is a short activity to start off a lesson. Teachers generally write these on the board for students to work on as they first come into the classroom.

Teachers did not know how decisions were made about the purchase and distribution of technology materials. They considered it to be inequitable. Different reasons for this inequality were provided. One teacher thought he received it “because I used a lot of technology in my class before that, so when they gave out the first batch of SmartBoards, they just gave me one” [A26]. Another teacher thought it was because she taught a particular subject: “I belong to the Math department, so they gave me the SmartBoard” [A22]. Yet another teacher who taught students who came from a low socio-economic background felt that she had limited resources because of the makeup of the student body: “No microscopes, no microscopes that can lead to the computers. ... I do think demographics certainly have something to do with it”. Later in the interview, she dramatically stated that the way to get something was by “cajoling, begging, waiting until the budget passes, seeing if we can beat some other department [out] of their money”. [A13]. Another teacher didn’t think she would get a SmartBoard because “it depends on how much money is in the budget and how many were purchased. I may never get one” [A9]. One teacher said that she may get something she requested “if it’s a piece that could be used by not only me, but everybody in the building” [A18]. A teacher who said she was disappointed at the way administration made technology related decisions said she was given equipment with parts missing and therefore it was worthless. It sat in a corner of the room. “What’s the point? To teach the students. People are putting obstacles in my way” [A4]. She felt frustrated to see teachers given equipment that they didn’t use or used in minimal ways when she, herself, had voiced her interest and demonstrated her skills.

What teachers said they want

Teachers, even those who were not regular users of technology, wished for something they did not currently have but had seen their colleagues using in the classroom. Those who had interactive whiteboards wished they had computers in the classrooms or vice versa. Generally they had seen other teachers use some hardware or software, and they wished they had it as well.

I would love to have one SmartBoard. I've seen it being used once or twice. I went into another classroom where a teacher had one and he showed it to me. He had notes already written up there and he would add to them important points and underline. He was doing a sample problem. Just added facts to it. It's just an incredible tool. I would love to have one. [A7]

In all three schools, teachers wanted interactive white boards because they had seen another teacher using it.

Also of interest were more computers in their classrooms. When asked how they would use the particular piece of hardware or software, their responses reflected the practices of their colleagues. Teachers definitely had ideas about how they would use the technology. "I could have [learning] stations where I could have students rotate having to do different things" [A21].

Teachers in all three schools mentioned that the availability of the computer labs seemed limited. "Some of the class periods are always booked because there are classes in there. ... A couple of the tech people actually have their classes in there. ... There are a couple of periods that it's very difficult to get into the lab because they're booked" [A23]. One teacher, whose colleagues had computers in their classrooms, felt "It would be so much nicer to be able to take them to the computer whenever you want to, to be able to use the Internet for research. It's hard for me because so many teachers are trying to get

into the labs. ... One of them is used a lot of the time because there are computer classes. So that room is sometimes hard to get to” [A34]. A teacher who was assigned to teach in one of the labs on a regular basis concurred with the other teachers. “Other teachers ... have to sign [up for] a time to come in here [computer lab]. And that’s difficult. Even though there are [X number of] computer labs in this school, one of them at least has a class” [A15].

There were teachers who wanted to use technology to teach the curriculum, and even as they described their frustrations with availability of resources or school and district policies, they managed to overcome these obstacles. Two teachers at one school were using their own personal laptops. “I bring my own personal laptop because it [the software the teacher wanted to use] is loaded on my laptop. [The district] doesn’t allow it to be loaded on here. So that’s something I’ve gotten around, using it that way, because it’s a great assessment tool. ... I just use it myself. I don’t corrupt the system” [A12].

Another teacher projected from a LCD projector to a pull down screen hanging from his blackboard. “The way I get around it [no interactive whiteboard] is that I’ve typed up a lot of notes. Or I’ll write notes directly on the computer and project it. So for the kids that are fine, they can copy notes and they’re good. For the kids that, on their IEP¹³ require notes, I just do a print out, they run to the library, pick it up. And for the kids who are just a little bit slower in the processing, I’ll do that as well” [A30]. Another teacher made an informal agreement with a teacher who had computers in his classroom: “[This other teacher] uses that [computer classroom] the majority of the time. ... So I worked it out with him [to use his classroom during the free periods]” [A11].

¹³ IEP - Individualized Education Program

Availability, including the reliability of technology resources, did affect the way many of the teachers used technology. As one teacher stated, “There’s things that I’ve wanted to do but couldn’t because we don’t have it” [A1]. Another teacher mentioned that she isn’t sure if she will be in the same classroom with an interactive whiteboard the following year, so she’s “not changing everything to make it exclusively a SmartBoard presentation everyday” [A2].

Two teachers who taught in a classroom with enough computers for their students, found it challenging to use the technology which was readily available to them because the teachers with whom they collaborated did not have the same resources. “The thing is, we do try to keep our curriculum fairly aligned, and the other [subject] teachers in the grade level don’t have that same access to technology. So sometimes it’s a challenge” [A38]. A teacher in the same department said that they at one point had “started pulling out some of the technology pieces and what they were doing on the computer they are doing in their notebook”. But, she said, they were “trying to schedule that a little better this year and trying to put more technology back in” [A35]. The teachers who had computer classrooms did feel that having the computers right in the classroom motivated them to use computers more with their students. “The first year I felt very guilty if I did something and we weren’t using the computers. You don’t want to take that for granted because it is a tremendous resource” [A38]. They use the computers “almost daily” because the technology is available to them in their rooms.

A few teachers mentioned the reliability of computers. “It fails on you sometimes. ... If you’ve based your lesson that day on the computer, you’ve got to have a back up

plan because sometimes they just fail” [A34]. Another teacher felt that, based on her experience, technology was not reliable.

I think the hardest thing about technology anywhere you are is you can't always rely on the fact. Like yesterday morning our computers weren't working initially. ... I mean every school district I've been – this is my fourth one if I include student teaching – there's always the possibility that the computer is not working. [A31]

Even though most teachers did not make any direct comments on the reliability of technology, many of them kept paper copies of student grades even while using grading software. “For grading purposes, it's hard. It's not always trustworthy” [A34]. Another teacher, who said the grading software was “wonderful” and “makes life very easy”, followed-up with, “I still keep a grade book” [A9].

The “if I had” type of statements that teachers made showed that teachers had ideas for technology use but did not have the resources available to put the ideas into practice, thereby affecting their technology use practices. “If I had the classroom with the computers, I would do a lot more things. PowerPoint I love. I would use that with the kids” [A34]. Another teacher wished she had “a plasma screen [television] in our classroom, because I wanted to do Math Jeopardy with them. But we just wound up doing it on the blackboard instead” [A1].

I think it would have gone a lot better if we had the whiteboard and I could actually write an instruction on the board with them. So I think computers are great to have. I wish I had a DVD player in here to show movies or news clips that relate to the books that we're reading. I like to play music so a stereo would be good to have so they can relate the songs to the book. [A32]

Technology training

Training to use new and existing computer resources was limited. Of the 19 teachers who made training related comments, six were positive and 13 were negative.

The negative comments pertained to either training they had not received or inadequate training. In many cases, teachers felt that, when interactive whiteboards and computer applications are made available, school districts should also provide the training necessary to use the technology. One teacher said she felt that, “if they [administrators] expect you to use something, I think they have to provide the training on how to use it. I don’t think it’s fair to expect the staff to just go figure it out” [A36]. She thought her peers “feel the same way. I think they feel my frustration” [A36]. Teachers who had the interactive whiteboards in their classrooms said they did not have prior knowledge that they would be getting the technology. These teachers did not get any prior training.

At one school, six of the nine teachers who discussed taking training for interactive whiteboards said they received informal training from technology staff or another experienced teacher in the building. One chairperson in this same school arranged content-specific training, during the summer, for teachers in the department. However, the only teachers to say that training was helpful were two teachers who had taken short courses on the topic. Most of the other teachers said the training was not helpful, either because it was not hands-on or because it was very brief. Teachers in the other two schools, who had an interactive whiteboard, were not offered training. They learned from other teachers and practicing on their own.

Teachers had two ways of gaining technology skills. One possibility is that they were provided training by the district for software and hardware available within their classrooms and schools. This training would be at the time and expense of the district. The other possibility was that teachers could take professional development workshops on their own time and for a fee. A couple of teachers mentioned that these self-initiated

professional development opportunities were a financial incentive, since taking the classes provided in-service credits to teachers which, with a certain number of credits, led to an increase in salary. However, several teachers mentioned that their personal responsibilities did not allow for free time to take these professional development classes. The teachers who had taken these workshops found them helpful. As one teacher said, “It was very, very worthwhile” [A20]. One aspect of some of these workshops that teachers identified as being particularly helpful was when they were hands on. “You really used it. You practiced it. It was very hands on” [A22]. Another teacher mentioned a workshop that she felt was very helpful because of the way it was designed.

A number of us chose to do the curriculum writing ourselves because we felt we would have something we could actually use. ... We chose to base it on technology. We took our curriculum and came up with some things we could use. It was our decision. There were other teachers and we decided to do it together. We decided because we work very closely together. [A9]

Those teachers who did not get formal training most often relied on their peers. These were teachers who already knew how to use the software or hardware.

I remember having the SmartBoard and not knowing what to do. Because I got it over the summer when obviously no classes are going on and so when I came back in September I didn't know how to use it. But the teacher who teaches in the classroom across from me was one of the pilot teachers. So she helped me with the basics. [A21]

Teachers who were required by their school or district to use specific software with their students did receive training. However, this training, as with most training provided to teachers on how to use software and hardware within the school, had its limitations. As one teacher said, “I would have to say that, in general, the trainings have not been very good” [A14]. This teacher gave the example of how she was trained at the same level three times.

They came in to teach us what [this software] was and instead of coming in again and going to the next level, they came in and said this is what [this software] is. I already knew that. And then a third time, the following year, the same thing. ... They just kept providing the initial training, the very, very basic training. So anything beyond, we've kind of had to figure out on our own. [A14]

Teachers did have avenues for training available to them within their work environment. However, these were limited. The training was general and not content specific. As one teacher said, "We don't do enough professional development in our content area" [A17]. Informal training was self-initiated when teachers reached out to others in their building. It was on their own time. Formal training was not based on the needs that teachers expressed, but the needs assumed by administrators. Appropriate training, based on the needs of teachers, provides them with the skills to use the software and hardware, and effectively integrate technology.

Technical help

Technical help came from a number of different directions. Computer lab assistants, technically savvy teachers and even students provided assistance.

In two of the schools, the technology staff was physically located in the school building. In one school, the computer labs had regular technology specialists. In the other school, there was assistance during some part of the day. The third school had no technical specialists located in the school. Teachers had to call in requests for assistance. In the schools with the technical specialists, a small number of teachers stated that they went to them for ideas. "I'll go to the computer lab person and probe him a little on what to do. He'll show me, but it'll be too fast and then I'll toy with it on my own and pull it apart and learn it" [A3]. Another teacher said, "[One of the technology facilitators] was

very helpful. She used to be here one day a week and she would give us websites and things like that” [A23].

In the schools where technical assistants were available, teachers made use of them. Mostly teachers went to them for assistance in technical matters related to repair or maintenance of equipment. “There is a person in the wing, a computer tech. I’ll leave him a note by the end of this period, and he’ll probably be up here tomorrow. I’ve left him notes, if I run out of ink, and he usually comes in a day or two and replaces the ink” [A7].

In one school, where there was no in-house technical assistance, teachers said they either relied on other teachers who were known to be technically capable or submitted a help request to the district office.

We have people in the district that travel. If we have a problem, we have a tech person. We have to notify them and they’re very quick about making their way over. We also have very knowledgeable teachers here. There are technology teachers; if you have any questions, they will be able to help you. [A34]

If I have a problem that I can’t get something to work, I can go to the tech teachers and ask and they do know a little bit more. ... Yesterday, we let the office know, and they called the district technology coordinator and he came in and it was up and running very soon. [A31]

In each of the three schools, the support varied. However, even with the disparity in the quality of technical support, teachers said they were generally satisfied. Teachers in school B, where turn-around time for technical support could take several days, did not complain any more than teachers in school C, where assistance was more immediate.

However, observations of teachers using the computer lab for instructional purposes showed some noted differences in having technical assistance versus not having assistance. For example, school C was staffed with a full-day technical assistant for each lab, and in each instance, the technical person was there to guide the teacher and

students. In one instance, the technical assistant started off the class by providing the students with a short instructional session on how to use the software.

At the other two schools, there were differences noted with classroom management and safety. At school B, where there was no technical help housed in the school building, one teacher spent most of the class session attempting to troubleshoot computer problems, since there were not enough working computers for all the students. Four of the computers had notices, written by teachers, that the particular computer was not working. When a student approached the teacher for help, he told the student, “I can’t help you right now,” and to come back later. As the teacher spent time troubleshooting, one student downloaded Adobe Flash Player for a website that was not part of the assignment. Another student was observed playing a game as two other students watched.

At school A laptops were available to teachers. However, these were the responsibility of the teacher. Within the time frame of the class period, teachers had to distribute the laptops, provide instruction and technical assistance, and collect and return the laptops to the cart. In most instances, if the teacher could not resolve a student’s technical problem, the student was given a different laptop if available. At one observation of a class in the Library Media Center, most of the laptops did not work. The librarian explained to the teacher that the batteries needed charging because they had been used by another class during the day. So the teacher and the librarian, with help from the students, plugged in the laptops. There were wires running across the room. It was noted that the teacher almost tripped on one of these wires.

Several teachers mentioned their students were a source for technology help. “I had students who, through tech classes, knew how to do it and they were actually more

familiar with [this software] than I was. So I had students help me show how to use the [software]" [A31]. These teachers saw it as a positive experience for the students. "What I'll also find is that, often times, a lot of the students will know more than me, so I let them do it. Which is nice. Because they feel, they like to see that they can show something they know" [A12]. These teachers did not feel intimidated that there were students in their classes who knew more than they did. "A lot of times they are more comfortable than I am or they know more. If you can't figure something out, you can count on, there's at least one other student in the room who will be able to figure it out. Which is nice, because then the students also see you as a learner" [A38].

One teacher mentioned that she felt technology was "wonderful" but students "spent too much time on the computer playing games". She hesitated to let her students use the computer. She did not allow it because she felt "the students were not ready; they didn't have the maturity to use the Internet" [A18]. She felt that using technology was easier if she understood it first, and then broke it down for her students, "so therefore it becomes simple for them". Generally, however, teachers felt that students were quick and eager technology learners and users.

Teachers got their technical help from wherever they could find it. Technical assistance came from other teachers, technical staff and students. Teachers felt comfortable using these sources and felt that the avenues for help available were adequate. This was also true in the one school where the technical staff was not located in the building.

Testing

The participants of this study were teachers in New York State. Schools in New York are required by the No Child Left Behind Act (NCLB) to administer standardized assessments to measure how well students are meeting the standards. Of the 37 participants in the study, 11 initiated discussion about the state standardized assessments that students are required to take and their effects on technology use. All three schools had the English and Mathematics assessments for sixth, seventh and eighth grade students. In New York State, the English assessments are generally given in January and the Mathematics assessments are in March.¹⁴ At one school, where there was a large student population of English language learners, the English as a Second Language Achievement Test (NYSESLAT) was also given to the English as a Second Language (ESL) students. Another school gave the state's Science assessment to their eighth graders. Teachers, whether they were teachers of these subjects or not, seemed to feel that these tests affected their decisions on whether and how to use technology in the classroom.

Teachers who taught the assessment related subjects felt that time limitations affected technology use in the classroom. As one teacher said, "The whole curriculum up to January or March was based on that test" [A32]. There were meetings to discuss the tests. "Well, one reason [for the meetings] is for the testing. We have a big state test. ... After testing, meeting is infrequent. It's more frequent before testing" [A29]. The meetings provide information to the teachers on what to expect and strategies to prepare the students. For example, one teacher reported, "Ok, we're getting ready for the Math

¹⁴ Much of the data for this study was collected in May and June.

assessment or the English assessment. You're going to be receiving worksheets in your mailbox. Do it with your study lab kids" [A1].

One teacher discussed the various activities he did with his students in previous years, that were technology related as well as non-technology related. He said he didn't do them this year "because of the testing schedule" [A29]. Another teacher had this same experience. "I haven't been using it [computers and the website she created] as much as I should this year. I think we're just really crammed with time. I keep forgetting to use it" [A35]. When asked what was taking up time, she replied, "Just more testing for the school". One teacher responded that they had not been using technology much this school year. "But from this point on, we'll be [doing a technology related activity]. So we will be from now on using the computer, but we were getting ready for the New York State assessment. So we weren't doing that many hands on projects" [A11]. Another teacher who had taken the students to the computer lab to work on a WebQuest was aware of the time limitations because of the time she spent preparing her students for the assessments. The teacher considered the assessments a "barrier" to her technology use. "We can't devote like huge, huge blocks of time. So this assignment they started in there [the computer lab] and then they finished on their own" [A9].

Teachers who did not teach these subjects felt that, because of the state assessments, priorities had shifted. "I don't know that K-12 Science education may not be a particular priority. Right now the priorities are Math and English" [A13]. This sentiment was repeated by several teachers who did not teach the assessment subjects. One teacher said he had made a number of suggestions on how to use the computer labs in a more accommodating manner, but he felt, "we're low on the totem pole. They have a

Math test and an English test, the two most important tests in the school. So those people are the most important. They know it. Everybody knows it. That's the way life is" [A15].

When discussing technology-related expenditures, again, the English and Mathematics assessments were brought up.

I think there's been a lot of emphasis on Language Arts and Math in terms of the state assessments. ... So many ways you can cut the pie and since the Science, the results of the Science test are not published, that's just one of the things. I don't want to say that Science is devalued. I don't think it's devalued. I just think that Math and Language Arts are looked at as something that is in dire need of things, of money being funneled into that. [A17]

By contrast, the standardized test was a reason to use technology for one teacher. When an English teacher was asked where she got her technology ideas from, she responded, "I try to look at what the kids are struggling with. ... So I may go back to standardized test data, we might look at assessments that I give them. It could be a worksheet" [A35]. This particular teacher has computers in her classroom for all her students. She describes one of the activities she has created for her students.

So I had them go on the computer and I had a PDF file of a old ELA test. ... I just Google searched it this morning and got a PDF file and saved it to the common folder for them so they can access it. ... And then they discuss with their partner if they get stuck. 'Ok, what do you think about this one?', and then it's easier for the kids to look at the screen and it's easier for me to gauge where they are, what they're doing if they're stuck on something. And then I have them, in Microsoft Word, just write their answers. You know, what kind of question it was."

Preparation for the standardized state assessments, which includes meetings for the teachers and practice time for the students, has limited the time that teachers feel they can allocate to their use of technology in the classroom. Teachers feel that a shift in priorities has affected decisions about financial allocation, which have had consequences for teachers in areas other than the

assessment subjects of Mathematics and English. The technology use decisions of teachers of all subjects have been affected by the emphasis placed on the state assessments.

Summary

The three schools in this study had made technology available to teachers by way of computers and interactive whiteboards in the classroom, as well as access to computer labs. There were more computers and more variability in technology available to these teachers than has been reported in earlier studies of teachers and technology (Kleiner & Lewis, 2003; Smerdon et al., 2000). However, as new technology was introduced into the schools, administrator decisions about the types of technology to adopt and distribution issues led to dissatisfaction among teachers. It is clear from the plasma screen example, that teachers did not feel involved in the decision of placing the technology in their classrooms. The involvement of this group is essential in the success of technology integration, since teacher involvement provides support towards the acceptance of an innovation (Dyrli & Kinnaman, 1994).

Adequate training in technology use has been a concern of teachers since the introduction of computers into schools. Teachers in schools with higher quality support are more likely to use technology with students than teachers in schools with lower quality support. They are also more likely to use technology in multiple ways (Ronnkvist, Dexter & Anderson, 2000). If teachers are more likely to use technology, they will have more experiences with technology. More experience has been noted to be an important

variable in predicting the difference between teachers who successfully integrate technology from those who do not (Mueller et al. 2008).

Teachers in this study had training opportunities at workshops and professional development classes, which they attended mostly at their own expense and time. Most of these experiences, as well as those offered by the schools during school time, were inadequate. The training sessions provided by the schools were more related to learning the technology and basic uses, and less on its connection to the curriculum. As a result, most teachers used the technology in isolation instead of integrating it with their curriculum. Training teachers on technical skills first reflects national technology standards that emphasize technical skills as the first step to introducing technology to teachers. Teachers did need technical assistance for computers and other equipment that needed maintenance. They relied on their own skills, on technicians, on colleagues and on students for technical support. However, burdening teachers with technical issues puts them in unfamiliar and uncomfortable territory. It is likely to be more productive to build on teachers' curriculum and instruction strengths (Sandholtz & Reilly, 2004).

4.4.2. Teacher beliefs

Beliefs related to technology's role in their curriculum and classroom, as well as their comfort with use were factors that affect teachers' use and integration of technology. The one unifying belief among almost all the teachers was that there were benefits to using technology with students. These benefits, however, were not necessarily learning related.

Students and technology

Thirty-five of the 37 teachers who used technology provided varying student-related reasons for use. Teachers felt students “learn better with it”, that they “love it”, and since “they grew up with it, they’re so adept” at it. Teachers felt that the technology environment was one in which students were comfortable. One teacher said that she, initially, had not been comfortable using it. “I had to push myself to use it. I pushed myself to use the wireless laptops, because I knew it was something that they [students] would really enjoy” [A12]. Students used computers at home and “if you could do something that they enjoyed doing at home, in school, they’re more likely to enjoy the activity and learn from it more” [A32]. Another teacher felt that it was “second nature” to them and “if we don’t use it, you’re doing a disservice to them” [A34].

Motivation was another factor for using computer technology with students. As one said, it “really helps them. Especially kids who are less motivated and have a harder time. And a lot of times the kids in that class have a hard time just writing. Doing it on the computer, they’re very proud of their work and it’s easier to check” [A20]. Another teacher spoke of “using technology to teach” because it “help[ed] reach these kids, who are so technologically advanced. You use computers and that really speaks to them. They were so excited when they found out they were going to the computer lab” [A34]. One teacher, who was uncomfortable using technology but required by her district to do so, saw the benefits for her students. The students “behave better on the computer. Any time they’re on the computer they’re happy” and it gave them “a sense of success” [A14]. Two Special Education teachers felt that using technology in the classroom helped keep their

students, such as those who were identified with Attention Deficit Disorder (ADD), focused in the classroom.

Four teachers felt they needed to expose their students to technology because the lower economic status of their students did not provide these children with opportunities elsewhere. One said that the students should be prepared “for the real world; and I think we need to give them that experience” [A13]. Another teacher with similar views said the reason he teaches them a specific software is because, “What they get out of it by the end is they learn to use [the software application] ... so when they get a job, it’ll be there” [A15]. One teacher had used computers with her students in a previous school because the children at that school “didn’t have computers as much at home” [A33] and she felt this was one way of providing them with the opportunity to use the technology.

Only two teachers spoke of reasons for limiting their use of technology with their students. One teacher said that, even though her students enjoyed the use of computer technology in the classroom (“the kids are like, ‘Can we use the SmartBoard today? Can we use the SmartBoard today?’”), she did not use it regularly because she was not comfortable with the use. “They get such a kick out of it. But I don’t think that I should have to write on it just to entertain them. I can write on my board faster than I can write on a SmartBoard and that’s what I’m going to do” [A2]. A second teacher spoke of the dangers of the Internet. “We must know what’s down the pipeline before we send our children to do research, because it’s a dangerous world out there [A18].

Not all teachers used technology with all of their students. Five teachers pointed to reasons why they may use technology with some of their classes and not with others. One teacher, who used PowerPoint slides, used it more with her enriched class. When she

had “them copy notes off the PowerPoint...they seem to find it easier”, whereas the students in her other class “don’t like copying notes, so having to flip through the notes and actually sit and pay attention to a PowerPoint just doesn’t interest them” [A7]. Two teachers said that they did not use it as much with their advanced classes, but more with their challenged students. Both used the interactive whiteboards with all their classes. But one teacher included more computer related projects in her curriculum for the more challenged students and the other teacher provided more visuals on the interactive whiteboard. This second teacher said she used it most with her “intermediate” level classes.

One teacher used technology with all her students equally, but had noticed that the challenged students “pick up a concept, they’ll make some connections” that they may not have made if they had not seen a demonstration on the computer. Another teacher pointed to a change in the different computer skills students brought to the classroom. “Definitely some kids have a harder time with it. But they pick it up much quicker than I feel they had in the past” [A34].

Teachers provided a number of student-related reasons to use computers. Teachers felt that students liked using computers. Students were comfortable with the technology and it could motivate them in the classroom. Some students learned better and some were more engaged. There were students who struggled with computer use, either because of learning challenges or because the technology was new to them, but some teachers felt it was beneficial to use technology with them. The digital divide motivated some teachers to use computers with students who may not have computers at home.

However, not all teachers used it equally with all their students. Some of these teachers used it more or less depending on the abilities of the students.

Technology fits with teaching practices

Technology fits in well with the way many teachers teach. Of the 35 teachers who discussed how well they felt technology fit in with the way they taught, 24 said it fit their teaching practices. Many of these teachers had learned specific ways to incorporate technology into their curriculum. For example, one of these teachers, who did not feel comfortable using computer technology and described herself as an “old-fashioned”, “chalk and talk” type of teacher, had earlier in the school year been given an interactive whiteboard for the classroom. Until then she had not used computers with her students, but found this piece of equipment useful. Once she had started using it, she felt that she “couldn’t live without it”, that “it’s easy to use” and “everything was there” [A6] for her. Other teachers who thought technology fit well with the way they taught provided comments such as, “It works well” [A7], “It fits in very well” [A13], “I feel like my teaching is right with it” [A25], and “It’s pretty much hand and glove” [A30].

Teachers who felt it did not fit had various reasons for holding this belief. For one teacher technology did not fit the content area. For another teacher, using technology was too much work and not worth the results. For some of the reasons that teachers gave for why technology did not fit their curriculum, there were teachers who gave the same reasons as a rationale for using it. For example, two teachers in the same department had the same piece of technology with the same opportunities for training and support. One felt it required too much effort and the other felt that “the initial setup is work, but eventually it makes it easier.” Teachers who felt they were required to use technology did

so reluctantly. Two teachers, both in the same school, teaching the same content, were provided the same software. In one case, the teacher felt that not all components of the software were beneficial to the students, so the teacher “modified” it and “adapted” it with other materials to help the students. The second teacher felt that the software was only somewhat valuable to her students and passed on that part of her curriculum to an assistant to teach.

Comfort with technology

Many teachers felt comfortable using technology. Of the 37 teachers, when asked if they felt comfortable using technology or if they found it easy, 22 responded either “comfortable”, “very comfortable”, “easy” or “very easy”. Four teachers said they did not feel comfortable. The rest felt somewhat comfortable.

From the group of teachers who said they were comfortable using technology, there were a few teachers who did not use computer technology with their students on a regular basis. These teachers also used the technology in limited ways. However, they were consistent in the ways they used it and had become comfortable. For example, one teacher used Microsoft Word. After the students had handwritten their text, they typed it on the computers. Another teacher used PowerPoint to present review materials to the students.

The teachers who were not comfortable using technology provided a variety of reasons. One teacher felt the discomfort was the result of her personality.

I’m sort of a perfectionist and if it doesn’t go right then I’m going to be sulking around all day that it hasn’t gone right. It’s irritating. More than anything, it would be irritating if something didn’t work, a website or even if it’s just that the network is down. It’s hard to rely on doing certain things. [A2]

Another teacher was close to retirement and said she had been teaching without technology throughout her career. She also mentioned that, other than the grading and attendance, she was not required to use technology. Still another teacher said that she had no experience using technology in her academic background. She had only recently started using it with her students with assistance from the computer lab technician. She further stated that she doesn't "try anything new unless someone walks me through it" [A3].

Teachers' beliefs about the effects of age

The teachers who participated in this study ranged in age from recent graduates in their 20s to older teachers who had been teaching for more than 30 years. One teacher said this would be her fortieth year of teaching. There was little to suggest that age played a factor in whether or not teachers used technology for their professional practices. There were young teachers who were uncomfortable using technology and older teachers who embraced it and vice versa.

However, a number of teachers expressed the belief that age was a factor in technology use. This view came from teachers of all age groups. One younger teacher stated, "I think age matters. I think they [older teachers] appreciate but they're not willing to learn, because they're still working on 'How do I do my e-mail?', 'How do I send this attachment?'" [A2]. She felt the younger teachers were more likely to use technology, used it very well and enjoyed using it. "Kind of on the younger side, 20s, 30s. They're used to it." Teachers said, "older teachers are afraid of it" [A5], "scared of it" [A26] or "they have some anxiety over it" [A15]. One teacher, who would be retiring in a couple

of years, said she was not as comfortable as “the younger teachers are. I’m used to the paper and pencil and the chalk on the board” [A27]. She herself did not use much, if any, technology with her students. But she was required to use the computer in her classroom for attendance and said, “I have to say, change is good. I like the fact that, right now, I’m presently using the computer to take the attendance daily. That I find very easy” [A27]. Another teacher who had been teaching for thirty years said that she felt older teachers are “resistant to using computers” [A3]. This teacher said she had started using the computer with her students three years ago and uses it now with help from the lab assistant in the computer lab.

Most teachers who brought up age as a factor for using technology felt that the younger teachers were more comfortable using it because they “were brought up on computers” [A14] and the older teachers have “never really used it before or they see it as a whole different thing” [A15]. One teacher, who described himself as being very comfortable with technology and “open to new things” felt that there were some “seasoned teachers who may not use technology” and that these teachers “are my parents’ age, have been teaching before I was born” [A29]. He said, “maybe they’re comfortable teaching [without technology]. They’re wonderful teachers. Kids love them. They’re effective. That’s just their teaching style” [A29]. A teacher who had computers in her classroom said that “some older teachers ... weren’t comfortable with it [using technology] and really had no interest in learning it”. She could not “imagine teaching like that, knowing that all this is available to you. To me it makes life so much easier to have it. I can’t imagine going back to a traditional classroom after this” [A35].

There was a perception among some teachers, young and old, new and experienced, that older teachers were hesitant, and sometimes even resistant, to use computer technology, and that younger teachers were more comfortable and willing to use it. However, the teachers in this study did not show these patterns.

4.5. Conclusion

The focus of this study was teachers and how they define technology integration. It was thought that directly asking them for a definition of the term, it would provide a step towards understanding their technology beliefs and practices. The constructivist approach suggests an individual's reality is based on one's own experience and knowledge (Lincoln & Guba, 1985; Patton, 2002). Using this approach, the assumption was that, by providing teachers with the opportunity to "define" technology integration, some insight would be gained into why teachers continue to lag in using technology in the classroom. It should be noted that the effectiveness of teacher practices is not the focus of this study. In point of fact, two teachers provided the following contrary views on teachers who did not use computer technology with their students.

- View one: "There are some more seasoned teachers who may not use technology". When asked why they didn't, the reply was "I'm not sure... They're wonderful teachers. Kids love them. They're effective. That's just they're teaching style" [A29].
- View two: "They're depriving kids. They think it's fluff. It's like the bad teachers when I was a kid who just did lectures and handouts. That's a bad environment" [A16].

The definitions of “technology integration” that teachers provided were an indication that teachers have a limited understanding of technology integration. “Technology integration” is a process which entails that teachers adopt¹⁵ technology, incorporating it readily and flexibly into their teaching practices to support curricular goals (Hadley & Sheingold, 1993; Pierson, 2000; Rogers, 2000). When technology is integrated effectively, it provides for a deeper, more enriched learning environment where students actively seek and construct their own knowledge (Cadiero-Kaplan, 1999; Nicaise & Barnes, 1996). In defining technology integration, only one teacher in this study came close to describing it in such terms. Technology integration was defined as when “it all comes together for a very incredibly powerful teaching and learning tool” [A13].

It was the teacher interviews that offered insight into what technology integration means to these teachers and why they are limited when defining the concept. Networking with their colleagues provided teachers with the most support in their technology practices. These teachers shared information in mostly informal settings, passing along ideas on their experiences with technology. Teachers’ other sources of technology support were the Internet, the school district they worked in (including technical staff and professional workshops), and their undergraduate and graduate degree programs. The Internet was mostly a source of specific project ideas, whereas the district provided skill-specific hardware and software training. Of the small number of teachers who pointed to their academic training, only three described experiences that would be considered technology integration. Teachers learned about technology integration from a number of

¹⁵ Everett Rogers’ (1995, p.21) definition of the term adoption, “to make full use of an innovation,” is presumed here.

sources including their interaction with colleagues, administrators, students, and their own teachers. These experiences, as well as their beliefs about teaching and learning, provided them with reasons to use technology in either limited or integrating ways. .

5. Results: Patterns of technology use among teachers

This chapter presents the study results related to patterns found among the teachers in the study. The interviews and observations of the teachers provided the opportunity to examine their responses and identify similarities among teachers. These similarities in their beliefs, motivations and practices were used to categorize the teachers into five groups. Beliefs are their personal views about technology use with their students for purposes of teaching and learning, motivations are their reasons to either integrate or not integrate technology, and practices are their own classroom practices related to technology. The groups are 1: Dynamic Users, 2: Technology Integrating Users, 3: Knowledgeable Users, 4: Limited Approach Users, and 5: Non-users.

The five groups include all participants in the study; are mutually exclusive, in that each participant is excluded from appearing in more than one category; and are conceptualizations based on teachers' perceptions of their own technology uses. Since the groups were developed to make practical comparisons, it is possible that there are other teachers who do not fit into these categories (Rogers, 1995).

5.1. Group 1: Dynamic users

There were five teachers in Group 1. These dynamic teachers were self-motivated, resourceful, active and energetic in their approach to technology use. They did not limit themselves to resources within their own community but also went outside their own department and school. They brought back ideas and shared their technology

experiences with their colleagues. They provided environments and opportunities for creative learning to their students. They were knowledgeable about technology use and comfortable with it, as well. These teachers came from two of the three schools and used technology in their curriculum on a regular basis. They had been teaching an average of eighteen years, ranging from eight to forty years. Teachers from three core subject areas were represented with one from English, two from Math/Technology, and two from Science.

5.1.1. Beliefs

The teachers in this group felt that technology fit in “very well” with their teaching practices and “helped get different concepts across to the students.” When asked “What does technology integration mean to you?” one teacher responded, “That it’s seamless. That I don’t have to plan the day of technology. It’s there just like the chalkboard” [A30]. This was reflective of the way in which teachers in this group viewed technology. They did not spotlight technology available to them. Rather than describing specific software, hardware, or websites, they spoke of their curriculum and projects and the ways in which students learned and how technology benefited student learning. For these teachers, technology was not the focus of their curriculum; rather, the curriculum and the students were the focus, and technology was a method that made the content more meaningful to the students.

Another commonality among these teachers was the belief that students learn well in groups and from each other.

I feel they learn best within groups, with each other. That’s why I have the round tables so the students can work on solving problems. They often

like getting help from each other rather than calling for the teacher. I always see them asking each other for help. [A11]

Another teacher said, “I like it when kids help each other”. He felt that, “if you can have a kid show another kid how to do it, they’ll really remember it. And then they remember for years after that” [A15]. The classroom atmosphere allowed for interaction among the students and the teachers provided students with opportunities to work together and to help each other.

5.1.2. Motivation

The teachers in this group were enthusiastic educators and learners. They provided students opportunities to explore while seeking out opportunities for themselves. They used technology because it was “easy” to use and provided the opportunity to “learn so much”. They believed that there was a “wealth of information online that you can’t get in other places”. They felt that their students enjoyed using technology. It provided an avenue for “creativity”, and to “learn in different ways”.

The teachers in this group discussed barriers to technology, but were generally positive about access and availability. They were comfortable with using technology and found ways to overcome barriers to technology use. A teacher, who did not have computers in her classroom had “worked it out” with another teacher so she had regular access for her students. All the teachers in this group found ways to access the technology resources they wanted, whether it was time in computer labs, getting an interactive white board or getting use of specific software. They collected hardware and software, storing away materials for future use. They had projectors, computer monitors, CPUs, printers

and other assorted materials in their classrooms. One teacher said she was in the process of creating a small computer lab in her classroom with equipment she had collected.

5.1.3. Practices

Teachers in this group were active learners and participated in workshops, conferences and formal and informal discussions with others within and outside their work environment. These teachers had taken several workshops on technology use and were comfortable using technology. The types of workshops they had attended went beyond general “how-to” classes. “How-to” classes usually demonstrate how to use specific software and hardware at basic levels, such as “How to use the Internet”. The types of workshops in which these teachers participated included those on technology integration in the classroom, critical thinking with computers, and collaborative learning. These teachers also interacted with other professionals who, like them, were seeking meaningful ways of using technology. One teacher noted, “I find that going to conferences allows me to see what’s been made, what’s newly available and try to bring that back and incorporate that into my practice”.

The types and uses of technologies, by these teachers, included a greater variety than those in any of the other groups. These teachers were flexible in their classroom practices and were willing to try new things. These teachers mentioned use of iPods, gaming software, and remote response systems. They were willing to explore with their students and were creative in their teaching approach. A Math teacher used PowerPoint projects to relate “real life situations” to the students. A Science teacher described an interactive game she had brought back from a conference. She asked a student to explore it and come back with a report.

She's a nanobot and she rides in a little vehicle called a hyperion. Unfortunately it's attacked by white blood cells all the time because the body is assuming it's an invading thing. So, what it does is, it incorporates the content of biology into a game. And I gave it to a student to look at so they can teach me because I'm not a gamer. [A17]

Another teacher laughingly replied, "I don't know. Never did it before", to a question about what the outcome of a new project would be. The teachers in this group were comfortable with the technology and adapted it to their own curriculum. In observations, these teachers offered opportunities for lively discussions and interaction. Their classrooms provided materials for exploration. For example, in teaching the students about eclipses, a teacher showed the students a model. He explained the conditions under which an eclipse would occur, turned on a switch which lit up the sun and moved the earth and moon. During the class, he also showed them an animation of different types of eclipses on the interactive whiteboard. At the end of class, he told the students, "If anyone wants to come after school and play with it (the model), I'll show it to you"

5.2. Group 2: Technology integrating users

There were fourteen teachers in Group 2. They used technology in their curriculum on a regular basis and they all said that one reason they used technology was because it benefited their students. All three different schools were represented in this group. They had been teaching an average of fourteen years, ranging from two to thirty-four years and the subject matter they taught varied. Most of the teachers had used at least basic computer technology for their college courses. All of them had taken at least one professional development course related to technology in the classroom. Their

comfort level, in regard to technology use, varied as did their knowledge. Generally, they were more comfortable and more knowledgeable than teachers in Groups 3, 4, and 5.

5.2.1. Beliefs

All fourteen teachers in this group said that technology benefited their students. They identified a number of ways in which it benefited them. In the case of the interactive whiteboard, the visual aspect of the medium and student interaction helped “students grasp the material a lot quicker” [A29]. They were learning what they were “supposed to be learning and not wasting time getting frustrated” [A28].

Students can come up and move things around. One time I had a matching assignment that had all the words jumbled up on the SmartBoard. Students could come and touch the words and move them to the correct location.
[A29]

Teachers felt that students were comfortable with technology. They “grew up with it”; it is “their world” [A12]. “It just reaches them a little bit more and it keeps them a little bit more engaged.” One teacher expressed the benefits as follows:

I think there is better student achievement, higher interest, better classroom management, because they are more engaged. They love technology. They are very good with technology for the most part. So if we go to the computer lab to do a WebQuest, everyone is focused. They’re not even interested in talking or socializing. [A21]

The teachers in this group said the technology helped all students, whether they were in enriched, regular or special education classes. “They all seem to engage with it equally” [A25]. The teachers who taught special education students, either in inclusion classes¹⁶, or as a separate group, said that these students were more engaged when technology was used. One teacher who regularly taught challenged learners said:

¹⁶ Inclusion classes are regular education classes that include special education students.

The Special Ed. kids do better with multimedia. They do better with sound. I think because they have learning differences, you have to find different ways to reach them. So, pretty much do all the same things; more examples with them. [A31]

5.2.2. Motivation

All the teachers in this group said they used technology because they believed that it was suited to the content they taught. “It goes very well with what I do” was the general consensus. A Math teacher felt that the technology tools they had were “wonderful”. “The things that you can do, especially with Geometry, it’s the best thing to teach Geometry. You can do different things. You can move angles. You can rotate, flip, transformation.”

A Science teacher gave an example of how it was “very helpful” to her. “So for example, if I want to show movement of particles in a gas, versus a liquid, versus a solid. You see the animation which makes it come more alive, which makes it more clear to understand” [A21]. And, because the teachers felt the technology was suited to their content, “it makes everything so much easier, more interesting, and more engaging” [A21]. One teacher went as far as to say that the technology made her “a better teacher” and the “students better learners” [A24]; another said that because it was “so easy to use” and “everything was right there”, she “couldn’t live without it” [A6].

One teacher’s description of how his use of technology evolved and how “it was a real motivating force” is representative of this group.

The kids responded really well. It really helped teach the writing process, you know, editing, revising, and it’s so much easier to edit and revise on a computer than crossing it out and revising it. You know, you correct five mistakes but you make six new ones when you rewrite it. This really helps them. Especially kids who are less motivated and have a harder time. And a lot of times the kids in that class have a hard time just writing. Doing it

on the computer, they're very proud of their work and it's easier to check. So when I tell them to do this over, it's not as arduous. And the spell check helps. It's using the tools to help them become more motivated and more eager to do more because they're very proud of what they can produce. [A20]

5.2.3. Practices

All the teachers in this group said they used technology every day in their professional practices. They used it regularly with their students. All of them had at least one computer in their classroom. Nine of the teachers had interactive whiteboards and two had some other form of technology that allowed them to project from the desktop computer. They used the computer hardware and software provided to them by the district, both in their classroom and the computer labs. Their ideas for use came from colleagues, the Internet, professional development coursework, and administrators.

These teachers allowed students to regularly interact with technology. "I use the SmartBoard as my board and I like the students to be involved in that. It's not just a teacher tool; it's for everybody" [A22]. Just as with teachers in Group 1, these teachers were flexible in providing students with new opportunities and trying new things. They stated that they were aware that students were technologically savvy and these teachers were open to suggestions from their students. One teacher noted that, when she first got her interactive whiteboard, "we found things together". The students had experiences from interacting with technology in their other classes and they shared these ideas with the teachers who were comfortable accepting this knowledge from their students. The teachers in this group did not hesitate to use technology that was available to them even if it was new to them. A teacher who wanted to do a new project with her students did not let her lack of knowledge about the software deter her.

“Actually I had students help me. I had students who, through tech classes, knew how to do it and they were actually more familiar with Publisher than I was. So I had students help me show how to use the Publisher. [A31]

One teacher gave the opinion that teachers who did not regularly use technology with their students were lazy. “They’re depriving kids. They think it’s fluff. It’s like the bad teachers when I was a kid who just did lectures and handouts. That’s a bad environment.”

5.3. Group 3: Knowledgeable intermittent users

There were five teachers in Group 3. This small group of teachers was comfortable with computer technology. All but one teacher had at one time used technology more frequently, but they were now only intermittent users. They all used computers for their personal activities. They came from just one of the three schools. They had been teaching an average of nine years, ranging from one to nineteen years and the subject matter they taught varied. These teachers had been exposed to computer technology in their college courses or in professional development workshops. They had professors who used computers in the classroom. Their professors also required at least some minimal computer use of their students for research and presentation purposes.

5.3.1. Beliefs

Using computer technology with their students was not a priority for the teachers in this group. They said that technology could be engaging for students but, as one teacher said, “Lots of times the lesson just, it doesn’t fit”. The teachers felt that it was either not a good fit for their particular subject area or topic, or the students they taught. These teachers questioned “how helpful” technology was. All the teachers in this group

said that they did not regularly use computer technology for their teaching practices because it did not match their curriculum needs.

They did not use it equally with all their students. They either used it more with their enriched classes and less with their regular or inclusion classes, or vice versa. Two teachers in the group said they had used more technology with their enriched students, whereas three said they used it more with their learning challenged students. Their general feeling was that it did not work with a particular group of students or that the technology did not provide any additional support and was, therefore, not needed. A teacher who had used the interactive whiteboard with an inclusion class said it was “a disaster because we have kids who really can’t stay on track.” She used the interactive whiteboard to sometimes show visuals to her inclusion class. She felt that it was not needed for her enriched class. “For visuals more with this (inclusion) class, than like my other class is pretty swift. I show them a couple of things, we move on. They’ll probably just read this. I won’t put it up on the screen” [A23]. Another teacher who felt that technology helped her special needs students had, in previous years, shown video clips from *The Magic School Bus* series to augment her lessons.

They love it at this level. They love it. I’ve shown it before. I showed it last year at the end of the year about chemical changes. It was ok. There was another one with the earth. I used to show it at my previous school. Because the low kids, they’ll pick up a concept, they’ll make some connection to it. [A33]

Teachers who felt technology worked better with their enriched classes did not use it as much with their other students. One teacher described the difference she observed when using electronic slides with her students.

I've learned that, with the enriched class when I do lessons on PowerPoint, they seem to have an easier time with it when I have them copy notes off the PowerPoint. The other kids don't like copying notes so having to flip through the notes and actually sit and pay attention to a PowerPoint just doesn't interest them. [A7]

Another teacher said she had pulled out some of the technology pieces from her curriculum when she stopped teaching the enrichment classes.

Actually, I used to teach an enrichment class; I don't teach it anymore. It was all technology, the enrichment class. So I might read a piece with them about like time travel and maybe they would do a WebQuest. And then maybe do a presentation. [A35]

5.3.2. Motivation

Students, colleagues or administrators were not motivating factors for the five teachers in this group. They were aware that peers used technology, but felt that it was not a requirement of the administration. Their department chairpersons did not prioritize technology use. One teacher went as far as to say, "I think that they don't really care either way."

They were aware that their students were interested in using technology and used words such as "engaged", "familiar", "awesome", and "second nature". But this awareness of student interest was not sufficient to motivate them to integrate technology. One teacher had created a website at a previous school some years earlier. The website covered various topics in her subject area. When discussing her use of technology, she proceeded to go to the Internet to demonstrate the website. But she could not recall the exact location and took a few minutes to find it.

I've been really bad this year and I don't know why I haven't done it and talking to you now is making me realize I should. I'm going to do it

tomorrow. Because I haven't shown them this website this year and there's so much good stuff on it. [A33]

When discussing the webpage, she remarked, "I keep forgetting to use it".

Another teacher, who commented "I don't think it's that great" when asked about technology, expressed surprise that her students had enthusiastically completed an optional project.

I told them they could just come here and type if they wanted, write it neatly, I had magazines as well. Because, I just figured, some kids don't want to come up for lunch, or don't have a computer. So I gave them the option. It wasn't required that they had to use the computer. [A23]

The students came at their lunch time to use the computers in her classroom. "Most of them did. I was surprised. Most of them were able to very easily do that."

A third teacher in this group, who commented about computer technology that, "I think there's definitely overkill with it", said that she regularly used e-mail to communicate with parents. "I probably contact people and am contacted by them more because of the e-mail; because it's so quick. You could do it between classes. You're not playing phone tag". This same teacher used technology extensively with the students for extracurricular activities and was positive in her description of the activities and use of computers. She commented that she "definitely" thinks technology "keeps kids much more engaged" [A35]. But her classroom practices show limited use of technology.

These teachers did mention barriers to technology use, but were not enthusiastic complainers. They were all either "comfortable" or "very comfortable" with computer technology. They all mentioned the Internet as at least one source for curriculum ideas, including technology related ones. Barriers they mentioned included lack of access to computer labs, technology breakdowns, and limited time. One teacher mentioned that she

knew how to fix some of the minor problems. “I try to fix it first. Some of the things I know how to fix and that’s from dealing with them. They [technicians] would show me easy things. And then, sometimes it doesn’t work, and sometimes it does” [A35].

5.3.3. Practices

Even though these teachers were knowledgeable and comfortable with technology use, they used it infrequently. One teacher, who had in the past created a website that was of relevance to her subject, did not use the website any more. Another teacher who had created WebQuests in technology related workshops did not use it. These teachers were aware that, when they did use computer technology with their students, the students were engaged and enthusiastic. The teachers themselves were enthusiastic users of computer technology for their own professional needs. They used e-mail for communication with parents, found the grading software to be very relevant and used the Internet regularly for obtaining curriculum ideas. However, when it came to using the technology with their students, their practices did not meet their skill level.

5.4. Group 4: Limited approach users

A group of 11 teachers had a limited approach to their use of computer technology for their teaching practices. The teachers in this group were mostly from two of the three schools participating in the study. They had been teaching an average of nine years, ranging from one to thirty years. The subject matter they taught varied, though science teachers were not represented in this group. The teachers in this group had limited experience with technology in their college years. Most of these teachers had used computers in college but mostly with word processing software to type papers. Only two

said their professors had used some technology in the classroom. Teachers in this group also lacked professional development experiences. Only two of these teachers had taken a technology workshop since entering the profession.

5.4.1. Beliefs

Teachers in this group did not see the technology as a benefit to student learning. Rather, they described it as either having entertainment value for the students, or as a tool to visually “enhance” a project or activity. They used it to give students a break-time, or if there was extra time either at the end of a class period or in between units. A teacher described her most recent experience with technology use as, “Oh, we have two days before we start a new unit. What should we do? Hey, how about we go into the computer lab and let’s hope there’s something available” [A1].

For some of these teachers, the suggestion of “entertainment” associated with computer use was reason to limit use in the classroom.

The kids are like, ‘Can we use the SmartBoard today? Can we use the SmartBoard today?’. They get such a kick out of it. But I don’t think that I should have to write on it just to entertain them. [A2]

Another teacher described how the students came into the classroom asking, “Are we going on the computer today?” She said that “they don’t want to know what the topic is”. Instead, they were “more interested in ‘Yes, I can get on the computer’”. A teacher who had taken the students to the computer lab for the first time during the school year said they “loved it”. She commented, “If I did that everyday, they would be bored. If everything was like a TV program, they would be bored.” One of the teachers felt that the use of computer technology somehow

diminished her role in the classroom. She said the students should listen to her lectures and “take some notes” since that’s what they would face once they went to high school and college.

Teachers in this group provided students access to either a presentation or word processing software package because the end product looked nice. It was “visually pleasing” and “more professional looking”. The teachers felt this was pleasing to both teachers and students. One teacher noted, “Over the years the handwriting has not improved. It’s just easier to read and have” [A18]. Another teacher said that the students “are proud of their work” because of the polished look of their final product. Students first created rough drafts of their writing pieces or presentations. Once the rough drafts were completed, the information was then transferred to the computer. For one teacher, “the only benefit [to having computers in the classroom] is my kids can perhaps do their drafting and things right away on the computer” [A38]. One teacher described technology “as a tool to use for the students to finish up whatever you’re teaching them” [A8]. Another teacher described it as “just a means to complete a project”.

Teachers in this group also felt that the technology was burdensome, requiring extra work. One teacher said that she could “write on the blackboard faster than I can write on a SmartBoard”. Another commented that “You have to scan everything in” and another said that “It takes so long to do things”.

5.4.2. Motivation

School administration played a strong role in the decisions these teachers made to use technology. The main reason these teachers used technology was because they felt that the message they received from their school and district administrators was that they

should be using technology with their students. The message was either explicitly expressed in personal dialogs and at meetings or, the teachers felt, implicit in the actions of administrators, such as providing interactive whiteboards and computers in the classrooms. One teacher said, “They always say that they like it when you use technology in the classroom, like the SmartBoard or take the kids to the computer lab” [A1].

When asked if technology use was required, most of these teachers said it was not required, but a “goal” for the teachers was “to increase the amount” or number of times teachers used technology for their teaching practices. As a teacher with an interactive whiteboard in her classroom said, “I’ve had a joking comment here or there about, ‘so you using it yet’. And I’m proud to report that now I am” [A2]. Two teachers in this group said they were required to use specific software with their students and the school administrators were monitoring the progress students made. Before administration began to monitor student progress, one of the teachers had been using it in limited ways. But then administration provided training “and they said that they want to see the kids’ progress on it and they’re coming back to look at the scores”. These teachers now used the one specific software regularly with their students.

When asked, these teachers knew colleagues who used computer technology with students on a regular basis. However, the teachers in this group provided a number of reasons for their own limited uses. They felt the technology-using teachers had been given extra training, better access or better equipment, had fewer students in the classroom, or their students were more motivated, and so on. The teachers in this group had access to technology in their own classrooms. All had at least one computer with a presentation platform such as a large screen television or an interactive whiteboard.

However, these teachers felt that they were expected to use technology but were not provided with support. They pointed out that administration had not included them in the decision making and they were given limited training and technical support. The teachers in this group listed a number of barriers to their use of computer technology. These included difficulties gaining access to computer labs and equipment, and lack of training and lack of time to develop a curriculum that included computer use. These teachers also felt that their particular subject matter was not well supported by technology use.

The teachers in this group identified limited sources from which they got their ideas for technology use. Only three teachers identified other colleagues as a main source for ideas; however, these three were from the same department within the same school and identified the same limited uses. One small cluster of five teachers within this group, all from one school, identified the same computer technician as their resource for ideas. He was considered the “resident expert”. For two teachers, the technician actually taught the students how to use the software they subsequently used for the project. They looked to him not only for technical support, but for technology related curriculum ideas as well, even though he had no academic background in educational technology. Teachers who said they did not get their technology ideas from either colleagues or staff said they came up with their own ideas. One added that she had started using the website address printed in their classroom textbook. Another said “driving down the parkway” helped with ideas. A third teacher responded that “it depends on, like, who’s requiring us to use it”.

5.4.3. Practices

These teachers were not comfortable using technology. At best, they were at ease using computer technology for specific activities. They used it in only one or two ways,

repetitively, and seemed satisfied with their use. Their activities revolved around using a single website, or use of a specific software package or template. The limited ways in which this group of teachers used technology is reflective of the limited sources of ideas they identified.

These teachers lacked ideas and stated no interest in adding to their portfolio of ideas. Even teachers who had ready access to computers for all the students in their classroom used it mainly for typing final copies of papers and to create review materials for the students. One of these teachers, who used the overhead regularly, stated an interest in getting an electronic whiteboard. When asked why she wanted one, she replied that having one would benefit her. “It’s a waste of things like transparencies, what I spend in that. It would be so much easier if I could just have it all on a SmartBoard” [A37]. Teachers created electronic slides to present materials to students or had students create electronic presentations or flyers using presentation software. In two cases, teachers had created an electronic presentation for each unit in the textbook. After the students completed study of a unit, they went to the computer lab where they used the slides for a self-review. This activity occurred about once every ten weeks for one teacher. Another teacher said the only use for the large screen television in the classroom was when, once a year, the students watched a short video clip that had been downloaded from the Internet. The television was connected to a computer and its usual role in the classroom was as a display unit for “Do Now” assignments. The use of interactive whiteboards and television screens to display “Do Now” activities was common practice among the teachers in this group.

5.5. Group 5: Non-users

Group 5 teachers did not use computer technology for their teaching practices. There were only two teachers in this group. At first glance, they had little in common. They were from different schools with each school having its own demographic differences. One had been teaching for over thirty years and the other for less than half that time. One taught Language Arts and the other Math. One had taken extensive college coursework on using technology in the classroom and knew how to use it. The other had not taken any classes in technology use, either in college or via professional development opportunities. However, in spite of these differences, there were commonalities in their beliefs, motivations and practices.

5.5.1. Beliefs

The teachers expressed negative views on the use of computer technology in the classroom. They both expressed a concern about how the presence of computers changed their role in the classroom.

I can see the computer actually becoming the teachers. I can see that happening even though I would hope that it doesn't happen entirely. I'm hoping there's going to be the teacher in the classroom and the computer is like an aide, sort of as a complement to the teacher. [A27]

The second teacher felt she was "competing with tech media". She felt that it was not effective in learning; instead, in a short period, it would lose any positive effects it may originally have had. The potential positive effects were the enthusiasm and focus students initially exhibit when presented with the computer in the classroom. But soon after, "it loses its glitz" [A5].

When asked why they did not use technology, both noted that how teachers teach depends on the individual's style and personality. "I think every teacher has a different style. Every teacher has a different comfort level. And I think what happens is, after several years, you create your own style." Both said they had a traditional style of teaching. One teacher described herself as an "old-fashioned" teacher. The other teacher said, "More than likely, I modeled myself after many of the teachers that I admire and the teachers that I had when I was going to school". Both teachers also felt that age was a factor in technology use. The more seasoned teacher said that "the younger teachers are more comfortable" with using computers. The younger teacher noted that "older teachers are afraid of it" and that is why they don't use it.

Both felt that technology was more appropriate for subjects other than their own. The Math teacher noted that its use was more appropriate for English and History and the English teacher felt it was more appropriate for Math.

5.5.2. Motivation

Neither teacher felt influenced by the school administration or by colleagues to use computer technology with their students. One teacher said, "I would imagine if it [using computer technology] was mandatory, I would. But the fact that it isn't mandatory right now, I think that's one of the reasons why I've been doing this [teaching without technology]." Technology use was not discussed in either teacher's department. It's "not something that's stressed" in department meetings. However, both had opportunities for training and equipment provided to them by their schools. Neither had participated in the training opportunities or accessed the equipment provided.

Both were aware that they had colleagues who did use computer technology, because they had seen other teachers using it. However, there was little, if any, discussion with peers about technology use in the classroom.

5.5.3. Practices

Both teachers had a computer in the classroom, with an internet connection. Neither expressed any interest in getting more computer technology for their classroom. When discussing the interactive whiteboard, one teacher said, “I’m used to the paper and the pencil and the chalk on the board”. The other said that the “problem with technology is that it’s always changing”. She also felt that it slowed her down in her work. For both, the amount of work they felt that technology use required was a barrier. Both were comfortable with their existing teaching methods. When discussing e-mail, both teachers noted that they did use e-mail for personal communication, but they did not use it for communication with parents. One teacher said that “parents write things that they wouldn’t say in person” and so she preferred not to use e-mail as a communication tool.

5.6. Summary

Analysis of the discussions and observations of the teachers in this study identified some common beliefs and motivations among teachers with related technology practices. Teachers were grouped into one of the following categories: Group 1, Dynamic Users; Group 2, Technology Integrating Users; Group 3, Knowledgeable Users; Group 4, Limited Approach Users, and Group 5, Non-users. The characteristics of each group are summarized in Table 7.

Teachers in Groups 1 and 2 were identified as individuals who integrated technology and teachers in Groups 3, 4 and 5 were non-integrating. One notable difference between teachers who integrated computers and those who did not was their views on computer use and student learning. Technology integrating teachers believe that the use of computers in the classroom benefits all students in their pedagogic goals. Teachers in these two groups identify with the characteristics of individuals in Rogers' Early Majority, Early Adopter, and Innovators categories (Rogers, 1995). Teachers in Group 2 characterized a mix of Early Adopters and Early Majority. These teachers were not cosmopolitan, but rather remained local for their resources. Their network included other teachers and technical staff within the school and they looked to the district community for assistance with technology, including workshops, hardware/software availability and curriculum ideas. If opinion leaders were to be found, they were in this group. Some teachers in this group were identified by others as a source for ideas related to technology. Their technical grasp was not as strong as the Dynamic Users, but they were knowledgeable. This, along with a feeling of support from colleagues and technical staff, helped move them forward with technology integration. Similar to the Rogers' Innovators, the teachers in Group 1 did not limit themselves to the resources available at the school or district level. They went beyond and networked in more sophisticated environments. They were not necessarily the leaders in their school, but they played an important role by bringing new and innovative ideas into the school community. When teachers discussed colleagues who used technology, these teachers were identified. They were a knowledgeable group and were able to understand and initiate new ideas, as well as overcome setbacks or barriers.

Table 7. Beliefs, motivations and practices by group type

Group Type	Beliefs	Motivations	Practices
Group 1 Dynamic users	<ul style="list-style-type: none"> • Technology benefits student learning • Technology fits in very well with their teaching practices • Students learn well in groups and from each other 	<ul style="list-style-type: none"> • Technology was easy to use 	<ul style="list-style-type: none"> • Active learners who go outside their community and bring information back & share • Have training beyond basic technology education • Used a variety of technology available within their community and from outside • Flexible in their classroom practices
Group 2 Technology Integrating users	<ul style="list-style-type: none"> • Technology benefits student learning 	<ul style="list-style-type: none"> • Using technology is beneficial to their teaching goals 	<ul style="list-style-type: none"> • Used technology & resources available within their schools • Multiple sources for ideas • Allowed students regular opportunities to interact with technology in varying ways • Flexible in their classroom practices
Group 3 Knowledgeable Intermittent users	<ul style="list-style-type: none"> • Technology benefits some students in learning, not all • Technology was not always a good fit for their content 	Did not use regularly because <ul style="list-style-type: none"> • they are not required to use technology in the classroom • there are some barriers 	<ul style="list-style-type: none"> • Limited classroom use
Group 4 Limited approach users	<ul style="list-style-type: none"> • Technology does not benefit student learning • Useful for extra-curricular activities 	<ul style="list-style-type: none"> • Used it because school administration suggests use • Use is limited due to barriers 	<ul style="list-style-type: none"> • Used technology in limited ways
Group 5 Non-users	<ul style="list-style-type: none"> • Traditional teaching methods • Technology does not benefit student learning • Technology is not appropriate for their content • Age is a factor for whether teachers will use computers 	Did not use because <ul style="list-style-type: none"> • they are not required to use technology in the classroom 	<ul style="list-style-type: none"> • Did not use any computer technology with their students this school year. • Uses the blackboard and hand-written handouts

On the other hand, teachers who did not integrate believed that technology use did not benefit student learning at all (Groups 4 and 5) or that it did not benefit all students equally (Group 3). The Intermittent Users in Group 3 were knowledgeable and comfortable users of computers. However, their belief that not all students benefit from using computers was a factor in their limited use. Rogers discusses 'selective exposure' as an individual's interest in interacting with information that is consistent with their own attitudes and beliefs (Rogers, 1995). In the case of these non-integrating teachers, technology did not fit in with their beliefs and practices. As such, they had limited interactions about technology use, such as through workshops, collegial discussions or self-exploration. These limitations led to limited knowledge and use of technology, even though opportunities were available.

A difference in teaching philosophy was noted between teachers in the integrating and non-integrating groups. Teachers in Group 1 said that students learned well in groups and from each other. Teachers in Group 2 did not all state this but from classroom observations, it was noted that these teachers had the same view. Teachers in these two groups had fewer restrictions within the classroom. For example, in observed classes, students moved around in the classrooms and labs, conversing with each other. Students in these classes were engaged in discussion, among themselves and with the teacher. In many of these classrooms, the teachers had arranged their classrooms in less traditional ways. The teacher's desk was not the main focus in any of these rooms. The desks were off to the side or corner. Round tables or desks pulled together created separate spaces within the classroom. Students could gather in these areas and have discussions with the teacher or other students. Teachers in the non-integrating groups followed a more

traditional style of teaching, where students sat in their individual classroom seats and copied notes from the blackboard. These students followed directions given to them by their teacher. The classrooms were expected to be quiet areas of learning and the students worked independently. One teacher said she posted her “Do Now” list on the blackboard before the start of each class, and as the students came in, they knew to immediately start that work quietly while she took attendance.

Table 8. Average years of professional experience by group

Group	Number of teachers	Mean years of Professional experience
Group 1 Dynamic users	5	18
Group 2 Technology Integrating users	14	14
Group 3 Knowledgeable Intermittent users	5	9
Group 4 Limited approach users	11	9
Group 5 Non-users	2	*

**The mean is not noted for this group to protect the identity of the teachers in this group.*

Demographic data, specifically the number of years participants had been in the profession, provided evidence that teachers in the technology integrating groups had on average, been teaching for more years (Table 8) than non-integrating teachers. Teachers

in Group 3 and 4, both non-integrating, each had an average of nine years of professional experience. In Group 1 and 2, this increased to 14 and 18 years, respectively. Group 1, the Dynamic group, had worked the most number of years in the profession. Group 15 teachers were also the only group to have all taken technology-related professional development training beyond the basic beginner level.

Table 9 shows the number of teachers in each integrating group and their schools. Groups 1 and 2 are technology integrating and Groups 3, 4 and 5 are non technology integrating. More than three-fourths of the teachers at school A, 14 of the 18, were categorized as technology integrating teachers. In school B, only two of the nine teachers were technology integrating, and in school C, three of the ten teachers were. What were the differentiating factors that could explain these differences?

One answer could be ‘support’. Organizational support has been shown to be an important factor in technology integration (Pelgrum, 2001; Rogers, 2000). The resources available to the teachers at the three schools varied. In terms of building support, there was no technical help available to teachers at school B. Teachers at this school also did not have department chairs. At school C, there was technical help within the computer lab. Some of the teachers had department chairs but for these teachers, interaction was limited. As one teacher, who still had a department chair noted, “We don’t come together in a school so big”.

School A had some technical support in the labs and some support by way of a technology facilitator who visited the school on specified days. All teachers in school A had department chairs, and all the Mathematics and Science teachers at this school who participated in this study, mentioned that their department chairpersons provided them

with support in their technology integration practices. All eight of these teachers are in one of the two groups of teachers who integrate technology (Groups 1 and 2). This is important to note since, of the remaining six Math and Science teachers from the other schools, only two were in the integrating groups. Also, Becker's study (2001) noted that Math teachers were the least likely to use computers.

Table 9. Number of teachers in each school by technology group

		School			
		Group	A	B	C
Integrating Groups	1	4	1	0	
	2	10	1	3	
Non-Integrating Groups	3	1	3	1	
	4	2	4	5	
	5	1	0	1	
Total		18	9	10	

Analysis of interview data of the two department chairpersons provided insight into their technology beliefs and practices as it related to the teachers. Both of these Mathematics and Science department chairpersons were comfortable using computer technology and both used it regularly. They were both open to new ideas and introduced these to their teachers. The Mathematics chair had introduced his teachers to new Mathematics software, affording them opportunity for training on it as well. The Science chair was the first to use new communication technology to bring together her teachers in two different locations.

Both chairs discussed the technology in terms of helping the students. The Science chair said “I just like technology” and felt that computer technology fit Science. “There’s stuff out there on websites, many of them free that are interactive that really help to get the concepts in science across and are really, really effective” She said, “most children really love technology. They may not like science. But if you give them a project that’s technology based” the students were engaged in learning. She discusses different projects she has introduced to her students. About one she says, “They had such pride in it. And it was only because of the technology. ... They worked so hard at it. Did they learn? I think they learned more than they could have ever possibly learned through any other way.”

The Mathematics chair felt that certain types of technology fit well, such as the Mathematics software introduced to the teachers and the interactive whiteboard. The teachers would do better with the students if they had “them use technology to solve problems instead of just create projects”. He discusses his use of the interactive whiteboard with his students.

One thing I like is ordering rational numbers, ... And then very visually they can move around and debate where it should go, it’s a really interactive way to use the number line. I think both those topics lend itself. ... a lot of times I just quickly print out our work [from the whiteboard] and it’s like you have to respond to it. ‘What did we do? Why did you do this?’ It’s also a record of our work.”

He felt that the interactive whiteboard was “a very special tool” for Mathematics. “I think SmartBoard can capture and record our lessons, make a record of it. Those files can be shared with your students the next day, with other teachers. And just some of the SmartBoard software from the Mathematics perspective. You know there are a lot of tools, drawing tools and line tools.”

Both chairpersons actively communicated ideas to their teachers. The Mathematics chair said he preferred meeting with the grade-level teachers in person, rather than sending out e-mails. He also used the school network to share his ideas.

I think that's another nice thing. We have a T-share. We have a network. We put common lessons there, ideas there. I often print out the visual work that happened during the lesson and I'll print it, and jot some notes on it. 'I used this number and that made them think of this' you know just for your information and I give it to the teacher."

The Science chair used e-mail heavily since her teachers were spread out among three different buildings. She also sent out regular newsletters with news and ideas for the teachers. There were regular department meetings as well.

The two chairpersons described here illustrate technology integrating practices and these practices have influenced the technology use practices of their teachers. As administrators who were also teachers, the two chairpersons described here were sympathetic to barriers their teachers faced in using technology. As experienced users of technology, and users within the same environment, they were able to provide guidance that their teachers identified as adding value to their technology experience.

Does movement from one group to another occur or are these groups static? And if movement is possible, under what conditions could such transfer occur? Four of the five teachers in Group 3 (Knowledgeable Intermittent users) acknowledged that at one time they were regular users of technology. Whether they were technology integrators is not clear. However, at the time of this study, they described themselves as limited user. They did not feel that computer technology matched their curriculum needs and they questioned "how helpful" it was. Rogers (1995) discusses *discontinuance* as the rejection of an innovation after having previously adopted it (p. 182). He specifically notes that

disenchantment discontinuance occurs when an individual is dissatisfied with the results of using the innovation. The dissatisfaction leading to rejection can result from outcomes not meeting levels of perceived relative advantage over alternative methods. Rogers also suggests that discontinuance could result from misuse of the innovation, whereas proper use could have resulted in positive results.

Rogers' category of users labeled *late majority*, adopt an innovation as a result of economic need and pressure from peers. Availability of resources is also important to this group's decision to adopt. Teachers in Group 4 (Limited Approach users) are described as a group with limited experience, professional development and ideas for technology use. Given this description, it is not surprising that their practices were limited as well. In comparison to Rogers' group, these teachers said they used technology because of administrative pressures. They felt that barriers prevented them from integrating technology.

Both Group 3 and 4 teachers discuss barriers to technology integration including professional development and support. As already noted, such support is important in the integration of technology. Supporting them by providing them with tools that assist them could be a path to moving these teachers to integrating groups.

6. Discussion

This chapter consists of two sections. The first section discusses the evidence related to technology integrating teachers. The next section discusses the significance of teacher belief to technology integration.

6.1. Beliefs, motivations and practices of teachers who integrate technology

Analysis of the data provided significant insights into teachers and their understanding of technology integration. As discussed in the previous chapter, teachers can be grouped together based on their level of technology integration. Keeping the focus on effective teaching, the findings discussed below are specific to teachers who integrate technology (i.e., teachers in groups 1 and 2). Data from the non-integrating teachers also lends credence to these conclusions.

6.1.1. They provide rich descriptions

Teachers who integrate technology use rich, descriptive expressions to define the concept “technology integration”. These descriptions are also reflected in their teaching practices.

Teachers were asked to define “technology integration” because it was presumed that these definitions would provide a path to understanding their technology beliefs and practices. As they defined technology integration, teachers provided descriptions of their

own computer-use practices, or practices they understood to be technology integration.

Whether or not their definitions were reflected in their classroom practices was confirmed by further discussion and observation.

The research literature discusses the practices of teachers who integrate technology. Some describe these as “exemplary” users of technology who:

“..directly addressed curriculum goals by having students use a wide variety of computer software, including simulations, programming languages, spreadsheets, database programs, graphing programs, logic and problem-solving programs, writing tools, and electronic bulletin-board communications software” (Becker, 2000, p.274).

Hadley and Sheingold (1993) state that technology integration “requires that teachers readily and flexibly incorporate technologies into their everyday teaching practice in relation to the subject matter they teach” (p.265).

The practices of such teachers are presented in the research literature as being aligned with either learner-centered beliefs or constructivist practices (Grove, et. al., 2004; Becker, 2000; Cadiero-Kaplan, 1999; Grabe & Grabe, 1996; Hadley & Sheingold, 1993; Prawat, 1992). In the school environment, technology-integrating teachers provided their students with opportunities to explore and develop their own knowledge. They do not follow the traditional teacher-student model, where the teacher is the only purveyor of information and the student the passive recipient. Instead, they use a learner-centered approach, where there is a free flow and exchange of ideas from both teacher and students. These teachers are knowledgeable facilitators and resourceful providers. They also understand their goals and see the link between their curriculum and the technology. They embrace the use of technology, incorporating it into their curriculum, and perceived it to be beneficial in creating a rich learning environment for their students.

Clearly, the teachers in this study who did integrate computer technology (i.e., those in Group 1, Dynamic Users, and Group 2, Technology Integrating Users) defined technology integration in terms that corresponded with the described practices of exemplary teachers with constructivist practices. Teachers in this group defined technology integration as a practice where computers were used to bring “new ideas to students”, as “seamless”, providing students with “different ways” of learning, “part of the learning process” where “it’s part of the classroom” and “it all comes together for an incredibly powerful teaching learning tool”.

In-depth discussions with these teachers regarding their technology practices provided multiple examples of the ways in which they use computers with their students. They described their efforts at creating environments where the students had various resources and opportunities for learning. They used an “inquiry approach” where students “discovered the information on their own”; the students “actually touch it, and count them and move it, versus just putting a point on a piece of paper or something”; “a multi-faceted environment”; “you show it from a bunch of different angles and kids get it much better”; “an associative view”; an environment with “technology, computer, visuals, things going on, different ways to research things instead of just a book”.

Classroom observations of teachers in Groups 1 and 2 confirmed that their definitions and descriptions of technology integration were aligned with their teaching practices. Constructivist practices provide the teacher the opportunity to make the subject-matter relevant to the students’ lives. These teachers were aware of this need. Their projects and curriculum reflected this. In a technology class, students were learning computer tools by creating materials related to their career interests. In a Math class,

students created brochures for retail stores selling their items of interest. These teachers used computer technology regularly in their classrooms and created opportunities for students to interact with the technology. Teachers were knowledgeable in their content area and comfortable in their teaching environment. Students were allowed to share information with other students, working in groups or providing assistance to others, including the teacher. Teachers were flexible in their classroom management, providing students with the opportunity to explore and express themselves.

Teachers in the other groups (Groups 3, 4 and 5, Knowledgeable Intermittent Users, Limited Approach Users, and Non-users, respectively) were teachers with non-integrating practices. Their definitions of technology integration lacked the rich description provided by the teachers in the integrating groups. Teachers in these three groups repeated the term “integrate” in defining technology integration (e.g., “It would mean integrating technology into my lessons”), mentioned frequency of use, (e.g., “..trying to use it as often as I can..”) and even offered the view that there was too much focus on technology use in the classroom (e.g., “I think there’s definitely overkill with it”). In discussions with these teachers, they did not provide multiple examples of specific practices as had teachers in the other groups. There was a range of knowledge among these teachers on the availability and use of computer software and hardware that would support their pedagogic practices. However, just as their definitions lacked clarity and their discussions were limited in scope, their classroom practices using computer technology lacked the variety and richness observed in the integrating groups.

6.1.2. They overcome environmental barriers

Teachers who integrate computer technology find ways to overcome environmental barriers.

The research literature describes a number of barriers to teachers' integration of technology (Ertmer, et. al., 1999). These barriers include lack of resources, such as computer hardware/software and technical support (Dreyfus, Feinstein, & Talmon, 1998; Dwyer, Ringstaff & Sandhotz, 1991), limited professional training opportunities (Bauer et al., 2003; Smerdon et al., 2000) and lack of administrative involvement (Staples, Pugach & Himes, 2005). With increased expenditures on technology and technology support, including professional training, these types of environmental barriers have been slowly diminishing. All three schools in this study had computer labs for teacher use and classrooms with at least one Internet-connected computer. All three schools also provided some level of technology support. Teachers in these schools also had professional technology workshops offered to them through different venues.

Teachers from all five groups in this study, those who integrated technology as well as those who did not, spoke of barriers within their environments. These included lack of access to computers, training issues, lack of support and lack of time. All teachers in the technology integrating groups (Dynamic Users and Technology Integrating Users) mentioned ways in which they overcame these barriers. Several noted that these barriers affected the use of technology by other teachers within their school community. For example, one teacher gave examples of teachers who could not use computer labs because the particular time slot was always filled; another said that teachers were limited by the administration in the variety of software they could use. However, these teachers

did not perceive the barriers as obstacles to their own use of technology. Rather, they found ways to overcome these barriers. The teachers in Group 2 (Technology Integrating Uses) established relationships within their school community that offered them opportunities to access and use technology. Teachers in this group knew other teachers who had specific equipment they could borrow and they took technology workshops offered to teachers, even if they were outside their department. These teachers were also more likely to have interactive whiteboards in their classrooms. Teachers in Group 1 (Dynamic Users) went even further. Group 1 teachers negotiated time on computers with other teachers, whether in a computer lab or a classroom with computers; they brought in their own hardware and software; and they learned to repair breakdowns in equipment. They attended workshops and conferences outside their school community and brought this information back to their own schools, sharing it with administrators and colleagues. As one teacher noted, she belonged to “a bunch” of groups and was active in them. Teachers in both Group 1 and Group 2 found ways to overcome barriers within their environment and integrated computer technology in their classrooms.

6.1.3. Technology is beneficial to students

Teachers who integrate computer technology believe that computer technology is beneficial to student learning.

Teachers’ beliefs regarding the use of computer technology in the classroom impact their technology integrating practices. One consistent belief among the teachers in Groups 1 and 2 (Dynamic Users and Technology Integrating Users, respectively) was that computer technology benefited student learning. Teachers in this study who integrated computer technology, when providing reasons for use, specifically noted that

student learning benefited from technology use. Teachers said “it stays with them a little more”, there was “better student achievement”, it “makes the students better learners”, “they grasp it more” and “it’s so effective”.

Constructivist practices provide students with lessons and activities that encourage higher-order thinking and problem solving where students construct their own knowledge. Technology integrating teachers in this study provided such opportunities to students. In classroom observations, these teachers provided opportunities for active learning and discussion. Students researched topics, developed projects and presented these to their teacher and classmates. For example, a Science class was observed as students searched for information related to soil samples they had collected at home. This information would be later presented to their class.

Teachers who did not integrate, did not believe that student learning benefited from technology. Instead, these teachers said they used technology because “it’s fun”, “they enjoy it”, it “looks nice”, “to show visuals” and because “it’s required”. Discussions and observations demonstrated that those non-integrating teachers who did use computers with their students did so to manage student behavior in the classroom, for extra-curricular activities in between lessons, and for quick projects that demonstrated that they were using the technology made available to them in the classroom or in computer labs.

These teachers who do not integrate had more traditional styles of teaching. They wrote notes on the blackboard for students to copy. Even those who had an interactive whiteboard used it to present notes. It was a teacher-centered approach where students learned directly from information the teacher provided. The teachers had more control of

the students, the curriculum and the way it was taught within the classroom. The research states that even teachers with technical expertise are reluctant to adopt technology when they prefer the traditional classroom (Sandhotz et al., 1997; Hannafin & Savenye, 1993; Cuban, 1986). Such teachers perceive technology to be an extra, or a supplement to classroom activity and not beneficial to learning (Angers & Machtmes, 2005, Ertmer et al., 1999).

6.1.4. Technology fits well

Teachers who integrate computer technology believe that it fits well with their curriculum and teaching practices.

Just as the teachers who integrated technology believe that its use benefits student learning, these teachers also believe that its use fits in well with how they taught and what they taught. Teachers in this study were asked the question, “How well do you feel technology use fits in with the way you teach?” All teachers in the two technology integrating groups said that technology fits well with their teaching practices. Discussions with these teachers and observations of their classroom practices supported their statements. They were comfortable using technology with their students. These teachers used technology for classroom teaching, as well as to provide opportunities for their students to use computers for creating and exploring curriculum-related topics. They used a variety of technology resources, basing it on their curriculum goals.

For the ‘Dynamic’ teachers in Group 1, interviews and observations revealed that they provided students with an enriched environment. Within constructivist environments, teachers are guides and facilitators to student learning. These teachers had students work on more project- and group-related activities, where the students had the

opportunity to learn from their own discovery and from each other. These teachers did not feel that they had to be masters in their own classrooms and they created an environment where students were comfortable asking and answering questions. Their classrooms had a variety of equipment, including subject-related educational models and toys.

These teachers easily manipulated the tools in their environment, including computing technology, to achieve their goals. A clear example of this is an English teacher describing his many uses of computer technology during a classroom discussion of a novel set during the Great Depression:

The kids were asking about the Great Depression and they were kind of questioning the Great Depression ... So what I just quickly did was, I had them independently work for a moment and then I pulled up a couple of files that I had stored about the Depression. I showed them pictures of kids, things like that. And that gave them a flavor for what was going on.
[A30]

There were some teachers in the non-integrating groups who said that technology fit well with the way they taught. These teachers, however, described a limited number of specific uses and used these methods repeatedly. They were generally comfortable using it in these practiced ways. For example, one teacher gave students access to Microsoft Word to type letters they had already handwritten. She was comfortable using the software application and it fit in well with the letter writing activity which was already a part of her curriculum. However, this was the only computer application she used and the only type of activity for which she used it. Another teacher used Microsoft PowerPoint to create slides of her notes and present these to her class on the interactive whiteboard. Here again, this was the only application and method used by this particular teacher.

These teachers used technology in isolated instances and not as part of an integrated curriculum.

Earlier research has discussed changes in teaching practices based on the introduction or use of technology in the classroom (Becker & Ravitz, 1999; Hadley & Sheingold, 1993). The teachers in this study did not state that their beliefs or practices had changed as a result of using computer technology. Rather, the teachers who integrated technology said they believed that technology use fits into their existing teaching practices and their content area. Their comments suggested that using technology aids them in achieving their existing goals. They commented on how it provided them with more tools to teach, made their professional practices easier and assisted in student learning.

6.2. Teacher belief: a factor to integration

This study selected participants who had experience with computer technology. Level of knowledge or practice was not a criterion. With this approach, teachers with a range of beliefs and practices were examined. This also provided the opportunity to examine teachers individually, create groups based on their commonalities and study the differences between groups.

Findings from this study indicate a pattern of practice based on teacher beliefs. Beliefs about gains in student learning were a particularly strong impetus for technology integration. Teachers who integrated technology believed that technology use helps their students learn. On the other hand, teachers who did not integrate technology believed that it does not help students learn. Such beliefs are barriers to integration even with

experienced teachers. It limits their experience and knowledge of technology, as well as their ability to clearly conceptualize what to apply in the classroom (Stein, McRobbie & Ginns, 2002).

This vague conceptualization of technology integration is evident in the non-integrating teachers in this study. Whereas teachers who integrated were able to provide rich, descriptive definitions and examples of their understanding and practices of technology integration, the non-integrating teachers were not. These teachers' beliefs, related to the effectiveness of technology use in student learning, negatively affected their interest and experience. They did not take classes beyond what was required within their school community. Their resources for assistance and knowledge were in most cases technical, non-pedagogic staff. They did not take extra workshops, explore with other teachers, or ask for more technology-related resources as the integrating teachers did. These experiences lead to the limited definitions and examples they provided when asked to conceptualize technology integration.

Earlier studies have noted that it takes time to learn how to integrate technology into the curriculum and that professional experience is an important element (Abrami, 2001; Hadley & Sheingold, 1993). This was evident in this study. Teachers who integrated did have, on average, more professional experience. This finding is perhaps an indication that, as teachers gain experience in teaching their own content, they are more open to exploring the use of other tools, including technology. However, if teachers do not see the benefits, use will be limited. The non-integrating teachers, including those who were comfortable with technology use, held the belief that technological innovation would not provide any advantage over their current practices (Rogers, 1995).

Beliefs related to teaching style are also important to the differences between integrating and non-integrating teachers. In this study a difference in teaching styles (traditional teacher-centered versus student-centered) was evident between integrating and non-integrating teachers. Previous studies have noted that computers are mostly used by teachers with constructivist views within a student-centered learning environment (Newhouse, 1999; Hannafin & Savenye, 1993). In this case, teachers in Group 1 and Group 2 expressed views that were aligned with constructivist, student-centered practices. An example of this was a Group 2 teacher who was observed using laptops in the classroom. Students included small groups and independent users. They had discussions with the teacher and with each other as they maneuvered websites that helped them explore and answer questions.

In the case of non-integrating teachers (i.e., Groups 3, 4, and 5), they were primarily concerned with completing their curriculum goals and class management; discussion and observations suggested a teacher-centered approach with this group. An example of this was a Group 4 teacher who stated that “she hasn’t totally embraced it (computers)”. She felt that the students “behave better on the computer” and she knew there was a “babysitting component” to it. When the “kids get wild” she did “give them that opportunity to just give myself a break and get them focused on something.” This was with her challenged students. For the advanced class, she did not use computers at all. Teachers with beliefs aligned with traditional methods need more structure and feel they must direct the class. When they try to integrate technology, the conflicting belief/practice can lead to limited use or abandonment of technology use (Henry & Clements, 1999). Previous research has suggested that educators’ beliefs are stronger

predictors of decisions and behavior than is their knowledge (Pajares, 1998). This study corroborates those findings. The Group 3 teachers were knowledgeable about technology, but felt that technology did not fit their teaching practices and so did not use it.

7. Summary and Conclusions

The purpose of this study was to examine middle-school teachers' perceptions of the term "technology integration" and identify the factors that had contributed to their understanding. With this study, the approach to directly speak with teachers regarding their technology practices was used to provide more meaningful results. Three questions guided the study:

1. How do teachers define "technology integration"?
2. Is their definition of "technology integration" reflected in their teaching practices?
3. What factors contribute to how teachers define "technology integration"?

Differences were found in how teachers define "technology integration". Teachers who integrated technology described the concept and their practices using multiple examples, expressive details and affirmative assertions about its benefits. On the other hand, teachers who did not integrate were limited in their expressions. They had few examples of the ways in which they used technology. They lacked variety in the tools they used and in their classroom technology practices. They were not enthusiastic about its use and did not find it beneficial to their curriculum goals.

Observations of their classroom practices showed that their definitions and descriptions of "technology integration" were reflected in their teaching practices. Teachers who integrated technology into their curriculum used it to support their curriculum goals while providing students with the opportunities to share and learn from

each other. They were comfortable in their practices and in uses with their students. Teachers who did not integrate were observed using technology in limited ways. For example, they used the interactive white board to display class notes or the “Do Now” assignments.

Teachers defined “technology integration” based on their technology experiences. From the discussions, it was apparent that teachers who integrated technology had numerous experiences. They were involved in practices that provided them the opportunity to learn from a variety of sources. They were active learners and searched for chances to gain new insights. They shared what they had learned and also incorporated these into their teaching practices. Teachers who did not integrate, even those who were comfortable using technology, were limited in their expressions. Their limited expressions were reflective of their limited uses of technology with their students.

Teachers continue to use technology in limited ways (Cuban, 2001). Barriers noted in earlier studies, particularly those related to environmental resources, such as limited hardware and software and access to the internet, have been diminishing (Anderson & Becker, 2001; Kleiner & Lewis, 2003; Smerdon et al., 2000). Teachers in this study gave a number of such reasons for limiting the integration of technology in their classrooms. Availability and access were still discussed as barriers. They noted that the types of hardware and software available to them were limited to what was selected by administration with no input from teachers. The purchase of technology was not based on formal assessment of needs of teachers. Teachers who were required to use specific software, and did not want to, either limited their use or reinvented use (Johnson & Rice, 1984; Rice & Rogers, 1980). They felt training was inadequate. When provided by the

district, it was usually basic and not connected to curriculum goals. Helpful training was described as providing teachers with opportunities for hands-on practice, was content oriented and was related to curriculum goals. Teachers who had administrative support from their immediate supervisors said that support was important to their technology practices. The beliefs and practices of these administrators are critical to integration as was illustrated by the role of the Mathematics and Science department chairpersons at school A. Teachers in this study also noted that state mandated testing was a barrier to technology use. Expectations from administrators related to test preparation and goals were time consuming and stressful.

Based on commonalities in their beliefs, motivations, and practices, teachers in this study were categorized into five groups (Group 1: Dynamic; Group 2: Technology integrating; Group 3: Knowledgeable intermittent; Group 4: Limited approach; and Group 5: Non-users). The commonalities were based on teacher beliefs, motivations and practices. Dynamic teachers (Group 1) believed that technology in the classroom benefited student learning and that it fit well with their teaching practices, which included students learning from each other and in groups. They found technology easy to use and gathered information about uses from a number of different sources, within and outside their academic community, and shared this with others. Technology integrating teachers (Group 2) also felt that student learning benefited from technology use. They felt it fit well with their teaching practices and had multiple sources for ideas. Teachers who integrated technology followed constructivist practices. They provided their students with opportunities for meaningful learning, and lessons that encouraged higher-order thinking

and problem solving. They were facilitators in the classrooms, guiding their students to discover.

Teachers in the other three groups, Knowledgeable intermittent, Limited approach and Non-users, believed that technology was helpful, but not always beneficial in student learning. Technology also did not always fit well with their content and practice. They felt barriers hindered their use, and their practices were limited. With these beliefs, they provided only limited opportunities to their students in the ways they could learn and the tools they could use.

The findings in this study point to the importance of beliefs to teacher practices, as it relates to technology integration in the classroom. Prior studies have found that teacher beliefs can play an important role in technology integration (Becker, 2001; Sandholtz et al., 1997; Hannafin & Savenye, 1993), and this study's results corroborated those findings. The rich expressions of those teachers who integrated, illustrated a conceptual understanding of technology integration as presented in the research literature of exemplary and technology integrating teachers (Angers & Machtmes, 2005; Becker, 2000; Hadley & Sheingold, 1993; Grabe & Grabe, 1996; Sheingold & Hadley, 1990). On the other hand, the teachers who did not integrate technology and believed that it did not benefit student learning, were limited in their expressions. If teachers do not believe that it is beneficial to their goals (i.e., if it conflicts with their beliefs), they will not integrate technology into their teaching. As a prior study of non-adoption found, teachers did not adopt because they found computer use to clash with their values and beliefs regarding the "nature of knowledge, the nature of learning, and the nature of the relationship that they wish to maintain with students" (p. 171, Stocker, 1999). Pajares (1992) notes that

beliefs are important to defining behaviors and to how knowledge and information is organized. By using a qualitative approach and providing teachers the opportunity to express themselves, the importance of teacher beliefs as those beliefs relate to their use of technology was observed in this study.

7.1. Limitations of the study

Lincoln and Guba (1985) state that “generalizations are assertions of enduring value that are context-free” (p. 110). Since this study examined specific teachers, and their practices were influenced by contextual variables, a limitation of this study is that findings cannot be generalized to other settings. However, Lincoln and Guba (1985) discuss “fittingness”, relying on the degree to which two contexts are similar.

Transferability could be applied based on the “thick description” provided. However, to apply conclusions from one context to another, it means that both contexts need to be understood.

In this study, participants were from three schools in New York State. Also, only middle schools were included in the study, leaving out elementary and high schools. Limiting the study sites to only middle schools restricts the “fittingness” aspect of the study. However, only middle schools were selected to allow for homogeneity in the environment, schedules and materials taught. In this way, analysis of teacher discussions and observations of their teaching practices was more contextual.

Schools were selected to try to represent the various characteristics detailed in an NCES report which suggests a relationship between certain school characteristics and technology availability and use among teachers (Smerdon, et. al., 2000). However, the data collected in the three schools in this study did not support the relationships indicated

in the report. The NCES report indicates a relationship between the availability of technology and certain school characteristics. Teachers in schools with less than 1000 students or less than 50 percent minority were more likely to have computers available to them. The schools in this study were selected based on differing characteristics; however these correlations on availability were not observed.

The goal of this study was to better understand teachers' views of technology integration by speaking to them directly and observing their technology use practices within their teaching environment. The primary focus of the study was the perceptions of the teachers in regard to their environment. As such, data regarding technology resources within the individual schools was limited to what could be observed by the researcher during visits to the schools and interviews with teachers. The researcher also spent time discussing technology resources with non-pedagogic staff, including administrators and technical staff, to gauge the quality of data collected from teachers. Field notes were made of observations of the three schools and included diagrams of labs and pictures of classrooms. However, such observations were not sufficient to develop conclusions. Collecting 'official' documents related to equipment and use from the Technology Department would have perhaps pointed to environmental factors related to integration practices; however, there was reluctance to offer such information on the part of one school, and so it was decided that gaining access to schools and teachers was of much greater importance. Thus, while multiple data collection methods were used, there were still limitations on the data available for analysis.

The potential for researcher bias is also a limitation of the study. The researcher is a certified teacher with personal beliefs regarding the effective use of technology within

her own curriculum. Steps in data collection and analysis were taken to minimize the effects of such bias. An interview and observation guide was used to collect data. Tables were used for data analysis. Member checks and peer debriefing provided validation of data and credibility, respectively. In this way, each participant's information was charted based on concepts as they emerged using coded names.

7.2. Implications for further research

In this study, teacher beliefs are shown to be an important factor in teacher integration of computer technology within their curriculum. If beliefs are important to decisions that teacher's make and, as suggested by Bandura (1997) if self-efficacy beliefs are the best predictors of motivation and behaviour, then research in this area is relevant. Pajares (1992), in his reflections on past research related to beliefs provides some suggestions for further research. Relevant to teacher education and to schools is the view that beliefs form early and are self-perpetuating. He states that the earlier a belief is adopted, the more difficult it is to change. Several teachers in this study suggested that they had picked up their beliefs about teaching from their own teachers. Further research on the effect of teachers' integration of technology on student beliefs can provide more insight. And what about the teachers in this study? What was the catalyst that formed these teachers' beliefs regarding technology integration? In particular, what influenced the beliefs of these integrating teachers? Teachers said that they could see the difference in student learning. Is this sufficient motivation to integrate technology? Will teachers who have a traditional approach adopt technology integration if they see that there is a positive influence on student learning? What about the impact of supportive versus non-supportive environments on technology integrating teachers? In this study, one school

was observed to have more technology resources available than the other two schools. There were also more teachers in the integrating groups from this school. However, data directly addressing this question was not collected in this study and , thus, it remains an open research question.

7.3. Implications for practice

Transferability (Lincoln & Guba, 1985) provides the basis for suggesting some approaches that may help teachers and administrators create environments for better computer technology integration. Transferability is the responsibility of users of the results, but some possibilities are suggested here. First, teachers need to be included in technology decisions. When teachers are included, the chance of integration is better (Sandholtz & Reilly, 2004). Teachers in this study strongly expressed their discontent with not being included in such decision making. As a result, expensive technology was either not used or used in limited ways. Part of including teachers in this decision making is a formal needs assessment that would help identify and evaluate needs. Discussions with teachers, technicians and administrators showed a lack of any such analysis before expenditure for technology was made. Teachers were also unaware of how decisions were made regarding who got which technology. One such example was the interactive whiteboard. Most teachers said they did not know why they were given one as compared to some other teacher in the school. Such seemingly arbitrary distribution created ill-feeling between teachers and departments.

Second, teachers continue to have limited opportunities to experience technology integration during pre-service or in-service training. Only a small number of the participants in this study said they had professors who had used technology for teaching.

Professional development lacked depth and was not based on needs, but rather on the assumptions of the administration. Teachers who had training were shown the mechanics of using the tools. The training should be content specific, so that once teachers are comfortable with the tool, they have ideas on how to use it in their specific subject-area. Teachers in a Mathematics department at one school suggested their satisfaction due to the specific training they had received.

Collegiality seemed to be important to these teachers in gaining new knowledge. Teachers said they got ideas from speaking to and observing their colleagues. Modelling behaviours and attitudes is important to learning. According to Albert Bandura (1977), observation of modelled behaviour is how most behaviour is learned. Providing opportunities for observing such behaviour can give teachers more experiences with technology.

The purpose of this study was to examine teachers' understanding of the concept "technology integration". Using qualitative methods provided rich data that helped provide a clearer perspective. Integration occurred in the classroom when teachers used computer technology tools to provide students with learning opportunities that met curriculum goals. Students and teachers collaborated on a variety of activities where exploration led to new discoveries and conceptual understanding of subject matter.

In this study, teachers' individual beliefs about student learning and about their own teaching styles were two important factors in decisions about technology use. Teachers who integrated technology showed a knowledgeable understanding of technology integration that was aligned with constructivist and student-centered teaching practices described in previous research literature.

Appendices

Appendix A. Consent to Participate in a Research Study

University of North Carolina-Chapel Hill
Consent to Participate in a Research Study
Adult Participants
Social Behavioral Form

IRB Study #__07-0651

Consent Form Version Date: May 30, 2007

Title of Study: K12 teachers and their use of technology for teaching.

Principal Investigator: M. Lovetta James

UNC-Chapel Hill Department: School of Information & Library Science

Study Contact telephone number: xxx-xxx-xxxx

Study Contact email: xxxxxxxxxxxx

Faculty Advisor: Dr. Barbara Wildemuth

Advisor Phone number: xxx-xxx-xxxx

Faculty Advisor email: xxxxxxxxxxxx

What are some general things you should know about research studies?

You are being asked to take part in a research study. To join the study is voluntary. You may refuse to join, or you may withdraw your consent to be in the study, for any reason, without penalty.

Research studies are designed to obtain new knowledge. This new information may help people in the future. You may not receive any direct benefit from being in the research study. There also may be risks to being in research studies.

Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study.

You will be given a copy of this consent form. You should ask the researchers named above any questions you have about this study at any time.

What is the purpose of this study?

The purpose of this research study is to examine K12 teachers' use of computers in their teaching. You are being asked to be in the study because you are a teacher who is using technology within your curriculum practice.

How many people will take part in this study?

If you decide to be in this study, you will be one of approximately 40-45 teachers from three different school districts participating in this research study.

How long will your part in this study last?

You will be observed during one class period. A follow-up interview will take approximately 20-40 minutes, depending on the length of your responses.

What will happen if you take part in the study?

You will be observed during one class period when you are using technology. The researcher will be as unobtrusive as possible and take notes on a laptop. Also, a follow-up interview will be scheduled. The purpose of the interview is to discuss what was observed during the class session(s) and to obtain your views on technology integration. The interview will be tape recorded. You do not have to answer any questions that you do not wish to answer, for any reason. I may contact you within a few weeks of the interview if any clarification is needed regarding your answers.

What are the possible benefits from being in this study?

Research is designed to benefit society by gaining new knowledge. While you may not benefit directly from your participation, it is hoped that the study results will have a positive impact on teachers' use of technology.

What are the possible risks or discomforts involved from being in this study?

We do not think you will experience any discomfort or risk from the observation or interview.

How will your privacy be protected?

Your name, initials or any other identifying factors will not be used in the presentation of this research to others, so no one here in your community, or elsewhere, will be able to identify your views. All notes and recordings will be maintained on the researcher's personal equipment (laptop and digital recorder) and will not include any personally identifying information. School computers or electronics will not be used. All notes, transcripts and tapes from the interview will be kept confidential and will not be made available to anyone except to the researcher's advisor.

Interviews will be recorded on digital recorders. The interviews will be transcribed as soon as possible. All digital recordings will be deleted after completion of study.

Will you receive anything for being in this study?

After completion of this study, you will be given a report that provides examples of the different ways in which teachers are using technology.

Will it cost you anything to be in this study?

There will be no costs for being in the study

What if you have questions about this study?

You have the right to ask, and have answered, any questions you may have about this research. If you have questions, or concerns, you should contact the researchers listed on the first page of this form.

What if you have questions about your rights as a research participant?

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the UNC-CH Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

Participant's Agreement:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily agree to participate in this research study.

Signature of Research Participant

Date

Printed Name of Research Participant

Thank you for helping me with this study.

Appendix B. Observation Guide

School name	xxxxxx
Teacher	xxxxxx
Grade/Subject	xxxxxx
Class size	xxxxxx
Room	xxxxxx
Time/Period	xxxxxx

Room setup/student seating:

- How is the room set-up?
- Is the room bright and comfortable?
- Is there enough working room or is the room too small?
- What is the technology available/used in the room?
- Are there enough computers/equipment for all students who need it?
- Is there a technician or other technical assistance available in the room?
- Does she ask/need any help? Does she get help?

Assignment

- What is the lesson? Is it prepared lesson plan?
 - What technology are they using?
 - Does the teacher explain the goals of the class session?
 - Is the lesson part of a larger curriculum program?
 - Is this their only day working with technology for this project?
 - Do the students understand what they should be doing?
-

Troubleshooting/technology use during class

- Does the teacher encounter any problems with the technology?
- Does she resolve it? What does she do?
- Does all equipment seem to be working condition?
- Is the teacher comfortable using the technology available?
- Does she use any? How?
- Do the students ask her for help?

Teacher-student interaction

- Descriptions of student-teacher interaction
- What is the mood of the class?
- Does the teacher stay in one area of the room or does she walk around?
- What is the teacher doing when not interacting with students?
- Does the teacher approach students?
- How does the teacher answer student questions? Does she give them answer or does she give them directions on how to find the answer?
- Does she prompt students as the end of the class session approaches?
- explains the problems very patiently to each student
- Did all students finish their work at the end of the class session?
- If not, will they be returning?

Classroom atmosphere

- Is the class quiet?
- Indications of teacher's classroom management style?
- Indications of teaching style?
- Is the work independent or group?

Appendix C. Interview Schedule for Teachers

1. Teacher subject area
2. Grade level
3. Number of years teaching
4. Did your college education include any learning activities on how to use technology for teaching? If yes, please describe.
5. Have you taken any workshops provided by the school or district on how to use technology for teaching? If yes, please describe.
6. Was the computer lab easily accessible?.
7. Why did you decide to use technology for this lesson?
8. If it was a planned lesson, was the lesson new or one that had been used with other classes?
9. Where did the idea for the lesson come from?
10. Is this part of a larger instructional unit? If yes, describe.
11. Was the lesson successful?
12. Would it have worked without the use of technology?
13. How long have you been using technology for teaching?
14. Why did you first begin using technology?
15. Do you find it easy or difficult to use new technologies? Can you give me a brief example of a new technology you recently adopted?
16. How often do you use computer technology with your teaching?
17. Do you use technology equally with all your classes or some more than others?
18. How well do you feel technology use fits in with the way you teach?
19. In what kind of environment do you think students learn best? Give an example?
20. How complex or easy-to-use do you feel is the technology that is available to you?
21. What was the last assignment that you gave to your students that asked them to use computer technology? When was it?
22. Describe the assignment.
23. “What does *technology integration* mean to you?”

24. What types of technologies are included in this concept?
25. What does it mean to integrate them into your teaching?
26. What are some of the different technologies you use with your students?
27. Do you feel that you have integrated technology into your teaching, based on the definition you provided?
28. How do you think your understanding of what “technology integration” is came about?
29. Are there any advantages to integrating technology?
30. Are there any disadvantages?
31. Are you required to use technology by either your department or school administration? Or is using technology your own choice?
32. If you wanted a specific software or hardware that wasn’t available in the school right now, but you wanted to use it with your class, how would you go about requesting it? What are the chances that you would get it?
33. How do you think your peers generally see technology? As a positive or a negative?
34. Do you think that most of your peers use technology?
35. Do you discuss or share the lessons that incorporate technology with your peers?
36. Describe the most effective lesson you have taught that integrated technology.
37. Could you have taught the lesson just as well without the technology?
38. Where do you usually get your ideas from for integrating technology?
(magazines, colleagues, workshops, technology coordinator, Internet, etc)
39. How has your technology integration evolved?
40. Do you face any challenges in integrating technology?

Appendix D. Sample codes/concepts used during data analysis

Demographics

ID	Teacher ID
D_sm	Subject matter teacher teaches
D_yrs	Number of years the teacher has been teaching as a certified teacher
D_techyrs	Number of years teacher has been using technology
D_gdr	Teacher's gender
D_age	Teacher's age

Barriers

Bar_teched	Technology use in college/school by self/teachers
Bar_wksp	If they have taken workshops provided by the district
Bar_lab	Accessibility to computer lab/computers
Bar_int@sch	Do you have the opportunity to integrate technology here at this school the way you want to
Bar_clvl	Comfort level; is it easy to use
Bar_use	How long have they've been using technology
Bar_getware	How easy or difficult is it form them to get the technology from the distict
Bar_techhelp	Is there technical help if you need it or an instructional technologist
Bar_01time	Time
Bar_02avail	Availability of resources in the school/district; problems with system, etc.
Bar_03test	Testing
Bar_04dem	Demographics of the school
Bar_05adm	Administration decisions
Bar_06train	Professional development
Bar_07@hm	Availability of software at home

Bar_08age	Age
Bar_09chair	The chairs role in technology use

Social

S_Ideas	Where does the teacher get lesson ideas from
S_peers	How peers see technology
S_discuss	Do they discuss with other teachers in the school

Teaching beliefs/practices

BP_#times	How often they use technology with students
BP_Unit	Is the instruction part of a unit
BP_times	Done this type of lesson before
BP_frstuse	Why/how did they first start using technology
BP_allclass	Use technology with all classes
BP_fit	How well technology fits in with teaching practice/was lesson successful/how often
BP_bstenviron	Best environment for student learning
BP_advdis	Advantages and disadvantages
BP_requse	Are you required to use technology by administration
BP_student	Comments on students use of technology
BP_ITmean	What does TI mean to you
BT_ITunderst	How did their understanding of IT come about
BP_ITyes	Integrate technology based on the definition provided

Appendix E. Letter of Introduction to School District



THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

School of Information and Library Science
Student Research Projects
Phone# (919) 962-8366; Fax# (919) 962-8071

The University of North Carolina at Chapel Hill
CB# 3360, 100 Manning Hall
Chapel Hill, N.C. 27599-3360

XXXXXXXXXX
Superintendent of Schools
XXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXX

Dear XXXXXXXXX:

I am a doctoral student in the School of Information and Library Science at the University of North Carolina-Chapel Hill. Currently, I am working on my dissertation proposal and am requesting permission to collect data from one of the schools in the XXXXXXXXX District.

Briefly, my dissertation will be a study of teachers and their understanding of technology integration. My study looks only at teachers, not students. I am requesting to collect data at XXXXXXXX Middle School. If my request is approved by your office, I will ask for written approval from teachers who agrees to participate in the study. Within the next week, I will be submitting my research proposal to the Internal Review Board (IRB). Once approved, I can provide a copy of the documentation upon your request. I am requesting to collect data during the current school year.

I have attached an abbreviated version of the methodology section from my dissertation proposal. I believe that the findings of my study will provide pertinent information about teachers and technology. This information can be used to direct professional development strategies for teachers at XXXXXXXX Middle School. After completion of the study, I can provide, at your request, a report on my findings specifically tailored to XXXXXXXX Middle School. I believe that the findings of my study will provide pertinent information about teachers and technology. This information can be used to direct professional development strategies for your teachers. .

If you have any questions related to the study or would like to discuss the proposal, please contact me at ###-###-#### or e-mail: xxxx@ils.unc.edu. If you would like to contact my advisor, Dr. Barbara Wildemuth, her phone number is ###-###-####; email: xxxxx@ils.unc.edu. I will be in touch during the coming week to discuss my request further. Thank you for your support in this endeavor to better understand how we can assist teachers in integrating technology within their teaching practices.

Sincerely,

M. Lovetta James
/attachment

PROPOSAL FOR RESEARCH

The focus of this study is teachers and how they define technology integration. The specific questions the research will address are:

1. How do teachers define “technology integration”?
2. Is their definition of technology integration reflected in their teaching practices?
3. What are the factors that contribute to their definition of “technology integration”?

Data Collection

Data will be collected from three schools within different school districts. Theoretical sampling techniques will be used as the selection criteria for the schools. Theoretical sampling, a purposeful sampling approach, selects from a population on the basis of their potential to represent the theoretical construct under study.

Teachers will be selected using criterion sampling methods. Criterion sampling allows selecting samples that meet particular criteria. In this study, teachers who use the school’s computer lab to teach will be approached to participate in the study. Also approached will be teachers who have computer technology available to them in their classrooms. These teachers will also be interviewed.

The researcher will be in the observer-as-participant role and all observations of teachers will be overt with prior written consent. Notes will be taken during all observations. Observations of teachers using computer technology in the computer lab and the classroom will inform the researcher on the participants’ practices in their professional environment.

The researcher will attempt to collect data throughout the day. If there are multiple labs, a request will be made so data is collected in the different labs. Each teacher will be observed during the complete class session. During observation of the teachers in the computer lab or classroom, the researcher will be watching for some of the details listed here.

- What technology (hardware/software) is being used?
- Is there availability for all to use?
- Are teachers following a prepared lesson plan?
- Is it teacher-led, student-centered or are students doing independent work?
- Is the teacher knowledgeable of the technology in use?
 - What types of challenges did the teacher face during the lesson?
 - Technology-related questions by students
 - Hardware/software setbacks
 - Was the teacher able to resolve the challenges?
- Was there technical support in the lab?
- Did the teacher use the support when needed?
- Specific description of lesson?

Teachers who are observed will also be asked permission to be interviewed. Written consent from the teachers will be obtained for the interviews. Interviewing provides context to observed behavior. The interview sessions will be face-to-face, semi-structured and will take approximately 30-45 minutes. The outline of questions will ensure that topics are introduced to each teacher in the same order. With permission from the teacher, a tape recorder will be used to

record the data and notes will be taken as needed. The general scope of the interview is to gather demographic evidence, inquire about their interpretation of “technology integration”, validate data gathered at the observation, and elucidate how they came about this interpretation of “technology integration”.

- Demographics
- Teacher subject area
- Grade level
- Number of years teaching
- Educational background including certifications
- Any technology-specific training they have received
- Technology integration question:
- “What does technology integration mean to you?”
- Questions related to observation:
- Was the computer lab easily accessible?
- If it was a planned lesson, was the lesson new or one that had been used with other classes
- Where did the idea for the lesson come from?
- Was the lesson successful? Would it have worked without the use of technology?
- Related Questions
- How long have you been using technology for teaching?
- How well do you feel technology use fits in with your teaching practices?
- How complex or easy-to-use do you feel is the technology that is available to you?
- Are there any advantages to integrating technology?
- Are there any disadvantages?
- What was the last assignment that you gave to your students that asked them to use computer technology?
- Describe the assignment.
- Describe the most effective lesson you have taught that integrated technology?
- Where do they get their ideas for integrating technology? (colleagues, workshops, technology coordinator, Internet, etc)
- How has their technology integration evolved?
- Are there any barriers to integrating technology
- How do you think your understanding of what “technology integration” is came about?

All data from this study is deemed confidential. No identifiable information related to the school, school district or participants in the study will be presented in material written for publication.

Upon request from any school district participating in the study, a written report based on the findings will be presented. Results from the study can provide valuable information that can inform the direction of teachers and possible professional development needs.

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