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Exploring technological literacy: Middle school teachers' perspectives

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This is to certify that the doctoral study by

Jane Baker

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2008

ABSTRACT

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M.S., Walden University, 2004
B.A., State University of West Georgia, 1976

Doctoral Study Submitted in Partial Fulfillment
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ABSTRACT

The No Child Left Behind (NCLB) Act of 2001 mandates that middle school students be technologically literate by the end of 8th grade, but teachers need more information on how to make this outcome a reality. This qualitative phenomenological study used a constructivist theoretical framework to investigate teachers' descriptions of technological literacy outcomes, instructional practice, and challenges influencing middle school student technological literacy. Twelve teachers at 1 public middle school in a large urban area of Georgia were interviewed. Data were analyzed using the typological method with the inclusion of both inductive and predetermined categories. Teachers described technologically literate middle school students as able to perform basic computer skills and use those skills for research and problem-solving. Teachers' instructional practices included modeling and demonstration, hands-on practice, coaching, collaboration, and frequent assessment to achieve the outcome of student technological literacy. Challenges that can impede teachers' implementation of practices for technological literacy included lack of school support, equipment, time, and effective professional development. Recommendations to overcome challenges include increasing availability of equipment by providing better ways to schedule the computer laboratories and staff to monitor the equipment. Relevant up-to-date staff development and inclusion of technological literacy as a school goal were also suggested. This study may influence social change because it may help teachers improve practices to develop students' technological literacy skills necessary for successful employment in the 21st century.

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DEDICATION

To my husband David A. Baker, without your love and support I would not have been able to accomplish this. To my sons Patrick and Eric for your unwavering love and faith in me and to my parents Walter J. and Patricia McEver for instilling in me the commitment to education that fueled my desire to complete this study.

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CHAPTER 1:

INTRODUCTION TO THE STUDY

Overview

The presence of technology in every aspect of our lives has made the importance of technological literacy in the schools to become more evident. Specifically, the need and demand for our future workforce to be technologically literate has led to the demand for schools to include technological literacy as part of the curriculum. Duggar (2001) described technological literacy as "the ability of a person to use, manage, assess, and understand technology" (p. 513). Several authors (Bassett, 2005; Charp, 1996; Griffin & Lewis, 1998; National Education Plan, 2004; Shotick & Stephens, 2006; Van De Linde, 2000; Yeuk-Mui, 2001) reported that technology has been an integral part of businesses for many years. The use of computers has improved the speed and communication of businesses throughout the world because professionals have access to computer technology as needed. Many businesses rely on technological innovations such as laptops, cell phones, digital imaging, and now BlackBerrys for everyday productivity and facilitating communication with customers. The steady introduction of new technology into the business world has increased employee productivity, improved communication, and advanced the progress of companies around the world. These advancements in technology have changed the perception of the ideal employee skill set. According to Shields and Behrman (2000), "Not only are computers changing the way goods and services are manufactured, distributed, and purchased, but they are also changing the skills workers need to be productive and earn a living" (p. 4). Therefore, businesses are

interested in workers who are technologically literate and can use these tools proficiently. To support the development of such workers, businesses have influenced educational reform to match these interests. Goddard (2002) found:

> Our democratic and capitalistic foundations also play into educational reform (and consequently into the trend toward integrating technology into curriculum). These foundations create an atmosphere whereby private business can see the profit potential in offering short-term, inexpensive, market-intensive products and training that matches the digital millennium of educational reform. (p. 19)

These trends sustain the public feeling that the acquisition of technological literacy skills is a necessary part of education. Duggar, Meade, Deland and Nichols (2003), reported that "attaining technological literacy is as fundamentally important to students as developing knowledge and abilities in the traditional core subject areas" (p. 316). Several studies supported the finding that businesses want students to be technologically literate (Hargreaves, 2003; Nasqui, 2000; Wambach, 2006; Wilhelm, 1997). For example, Nasqui found that students need technological literacy skills that include not only basic concepts but also the "introduction of business software such as word processing, spreadsheet/graphics, and databases" (p. 1). These types of skills are not only preferable but are expected of the employees who are hired.

Chisholm, Carey, and Hernandez (2002) reported that education and training are necessary to provide the technological literacy that will be needed for jobs of the future. They also remarked that "among the institutional responses to our changing social and economic milieu is a heightened commitment to the integration of interactive technology" (Abstract section, ¶1) as a way to achieve technological literacy. Wambach (2006) supported the idea that using computer-based technology in the classroom "helps

students acquire critical 21st century skills" (p. 58) needed for technological literacy. It is important that changes in the schools reflect these societal needs.

These ideas have also influenced the national legislation that governs schools to include provisions for technological literacy in the middle school requirements. The technology portion of the No Child Left Behind Act of 2001(NCLB), for example, described the importance of technological literacy in the schools. It reaffirmed the importance of schools using technology to increase learning for all students regardless of their situation. Portions of the National Technology Education Plan (2006) formulated to implement the No Child Left Behind legislation stated that to achieve technological literacy, schools need to "effectively employ technology" (p. 1) in the same manner that businesses already do. Part of the plan that affects middle schools includes attempting to have students proficient in technology skills by the eighth grade and finding better ways to use technology for instruction to accomplish this goal. It also affirmed the importance of using technology in schools to not only increase technological literacy but also to provide the best education for all students in every subject area at the same time. Patrick, Director of Education Technology for the United States Department of Education, stated that "technology-based assessments, online resources and tutoring enable personalization and differentiation of instruction for each student's individual needs, learning styles, levels and abilities" (National Technology Education Plan, 2004, p. 1) and that being able to personalize instruction is the best way to address technological literacy. These ideas will be addressed in chapter 2 of the study.

Goddard (2002) wrote, “the rapid and continued advancement of technology places enormous pressures on educators to provide students with the knowledge and skills necessary to lead productive lives” (p. 19). To meet the needs for technological literacy, teachers must ensure that the school curriculum helps students increase their access and become proficient in technology skills. In order to help students become technologically literate in a changing world, teachers must know what skills are necessary for technological literacy and have the ability to teach them. Hargreaves’ (2003) view on the knowledge teachers need to help students achieve technological literacy is representative: “In their preparation, their professional development, and their working lives, today’s teachers must get a grasp of and a grip on the knowledge society in which their students live and work” (p. 2). These thoughts are echoed by others (Bassett, 2005; CEO Forum, 2001; Jones, 2005; Manning & Ritz, 2004; Roman, 2001; Van Der Linde, 2000). In addition, employers need graduates who not only have basic computer word processing skills, but are also technologically literate problem solvers. Unless teachers have a firm grasp on how to help middle school students learn to use technology for problem solving, meeting this need also becomes a challenge for teachers.

To answer the growing demand for students who are technologically literate, schools have spent portions of their money to acquire equipment to be used by teachers and students (Bennett, 2003; Simplicio, 2002). Simplicio found that “across the nation school districts have spent literally millions of dollars in attempts to enhance their capabilities and provide their students with the latest technological advancements” (p. 1).

The money has been spent with the assumption that teachers would be using this equipment to improve student literacy.

Some of this money has come from the NCLB Act of 2001. Bennett (2003) discovered that some of the provisions of NCLB have provided money and incentives for schools to acquire the equipment needed to integrate technology and attempt to address technological literacy. He also found that this situation has presented many benefits and challenges to the school systems. While providing needed equipment, it has also placed requirements on middle schools to ensure that this equipment is used to help students achieve technological literacy before they leave the eighth grade. Since the passing of NCLB, many middle schools have focused on acquiring the needed equipment to address student technological literacy. However, having the equipment solves only part of the problem.

Problem Statement

Bennett (2003) reported that while millions of dollars have been spent on equipment to improve student achievement, little has been done to insure that the equipment would be used in the best way to help students achieve technological literacy. In other words, middle school teachers are given equipment and charged with providing practices that will insure their students are technologically proficient by the end of their middle school years, but the teachers are never shown the best teaching practices to address this outcome. In fact, there is an outright lack of published knowledge about the topic of student outcomes of technological literacy in the middle school.

Research studies delving into technological literacy have typically been quantitative survey studies focusing on equipment and technology integration (Barron, Kemker, Harmes, & Kalaydjian, 2003; Becker, 2007; Fowler, 2007; Virga, 2007; Goedde, 2006; Yidana, 2007). The majority of the research has concentrated on finding out what software is used in the classroom and what the factors are that affect teacher uses of technology (Barron et al.; 2003; Cassidy & Eachus, 2002; Copeland, 2004; Corbin, 2003, Johnson, 2006). Added to this literature are the Standards for Technological Literacy: Content for the Study of Technology (ITEA, 2000), which include what teachers and students should know and be able to do to achieve technological literacy. While a list of guidelines is helpful, such a list does not provide answers about how to implement these guidelines to achieve the outcome of technological literacy. In fact, there is very little information asking teachers about their understanding of how to achieve technological literacy outcomes at the middle school level. Several studies (Fletcher, 2006; Pearson, 2004, 2006; Reeve, 2002) have reported that the gap in the literature on technological literacy in the classroom has led to confusion about how to accomplish this outcome. Therefore, a qualitative approach is needed asking teachers to describe technological literacy for the middle school age student and what practices should be implemented to help the students achieve this outcome. Such a study will contribute to the knowledge needed to address the NCLB Act's (2002) middle school requirement that all students be technologically literate by the end of the eighth grade. Exploring middle school teachers' ideas can help provide a guide to develop middle school age appropriate instructional practices to facilitate the student

outcomes of technology literacy. This can provide sixth-, seventh-, and eighth-grade teachers with information about how to improve classroom instruction.

Nature of the Study

A phenomenological study was used to gather data on how to achieve technological literacy in a middle school setting. This qualitative phenomenological study examined middle school teachers' viewpoints to gain an understanding of how teachers describe technological literacy outcomes for the middle school student and their perceived role in developing student technological literacy. Further explanation of the research design and methodology used for this study will be found in chapter 3 of this study.

Research Questions

The following research questions reflect qualitative questioning and how teachers can improve the teaching of technological literacy.

1. How do middle school teachers describe current and desired technological literacy outcomes for their students?
2. What practices are middle school teachers currently using or what practices should they be using to achieve student technological literacy outcomes?
3. How do middle school teachers currently assess student technological literacy and how do they propose that student technological literacy be assessed?
4. What current and future issues do teachers think affect student technological literacy?

5. What role do teachers think their own technology literacy plays in the development of student technological literacy?

Purpose of the Study

The purpose of this phenomenological study was to explore the perspectives of middle school teachers to gain an understanding of how teachers describe technological literacy outcomes and their perceived role in helping students achieve this literacy. Duggar (2001) provided a general definition of technological literacy that was used for the study. He described technological literacy as "the ability of a person to use, manage, assess, and understand technology" (p. 513). He extended this description by adding that technologically literate people will be able to use their skills to make sense of the changes in society and to adapt. In this way, they can effectively take advantage of the improvements that are ongoing. Further descriptions of technological literacy will be presented in chapter 2. Using constructivist theory as a conceptual framework, teachers' perspectives on what practices should be implemented by middle school teachers to achieve the outcome of technological literacy were explored.

Conceptual Framework

The current emphasis on technological literacy has led to a focus on pedagogical practices that affect literacy outcomes. In their focus, the National Educational Technology Project (International Society for Technology Education, 2000) described the importance of constructivism in increasing technological literacy. They found that teachers must be able to meet students where they are academically speaking and bring them to a level of technological literacy determined by the NCLB Act of 2001(2002).

Spoerk (2005), author and technology educator, agreed that teaching must be "rooted in constructivism" to achieve "the ultimate goal of improving overall technological literacy among students" (p. 29). In exploring how teachers are planning to help their students achieve technological literacy, constructivist theorists' ideas can help to frame the research. The constructivist ideas of Piaget (1952, 1969) provide a link to development of the student and learning that can help teachers understand how to improve the technological literacy of the student. Piaget described the development of children as a succession of stages, each building on the one before. The ideas of Piaget can provide teachers with support in how to use what students already know to increase their technological literacy. According to Piaget (1969), the child being taught needs to take an active part in the learning so that he or she can understand what is being taught, thereby increasing his or her literacy. Piaget's ideas are consistent with the use of the many interactive resources that are available through technology to help the student increase technological literacy. Many of the constructivist ideas that Vygotsky (1978, 1987) has are similar and can also be applied to the teaching of technological literacy. He differed, however in the importance of social interaction to learning. He reported that social interaction is one of the important characteristics of teaching children and can be an important component in increasing technological literacy. Atwell (1998) found that middle school age students need social interaction to remain engaged and increase their learning. These ideas can form a basis for using interactive technology resources along with social interaction with the middle school age student to increase technological literacy outcomes.

Constructivist theory, as explained by Walker (2002), is described as "an internal process in which the learner uses prior knowledge and experience to shape meaning and to construct new knowledge" (pp. 6-7). Applying constructivist principles to finding best practices to teach technological literacy can give teachers guidance about how to improve instruction. Judson (2006) applied this to computer-based technology literacy. He found that "the use of technology may very well enable the dynamics of students constructing personal meaning, learning from one another, learning from experts, and creating unique interpretations" (p. 581). Research on how teachers are currently implementing practices for technological literacy and their perceptions of how it is working with actual students can provide valuable knowledge about the role of these practices in individual classrooms. Ideas of how their practice affects student outcome can provide school leaders with a framework for what constitutes best practices for technological literacy. It is the ideas formed from teachers who are actually part of the phenomenon that can lead to ways to help others achieve technological literacy. By looking at teacher perceptions, the existing ideas can be either supported or changed.

Operational Definitions

Constructivist learning theory: Constructivist learning theory is described by Lambert et al. (2002) as originating with well- known theorists Dewey, Bruner, Piaget, Vygotsky, and Gardner, for example, where students construct meaning from personal values, beliefs, and experiences. In the application to education, Walker (as cited in Lambert et al.) stated that "knowledge is formed within the learner and is brought to the surface by a skilled teacher through processes of inquiry" (p. 24).

Middle school: Refers to a school with students in Grades 6, 7, and 8.

Technological Literacy: Competency in using, managing, assessing, and understanding technology (Duggar, 2001).

Technology: The International Society for Technology in Education defined the term *technology* to include accessing information to become more effective in the areas of research, planning, presenting, and communicating (ISTE, 2000a). For the purpose of this study, technology includes computers, hardware, software, online learning resources, graphing calculators, projectors, digital cameras, CD/DVD, and Internet connectivity.

Assumptions

The following assumptions were applicable to this study:

1. The semistructured interview questions in this qualitative study are assumed to provide sufficient data to answer the research questions.
2. The purposeful sampling is based on the assumption that the teachers in the study are interested in student technological literacy outcomes.
3. The definition for technological literacy used in the study is assumed to be operational for the study.
4. All teachers chosen are assumed to have answered the interview questions honestly.

Scope, Limitations, and Delimitations

This study was limited to interviews with 12 middle school teachers from Grades 6 through 8 in a large middle school in Georgia. The teachers used in the study were chosen because they are known to the researcher to have knowledge and experience with

technological literacy based on the definition provided by Duggar (2001). Because of the small purposeful sampling at one middle school, this study cannot be generalized to any population. Although every effort will be made to conduct interviews that will provide quality information, it will be limited by the researcher's experience and interpretations.

Significance of the Study

Acquisition of new equipment and new middle school provisions of the NCLB Act of 2001(2002) that require that all students achieve technological literacy before they leave eighth grade have reaffirmed the importance of learning more about technological literacy in the middle school setting. Part of the No Child Left Behind plan that affects middle schools includes having the middle school classroom teacher implement practices to accomplish technological literacy without providing specific guidelines. The rich descriptions provided by study participants about the phenomenon of technological literacy can provide teachers and administrators with knowledge to improve pedagogical awareness about how educators can help students achieve technological literacy.

Knowledge Generation and Social Change

By exploring the teachers' perceptions about the best methods of instruction for technological literacy, new information can be contributed to the literature on ways to improve methodology. Therefore, this study may influence social change by providing an exemplar to applied literature. Since teachers are charged with the goal of implementing practices for technological literacy and no one knows exactly how to put this program into place, it makes sense to study the ideas of a small group of teachers who are confronting this issue. Findings from this study may be enlarged or expanded on at a later

time. They may be used as a base to develop a broader or more universally accepted program for implementing practices to achieve the outcome of technological literacy. When teachers help students to develop technological literacy, students will be better prepared for the workforce. Society may be more productive because individuals may have better technological literacy skills for successful employment.

Summary

The first chapter presented the introduction to this study about technological literacy in the middle school environment. It describes the problem of limited qualitative data about how students are to achieve the outcome of technological literacy from a middle school teachers' perspective. The purpose of the study provides qualitative phenomenology as the strategy of inquiry and a general definition of technological literacy. The operational definitions include a broad definition of technological literacy that will apply to this study to provide clarity. The remainder of this study will be presented in the subsequent sections. Chapter 2 continues with a review of relevant literature that includes definitions of technological literacy, No Child Left Behind legislation, national standards, an overview of constructivist theories, current studies on technological literacy and assessment, barriers or other issues affecting technological literacy, and a summary. Chapters 3 and 4 explain the methodology and the research results. Chapter 5 concludes with the summary, conclusions, and recommendations.

CHAPTER 2:

LITERATURE REVIEW

Proficiency in the content areas of math, science, social studies, and language arts has long been a focus of middle school teachers. Now, instead of relying on schools to gauge student learning, this focus has become a priority for government legislation. Testing results have brought increased public scrutiny along with legislation to ensure that all students are succeeding by placing accountability on the schools. Legislation such as the No Child Left Behind Act of 2001 (NCLB, 2002) has provided quantifiable ways of designating schools as "high performing" or "needs improvement" by using test scores to measure adequate yearly progress (AYP). With the increased need for students to graduate with technological literacy, NCLB legislation has included provisions for technological literacy along with proficiency in the four primary subject areas. Kutz stated that, "the need for technological literacy is as fundamentally important to students as traditional core subject area knowledge and abilities" (Ohio K-12 Technology Education Plan, 2003, p. 1). In 2002, President Bush signed into law legislation that sets objectives for teachers in relation to technological literacy and provides increased accountability at the middle school level. As a result, an increased focus has been placed on ways to improve technological literacy (Bassett, 2005; Ohio K-12 Technology Education Plan, 2003; Reeve, Neilson, & Meade, 2003) that has affected educational policy and practices in the schools.

The remainder of this chapter will focus on research regarding definitions of technological literacy that can be applied in the middle school setting. In addition, to help

answer the question about how middle school teachers describe current and desired technological literacy outcomes for their students, technology provisions of the NCLB of 2001 (2002) and National Standards will be explored. This will be followed by an overview of the key concepts that will inform the data collected, including constructivist principles and types of technology that can affect practices that middle school teachers are using or should be using in their classrooms to achieve the outcome of technological literacy, assessment areas, issues affecting teachers' development of student technological literacy, and studies showing how teachers evaluate the role of their own technological literacy in developing student technological literacy.

Definitions of Technological Literacy

In order to describe technological literacy outcomes for students, there must first be a definition of technological literacy that can be used by teachers in determining what those outcomes should be. The ITEA (2000a) provided a definition that has been used and expanded on by various authors in an attempt to improve technological literacy: "the ability to use, manage, understand, and assess technology" (p. 9). In discussing whether the United States is heading toward technological literacy, Duggar's (2001) definition maintained the basic ideas presented in the Standards for Technological Literacy: Content for the Study of Technology. He described technological literacy as, "the ability of a person to use, manage, assess, and understand technology" (p. 513). He emphasized that the technologically literate person will be one who is able to use his or her skills to make sense of the changes in society and be able to apply those skills to solving problems that may occur.

These definitions, while pinpointing the general meaning, do not provide enough of a focus to apply to middle school students without more specificity. By looking at additional definitions, teachers can improve their understanding of what is necessary for the middle school student to learn. Russell (2003) expanded the definition of technological literacy to include the ability to use technology for the purpose of problem solving, inventing and designing, and trouble shooting. This definition can be used to improve teaching and learning by giving information that can be applied to the curriculum. Deal (2002) agreed that "specifically technological literacy is a process where the learner develops the capability as a life-long learner to use, manage and assess the impact of technology and understand the technological nature of our society"(p. 1). Brasley (2006) described technological literacy in more specific terms when he described it as "the ability to use digital technologies, communication tools, and/or networks to solve information problems in order to function in an information society" (p. 7). While the above definitions apply to technological literacy in general, the same premises are present in the middle school setting.

Aronson (2007) showed how these definitions can be used with students to improve their technological literacy. He used descriptions of his son to give a picture of technological literacy for students at the middle school level. When working with his son on an assignment, Aronson discovered that while his son might have the basic skills to use technology to locate and place things on a document, he did not have the ability to use what he had found. His son was just moving the information around. Aronson described technologically literate students as having "the creative intelligence it takes to

take advantage of the information and the interconnectedness that the latest technology makes possible" (p. 25). The students will be able to understand a problem and use the technology to solve whatever problem they are working on. The definitions of technological literacy may provide middle school teachers with a foundation in which to improve their practices aimed at helping students advance their technological literacy. Furthermore, these definitions can help answer questions about the provisions included in the NCLB Act of 2001(2002) related to how they would best describe current and desired technological literacy outcomes for their students

No Child Left Behind Legislation

When President Bush signed the No Child Left Behind Act of 2001 (NCLB, 2002) into law on January 8, 2002, federal support for education became more interactive than it had ever been before. The NCLB Act, while providing federal money for schools, also set standards for both student performance and teacher quality. NCLB was "built on four principles: accountability for results, more choices for parents, greater local control and flexibility, and an emphasis on doing what works based on scientific method" (Department of Education, 2004). It required all states to implement statewide accountability assessments broken down by grade, poverty, disability, ethnicity, English language acquisition, and race. To ensure that none of the groups is failing to make adequate yearly progress (AYP), states must provide plans for annual testing and corrective action to improve schools that do not meet these test goals.

While, the major emphasis on NCLB since President Bush first signed it has been on language arts and math because of the AYP testing and requirements, NCLB has

provisions that include the importance of technology use in the classroom. Enhancing Education through Technology Act of 2001, Part D of NCLB, has purposes and goals for technology that are applicable to both elementary schools and secondary schools. This act stated that "the primary goal of this part is to improve student academic achievement through the use of technology in elementary schools and secondary schools" (NCLB, 2002, p. 2 Section 2402).

Each year has brought new emphasis on different requirements of NCLB (National Technology Educational Plan, 2006). Changes in the global economies and success in business has increased interest in knowledge and learning of computer-based technology in schools, including specific requirements at the middle school level. Specifically NCLB "mandates that schools be able to use technology effectively" (p. 1) to support quality teaching and learning for all students. It suggested that in order to use technology effectively, individual teachers should be using technology in a way that improves learning of curriculum material and improves student skills for the future.

Portions of the NCLB legislation call for using methods that have been proven to be effective by use of research. In their study of NCLB, Wolf and Hall (2005) reported that "the integration of educational technology should be based upon the needs of the students and communities and embedded in educational goals" (p. 3) They also found that schools are recognizing the need to make sure they are providing strategies to increase student technological literacy to ensure that the federal government will continue monetary support. NCLB includes provisions that apply specifically to middle schools. Fletcher (2006) reminded us of the important provision of NCLB that by the eighth grade

all students should be technologically literate. Specifically, he stated that "the federal government, through your state's department of education, will be asking you how many eighth-grade students have been determined to be technologically literate" (p. 2).This provision promotes the idea that all grades in middle school should be working toward this goal.

But recent research (Department of Education, 2004; Fletcher, 2006; Petrelli, 2007) found that even with this provision of NCLB, there has not been a large change in the use of technology for the teaching and learning of technological literacy. For example, Petrelli (2007) used a 65-item questionnaire to survey 630 K-12 public schools teachers in the Northeast about their use of technology for teaching and learning. Of this sample, 217 of these teachers were middle school teachers. She discovered that although the schools had spent large amounts of money for equipments, there was not widespread use of technology for teaching and learning. She also found that 69% of those surveyed found technology "somewhat important" or "very important." While she suggested this number could be influenced by the provision of NCLB Act that mandates that every child be technologically literate by Grade 8, she felt that the NCLB Act's requirements for standardized testing were more of an influence on what was happening in the classroom. She found that teachers were focusing more on curriculum changes that they thought would improve test scores on state-mandated tests. The teachers felt that "technology does not parallel the strategies needed to prepare them for testing" (p. 164). She also stated that "technology use is not a tested state standard, and therefore the pressure to

integrate its use into classroom instruction was lessened" (p. 165). Therefore, teachers were not making large scale changes needed to affect technological literacy.

So, how are teachers in the middle school to promote technological literacy for their students? What practices should they be using to achieve this outcome of technological literacy? How will they assess their students to be sure that they are technologically literate as NCLB has stated?

Using Technology in the Middle School for Technological Literacy

In the middle school setting, teachers can use computer based technology to motivate students, enhance learning, improve self-expression, and facilitate collaborative groups or individual learning. There are many applications that can be a vital way for teachers to excite students about their own learning while increasing technological literacy. Lamb (2002) reported that working with computers can provide both visual and auditory stimulation at the same time. Computers have the capacity to help teachers hold student interest and attention. "As a result, they learn more and remember more of what they have learned" (pp. 216-217). Teachers can also facilitate self-expression by allowing students to use the tools included with the computer to create attractive and professional looking projects. They can emulate work seen in books and articles. Teachers have the ability to allow students to work alone or in cooperative groups. All of these methods can provide "a context rich environment" (p. 216) that can increase student knowledge and learning. Leu and Leu (2000) agreed that as long as teachers are active in guiding students use, computer based learning will benefit students by increasing their

technological literacy. The national standards can help teachers focus on important uses of technology to increase technological literacy.

Standards for Technological Literacy

In 1991, the International Society for Technology in Education (ISTE), published guidelines to help teachers working toward increasing the use of technology in their classrooms. In 1998, they published skills that teachers could use to make sure that their students were obtaining the needed knowledge in the field of technology. The following guidelines published by the International Society for Technology in Education (ISTE, 1998) were called National Educational Technology Standards (NETS) for Students:

I. Basic Operations and Concepts
    a. Students demonstrate a sound understanding of the nature and operation of technology systems.
    b. Students are proficient in the use of technology.
II. Social, Ethical, and Human Issues
    a. Students understand the ethical, cultural, and societal issues related to technology.
    b. Students practice responsible use of technology systems, information, and software.
    c. Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.
III. Technology Productivity Tools
    a. Students use technology tools to enhance learning, increase productivity, and promote creativity.
    b. Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.
IV. Technology Communications Tools
    a. Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
    b. Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.
V. Technology Research Tools
    a. Students use technology to locate, evaluate, and collect information from a variety of sources.
    b. Students use technology tools to process data and report results.

c. Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.

VI. Technology Problem-Solving and Decision-Making Tools
   a. Students use technology resources for solving problems and making informed decisions.
   b. Students employ technology in the development of strategies for solving problems in the real world. (p. 1)

These general standards were to be used by teachers at all grade levels in their curriculum to help their students effectively use technology. At the time of their publication, the ISTE was focusing on ways to help teachers incorporate these skills into their classroom.

In 2000, ISTE refined the standards and developed the "Standards for Technological Literacy: Content for the Study of Technology" to include what teachers and students should know and be able to do to achieve technological literacy (ITEA, 2000). Pearson (2004) found that this "was a critical point in the history of technology education" (p. 28) because these standards brought attention to the importance of using standards for growth in technology education. This was followed in 2003 by "Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards" (ITEA, 2003). ITEA found that teachers are becoming familiar with and are beginning to use the standards and performance indicators from the National Educational Standards for Teachers (ISTE, 2004) to teach students about technology. ITEA described performance indicators as grade specific performances that are developmentally appropriate for students to demonstrate at the different grade levels. These performance indicators formulated from the standards detail the skills that have been identified by society as necessary to be successful when using technology to

become technologically literate. Performance indicators from ISTE for middle school students in grades 4-8 include:

1. Applying strategies for identifying everyday routine hardware and software problems that occur during everyday use
2. Demonstrate knowledge of current changes in information technologies and the effect those changes have on the workplace and society,
3. Exhibit legal ethical behaviors when using information and technology, and discuss consequences of misuse.
4. Use content-specific tools, software, and simulations (e.g. environmental probes, graphing calculators, and exploratory environments, Web tool) to support learning and research
5. Apply productivity/multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum.
6. Design, develop, publish, and present products (e.g., Web pages, videotapes) using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom.
7. Collaborate with peers, experts, and others using telecommunications and collaborative tools to investigate curriculum-related problems, issues, and information, and to develop solutions or products for audiences inside and outside the classroom.
8. Select and use appropriate tools and technology resources to accomplish a variety of tasks and solve problem.

9. Demonstrate an understanding of concepts underlying hardware, software, and connectivity and of practical applications to learning and problem solving
10. Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems.(Grades 6-8 section, ¶ 1)

These indicators provide guidelines that should be used to increase comfort with technology and enhance student learning. The guidelines also include information that will help students to increase problem-solving skills as their teachers apply their use on a regular basis.

Current literature finds several research studies that support use of the national standards for technological literacy. Donan (2003) surveyed 100 technology education teachers in Tennessee to find out their level of endorsement of the national standards for technological literacy and if using these standards increased student ability to acquire technological literacy. His results found that 82% of teachers endorsed the use of all of the Standards for Technological Literacy (ITEA, 2000) in helping students increase their technological literacy. Teachers also reported that more in-service training was needed in both the subject matter area and also in how to use the standards in their classrooms to help students. Donan also found that further investigation was needed of the data collected regarding student ability to acquire needed understanding of the content contained in the standards at the middle school level. This was due to some level of disagreement by a significant number of the population of his study about students' ability to acquire the content of some of the standards.

Nielson (2003) conducted a survey study with Utah junior high school technology teachers to find out how much they know and use the Standards for Technological Literacy. His study which was sent to 107 technology education teachers was returned by 51 teachers or 47% of the population. He found that most of the teachers think that standards are very important in helping students increase technological literacy. The survey results showed that 70% of the teachers were familiar with the Standards for Technological Literacy. It also showed that 81% felt that the content in the standards were adequate to describe what students needed to know to be technologically literate. He also found that while they feel qualified to teach the content covered in the standards, they need curriculum material and help on how to implement them in the classroom (Reeve, Neilson, & Meade, 2003).

Brown's (2007) qualitative study of technological literacy used interviews, observations, and document analysis from three classrooms to find out how the Standards for Technological Literacy were used in the classroom. He reminded us that these documents "are lists of standards and benchmarks that should be met when studying technology and not examples of curriculum (p. 30). His study found that the teachers were inclined to think if they used their curriculum guides and/or textbooks, they would be helping students learn according to the standards. Brown's study also reported that portions of the standards were not present in the curriculum when the study was done. He discovered that teachers were more influenced by making sure they were "enabling students to explore interests, to teach life skills, and to make personal connections with students" (p. 218) than by the outcome of technological literacy.

Taylor (2004) used a mixed methods approach to find out if specific activities affected technological literacy using the Standards for Technological Literacy. She surveyed a group of 1138 participants that included 588 middle school students and 418 high school students that participated in select Technology Student Association (TSA) activities. TSA includes competitive events that are reflective of the Standards for Technological Literacy. Although it was accepted that TSA activities improved technological literacy, there was no documented research before Taylor's study. Her findings reported that selected TSA activities using the Standards for Technological Literacy do affect student perception of technological literacy and development of skills particularly problem solving and hands-on skill development. This supports the ideas that the guidelines can provide a framework for teacher use computer based technology to engage students and further student learning. This can be supported by the ideas of several constructivist learning theorists, most of which will be detailed in the following sections.

Overview of Constructivist Framework

Several researchers (Howard et al., 2000; Kelley-Lowe, 2004; Sherman & Kushan, 2005) found that student technological literacy is positively influenced when the teacher employs constructivist theories in the classroom. In order to support technological literacy for students using constructivist principles, Sherman and Kushan reported eight teaching characteristics teachers must use to help students be successful. They must include lessons that : (a) are learner centered, (b) are interesting to the learner, (c) apply to real life, (d) allow interaction between peers, (e) provide for active writing and

discussions, (f) use time efficiently, (g) provide immediate feedback, and (h) are tailored to the needs of the individual student (p. 11). These lessons go beyond the traditional use of technology as a separate subject or use of the computer only for drill and practice. They include real life applications that will be useful to students now and in the future. Computer based technology is a means for teachers to engage students and further student technological literacy that can be supported by the ideas of several learning theorists. Cox, Fields, and Rakes (2006) reported "that technology enhanced instruction" (p. 409) as traced to Piaget and Vygotsky is a relatively new tool that can be applied to student learning. Constructivist theories influenced by Piaget and Vygotsky can provide useful models for looking at practices teachers can use to increase student technological literacy.

The Learning Theories of Piaget and Vygotsky

Piaget (1952, 1969) described the development of children as stages that build on the one before. He believed that knowledge is the result of interactions with the environment. These pressures by the environment or accommodations cause adaptations in intelligence. Adaptation takes place when the new information interacts with knowledge that the person already has. According to Piaget (1969), children need to be actively involved in the learning so that they can understand what the teacher is teaching and use it to build new knowledge. Piaget's ideas are consistent with teachers using technology to help students learn by means of the resources that are available through the Internet. Gros (2002) found that by taking the knowledge a student already has and adding to it by use of research, teachers are helping students construct their own learning.

Computers give teachers the cognitive tools needed to have students express what they know. He describes examples of cognitive tools as "databases, spreadsheets, semantic networks, communication software, online cooperative environments, tools for building hypertexts, and multimedia" (p. 323). These tools can provide resources that help students show their level of technological literacy.

Vygotsky had many constructivist ideas that are similar to Piaget, but he differed in the importance of social learning. Vygotsky (1978, 1987) found that it is the neuropsychological processes of the individual that are more important than social variables. He used these processes to describe learning in the individual. His Zone of Proximal Development is the difference between the developmental level of the student and the potential of the student when helped. Teachers can use computer based technology to provide environments that make it possible for students to work within this "zone" with a number of people from peers to experts. Gros (2002) pointed out that technology has several applications that support Vygotsky's theory. He found that "Communication technologies have contributed a great deal to the development of these approaches as they provide a good medium for joint cooperation and construction of knowledge" (p. 323). Gros described these applications, "(a) problem-based learning, (b) distributed cognition, and (c) situated learning" (p. 323). Problem-based learning occurs when teachers give students a problem to solve and, using multiple methods, the student finds solutions to the problem. By using the Internet, teachers can facilitate student access to a large variety of resources to solve the problem. Distributed cognition uses learning environments to allow students to develop learning by carrying out complex tasks. Using

complex tasks can help students with the critical thinking skills described as important outcomes of technological literacy (ITEA, 2000, 2003; Duggar, 2001; Russell, 2003; Brassely, 2006, Aronson, 2007). Then, as the student learns, new situations are introduced that will increase his or her level of learning.

Another example of constructivist theory that can help to explain an issue that can affect teachers' development of student technological literacy is the expectancy theory of motivation. Vroom (1964) described expectancy theory as the belief that effort will result in valued outcome. Hancock's (1995) application of this theory can be applied to how teachers behave when teaching students technological literacy. He stated that the motivation of the individual depends on what they expect to be able to do with the instruments that are available to them. These perceptions determine the amount of effort a person will exert. Expectancy theory seeks to describe why individuals are motivated to use computers for learning. Because an individual perceives that using technology will result in a successfully desired outcome, he or she is motivated to use technology and remains engaged during this use. This motivation can be a factor in increased technological literacy.

Technological Literacy and Different Learning Styles

Stewart (2002) stated that "the best of educational theory and philosophy is only valuable if it can be translated into practice" (p. 777). She found that the combination of constructivism and technology provides "students-centered curriculum" (p. 777) that is the best way to teach technological literacy to students. Several other constructivist theories that are applicable to helping students increase their technological literacy can be

applied to practices that can be used in the classroom. These theories include Kolb's learning styles, Gardner's theory of multiple intelligences, and Jung's psychological types.

Teachers are continually looking for pedagogical strategies that will help them to reach the diverse students in the classroom. Information about student strengths and weaknesses can be very important to teachers in helping students achieve their full potential. Kolb's (1984) experiential model of learning can be used to help teachers design effective lessons to promote technological literacy. He found that teachers can use the four stage cyclical process to guide new learning. Teachers can help students move from experience to observation to conceptualization to experimentation and then continue this cycle. Hoberman and Malilick (1994) reported that "In experiential learning, the student is physically engaged in a professional activity with real consequences" (p. 22). Technology, particularly computers, allows the teacher to have the student not only observe learning, but also attempt to apply knowledge. He or she can see a program on the computer, observe and figure out how it works, physically experiment with it, and adapt usage based on this experience. This allows the student to increase his or her technological literacy.

The Kolb (1984) model also included four learning styles that can be applied to computer based technology for technological literacy. These styles include accommodator, diverger, assimilator, and converger. Sugarman (1985) described the accommodator as a student who would use technology as a way to have a hands-on approach to learning. The teacher could make use of the information that the student

would be comfortable using the keyboard and trying out the different tools and programs. This student is one who would enrich his or her learning opportunities by using the Internet to look at different information that could be used to solve problems. In describing the accommodator, Sugarman reported, "They are most comfortable with unstructured experiential learning but may criticize as intellectualization other people's attempts at understanding and analysis" (p. 265). Accommodators prefer making their own analysis to using others' ideas from material such as a textbook. Sugarman said that the diverger is a student who would use technology to look at information from many different perspectives. He or she would learn technology skills from looking at the ideas of many different theorists. The World Wide Web would provide many resources combined with imagination to construct new learning. Students can design or develop new products using this creativity in experiments or Web pages. The assimilators enjoy creating their own theories. They can use the Internet to join an Internet Project or contribute to an ongoing experiment. Sugarman finds that these students "excel in creating theoretical models and in assimilating disparate observations into integrated explanations" (p. 265). Student learning results from using different perspectives to create new ideas. Lastly, the converger would enjoy using technology to participate in a project that would allow him or her to experiment with ideas and test their application. In each of these learning styles, as students acquire new skills in planning, researching, communicating, and presenting, they can extend what they are learning by gaining a deeper grasp of the material.

Jung (1971) looked at behaviors as being a function of perception and judgment. He used psychological types to show how individuals react with the environment. Jung's development of psychological types can help educators to explain natural differences in behavior related to learning. Silver, Strong, and Perini's (2000) description of learning styles based on Jung's psychological types can be used to differentiate personality preferences and develop plans using technology applied to educational content. They describe the mastery student as "efficient and results-oriented, preferring action to words, and involvement to theory" and as having "a high energy level for doing things that are pragmatic, logical, and useful" (p. 24). The mastery student likes to remain busy. If things move too slowly, he or she loses interest. Using computer-based technology allows students to have hands-on work experience and proceed at their own pace. Computer programs such as Inspiration allow teachers to have students organize information while programs like Microsoft Word allow efficient use of time to complete assignments. Mastery students also prefer assignments that have right or wrong answers and they are very competitive in nature. Online tests such as the Criterion Referenced Competency Testing (CRCT) practice provided by the state of Georgia or practice tests prepared by the teacher provide immediate feedback and allow students to move quicker than pencil and paper tests. Students can decide how many problems they want to complete in the time given. There are also many educational programs Teachers can use grammar games or math games that provide an element of competition in their learning programs to challenge mastery students. While playing these games, students are reinforcing needed math skills.

The next learning style described by Silver et al. (2000) is the understanding style. The students who prefer to learn using this style like to be challenged intellectually. They are avid readers who can find a wealth of information on the Internet. They can search until the answers they seek are found. Understanding learners like preparation before beginning an assignment. The teacher can provide resources in a "hotlist" or the students can look them up before planning the assignment. According to Lawless and Smolin (2003):

> A hotlist is a categorized list of websites that can be used to support a curriculum unit. Teachers can 'mine' or search for and gather, websites that they want their students to explore. Once mined, Filamentality can be used to create and post the hotlist on the Web. Hotlists are an effective way to point students to Web-base resources. They can also be used to organize websites. (p. 1)

Providing a list of can help teachers to make the most efficient use of the limited time they have with the understanding learner.

Technology can allow students to express ideas in detail. They have the ability to use a word processing program, graphics, or any of the presentation software to accomplish this. Since understanding learners do not need immediate feedback, computers allow them to work independently while the teacher functions as a guide. They can investigate an idea as long as their interest remains.

Interpersonal style learners like to work with other people and prefer to learn things that have to do with people. Collaborating with other students on assignments using technology can be a very effective way for these students to learn. Interpersonal style learners can think out loud and share their ideas with others in groups or through contact on the computer. They find pleasure in helping others and can learn by

functioning as teachers to other students. Joining Internet projects or working with others can also engage them. Even when students are alone, they are able to use e-mail, chat rooms, instant messaging, and wide area networks to collaborate with others in real time. This form of technology expands student relationships outside of the classroom and into a real world community. Additionally, by using the Internet to explore real life problems, teachers can help students be motivated to be successful learners. Rubrics can be provided or experts can be contacted to reassure students that they are doing things correctly.

The fourth learning style described by Silver et al. (2000) is the self-expressive style. Self-expressive students find technology the perfect way to use their imaginations to explore and communicate their ideas. There are many multimedia programs available, such as PowerPoint, which allow this type of expression. Students can use many different colors, fonts, formats, and graphics to express their creativity. They can complete assignments without following step-by-step teacher directions. Technology provides many different resources to help students work out solutions to problems. Because they like to start several projects, saving work on the computer, CDs, memory sticks, or floppy disks allows students to go back and finish multiple projects.

Technological Literacy and Multiple Intelligences

Gardner (1983) described a new way to define intelligence that can be applied to help students achieve technological literacy. He divided intelligence into seven different categories. His subsequent research added an eighth intelligence (Gardner, 1995). Gardner's eight ways that intelligence can be expressed include verbal-linguistic, spatial,

logical-mathematical, musical, bodily-kinesthetic, interpersonal, intrapersonal, and naturalist. His ideas changed the way educators thought about the intelligence of students. Instead of intelligence being something students were born with, it became something that can be developed. Technology, especially the Internet, can be a tool to help teachers use instruction to reach students in all these intelligences. It provides many resources that the teacher can use to implement Gardner's theory. Ross and Schulz (1999) stated, "When used judiciously and with students' needs in mind, the Web can serve as a powerful teaching tool, providing students with new learning opportunities" (p. 2). By using Gardner's theory as a guide to designing instruction, teachers can infuse their traditional lessons with individual applications that will reach all their students and increase their technological literacy. According to Gardner (1993), "Even as computers offer a useful way to think about the marshaling of intelligences to master educational goals, the potential utility of computers in the process of matching individuals to modes of instruction is substantial"(p. 391). Furthermore Gardner (1995) added, "If this personalized education is fused with commitment to the achievement of worthwhile (and attainable) educational understanding for all children, then the basis for a powerful education has indeed been laid"(p. 208). This personalized education can be achieved by using a variety of applications.

By shifting thinking for the verbal-linguistic learner from repetitive language learning to interactive learning through the computer, teachers can make learning challenging and fun. Grant (1999) pointed out, "Use of the Internet, video conferencing, E-Pals, e-mail, and virtual reality are all tools for language learning (potentially engaging

all of the intelligences)" (p. 214). Programs such as Microsoft Word, Inspiration, Multimedia, and Digital Video (video clips) are other resources that would help the verbal-linguistic learner. These students prefer "speaking, writing, listening, and reading" (Silver, et al. p. 11). These programs would allow the student to see the written word, or use it to write. Microsoft word can be used for journal entries that can be saved as a digital journal or diary. This word-processing program is easy to use and provides tools such as spell check and grammar correction that make it popular with students. The Internet provides several sites for students to communicate with other writers. Locations for writing include Inkspot for Young Writers and The Quill Society while other locations help students to publish such as International Kids Space or Cyberkids (Leu & Leu, 2000, pp. 183-184). Students can also use Internet Writing Centers to improve writing. These centers provide students with a tutor that can help them practice writing skills (Jones, 2001). Gardner (1993) found that individuals with linguistic intelligence enjoy oral and written forms of language but need to learn additional skills to become an accomplished writer. He described necessary skills to include point of view and context. By looking at examples of writing from famous published writers on Internet sites, students can learn how to emulate these skills.

Students with linguistic intelligence can also look at text and pictures from multimedia presentations or read a book or article on-line. Joining a list-serve, e-mail, or conference can provide a way to exchange language with others. Lectures, stories, or debates can be listened to or joined on the Internet. Online dictionaries and thesauruses provide information about words. These students will find that technology provides

unlimited access to “the sounds, meanings, structures, and styles of language” (Silver, et al. p. 11).

Students preferring to learn using the spatial intelligence will find that they can represent their ideas by using programs that will allow the creation of visual dimensions. Drawing programs such as Photoshop, AutoCAD, Internet coloring books, picture drawing websites, and geometric sketchpad are a few of the programs that allow visual creativity. When assignments require a project or writing assignment, spatial learners can use concept-mapping programs such as Inspiration or Microsoft Word to organize information into charts and tables to help them see their ideas. Virtual simulations help students to see examples that would be difficult to bring to the classroom. They can use multimedia presentations to work with pictures, colors, and other visual representations. Additionally, maps are available from many sources. The maps show not only directions but provide a visual representation of movement that increases student understanding of events.

The logical-mathematical learner will find that technology has many different ways to enhance this intelligence. The Internet can be used to look up a variety of sites that contain math information and allow students to develop mathematical thinking. Statistics can be found on any number of subjects. Mathematical games and calculations can be used to facilitate student learning. Math practice and homework help can also be found. Microsoft Excel is an excellent tool for making spreadsheets, graphs, and organizing. There are many sites that teachers can use to help their students practice critical learning in the Math content area. Sites such as Math Problem of the Week,

Fractals, and Finding Data on the Internet can challenge students to extend their learning (Leu & Leu, pp. 266-267). These sites provide problems that help students to practice math strategies. There are also many sites that teachers can use to enrich their curriculum materials. Leu and Leu (2000) find that, "In addition, the Internet provides a wealth of mathematical data which may be used to help students learn more about themselves and the rest of the world" (p. 269).

The musical learner can find much to celebrate using technology. The ability to look at music from many sources and hear it is a benefit that technology brings to this learner. The Internet can be used to download music for listening pleasure or to analyze for sound and melody. Students can listen to a CD or make one of their own. Searches of the Internet will provide many resources to use with the musical learner. Music MasterWorks Composing Software at changes notes to music.

Bodily-kinesthetic intelligence involves activities that are physical. Students with this intelligence enjoy learning that includes movement and touch. Using the keyboard or mouse on a computer gives bodily-kinesthetic students a way to learn that can provide the active involvement these learners do not receive when sitting through a lecture. Joining experiments, WebQuests, Internet Workshops, or Internet Projects that involve life applications can allow students to increase this intelligence as they combine strategies learned with actual experimentation. For example, students may leave the classroom to collect weather readings for an experiment on climate changes in various parts of the world. The bodily-kinesthetic learner can also use technology to look up plays to rehearse, dances to perform, or video clips to study movement.

The interpersonal learner can use technology for a variety projects. Projects using computer-based technology can prove very motivating as these learners connect with others in several different ways. The interpersonal learner can work together with peers in his or her own classes or students completely around the world. In this way, students can build relationships with people in other communities. They can conference by use of e-mail or consult with experts about a variety of subjects. Technology can be used to collaborate in many ways. Students in groups can divide up tasks to complete using the Internet for resources. It can be a medium to share finished stories or projects with others. Students can set up Web sites, use e-mail attachments, or post assignments to the school site for others to enjoy.

Technology can provide a unique way for the intrapersonal learner to explore learning opportunities. They can work on their own to find a variety of information. These students can use Microsoft Word to write their reflections in and save them in an online diary or journal. They can keep observations on classes or watch others for examples using technology. They can e-mail questions to their teachers instead of asking them in class. All of these are different ways to reach students and help them increase their learning.

Assessment of Student Technological Literacy

An important component of teaching technological literacy is assessment. Lamb (2002) found that in order to facilitate learning teachers must receive information about student learning and use it to make changes in instruction and provide feedback to the students. The information about students' level of technological literacy can help the

teacher improve practice and provide the students with reinforcement for learning (p. 46). Therefore, to determine the technological literacy of students, middle school teachers' must be able to assess students. Duggar (2000) defined assessment of technological literacy as "the process of gathering evidence about what a student knows and is able to do with technology before making inferences from that evidence for a variety of purposes" (p. 27). This evaluation includes both informal and formal assessment and formative as well as summative assessment. Duggar described formative assessment as ongoing during teaching and summative assessment at the end of the learning.

Brassely (2006) was part of a panel that looked at ways to assess technological literacy. The panel decided that in order to assess technological literacy, they would first have to have a working definition. The definition the panel formulated was:

> The ability to use digital technologies, communication tools, and/or networks to solve information problems in order to function in an information society. This includes the ability to use technology as a tool to research, organize, evaluate, and communicate information and the possession of a fundamental understanding of the ethical/legal issues surrounding the access and use of information. (p. 7)

The panel felt that it was necessary to include seven proficiencies that covered both cognitive and technical aspects of technological literacy. The seven proficiencies include the ability to: define, access, manage, integrate, evaluate, create, and communicate. These same proficiencies are an important part of assessment of technological literacy whether it is teacher observation, collection of student work, portfolios, or formal tests.

Pearson (2004) reported that the Committee on Assessing Technological Literacy recognized that there is very little research data about the assessment of technological

literacy. They also concluded that there is not one single instrument sufficient to assess all aspects of technological literacy. They found this was an area that was in need of additional study. In his later paper, Pearson (2006) found that there still was a lack of data about assessment of technological literacy. Pearson stated "we know very little about what children or adults know, can do, and believe about technological literacy" (p. 24). He believed that assessments are still needed to show where students are and where improvements can be made. So, how is this to be accomplished? Hummell (2007) asked if student technological literacy in the middle school should be assessed by designing a series of tests, a single examination, or portfolios of student. By having middle school teachers answer research questions about how they currently assess or propose that student technological literacy be assessed, information can be collected that can be applied to making an assessment to show if students are really able to use technology as described by Brassely (2006). Ultimately, this can lead to improved practices for the outcome of student technological literacy work.

Professional Development for Technological Literacy

Even with all the benefits of using technology in the classroom, teachers still face several challenges in helping their students achieve technological literacy. One of these areas is in providing the best instruction for their students. Many teachers fear that they will not be up to the task of providing effective lessons for their students. This can affect teacher attitudes. Teacher attitudes are one of the major predictors of whether or not teachers will use technology in the classroom (Milbrath and Kinzie 2000; Jaber and Moore 1999; Kadel, 2005; Crosby Iding and Speitel 2002). Milbrath, and Kinzie (2000),

found, “to be effective users of computer technologies and be models for students’ computer use, teachers must have positive computer attitudes and feel self-efficacious in using them” (p. 1). They also found that professional development and training was responsible for improving teacher attitudes about how to plan lessons that help students develop their own technological literacy. Planning for the type of lesson and the skills that students need to improve technological literacy is the best way to handle these challenges (Lamb, 2002, p. 5). Therefore, teachers need training to implement lessons for technological literacy. The opportunities for training are part of teachers’ professional development. Daugherty (2003) described professional development for technological literacy as “an ongoing process through which teachers acquire increasingly complex levels of content knowledge, pedagogical skills, and knowledge of student learning and motivational needs” (p. 27).

Teachers who receive increased professional education to learn about technological literacy and have had the opportunity to use it in a professional collaborative manner have passed these benefits on to their students. These teachers view technological literacy differently from teachers who have remained isolated and use primarily traditional methods. In a study of 4,083 teachers, Becker and Riel (2000) found that teachers who take a leadership role in education are more likely to use technology to achieve technological literacy. They stated, “Their use of computers with students is not limited to computer competence, but extends to involvement in cognitively challenging tasks where computers are tools used to achieve greater outcomes of students communicating, thinking, producing, and presenting their idea” (p. 36). Therefore, if

schools are to use technology to reach all students, teachers must be encouraged to use professional development opportunities to learn how to implement these ideas into the classroom. Daugherty (2003) looked at the "Professional Development (PD) Standards in Advancing Excellence in Technological Literacy" (ITEA, 2003) standards developed to complement "Standards for Technological Literacy: Content for the Study of Technology" (ITEA 2000). He found that while the standards contained knowledge the teachers needed for professional development, they do not contain practices teachers are using or should be using for technological literacy outcomes. This is an area that needs further qualitative research to collect data.

Summary

Even though performance indicators for students from the International Society for Technology in Education include information that can be used for successful implementation of technology literacy skills to further learning in the school environment, there is little literature to show how they can be used in the classroom. In fact, ITEA stated that the standards are there for guidance when they reported that "these standards do not attempt to define a curriculum for the study of technology; that is something best left to states and provinces, school districts, and teachers" (p. 9) But, there are many resources available through technology to provide teachers with a way to design lessons for the curriculum that will help all students increase their achievement and prepare them for technological growth. Applications as described above are available to reach students in the different stages explained by Piaget (1969) as well as the Zone of Proximal Development described by Vygotsky (1978, 1989). Teachers can use

technology programs to appeal to all learning styles including those described by Kolb (1984) and Jung (1971). There are many resources that can reach students preferring to learn through multiple intelligences as expressed by Gardner. Furthermore, technology can help to support learning for students that limited textbook materials may not be appropriate for. These children may include ESOL students, special education, and regular education students who have problems learning from traditional methods. So, while teachers are preparing students for jobs in the future by increasing technological literacy, they are also facilitating and motivating student learning.

In order to learn about the many available programs and become proficient in them, teachers must have effective training and support in not only types of programs to use but how and why to use them. Darling-Hammond (1999) proposed that teachers need "job-based professional development opportunities that involve them in collegial planning, curriculum work, and study throughout their careers" (p. 1). These programs can not be presented as a one-time training period but must be ongoing.

Conclusion

Technology has the ability to reach students in a variety of different ways. Information can be brought into the classroom from a variety of areas. Students can access resources that will provide answers for problem solving. All of these uses of technology can contribute to student technological literacy described by Duggar (2001) as "the ability of a person to use, manage, assess, and understand technology" (p. 513) and expanded by Russell (2003) to include the ability to use technology for the purpose of problem-solving, inventing and designing, and trouble-shooting.

Technology can also provide teachers with creative ways to design learning environments that will keep students motivated during learning. The flexible nature of technology allows students to find the type of program that will help them to work in the intelligence or style they feel most comfortable. As teachers and students continue to learn about this important resource, they will increase the effectiveness of its use. Therefore, technology can be used to increase student learning of technology literacy skills and prepare students for the future at the same time once teachers have the information on how to accomplish this. Research (e.g. Brandtl, 2002; Huroni, 2002; Yoder, 2003) supported the addition of technology literacy guidelines to student centered constructivist classrooms to increase both learning and future skills. A key component of how well technology will be used in the classroom to promote technological literacy depends on the education of teachers. Becker and Riel (2000) provided ideas about promoting technological literacy when they stated:

> If, on the other hand, what we want from our schools is thoughtful and creative problem-solving and constructive, independent thinking. The most effective way to achieve these goals may be to design a system where teachers are encouraged to be thoughtful and creative problem solvers in the design of learning environments for students. (p. 36)

Therefore, using the ideas of learning theorists will become effective in schools when teachers not only receive instruction in technological literacy but also are given the opportunity to apply these ideas and share them with their colleagues. As teachers expand confidence in their abilities, they will be better able to build on the knowledge students already have to increase their technological literacy.

Next Step

Since middle school teachers are responsible for making sure students are technologically literate when they leave middle school, teacher practices or intended practices can provide a guide to improve classroom instruction and help develop middle school age appropriate instruction. Dana and Yendol-Silva (2003) find, "Systematically studying teaching strategies and techniques can lead to discoveries that would not have become apparent in the absence of systematic study, and these discoveries ultimately lead to new and significant change in teaching practice" (p. 32). Action Research, described by Creswell (2003) can be employed to collect data to inform practices used to facilitate the outcome of student technological literacy.

SECTION 3:

RESEARCH METHOD

Introduction

As society and legislation continue to place demands on schools, the need for information on how to help students become technologically literate is an important topic for teacher leaders in the middle school. Currently little information exists about how to achieve technological literacy (Reeve, 2002: Pearson, 2004, 2006; Fletcher, 2006) and data are needed to conceptualize a plan for implementation. A qualitative phenomenological study was used to explore the phenomenon of technological literacy. As stated in Chapter 1, the purpose of this qualitative study was to explore the perspectives of middle school teachers to gain an understanding of how teachers describe technological literacy outcomes and what their role should be in helping middle school students achieve technological literacy. Since middle school teachers are certified to teach this particular age group and charged with producing this outcome of technological literacy in their students, it is logical to gather research on their ideas for describing those outcomes and what practices they should be implementing to accomplish this. This chapter will describe the research design and methodology used for this study.

Research Design

Qualitative research using a phenomenology design was chosen to use an inductive approach to engage the participants in a discussion of the phenomenon of technological literacy and what it means to middle school student education. This research originated as way to collect information about teacher perspectives that would

help others to fulfill the mandate of No Child Left Behind Act of 2001(2002) that every child be technologically literate by the end of middle school. Originally quantitative research was considered, but the researcher felt that instead of quantifying data, qualitative data using descriptions would give better information needed to describe how to help students become technologically literate.

Qualitative Research

Creswell (1998) described qualitative research as "an inquiry process of understanding based on distinct methodological traditions of inquiry that explores a social or human problem" (p. 15). Qualitative research provided a way to explore the problem of how middle school teachers can help students achieve technological literacy. In conducting this research, it was important to explore teachers' views about the change from focusing on what type of technology was used in the classroom to how teachers can help students to achieve the outcome of technological literacy. Creswell also stated that qualitative research is where "the researcher builds a complex, holistic picture, analyzes words, reports detailed view of informants, and conducts the study in a natural setting" (p. 15). In this qualitative study, the researcher explored technological literacy from the viewpoint of middle school teachers. Exploring the views of participants who have experience working with middle school students was the best way to collect data that contributes to understanding of what teachers, and schools should be doing to promote technological literacy. Using a qualitative approach allowed the researcher to talk with the teachers, collect data to answer the research questions and attempt to understand their ideas. By choosing this method, the researcher asked for examples that helped facilitate

meaning. The perspectives of the teachers supplied a comprehensive description of how teachers describe students who are technologically literate and what should be done to insure that all students regardless of their beginning level achieve technological literacy.

Phenomenology Design

The design for this study was phenomenology. Creswell (1998) reported that the origin of phenomenology came from the philosophical viewpoint of Edmund Husserl (p. 15). Creswell revealed that "a phenomenological study describes the meaning of lived experiences for several individuals about a concept or the phenomenon" (p. 51). Although other methods were considered, this method was chosen over biography, grounded theory, ethnography, and case study as described by Creswell. In a biographical study, a particular individual is important to the study. Therefore, since biographical study focuses on the individual, it would not include the ideas of several middle school teachers as needed for this study. In a grounded theory study, although multiple individuals are studied, the emphasis is on generating a theory. Grounded theory was not chosen because the purpose of this study was not to develop a theory about technological literacy. According to Creswell, "An ethnography is a description and interpretation of a cultural or social group or system" (p. 58). Ethnography was not chosen because the purpose of this study was not observations of a group of people. Case study is described as "an exploration of a 'bounded system' or a case (or multiple cases) over time through detailed, in-depth data collection involving multiple sources of information rich in context" (p. 61). A case study was not appropriate because the purpose of the study was to collect information from interviews of teachers describing

their perspectives of technological literacy for middle school students. Since phenomenological study describes meaning "for several individuals about a concept or the phenomenon" (p. 51) it was chosen as the appropriate design for the study. In their descriptions, teachers were influenced by their experiences of the phenomenon of technological literacy in the middle school setting. As Merriam (2002) stated, "A phenomenological study seeks essence and the underlying structure of the phenomenon" (p. 38).

Research Questions

The following research questions were created to guide the study:

1. How do middle school teachers describe current and desired technological literacy outcomes for their students?
2. What practices are middle school teachers currently using or what practices should they be using to achieve student technological literacy outcomes?
3. How do middle school teachers currently assess student technological literacy and how do they propose that student technological literacy be assessed?
4. What current and future issues do teachers think affect student technological literacy?
5. What role do teachers think their own technology literacy plays in the development of student technological literacy?

Context of the Study

The context of this study played an important part in the perceptions of the teachers in the study. The study took place in a large public middle school in one of the

fastest growing urban areas of Georgia. The county in which the middle school is located has the largest school system in Georgia. The school system is considered to be one of the more progressive users of technology by the state of Georgia. The State of Georgia K-12 Technology Plan (2007) reported that adequate equipment is necessary to help teachers increase the technological literacy of all students. This has prompted the state to include increased support of equipment and access to technology as goals for schools. At the beginning of the 2007-2008 school year, the middle school received money that allowed new computer equipment for the five computer laboratories, media center, all classrooms, and trailers at the school. Every room inside the school building had a projector installed that can be connected to a computer for use of technology in presentations to the students as needed. Additionally, every teacher in the school was given a laptop to facilitate teacher use of technology. The state of Georgia and the school district reported that the addition of this new equipment will facilitate teacher attempts to increase the technological literacy of all students. The equipment is to be used to further the State of Georgia K-12 Technology Plan (2003) Vision that promoted "enhancing the technology literacy of students, parents, and educators; and developing a highly-qualified workforce for the 21st century" (p. 41).

The state of Georgia plan also has adopted the goal of the United States Department of Education, "To assist every student in crossing the digital divide by ensuring that every student is technology literate by the time the student finishes the either grade, regardless of the student's race, ethnicity, gender, family income, geographic location, or disability" (p. 40). Changes in the population of the middle

school have brought new issues for teachers. The population and mobility of the middle school has increased rapidly over the past few years. The enrollment has increased from 2,070 in the 2002-2003 school year to approximately 2,500 students in 2008. The diversity of the school and the number of students in lower socioeconomic groups has increased. This is tracked by the number of students needing free and reduced lunch. The number of free and reduced students has increased from 43% in 2002 to greater than 65% of the students in 2008. The combination of increased lower income population and increased diversity has led to new challenges for teachers seeking technological literacy for all students. Because of the increased amount of high poverty students in the school, there is frequently varied access to technology resources. This corresponds to fewer students coming into the classrooms being exposed to technology that would contribute to technological literacy. This has increased the need for teachers to find new ways to help these students "catch up" with their peers.

Population

The teachers participating in the study were selected from this middle school. Creswell (1998) reported that participants may be chosen from a single site when conducting a phenomenological study (p. 111). This is so that the researcher can interview teachers who are known to the researcher to have experience with technology and are located at the middle school being studied. Data collected by the administration report a large variety in the background and experience of the 177 certified teachers working at the middle school. Teaching professionals included those just out of college at their first teaching job, seasoned veterans of teaching, teachers seeking alternate

certification, and teachers who have chosen teaching as a second profession. The 2006-2007 school year data from the school Accountability Report issued in 2008 shows between 60-70% of all teachers have less than 5 years of experience, 40-50% of the teachers have 6 to 10 years of experience, 20-30% have 11 to 15 years of experience, 10-15% have 16 to 20 years, approximately 10% have 21-25 % years, and less than 10% of teachers have more than 26 years of experience. The breakdown of the teaching staff (Table 1) includes sixth, seventh, eighth, special education, speech, connections, and in-school suspension (ISS) teachers as reported in the Faculty/Staff roster 2007-08.

Table 1

Breakdown of Teaching Staff

Subject or specialty	**Number of teaching staff**
Sixth grade	36
Seventh grade	35
Eighth grade	36
Special education	30
Speech	3
Connections	25
ISS	1
Title 1 Positions	11
Total	177

Approximately 28% of the teachers have less than 3 years experience, 36% have between 4 and 10 years experience and 36% have greater than 10 years experience teaching.

Sampling

Purposeful sampling was used to gather data from the population of teachers at the middle school. Merriam (2002) recommended this type of sampling to get the most information about the phenomenon. Furthermore, she stated, “To begin purposive sampling, you first determine what criteria are essential in choosing who is to be interviewed” (p. 12).The participants for this study were chosen from the teachers who

are known to the researcher to be comfortable using technology. In the opinion of the researcher, these teachers have distinguished themselves among their peers by sharing technology ideas and work samples at curriculum and grade level meetings, attendance at professional staff development technology classes, time spent with students in the computer laboratories, and enthusiasm for helping peers with technological issues. The justification for using these teachers is that they were more likely to have in-depth information to share about technological literacy. Creswell (1998) described the importance of including "individuals who have experienced the phenomenon being explored and can articulate their conscious experiences" (p. 111). Twelve regular education teachers were chosen and asked to participate in the interviews. The teachers selected were from all grade levels in the middle school. Creswell (1998) recommended studying a small number of participants in a phenomenological study to allow the researcher to collect more in-depth information (p. 15). The number of teachers was chosen to allow adequate representation of the different grade levels and academic subjects while still collecting the information needed to answer the research questions. Teachers from each of the academic areas of social studies, language arts, science, and math curriculum areas who are known by the researcher to have demonstrated a record of effectively using technology by the aforementioned criteria were invited to participate in the study. All teachers chosen also have completed the technology requirements for certification required by the state of Georgia. These choices were made to have different views from teachers who have experienced the phenomenon in the middle school setting. The past experience of working with students in the middle school age group allowed

teachers to reflect on the effectiveness of methodology that works with this particular age group. As Creswell (1998) suggested, this type of "sampling works well when all individuals studies represent people who have experienced the phenomenon" (p. 118).

Ethical Considerations

In conducting the study, permission from the principal of the school was requested. After an explanation of the details of the study and protection of individuals participating, approval to conduct the study was given by the principal. A copy of this permission was submitted with the proposal for the study to the Institutional Review Board (IRB) for permission to conduct the study. Approval was received from the IRB with the approval number 02-20-08-0224322. After permission to conduct research was received, the researcher approached potential teacher participants and asked for their participation in the study. In considering ethics, Creswell (1998) recommended disclosing the purpose of the research. During this approach, the researcher explained that the purpose of the study was to collect the perspectives of the interviewees as they describe technological literacy and their ideas on how to provide practices that will give students opportunities to facilitate the outcome of technological literacy. Creswell (1998) also suggested, "In a phenomenological study, the access issue is limited to finding individuals who have experienced the phenomenon and gaining their written permission to be studied" (p. 117). The interviewees were given information about their selection and informed that participation in the study was voluntary. They were then given consent forms to sign. The interview and transcripts are privileged information and the identity of each interviewee was kept confidential to everyone except the researcher. Creswell

also suggested that the researcher share personal information about experiences related to the study (p. 132). The researcher disclosed information relating to her position and the study before the interviews.

Data Collection

Upon approval from the Walden University IRB, data collection began. Potential participants were given an overview of the study and invited to take part in the study. Once the participants agreed to be interviewees, they were given a full explanation of the study and a copy of the consent form (Appendix A). Once agreement was received, interviews were scheduled. Each interview was recorded by a digital recording device and transcribed. Additionally, field notes were taken to include observational information that cannot be collected from tapes and in case of problems with the taping. After transcription, information was collected and organized by use of computer files using Microsoft Word for word processing. The data were saved in a file on the researcher's computer. The researcher also backed up the computer files using a flash drive.

Interview Guide

The instrument for data collection was semi-structured interviews using an open ended interview guide. This guide was developed for the sole purpose of finding out about the interviewee's perspectives on how to achieve technological literacy with the middle school student. Rubin and Rubin (2005) suggested that researchers translate their research topic into questions that the interviewee can understand and discuss. Therefore, with the research questions in mind, open ended questions were asked that would allow the researcher to collect data about the phenomenon of technological literacy and still

allow the interviewee to elaborate. The questions were developed with the advice of the doctoral study committee to ensure that the questions reflected the research phenomenon and were focused in clarity. These questions as well as probing subquestions were used in the interview guide (Appendix B). The following suggestions from Hatch (2002) were also used to develop the guide:

1. Open-ended questions should be use to allow the interviewee's perspective about their experiences to be shared in the interview.
2. The language in the guide should be familiar to the interviewees.
3. The questions should be phrased so that the purpose of the questions is clear.
4. The researcher should avoid leading questions
5. The researcher should ask questions that respect the interviewees and let them know their knowledge is valued.
6. The questions should answer the research objectives. (pp. 106-107)

The resulting open ended questions include perspectives from the teachers on current and future technological literacy and individual and whole school support for middle school students achieving this outcome.

Interviews

Data were collected during prearranged face-to-face interviews in a quiet, comfortable place convenient to the 12 participants. The length of the interviews was approximately 1 hour to enable the researcher to collect the detail needed in the data. For a phenomenological study, Creswell (1998) recommended this type of interview to enable the participants' adequate time to share their perceptions. The data were collected

using a digital recording device. Hatch reminded researchers of the importance of insuring that you will have good documentation of your interviews by making sure that the recording equipment works efficiently and records with high enough accuracy (p. 100). The researcher checked out the equipment before each interview and put in fresh batteries after six of the interviews were finished. During the interview process, the researcher followed Hatch's (2002) suggestions for an interview that would yield the best data. The suggestions included "follow the rules of polite conversation, interview in a comfortable place, learn how to listen, plan well before the interview begins, explore informants' understandings, invite informants to help you be a better researcher, and transcribe your interviews right away" (pp. 114-116). Each interview began with a review of the consent form (Appendix A) and asking the participant for questions or need for clarification of any of its parts. After receiving consent, the researcher turned on the digital recording device and began with an introduction to the study that included its purpose, teacher contribution, and why it was important. Then, the researcher asked questions from the semi-structured interview guide (Appendix B). The interviews began with what Hatch (2002) called "throw-away questions." "Throw-away questions are often asked at the beginning of an interview and usually include information about demographics, background, or context" (p. 102). Interviewees were asked to describe their educational background and teaching experiences to get the interviews started and ease the interviewees into the interview. The rest of the questions were open-ended questions that were designed to collect information about the phenomena under

investigation. They were framed to answer the problem researched in as much depth as possible.

During the interview, the researcher took written field notes. Rubin and Rubin (2005) found that it is important to do this because "doing so forces you to listen carefully enough to get down the main points, and also provides a backup in case a machine fails" (p. 111). During the interview, the researcher asked some probing and follow-up questions when needed. Rubin and Rubin emphasized that "in working with follow-up questions, the researcher listens hard to the meaning" (p. 136) to be able to obtain more in-depth answers. At the end of the interview, interviewees were asked if they had any questions and then told that they would receive a copy of the transcript of their interview if they wished.

Data Analysis Plan

After transcribing the data, the researcher followed the nine steps in Hatch's (2002) typological model described for analyzing qualitative data. This method was chosen because, as Hatch related, "data from the interviews ought to provide lots of evidence related to participants' perspectives on the topic of interest" (p. 152) that can be processed with typological groupings. Following Hatch's steps, the researcher began by identifying typologies to be analyzed. When deciding on the typologies, the researcher followed Hatch's advice and started "with the topics the researcher had in mind when the study was designed" (p. 153). The only difference was that the researcher included both inductive categories arising from the data in addition to predetermined categories. The initial typologies were "descriptions of technological literacy," "instructional practices,"

"objectives, content, and skills for technological literacy," "teacher preparation," "support for technological literacy," "challenges," and "student assessment." These typologies were based on the research questions. This was followed by reading the interviews and marking entries related to the topologies. Then, entries were read by typology and the main ideas recorded on a summary sheet. Within the typologies, patterns, relationships or themes were looked for and coded. All the categories were coded using highlighting and a different font color was used for each of the subcategories.

The next step consisted of going back and reading all of the marked typologies and making a record of where elements that go with the patterns are. This was followed by looking at the data and seeing if they supported the researcher's patterns or if there were any data that might contradict the patterns. Then, the researcher looked for relationships between or among categories. These were written as one-sentence generalizations, because as Hatch described, "Writing specific generalizations from each category, examining and bringing them together under more general statements exemplifies the typological analysis process described here" (p. 159).

The researcher then asked questions about the data and related the answers to the research questions. Rubin and Rubin (2005) stated, "To complete the analysis you still have to put these concepts and themes together, show how they answer your research question, and pull out broader implications"(p. 223). The emerging answers helped to describe what middle school teachers think should be done to help the middle grade student achieve technological literacy.

Role of the Researcher

In a qualitative phenomenology study, Moustakas (1994) found that it is important that the researcher include a detailed description of his or her own experience with the phenomenon. This is particularly important in a phenomenological study where personal interpretation may affect the descriptions of the phenomenon. Creswell (1998) remarked upon the importance of including the researcher's experience with the phenomenon as part of the description. Since the perceptions of the researcher have been influenced by experiences before becoming a teacher and they may affect the way the data are viewed, the researcher felt that it was important to explain to the participants her previous experience in the medical field before becoming a middle school teacher and the importance of technological literacy in the success of her previous job. Twelve years ago, the researcher became a middle school teacher at the middle school where the study took place. As a 6th grade middle school teacher, her role is to provide the best quality learning opportunities for her students. With two children who have just completed school and assumed roles in the business community, she is acutely aware of the importance of technological literacy in their lives. The researcher also uses technology daily at school and at home. It has provided her with ways to improve her personal and professional life. Technology has allowed the researcher to use programs and access information that has improved her job as a teacher. It is the researcher's desire to help her students have the level of technological literacy that will be needed for their future endeavors. Furthermore, the new requirements of the NCLB Act of 2001 (2002) that seek to have all students achieve technological literacy by end of middle school have brought

this to the forefront. Merriam (2002) stated, "A research study begins with your being curious about something and that 'something' is usually related to your work, your family, your community, or yourself" (p. 11). It was the researcher's search for answers to questions about how to accomplish the outcome of technological literacy with her own students that led to this phenomenological study of other teachers' experiences. The interview participants in the study were her colleagues at the middle school. She had an equal relationship with the participants and was not in a supervisory position over any of them. Although having a prior relationship with the participants helped with the researcher participant relationship, great care was taken to identify any biases that were brought up and to remain objective. By researching other middle school teachers' perceptions, the researcher answered questions about how to help her students to be ready for any assessment that may be used to determine their technological literacy in the eighth grade.

Validity

In any qualitative study, the issue of validity is an important part of the process. Mills (2003) referred to validity as the way to know that the data collected in the study really reflected what the researcher is looking for. As Creswell (2003) suggested, it is how the researcher knows the perceptions of the phenomenon are accurate. Creswell and Miller (as quoted in Creswell, 2003) described specifically how validity "is used to suggest determining whether the findings are accurate from the standpoint of the researcher, participant, or the readers of an account" (pp. 195-196). Creswell (1998) described eight "verification strategies" that can be used in a qualitative study. While

using as many of these as possible contributes to the study, Creswell stated, “Examining these eight procedures as a whole, I recommend that qualitative researchers engage in at least two of them in any given study” (p. 203).

The following procedures recommended by Creswell (1998, pp. 202-203) were used in this study:

1. Clarifying researcher bias. This was accomplished by describing the role of the researcher and stating the bias of the researcher.
2. Member checks. As described by Creswell, accuracy will be determined by “taking the final report or specific descriptions or themes back to the participants and determining whether these participants feel that they are accurate” (p. 196). The researcher determined the accuracy of the findings by taking all the findings back to the interviewees and had them check it to see if they felt it was accurate.
3. Rich, thick description. The researcher made sure that there was enough detail to provide rich descriptions.
4. Peer review or debriefing. Creswell also suggested peer debriefing as an external check of the study. This was performed by having a peer from another school provide an examination of the data and ask questions about the results. This peer will not be involved in the study but was known to the researcher to be honest and fair in evaluations.

Using the procedures suggested by Creswell was helpful in assessing whether the findings from the middle school teacher interviews “are supported by the data” (p. 2) and answering the research questions.

SECTION 4:

RESULTS

Introduction

The purpose of this phenomenological study is to explore the perspectives of middle school teachers in order to understand how teachers describe technological literacy outcomes and to understand teachers' perceived role in helping students achieve this literacy. Creswell's (2003) descriptions of phenomenological research can be applied to this study. He identified "phenomenological research, in which the researcher identifies the essence of human experiences concerning a phenomenon, as described by participants in the study" (p. 15) as appropriate for exploring the ideas of a small group of participants who have experience with the phenomenon. Therefore, a phenomenological design was chosen to engage a small group of middle school teachers, who were selected by the researcher, in a discussion of the phenomenon of student technological literacy during interviews in the middle school setting. This chapter analyzes the qualitative interview data collected by the researcher during each separate interview.

Chapter 4 begins with data collection and continues with methods of analysis, an introduction to the participants in the study, analysis of the data, and evidence of quality.

Research Questions

The data collected from teacher perceptions was used to answer the following research questions:

1. How do middle school teachers describe current and desired technological literacy outcomes for their students?

2. What practices are middle school teachers currently using or what practices should they be using to achieve student technological literacy outcomes?
3. How do middle school teachers currently assess student technological literacy and how do they propose that student technological literacy be assessed?
4. What current and future issues do teachers think affect student technological literacy?
5. What role do teachers think their own technology literacy plays in the development of student technological literacy?

Participant Selection

Before collecting data, IRB approval was received from Walden University. To investigate the perspectives of the middle school teachers who had experienced the phenomenon, the researcher made a list of teachers who, in the opinion of the researcher, had distinguished themselves among their peers by sharing technology ideas and work samples at curriculum and grade level meetings, attendance at professional staff development technology classes taken by the researcher, time spent with students in the computer laboratories, and enthusiasm for helping peers with technological issues. These teachers were chosen by the researcher because she thought that they would be more likely to have in-depth information to share about technological literacy. As Creswell (2003) reported, "The idea behind qualitative research is to purposefully select participants or sites (or documents or visual material) that will best help the researcher understand the problem and the research question" (p. 185). After purposely selecting teachers as potential participants, each of the participants was sent an initial e-mail

describing the study and invited them to participate. The e-mail briefly described what was expected of the participants and approximately how much time would be needed for the study. The participants that replied indicating their interest were then contacted by email to set up a meeting for consent.

Data Collection

At the initial face-to-face meeting, each participant was given a copy of the consent form (Appendix A) to read and sign. Upon reading the consent form, the interviewer again explained consent and assured the participants of confidentiality and anonymity. After each participant was satisfied that his or her questions had been answered, each one signed the consent form. The consent forms were labeled with Participant 1 through 12, based on the order of the interview, and later placed in a notebook for storage at the researcher's home.

The 12 teachers who participated in the study were interviewed from February to April 2008. After agreeing to participate, the interviewees were allowed to select a private location for the interview. Eleven of the participants were interviewed at the middle school. Nine of the teachers were interviewed in their personal classrooms. Two of the teachers chose to come to the researcher's classroom for the interviews. One of the teachers was interviewed at the home of the researcher. The teacher had planned to come to the researcher's home for a meeting about an unrelated matter and felt that it would be conducive to a private interview.

Semistructured interviews were conducted individually with each participant using the interview guide (Appendix B) developed for the study. All of the interviews

were one on one face-to face interviews. The researcher's role was to ask the interview questions, listen to participant answers, write field notes, and record the interviews using a digital recorder. The researcher made the recordings and used the identification number from the consent form to identify each separate participant. The identification number was later changed to a fictitious name. The interviews lasted approximately 60 minutes, with the shortest interview lasting 52 minutes and the longest interview lasting 70 minutes. Each interview was then transcribed verbatim into a Microsoft Word document by the researcher. During this process, the researcher replayed the interviews several times to verify the transcription and then saved the Microsoft word document to both the researcher's computer file labeled *interviews* and a flash drive for backup. As Creswell (1998) advised, the researcher should choose a method of storage that allows easy retrieval and safe storage of the data. Using both the computer file and the flash drive enabled the researcher to have easy access to the data, keep all the doctoral study information together, and have an additional copy in case of damage to the computer or files.

After the first interview was completed and transcribed, the data were reviewed several times by the researcher. During a phone conversation with the committee chair, the researcher shared the first interview. The researcher and her committee chair determined that the answers from the first interview were very short and lacking the depth needed to understand how the participant described the phenomenon of technological literacy. Therefore, the researcher decided more probing questions were needed for increased detail in the interviews. The researcher added questions that

encouraged the participants to provide more description to obtain more depth in the interview answers. Most of the time asking the participant "to tell me more" helped him or her to open up about the topic. As each subsequent interview was completed and transcribed, it was examined to make sure that the information collected was sufficient to answer the research questions. As Rubin and Rubin (2005) recommended, "Analysis begins early on when you examine the first few interviews to make sure your project makes sense" (p. 202) and that your questions are understood by your interview participants. They also suggest that after examination, modification of the interview questions may be necessary. After each subsequent interview, the interview questions were slightly modified to help elicit more descriptive answers to the questions. For example, the interview question, "How important is teacher technological literacy in helping students achieve technological literacy?" was difficult for the first teachers to answer and so it was modified to read, "Can you teach children to be technologically literate if you are not technologically literate?" Rephrasing the questions allowed the participants to gain a better understanding of the information that was needed for the study. With improved comprehension of the question, the participants gave a more focused response.

Data Analysis

After all the interviews were transcribed, the researcher followed the steps in Hatch's (2002) typological model for analyzing qualitative data. The data were arranged according to the typologies pre-selected from the research questions. Each interview was read and marked using highlighting according to the initial typologies of (a) descriptions

of technological literacy; (b) objectives, content, and skills for technological literacy; (c) instructional practices; (d) teacher preparation; (e) support for technological literacy; (f) challenges; and (g) student assessment. Then, each typology was read separately and recorded on a summary page by using the cut and paste approach. During this time, the researcher changed "teacher preparation" to "teachers' technological literacy" to better reflect the research questions and added the typology of "future suggestions." She also added the subcategories of "basic computer operations" and "beyond the basics" to "descriptions of technological literacy."

These pages were saved in a file labeled *interviews* under the *participant categories* folder. Within the typologies, patterns were looked for and coded in the margins of the pages. The typologies were read again and placed into subcategories by using the cut and paste method with Microsoft Word. The subcategories that were added were (a) modeling and demonstration, (b) hands-on practice, (c) coaching, and (d) collaboration. After rereading all the subcategories, summaries were written. Once the summaries were on paper, the researcher read all the data from the interviews and began to look for patterns. As Hatch suggested, these patterns were written as sentence generalizations that could be related to the research questions.

Study Participant Profiles

All the participants in the study were teachers at a large middle school in Georgia during the 2007-2008 school year. Although there were several teachers working in an advisory capacity at the school, the researcher felt that better information would be collected from teachers who had daily interaction with middle school students. Each

study participant was a sixth-, seventh- or eighth-grade teacher working directly with the students. Pseudonyms have been used for the names of the teachers and the middle school to protect their identities. The teachers were purposely chosen by the researcher from her perception of their ability to be technology leaders.

Pam: Pam had been teaching at the middle school for 13 years. She has bachelor's, master's, and specialist degrees in education and believed that modeling the importance of continuing education was an important part of teaching. Her experience within the middle school age group included working with remedial students, regular education students, and gifted students. She had experience teaching sixth and seventh grade math and social studies. Pam reported that she felt very comfortable using technology. She said, "I tried to make sure before I became a teacher and during the time I have been a teacher that I learned as many technology programs as possible so I could educate my students or I could be proficient enough to go out and teach my students what I have learned." Pam was selected because she readily shared ideas for lesson plans using technology at curriculum and grade level meetings. Her enthusiasm for using technology with students was very apparent.

Blake: Blake has a bachelor's degree in management organization and master's degree in business. Teaching was his second occupation. His first career in sports administration involved keeping current with technological advancements. His experience included 5 years teaching sixth-, seventh-, and eighth- grade math. Blake volunteered his time before and after school sponsoring a club for middle school students and saw the after-school importance of technology in their lives. In describing his own

technological literacy, Blake reported use of Microsoft Word and Excel on a regular basis. He stated, "I'm pretty literate in all components of Microsoft Word; as far as Excel, I've gotten much better over the years with practice." The researcher chose Blake based on his ability to easily adapt technology during his professional staff development classes. The researcher was confident that his easy adaptation was a direct result of his first career in sports administration.

Allison: Allison had been teaching for 13 years. She has a bachelor's degree and a master's degree in education. Her experience included teaching at- risk students, regular education students, and gifted students. She loved teaching science because of the hands-on activities that could be incorporated into her lesson plans. Allison reported feeling competent using productivity and communication tools such as Microsoft Word, PowerPoint, and email. She also stated that if there is something she does not know, she feels comfortable asking the students for help. Allison felt the ability to have no fear when using technology was a big part of success when working with students of middle school age. Allison was asked to participate because of her passion when using hands-on lessons that included technology and her comfort during technology staff development.

Joan: Joan was a second year teacher at the middle school. She has a bachelor's degree in education and was finishing her master's degree at night and on the weekends. Her certification was in middle grades with a concentration in science and language arts. Both years of teaching had been in the eighth grade. Joan reported that "I feel very comfortable with day-to-day use of technology in my classroom. I feel that experimenting with programs is a great way to understand their use." Joan was chosen

because of her reputation for frequently using technology in the classroom and her willingness to share her PowerPoint lessons with other teachers.

Amy: Amy had been teaching for 5 years. Teaching was a second career for Amy. She began with a career in sales and decided she wanted to change to a middle school teaching profession. She has a bachelor's degree in history and English and a master's degree in education and reading. Administration considers Amy one of the top teacher leaders in the school because of her willingness to volunteer for leadership roles in planning lessons and her innovative use of technology in those lessons. Amy reported technology was very easy for her to use in the classroom on a daily basis because her prior job in technology sales provided her with opportunities to learn both software and hardware applications. She stated, "My strength is knowledge of not only the software but also the connectivity and how it works." The experience of using technology in the business world has kept her from becoming frustrated when programs at the school do not work. This comfort has helped her to be more willing to use technology with her middle school students. Amy was asked to participate because her lesson plans were usually shared at curriculum and grade level meetings. She was always willing to help her peers, and her expertise with technology was evident in her plans.

Teresa: Teresa had been teaching for 23 years. She has a bachelor's degree in education and a master's degree in education. Her middle school certification included ESOL, science, and language arts, and she had taught third-, fourth-, fifth-, sixth- and seventh-grade. She had taught at the middle school level for the last 9 years. When she described her own technological literacy, Teresa stated, "I think I am above average as

compared to other teachers my age. I think the younger people coming into teaching are much more comfortable using technology with the students because they have a much better background with technology." Teresa was chosen for her expertise in working with multiple grade levels using technology. She was always willing to share her experience with peers.

Harry: Teaching was a second profession for Harry. He had been teaching science for 16 years. Harry has a bachelor's, master's, and specialist degree in middle grades education. He regularly provides updates about legislation affecting teachers using technology. In describing his own technological literacy, Harry reported knowing how to do research on the web, e-mail, write a report, and basic computer competencies. He also reported using technology to teach critical thinking skills was most important to him. Harry has been known for using technology to connect to other schools for collaborative lessons that seem more like fun than "school work." When describing the collaborative lessons, Harry stated that "it is so much more than having them memorize it" The use of technology in a game type format made his students very excited about the lessons. The researcher chose Harry for his use of technology to further his own education and his knowledge of technology programs to increase middle school students' critical thinking skills.

Karl: Karl had been teaching for 12 years. He has a bachelor's degree in education with a concentration in social studies and language arts. He was finishing his master's degree in adolescent education. His experience was in teaching sixth grade students. Karl reported being a part of a group of teachers designated as "technobuddies"

by the middle school. “Technobuddies” are teachers who have volunteered and are designated by the administration as technology helpers for the teaching staff. They are available when teachers have a technology problem they can not solve on their own. Karl stated, “I know I have learned more this year helping other teachers than I have in the last two years. I would not know how to fix somebody's printer or other things if I had not started this role [as a technobuddy].” Karl was asked to be part of the study because of his expertise with technology. His expertise became known to the researcher when she worked with him on developing social studies curriculum materials. The researcher did not find out about Karl’s designation as a “technobuddy” until he came for the interview because this was a new staff role at the school. When he came to the researcher’s room for the interview, Karl described the program when he helped the researcher fix a printer problem.

Matt. Matt had been teaching for nine years. He had taught sixth-, seventh-, and eighth- grade. He has a bachelor’s and a master’s degree in education and had received training from the county for the job of computer specialist. He was teaching social studies during the time the study was conducted. Matt described his computer literacy as high. He stated, “I use quite a bit of technology with the students and during parent nights.” Matt was chosen because the researcher knew of his past training as a computer specialist and because he one of the first teachers at the middle school to post his lesson plans on the school’s shared drive so that all staff at the school could have access. He was also always available for helping peers with technology problems when needed.

Sandy: Sandy was in her first year of teaching. She has a bachelor's degree in middle grades education and special education. Sandy described her strengths as frequent use and comfort using technology the majority of the time. She attributed these strengths to frequent exposure during her degree program. She acknowledged her biggest challenge: "I think making things more interactive is the biggest focus for me when using technology; to try to make it something that the kids are participating with." Sandy was asked to participate in the study because she entered her teaching job with a real enthusiasm for using technology with her students, computer laboratory usage, and daily use of technology in her lessons.

Mary: This was the first year of teaching for Mary. She has a bachelor's degree in psychology and was working on getting her master's degree and teaching certification at the same time. During the study, she was working under a provisional certificate. Mary grew up with both parents having jobs in the computer industry. Because of her background, Mary felt very strongly about the importance of technology in education. She reported, "I think I am pretty technologically savvy; I can definitely get by on the computer. I normally help out my husband and a couple of my colleagues." Mary described being comfortable using word processing, searching the Internet, and computer programs for presentation. She was quick to pick up on how to use the school specific software by experimentation. The researcher selected Mary for her frequent use of technology in her lessons.

Janet: She had been teaching for 10 years. Janet has a bachelor's degree and is completing her master's degree. She was teaching social studies in the seventh grade

during the study. Her experience included everything from kindergarten through fifth grade as well as special education, ESOL, and gifted. Janet reported feeling comfortable using most software programs. She stated, "I feel that I am very strong in word, PowerPoint, Excel, and Inspiration." She expressed her interest in improving her ability to fix technical problems with technology. The researcher selected Janet because she was known for using technology with her students. Examples of her students' work can frequently be seen posted on the walls at the middle school.

Presentation of Findings

The presentation of the data was organized around the categories (a) descriptions of technological literacy, (b) teachers' technological literacy, (c) instructional practices, (d) challenges, (e) support for technological literacy, and (f) student assessment to help make sense of the information that was collected.

Descriptions of Technological Literacy

Gaining a common understanding of the meaning of technological literacy as it relates to middle school students allows teachers to do a better job with their students. All of the participants felt that for the outcome of student technological literacy to be successful, the description of technological literacy for middle school students should be explored and used to help students. The participants' descriptions of technological literacy include "basic computer operations" and "beyond the basics." Basic computer operations were those technology skills teachers felt students at the middle school should be able to do to perform routine tasks. The teachers felt that these routine tasks were ones that middle school age students would be able to use for middle school level assignments.

In addition to the basic operations, some of the teachers expected middle school students to be able to perform what they considered more advanced operations. The advanced operations are included in the subcategory "beyond the basics."

Basic Computer Operations

All 12 of the teachers felt middle school students should be able to perform some basic operations with technology particularly focusing on essential computer skills. As Karl stated, "Literacy in technology begins with learning skills for everyday use. I believe it is at least learning the basic operations of the computer." The teachers also felt that mastering these basic operations would be necessary as the students got older. The skills used to perform basic operations could be applied to learning different or more complex technology. Blake is representative as he remarks, "The things [technology operations] that they are going to have to do as they get older in certain professions are the things that they should know how to do before they leave middle school." Allison agreed and added, "These basic computer skills are important because they [the students] can show what they know about a topic by using a program like Word to generate a paper."

While the majority of these basic computer skills are similar, there are some variations about what each teacher considers important at this age. The majority of the basic functions selected by the teachers show that the teachers feel students should know how to turn on and manipulate components on a computer. Some of the teachers have added productivity and communication as part of their basic skill suggestions. Table 2 lists the computer skills and details the responses received from the participants.

Table 2

Basic Technology Functions for Middle School Students

Basic Functions	Number of Interviewees Choosing
Turning the computer on/off	12
Keyboarding (typing skills)	12
Use of the start menu	12
Use of the mouse	12
Login, ID, password	12
Opening the Internet	10
Basic word processing (edit and space)	8
Change font	7
Spell check	7
Print	7
Grammar check	4
Use of thesaurus	4
E-mail	3
Save function	3
Copy and paste	3
PowerPoint	3
Identifying computer parts	2

In describing the basic computer functions that middle school students should know, all 12 teachers agreed on several of the skills. The teachers felt middle school students should have the ability to utilize the computer, know how and where to use their identification number (ID) and password, and use the keyboard to maneuver different programs. Amy specifically describes the beginning skills of using the computer:

> The students should be able to turn on the computer. They should be able to use a mouse. They should be able to know about the left click option on the mouse. They should know how to use the keyboard and that the different keys allow a user to type. They should know how to sign onto a computer and understand that every person logs in using their own username and password. They should know that the purpose of a password is to protect their work.

As another example, Allison reported the skills she expected them to have when they entered her class. She agreed with the skills that Amy suggested but also added the importance of accessing the different programs:

> The students need to enter middle school knowing how to turn on the computer. They need to know how to log on to the computer. They need to be able to login as a student. They need to know how to go from the start menu and go to a certain program.

Matt agreed about the importance of including computer start up procedures as part of the students' basic skills:

> I think they should be able to go the computer and turn it on and wait for it to boot up. They should be able to enter a password if they need to log onto a network or even use a password to log onto a computer if it is password protected. They should be able to select and open the application that is appropriate for their need at the time.

The teachers also agreed that remembering the log in ID was something that most middle school age students needed to work on. They found that it was very frustrating to have the computers available and then the students could not get on the computers

because they could not remember their login or password information. Sandy's experiences are representative as she described, "I have had a lot of kids who could not log on when they needed because they did not memorize their password. They could not remember what it was supposed to be because they had changed it." Teresa agreed:

> When [my students] are working with laptops, one of the major problems is that they cannot remember their passwords. Since we [teachers] have no way to give them that information, the only choice is to use our own teacher number. Although this is something we are not supposed to do, it is the only way to let the child access the technological information.

Word processing and related tools were thought to be necessary for students this age. Eight of the teachers felt it was necessary for students to be able to use word processing programs including the features of edit and spacing. Teresa conveyed this message as she described the importance of basic word processing as an effective way to present and improve the appearance of their assignments. She stated, "The students should be able to have word processing skills because if they can get the words down by typing, that will make it [doing the assignment] quicker and look better." Allison agreed, "I think that it is real important that they learn how to do that [word processing] because a lot of stuff in adult life is not handwritten; it is generated via word processing. Learning it now will make them better at it in the future." Seven of the teachers thought being able to check the spelling of their documents, change the font, and being able to print should also be included in the basic functions. Mary exemplifies the thoughts of the teachers when she stated, "The students should be able to use the spell check program" and "change font size on another line." Janet added to Mary's comment when she reported the importance of "being able to print those documents off on their own." Four of the

teachers thought that grammar check and use of the thesaurus should also be included. Sandy expressed, "Students should understand that there is something [grammar check] there that will help you improve the grammar in your paper." Matt also agreed and added the importance of being able to "edit using the functions of that application including the thesaurus to improve your work."

Ten of the teachers described opening and using the Internet as a basic skill students should be able to do to gain access to a wealth of resources. Joan agreed with the other 9 teachers when she stated, "I believe that they absolutely have to know how to get on to the Internet to find information. It provides ways to be exposed to a variety of ideas." When asked about middle school student use of the Internet, Teresa described, "Students need to know how to get on the Internet because if you can get on the Internet you can get necessary information, whether it is an address you need or information about a class assignment." Mary explained her feeling about student Internet use when she stated:

> They [students] should all be able to use the Internet as a research tool. They should be able to find the resources they need. For instance the other day, we were talking about the Aurora Borealis and I brought it up so they could visually see it and read about it. This is a skill they need.

Mary also reported that it is important for her students to "use the Internet to find information both in a class setting and an individual setting. They can use the tools and technology to not only do the research but to publish their projects once they have done their research."

Three of the teachers found email to be an important skill for middle school students. Blake reported that "at minimum all students should be able to, as so many

students are already capable of, use e-mail and text messaging." Teresa described the importance of e-mail in the middle school. She stated that "all students should be able to use e-mail to contact their teachers because during the school day things move so fast that there is little time for conversation." She also described a student who made use of e-mail with an assignment. She explained, "I had a student who did not have a printer at home and she e-mailed it [an assignment] to me and I printed it on my printer. Without the ability to e-mail, I would not have been able to grade it."

Three of the teachers thought the copy and paste and save functions were important skills for the middle school student to know. Amy explained that "they need to know what copy and paste means and how to use the different tools that the browsers provide in order to take something and copy and paste it into a Word document to save for use in an assignment." As another example, Janet said, "in addition to copying and pasting, once they are done being able to get into the file, [students should] be able to use the 'save as' command. They need to be able to understand the difference between 'save' and 'file save as.' Only one of the teachers specifically added the use of drop down menus as a basic skill necessary for middle school students. Janet stated the importance of this skill for "changing the drop down menus so it saves under their specific unique ID."

Two teachers also said knowing the function of the basic parts of the computer was an important skill middle school students should have. Amy and Matt described the importance of identifying where the basic parts of the computer were and knowing what the parts were used for. Matt expressed, "I think that technological literacy for the middle

school student means that students have said they can identify parts of the computer. For the sixth grade students it is basic hardware and then seventh grade that would be hardware, not just the CPU, the monitor, the keyboard, and the mouse but also parts of a scanner." Amy agreed about the importance of identifying the basic parts of the computer:

> The students should know where the one/off switch is, where the monitor is on a desktop or a screen on a laptop, what a mouse is, and how to use it. Then although not every single specific machine would be the same, just like debit card machines with a different keypad at the grocery stores used by the parents, the students would know enough to be able to use commands to follow the instructions to use most any computer.

Using the PowerPoint program and adding pictures was thought to be a basic skill for middle school students by three of the teachers. Mary said, "They definitely need to use PowerPoint because it makes presentation so much easier." She described adding pictures through a program like Clip Art when making the slides as a desired skill. Pam acknowledged that "middle school students should be able to do a presentation on PowerPoint with little help. They should know where to go and what to do to get the work done." Teresa agreed that "Part of their [students'] skills should involve putting together a PowerPoint presentation summarizing their paper." Amy did not agree with the need to include PowerPoint as part of middle school student's basic skills for technological literacy. She explained:

> I do not have them use PowerPoint very often simply because it's far too time-consuming to create a Power Point presentation and with PowerPoint they are not writing in complete sentences for the most part. They are fine with pictures but as far as for our curriculum, I need to be focusing on their ability to write in complete sentences to be able to put together complete paragraphs especially since I teach language arts. I always try to incorporate that focus because one of the greatest literacy weaknesses academically is writing in complete sentences.

In choosing the objectives, content, and skills for technological literacy that were important, all of the teachers felt that strategies for showing how students were able to use the basic operations of the computer to complete a task should be included in the objectives. They felt that without a basic knowledge of how the computer worked and an understanding of the programs they were using, the students would be ineffective in improving technological literacy.

Beyond the Basics

Many of the teachers felt that to be technologically literate at the middle school level students should be able to do more than the basic functions described above. Pam's statement is representative when she said:

> I think it [technological literacy] is beyond the basic operations of the computer. I believe that most students, I would venture to say 90% of the students that we have today, know the basic functions of the computer. I think that we need to reach beyond basic competency skills and go beyond.

The more advanced skills for middle school students included (a) understanding plagiarism, (b) determining the validity of resources, (c) understanding how to use technology resources, and (d) using information for problem solving.

Eleven of the teachers felt that student understanding of plagiarism was a topic that should be included in the objectives for middle school teachers. The topic of plagiarism was very important to the participants because of the difficulty middle school students have in understanding the relevance. Several of the participants brought up the current articles in the local newspaper describing groups of students from two local colleges that had been expelled for plagiarism. They felt the incident underscored the

need for teaching the students a better understanding of the meaning of plagiarism and more instruction on the correct way to cite work. Amy said:

> I would say to exhibit ethical and legal behavior is a very strong topic that has currently been in the news. I am able to make a very strong point with the examples of young people who I know that have been reprimanded and one who has been expelled from college for plagiarism. That was at a local college.

The teachers want to make sure they have done their part in not only describing plagiarism to the students, but also provided opportunities for them to practice citations and documentation to give credit to people whose work they are referencing.

Defining plagiarism includes teaching the student to go beyond opening the Internet for information and copying down and presenting it as their own. They should be able to describe what they have learned in their own language. For example, Allison said:

> I think it is important that they be able to get information from the Internet and be able to put it in their own words, to communicate the information I am asking for, not just cutting and pasting into their document because that is plagiarism.

Joan agreed with Allison and provided an additional example for the importance of helping students understand plagiarism. She gives the example of her own PowerPoint programs as something the students copy in class. She explains to the students how using her work without her permission would be plagiarism. She stated:

> I believe that they [students] definitely have to understand the basic concept of what plagiarism is. It is not just when you have peeked over at somebody's paper and copied their answers. Students do not understand the concept that if you cut and paste anything, even if it is just a picture, and you do not give a valid link and hopefully the creator, it is plagiarism. I will even go as far as to tell them literally, if I was not giving you permission to use my outline in my PowerPoint, you would be stealing from me as well. I tell them that you have my permission, so you do not have to cite me. Any of this [the PowerPoint] is something you can use. I also explain how to do a bibliography.

By tying plagiarism to an example in the students' daily life, Joan provided a real life illustration they can understand.

The teachers interviewed also considered determining the validity of technology resources as an important part of technological literacy. Matt described how he approached validity with his students:

> In doing the research, they [students] should know how to find appropriate sources as opposed to most stuff that is out there. For example, we use an almanac and we also use student atlases in the classroom before we ever touch a website on the computer. We use them to look and talk about factual information. From there we go to the computer lab and we will use the CIA World Fact Book. During this time, I talk about not just relying on googling something or just looking at Wikipedia [on-line encyclopedia]. Everyone gets to contribute to Wikipedia and there really is not a good check on whether it is accurate or valid information. If we use an educationally maintained site or sites like the CIA World Fact Book or we use encyclopedias online that are known sources, then we stay with more valid information.

As Joan stated, "The students need to know how to search out good educational sites and tell which ones are not valid." Amy confirmed these ideas:

> It [technological literacy] means for me that students understand technology. The education of student's technological literacy should focus on media literacy rather than on specific software applications because the software applications will change. Understanding sources and validity of the sources is something that is not going to change.

Furthermore taking that information and using it for problem solving was also considered an important part of being technologically literate. Nine of the teachers felt that the objectives should also extend to using what students had learned for analyzing and problem-solving. For example, Pam stated, "I also think that we need to expose students to different documents and programs so the kids can know different programs so they can take those problem solving skills from one area to another."

The teachers' description of technological literacy for the middle school student included basic computer operations that involved (a) utilizing the computer equipment, (b) ability to maneuver, and (c) keyboarding skills for accessing different programs such as Microsoft Word and PowerPoint. They also described more advanced skills that would be used for critical thinking. These skills included (a) understanding plagiarism, (b) determining the validity of resources, (c) understanding how to use technology resources, and (d) using information for problem solving.

Teacher Technological Literacy

Teachers' technological literacy was thought to be extremely important in helping students become technologically literate. Pam felt that teachers needed to be technologically literate in order to effectively teach the students. Pam explained:

> You can not teach students if you are not technologically literate. It is like [comparable to] how can I teach physics if I do not know physics? That is the same type thing. You have to know the information in order for you to teach them. You can skim it with them but you will not be proficient enough to do a good job. The students will never learn to be proficient enough if you do not know enough about the topic. So I think that the teacher should be knowledgeable about the technological aspects of what they need to do.

Sandy agreed with Pam:

> I think it is similar to how important is it to know math if you're going to teach math. You can't teach something if you don't know it. I think it is extremely important. If these students are going to be required to learn than the teachers are going to have to learn it and be better at it than we want the students to be.

Allison also thought it was important for teachers to be technologically literate in order to teach the students. She also acknowledged the importance of sharing that technological literacy with the students:

> Teachers have to know how to use the computers if they want their kids to know how to use the computers. They have to be willing to use them [computers] themselves. So yes, a teacher needs to be technologically literate to help their kids be technologically literate.

Blake felt that it was important enough that all teachers should be required to show that they are technologically literate. They should provide proof that they can use those strategies to help their students. He advised:

> I think it could be a requirement for all teachers, especially for those who are not yet qualified for teaching, to show some sort of a level of computer literacy. That would show whatever county they are applying for a job that they are literate enough in this area. Then, they can also incorporate technology into their lessons to help their students. They should be literate enough, if anyone observes them, they will see them incorporating technology with their classes. That can really help the students.

Two of the teachers agreed that technological literacy is needed, but they specified that a basic level was enough. When asked how important teacher technological literacy was in helping the students become technologically literate, Harry said that it was not necessary for teachers to have a high level of technological literacy because there would always be students in the class who were technologically literate and could help the others with their skills:

> Well, the teacher downstairs, she doesn't know how to use technology very much. She was telling me yesterday on the way from bus call how the kids were helping her get Brain Pop up. They said, "Ms. Q. just hit this button here." The kids were helping her. The kids are sharp. They are more computer literate than we give them credit for, most of them.

Another of the teachers agreed with Harry about the students being able to help the teacher as long as the teacher has some basic technological literacy. Teresa stated that the students in today's classrooms have a wide range of skills when it comes to computer

literacy. The teacher can positively leverage this source of knowledge when working in the classroom. Teresa related:

> When teachers who do not have a lot of technological literacy need help, I am sure there are students in the classroom who can help the teacher in that respect. Several years ago, I was helping a student download a photograph and I couldn't get it exactly the way I wanted it. There was a student in the classroom that knew exactly what was wrong and why it was not coming up. They were able to show me. So, what I am saying is that the teacher doesn't have to be the most proficient person technologically, but they should have some background. They should be able to manipulate a mouse and they should be able to teach the basics.

All of the teachers believed if the school had technological literacy as one of its goals, then teachers should be prepared to carry this out. Teresa's ideas are representative: "If the school's goal or the system's goal is to have students to be as well-prepared technologically as possible, then everybody should work towards that." Matt agreed that if technological literacy is a goal than teachers should include technology in their instruction. He related, "I think if it [technological literacy] becomes a school goal and we are really going to do it, we [teachers] need to devote the time to use it in our regular activities and lessons."

Eight of the participants felt teachers who did not have the technological literacy required for the middle school level needed to improve their understanding of technological literacy so they could help their own students. Blake described the importance of understanding technological literacy to be better able to help the students when he stated:

> I think the better we are at understanding how to use information, the better we can help them [the students] to see and understand how to use technology for information as well. In other words, the better we are able to understand what we are being asked to do in terms of teaching students how to achieve technological literacy, the better prepared we will be.

Difficulty understanding how to use technology can be caused by low technology skills and/or difficulty keeping up with the advancements because technology is changing so rapidly. The participants felt that teachers should get the needed education or practice to improve their technology skills. In describing what the teachers needed to do, Pam stated, "I think they [teachers] need to go back to school, they need to brush up on their technology skills. I think we need to work together pushing the students to their maximum capabilities."

Several different times during the year, staff development for technological literacy was given by the school as part of teacher preparation to access information and to teach students the skills they need. Technological literacy staff development was usually done during instruction provided to a whole grade level with about 50 staff members in attendance. All of the teachers interviewed felt that the large group instruction for technological literacy given during grade level meetings is not very helpful because of the different skill levels of the teachers and because of the challenge of one person effectively helping a large number of people. Matt described the problem with having large groups of teachers attend a staff development session. He stated that the instruction can become ineffective when there is not enough support:

> It is just like a large group of students, you lose it, it gets watered-down, and it does not work. People get off task if they get a little bit lost, and one instructor cannot get all those teachers to do the same thing at the same time. Even if those teachers want to be there and they want to learn this new thing, it is still too big of a group.

Allison also agreed about the unproductiveness of attending large group instruction as part of a meeting. She finds that it can be a waste of time when it is something that she

already is proficient in or will not use in her classroom. She described her feelings of frustration:

> It is real frustrating for the teacher. At schools where some of the teachers know how to use the programs, they are still expected to sit in a meeting or a class. And we have had to do that in the past. It is a huge time management problem. It is hard to assess what the teachers know or what the teachers do not know in these large groups. Not everyone needs to sit in a meeting or class on how to do it [use technology] if they are not going to use it in the classroom.

Three of the teachers suggested that smaller staff development classes group by the levels or abilities of the teachers would be more helpful. Janet felt teachers who needed more help would benefit from more individualized instruction. She conveyed her feelings about the preference for less people in a class:

> I think the lower your technological literacy, the smaller your classes should be. I do not think you should put a big group of teachers that are just starting out together because you need that one on one attention from the instructor. When you get to the middle or more advanced level you can have a bigger class.

Two of the teachers felt more frequent staff development classes were important, but they would like to see those classes keep up with advancements so the teachers know the most current technology. As Allison reported, “I would like to see the classes focus on being current or the most current we possibly can be.” Mary agreed that the classes should be up-to-date and teachers should get this information regularly from frequent classes or computer updates. She explained:

> The teachers need to be able to be well-informed. They need to be able to either take regular up to date classes or print out the instructions from the class on certain programs or new technology because technology is always changing and if you don't stay current and up-to-date then you are going to get lost in the shuffle and then the kids won't have anyone to learn from.

Two of the teachers suggested that a step-by-step guide with printed instructions on how to use different technology programs would be very helpful. Joan thought that having directions that teachers could take and practice would be very helpful. Joan explained:

> It would be nice to have the instructions for different applications written down for you like the *Dummy for Technology* books. Those books are great. I think the books are absolutely fantastic. The step-by-step books are a good way to present programs because once you do it a couple of times you are okay.

One of the teachers thought instead of the classes being just about technology, they should combine content with the technology. Matt described teachers need to see how to use the technology as they teach curriculum concepts and still achieve technological literacy outcomes for the student:

> Teachers are trying to teach curriculum and so to tell them to throw in some technology to help students become technologically literate does not work well. We need to be shown how to use some of this technology not for the sake of the technology only but for the sake of the curriculum and then you get the technology literacy as an outcome.

Three of the teachers thought that teachers who were not comfortable with technology could improve upon their insecurities by spending more time on technology practice. Allison stated, "Teachers should practice to become more [technologically] literate; just experience using it!" Joan agreed that teachers who were not as comfortable probably did not have enough practice and would benefit by having more:

> Just not enough practice, that's what it comes down to. Especially, I noticed it with some of the veteran teachers. They have been here so long. When you have done certain things the same way for so long and all of a sudden have to start with something new, it's hard for them to understand where they can fit it in to their classes. Of course, it actually takes practice at first before you are comfortable enough to see the benefits.

While everyone thought that more classes were important, not everyone wanted the classes to be taught by the school. One of the teachers suggested that an outside specialist could be brought in to increase technological literacy of the teachers. Matt described how having an outside person could be used:

> I think an option is hiring outside help to teach teachers technology as opposed to having teachers teach teachers. I do remember a staff development I went to when a company was brought in to teach us something as opposed to having county teachers teach us. That [teaching technology] is all that they do and it was done much better. They would need to collaborate with a successful teacher so they can understand what we need to be able to do. Again the problem is, I think, we have needs that can be addressed by software and hardware and technology. But, if we do not know what is out there and how to use it, how do we address those needs. And then it translates into teaching the kids how to use it. It is like the software and the technology is on one side and the teachers are on the other side and neither knows the other one. They do not know each other. So, perhaps a professional trainer from a software company and a skilled teacher could get together, talk with each other, work with each other, and then present to the teachers as a pair.

Sandy made a suggestion about a new way to handle staff development. Sandy proposed that instead of teachers going to a class for staff development that the experts come to the classroom and work with the teacher:

> Instead of sitting through staff development, maybe if there was someone, if we had a person who could come around to the classroom, they could work with you at least, on using technology with the class. Maybe they could take a lesson you did when you did not use any technology and then kind of show or model for you or demonstrate how you can add more technology into that lesson. That way it would not seem like another class that you have to go to.

Matt also proposed changes in the way that staff development for technology should be presented in the classroom. He suggested that one member of each middle school team to be designated as the technology person. They would be the person who went to the

technology staff development to learn new concepts. He suggested the teacher chosen would be responsible for teaching the new technology to their team of teachers:

> This is an idea that I had for each team. There ought to be a technology person who learns the new thing [technology skill]. In a four person team whichever of the four people is the most able with technology, then that person would go to classes and bring information back for the other three. You would be the person who would go to the rollout of something new and then you would bring it back to the team of teachers. This is the middle school concept: the team idea. I think that there should be some support from the school. If there are still questions or misunderstandings or confusion, then the support should come from a person who is here for that.

One of the teachers suggested that the school continue and increase having teachers act as technology helpers for their peers. This would give the teachers more help when needed and make them feel less isolated when they have problems. Karl reported how having teachers as technology helpers could increase teachers' technological literacy by providing individual training. He described how this might work:

> I think I need and they [other teachers] need one-on-one training; maybe buddy up with somebody else in this school. I help out many people in sixth grade on a regular basis with basic things on a computer. I got called in the other day to fix somebody's computer because they didn't have Internet. They were in a trailer and I looked down and I said it might help if you plug in your Internet cable. Just showing teachers basic things is helpful. Teaching them [teachers] basic skills that they do not know that would make it easier for the teachers to use technology with their students.

Two of the teachers suggested that the technology coordinator spend more time in the individual classes working with the students and finding out what the students need and what the teachers need to be prepared to help them. Harry thought that the technology coordinator could be in the classroom at the same time working with the students and showing the teacher how to increase student technological literacy. He suggested:

> I wish the technology coordinator would do more on how to get us to use more technology by coming to the classrooms to work with the students. Both the teachers stay there while they are teaching the kids the basic technology skills. The classroom teacher can do the extensions later on but the basic competencies will be taught by somebody who is trained at teaching those minimum technology competencies to the kids.

Sandy also thought the technology coordinator should come into the classroom and work with the teacher and students like the math coaches do at the middle school. She felt the technology coordinator should show teachers how to use technology with a lesson to help teachers learn new strategies to assist students in becoming technologically literate. She proposed:

> In addition to working with the teacher, I would like to see a technology coach who could come in and demonstrate how to use technology with a certain class like the math coaches that we have, except it would be technology specific stuff. It would be good if the person was specifically trained in teaching students to be technologically literate and could come around to classrooms and work with you on how to use technology with a class to help increase their technological literacy.

The participants in the study reported that teachers' technological literacy was important in facilitating the outcome of student technological literacy. The majority of the participants found if teachers' technological literacy was low, it was the responsibility of the teacher to get the needed education or practice. The required education could be from college classes or school provided staff development. The participants felt effective staff development should include small classes and peer or technology coach involvement. The more teachers increased their technological literacy, the more strategies they would have to help the students.

Instructional Practices

Instructional practices the teachers use on a daily basis were considered by the participants as an integral part of helping students become technologically literate. Amy stated, "I think we need to use the best teaching methods to get the students as technologically literate as possible. I think we need to prepare students for entering the workplace." Janet felt the schools were responsible for preparing students for the future and to be potential leaders. Without computer skills, the students will be at a severe disadvantage in the workplace. Janet felt that emphasizing technological literacy was important to make sure that our students were on par with students who had technological literacy skills. Janet's ideas are representative:

> I feel passionate that technology in instructional practice needs to be stressed because it is the future for our students as future business leaders. If the students do not graduate with computer skills, they are severely at a disadvantage over students that have them.

The instructional practices the participants found important include (a) modeling and demonstration, (b) hands-on practice, (c) coaching or direct instruction, (d) providing opportunities for collaboration, (e) assessment as part of instructional practice and, (e) a separate computer class. The majority of the participants described hands-on or constructivist practices as the best way to observe and improve students' use of technology.

Modeling and Demonstration

The instructional practice of modeling or demonstration of technology on a regular basis was considered an important part of teacher practice by 11 of the teachers. During the past year, the middle school completed the installation of projectors in all the rooms in

the school and put a portable cart with a projector on it in the trailers. The addition of projectors in the rooms has allowed modeling and exposure to technology to be much easier for the teachers to implement. The teachers have the ability to connect their own laptops to the projectors for whole class exposure to numerous types of electronic media. Eleven of the participants stated the importance of frequent exposure to technology and included this as an effective strategy to help develop technological literacy of middle school students. The participants felt that showing the students the application or project ahead of time provided examples of good practices for students to use to increase their technological literacy and helped them to know what was expected for the assignment. When answering a question about what she considered one of the most important practices teachers can use frequently to help students increase technological literacy, Joan stated, "Well, first of all, of course, I teach a lot of the technology myself. So, as soon as the students walk into my classroom, they are introduced to it [technology] all the time by me using it." When Karl was asked how to increase student technological literacy, he included modeling and demonstration as a regular practice all teachers should use. He stated, "First, the school should make sure that everyone [all teachers] is modeling use of the computer in the classroom." He feels that this has helped his own students with their level of technology literacy. He shared, "I would say they are becoming more literate now because I have been modeling it [technology] a lot more, using programs I have learned from graduate school." Teresa agreed, "To increase student technological literacy, we should be modeling for them. I can show them these [the skills] are what I'm looking for. This is what I'm going to be looking for."

In answering how she increases technological literacy for students, Sandy explained her views, “I think that modeling the use of technology helps. I think that the more technology I use, the more I encourage my kids to use it. I use it to present lessons regularly.” It gives the students a chance to see technology skills in daily practice.

The participants found that modeling and demonstration gives teachers the opportunity to introduce multiple programs that the students may or may not be familiar with including productivity programs such as Word, Inspiration, and PowerPoint. They can also introduce United Streaming [on-line educational videos] as a way to collect both audio and visual information. Janet explained how she uses modeling:

> I try to model for them first. If we do not model it, there are kids that are not exposed to it and are not going to be as comfortable using it. I show programs they may not know. I use Word. I can use Inspiration. I use the projector. I present information using PowerPoint, so they are seeing what can be done in PowerPoint. I use the internet. I can show them how to look up information and highlight information. I can show video clips from streaming. I demonstrate this so they can see different applications the computer can do.

During teacher modeling and demonstration teachers reported using equipment such as Smart Boards, projectors showing computer programs, personal lesson plans, productivity programs, flash drive for storing information, observations, and assessment as part of lessons.

Matt told how this works in his social studies classroom. He explained the many ways he uses technology on a daily basis:

> In my class, I use a lot of technology, like the overhead LCD projector. I use the LCD projector to show a model of, step by step, what I am doing. This is done in order to show them how to produce whatever we are working on. So modeling and using the overhead projector quite often helps students learn. When I use the LCD projector to model, not only do they get verbal instructions but they also get

> the visual [representation]. They can also have a hard copy of the directions if needed.

Blake uses computer equipment for modeling and demonstration in his math classroom. He finds the combination of exposure to technology and demonstrating specific tasks to be the best way to model technological literacy. He explained:

> Incorporating technology into the lesson can really help the students increase their own [technological] literacy. Before we go into the computer lab, I give them a demonstration on how we are going to [use technology to] do the layout of a particular graph or whatever. I think that really helps a lot of them and they do not need my help as much because they saw exactly what it needed to look like. I expect my product to look this way or that way. I show them what I need them to do, what I want them to try to do on their own as much as possible. I think that really helps a lot of them because they saw exactly what they needed to accomplish.

Joan agreed with Blake about the importance of modeling technology. She reports that regular use of modeling by the teacher helps increase student comfort with technology. She finds that repeating the task the same way again and again leads the students to develop a higher level of comfort. Joan stated:

> Technological literacy is not modeled enough as a teaching tool, which is really a shame because not only are you missing great teaching tools for yourself but you're also not using the modeling the students need. In this situation, the more you model and show the kids the technology, the more comfortable they are. The repetition part is what they learn. If they keep seeing you do it the same way every time, the same things, the same motion including the pictures, making technology part of your every day teaching and learning, then they become more comfortable with it. The students will then automatically do it without thinking about it. It becomes second nature. So, I really think at school we're really missing on out on that part a lot if we are not modeling.

As shown in examples from these teachers, the use of modeling and demonstration is thought to help increase the students' depth of understanding of different types of technology and facilitate a higher level of comfort.

Hands-on practice

All of the teachers included providing opportunities for "hands-on" practice as very important for increasing technological literacy. They felt this exposure included taking the students to the lab, checking out laptops, and visiting the media center to use technology. They stated that regular use of the computer was important in increasing technological literacy. Pam felt students should be exposed to computer technology at least weekly as a way to help the student. Pam discussed this importance:

> I try to get the students to the computer lab or check out the portable laptop cart all the time. I'd say they have to do something with the computers/the internet every week; each week we do something. Teachers should use the labs or the carts at least weekly. It is absolutely the best way to help the students.

Blake agreed with Pam as he drew the connection between regular exposure to technology and technological literacy. He described how positive feelings about technology can encourage use and subsequently increased technological literacy:

> Regular exposure to technology can help them to become technologically literate easier. I think that all students this age love to use computers and different types of technology. It is just a matter when it is available to them.

When asked how she would increase her students' technological literacy, Teresa emphasized the value of going to the computer lab for practice. She explains that teachers must be prepared to meet the needs of different groups of students. Some of the students may need extra help in order to grasp the material while other students are much more advanced. She elaborated:

> The first thing I have to do is get them in the computer lab and the second thing is to help them put in their passwords and get them to a website. I show them how to manipulate or how to get into the specific areas or parts of the different programs. It is like baby steps. You take the very easiest steps and you have some students who will be way ahead and so you have to plan for that. You plan for the child

> that is really going to be proficient so you know that you have enough for them to do. Then you have to help the child that needs help. The improvement in their technological literacy happens over a long period of time with a lot of practice.

Joan stated the importance of hands-on practice with her seventh grade students, particularly those who were not as technological literate. She points out that some students do not have technology at home. These students are unsure of what the next steps are when using technology. She explained:

> Taking them to the computer lab for practice is important in increasing their technological literacy. I took them [students] to the computer lab and they were just sitting there in awe, like okay now what. They really needed the practice. You have to really go back to the basics. But I have several that are low income kids. They do not have the technology at home and somehow they got to seventh grade not using the computer much either. So those are the ones that you have to work harder with. Still show them step-by-step, how you turn it on, how you enter this into that and what a password is. Then show them how to put in the student name and then now you have to find this symbol to go to the Internet or go to the start key to pull up the Windows program. From there you go to the Word program. Any of those [students] with gaps in technological literacy that are pretty wide will need extra help. Those that have some know how about how to login and get to the Internet will need less.

Allison agreed with the importance of using "hands-on" practice. She discussed the need for the students to practice basic skills such as keyboarding and use of different applications. When asked to relate how to help students increase technological literacy she described:

> When I first started teaching, I scheduled myself in the lab every week at Little Broom Middle School back in 1994. I would just schedule myself in the lab so they could practice typing and getting into Microsoft Word. That's what we were using at the time and it did not matter that I would make something up just so we could go in there. I would say we are going to do a section review on the computer today. We are going to do our key terms on the computer today just so they could be using to computer. Then, as time progressed, I began scheduling time in the media center so that we could learn how to research, so we could learn how to look up information using the Internet, and "on-line encyclopedias." Now

> we are using laptops for lots of practice. They get more comfortable with it each time they use it.

Whether teachers used the computer laboratories, media center, or laptop carts, they agreed that practice was a necessary part of helping students become more technologically literate.

Coaching or Providing Direction

During this time, in addition to independent practice, eight of the teachers felt that coaching or providing direction, was an important component to help with increasing technological literacy. They reported noticing that as the student moved from teacher dependence to more independent practice, their confidence in problem-solving improved. When Sandy was asked how to increase student technological literacy, she acknowledged that coaching or direction was needed along with hand-on practice. As Sandy noted, "Coaching would help the students during practice instead of just expecting them to know something once we have talked about it."

Teresa told how she felt coaching should work with her classes. Once the material was presented, each student would work individually on a separate computer. Teresa could monitor the activities of the class and coach the students needing help when appropriate. She described:

> I would like to be able to have us all on the computers at the same time and to be able to have us all looking at the same lesson on the computer. We could do it [the assignment] together as a class so the students could watch my response so they could respond themselves. I could just walk around and be coaching them instead of doing it [the assignment] for them.

Joan described how coaching could allow the students in her classes to move to more independent work. She pointed out that once the basic skills are mastered, the students can move on to solving problems. She stated:

> Once they have learned the basic skills [computer] and you add in curriculum, you can provide direction and see if they can answer their own questions. At the end they are able to start solving a problem with little help and then on their own go a step further and actually find their own answers.

Matt acknowledged, "A teachers' role with technology is more of a coach than of a lecturer." He explained, "In the computer lab, I think that role could be some support. Then if there are still questions or confusion, the support should come from the teacher." Harry related how coaching worked with a middle school colleague he observed:

> So her job was to coach them [students] and to manage them and keep them on task and all that. So she said each kid had a different interest and it was awesome to watch them use technology to go down a different path of learning, researching and problem solving. I'd like to do that here at this level.

When the teacher functioned as a coach instead of directing students, he or she used technology to support technological literacy. Coaching allowed the students to have the creativity to find their own path of learning.

Collaboration

Six of the 12 teachers felt it was very important to provide opportunities for collaboration for students at the middle school level. Matt agreed, "Computers are a big collaboration tool that can be used in several ways with a classroom of students. I can give a project that is usually group work. I can assign research." Harry agreed that collaboration helps students increase their technological literacy as they learn to work with their peers. Harry stated, "I think in teaching technological literacy, we can do all of

these things needed in middle school: the collaboration, the working with peers, and using technology." He described how collaboration with another school worked in teaching diseases to students. The students were given a task to share with students at another school. Clues were given with instant messaging. This exercise resulted in the students mastering the material. Harry explained:

> One year a friend over at H. Middle School and I both went to the lab. Sarah went to her lab and I went to ours here. We had instant messaging. We used instant messaging and we had teams. It had to do with diseases. Each of us came up with diseases: mumps, measles, rubella, pneumonia etc. The kids had to come up with the symptoms of each. The teams on this side would type in a clue. And a team on the other end over there, they would take their clue, there were two or three people per team, and start trying to figure out what the disease was. Then they would come back with a question. And at some plying [prompting], our team here would give another clue. It's like when you go to the bars and they have the trivia games. You give one clue that leads to other clues. The more clues it takes less points you get. We did this for about three days and it was awesome. Those kids will never forget those diseases. It's so much more than having them memorize it.

Collaboration is considered important for future success as well as necessary for learning at this level. Janet felt that businesses succeed on assigned projects through collaborating with colleagues. These classroom exercises get them familiar with skills they will use in the business world. Janet clarified:

> This is important because one of my goals is to help them [students] start looking towards business and workplace. So, we had a project where they had to interview professionals in a particular business and then do online logs while they talked to people in different industries.

The teachers describe collaboration as a way to extend the opportunities to increase technological literacy by providing many different ways to connect learning at an age when students need social interaction. Janet described, "We have done WebPages to support and communicate our curriculum concepts. We post the presentations to show

them what we are doing. The collaborating with peers and experts using telecommunications is very important at this age."

In choosing students to work together for collaboration, teachers sometimes assigned students of different levels. They would pair a more technologically literate peer to work with one who needed more help with the assignment. Allison stressed the importance of collaboration as a skill she found important for technological literacy. She structured the assignments to require the students to work together. Allison related her feelings on the importance of students working together:

> We are using collaboration right now. The kids are generating review PowerPoint's for chapters one through nine or ten and they are working together. It was not an individual assignment. Working on their own was not an option because they need to learn to work together. I think that it is real important that they learn how to do that because a lot of stuff in adult life in done working together. They had to do it together and they had to come up with the information. It should be pretty interesting.

Theresa found collaboration provided opportunities to practice in a way that middle school students enjoy and it freed up the teacher to use observation to assess whether the students are making progress with technological literacy. She described how pairing weaker students with students that are more technologically literate helped both students benefit:

> I will take them to the computer lab. I will pair one student who is more proficient and I will pair them up with one who has very little experience and have them work together. I can learn how they are doing by observing them and they can actually learn by trying it along with that student. The proficient student learns by teaching [the student with less experience]. This is something they really enjoy.

Karl found when one student did not understand how to handle a specific task, the other student can help. Karl said:

> The students need to collaborate regularly. You may have two students working at a computer and one does not know what is going on, so they are collaborating. Now one is showing and the other is learning how to use it. So definitely I am teaching that skill [collaboration].

So whether collaboration is between a group of students, two students, students in other schools or experts outside the classroom, the teachers see it as necessary for technological literacy. Collaboration provides an exchange of ideas that would not happen if the students worked in isolation.

Assessment as Part of Instructional Practices

Half of the teachers described three ways of accessing the technological literacy of the students. These included observation, rubrics, and portfolios. The teachers felt it was imperative to frequently assess the students' level of understanding in order to help them increase technological literacy using one of these methods.

Karl describes observation as appropriate for assessing students' technology skills. Karl suggests that, "frequent assessment by use of observation is one way to look at students' level of technological literacy. Joan agreed with the regular use of assessment to gauge student learning. She finds that it is important to access the students by asking them questions and observing how the students use the technology. She explained how the informal assessment worked:

> I will assess them while I'm in the classroom. I'll say okay, where do they think I should go? Where's the next place where should I click? What do you think I need to do to get there? Observing them is very important. Moving around and seeing how they interact with the computer and going and looking and seeing if they are able to do things as I gave as basic instructions.

Teresa also suggested that teachers should use observation for assessment. She felt that combining observation with expectations can help teachers see if students are able to achieve assigned outcomes:

> For assessment, I find that observing is important. It is similar to what happens when you do a drivers license test. To find out if you can drive, they watch that you put your seatbelt on, adjust your mirrors, and turn your car on. That is what I would be looking for. I want to see if they can turn it on, do the work I expect, and shut down their computers.

Six teachers found that giving technology specific rubrics ahead of time allowed students to know exactly what was expected of them and increase their chances of building on what they have already learned. Matt thought that the infusion of technological literacy elements into an assignment reinforces student learning in all areas. He told about his use of rubrics for technological literacy in his math class. He described:

> For the technology part, I add a component layer they would produce with the unit. They would produce a table or bar graph and have the elements I am looking for. The kids would know that the bar graph, for example, has to have a title for the X axis and the Y axis and the bar graph itself would have to have a title.

Janet discussed with the importance of clearly outlining what is expected of the students in using rubrics for technological literacy. She suggested the rubric might need to be in the form of a checklist for basic skills:

> I think you very clearly need to outline the parameters of what you are expecting. If you are expecting a product or a project, than they [the students] need to know what it is. If you are just assessing if they can do certain functions, then they should know very clearly what the checklist would be. Am I being measured on turning the computer on? Am I being measured on putting in my password? If the students are being measured on things like I was when I took my teacher technological competency test, than what we had to do was just a checklist. Can you do this? Can you do that? If we are just looking to see if they can do certain functions, than it should be a checklist. But if we are looking to see if they can apply the functions, than it should be a very clear-cut project with a final product. The product should have a rubric with the technology skills that you are looking

> for. If you do the minimum, this is your grade. If you do more, then this is your grade. Then they [the students] will know where they fall on the spectrum.

Amy agreed about the importance of using a rubric with clear cut technology skills for assessment. By utilizing a rubric, consistent expectations are set for all students. She elaborated how a rubric would help students focus on the content needed to achieve technological literacy:

> I would think that a rubric that the students would have would be important in assessing technological literacy. The students need a copy of it and students need to understand it. They need to own it and they need to possibly have input into it. I mean just because it is mandated that they need to learn certain requirements. It needs to be consistent requirements, at least with the minimum standards. We can go above and beyond that, but I think a rubric would be the best way to assess it. So everybody would have the same set of expectations for their students and that would also keep us as educators all teaching the same basic content. We would not be emphasizing one thing over another without at least reaching a minimum mastery of all the technology they are supposed to learn.

Another suggestion for assessment was the use of portfolios. The participants felt that students could collect artifacts and use them to show how their technological literacy has increased over the year. Mary advocated use of the portfolio. She continued by stating that a portfolio could be used throughout the entire school year to show growth of technological literacy. Multiple forms of technology could be incorporated into the assignments included in the portfolio. She described how the portfolio could be used to assess the students without disruption of class time:

> I think the portfolio idea for assessing technological literacy should be used because that is something we can do throughout the school year. Perhaps, have them do a writing project using Word. Give them a rubric specifying things that they need to have. Have them be able to change the font on one line and be able to change spacing on another. Have them change size on another line. Write a story and check their spelling, check their grammar, print it off and put it in their own portfolio. Later on in the year, have them do a PowerPoint presentation and have them change the background and the cell. Have a set number of slides and

> change the way the slide is set up. Put it in the portfolio also. I think that would be a good idea and that would be an assessment that would not have to stop class time but it still shows their knowledge at the same time.

By using observation and frequent assessments along with demonstrations and coaching opportunities students would be able to better demonstrate the knowledge of technology.

Computer Literacy Class

Mandatory technology classes teaching basic skills were thought to provide a consistent baseline that the teachers could build on to improve student technological literacy. Nine of the twelve participants suggested that a separate class was needed to teach the basic skills needed for technological literacy. The teachers felt a mandatory computer class for all students should be part of the connections class curriculum at the middle school level. Blake felt a mandatory computer class would ensure that all students had basic computer skills when they entered his class. He felt that this class would make it easier for him to teach the content instead of focusing on the few students who were behind in basic computer skills. He expressed:

> I think it [the technology class] would give the students the opportunity to then have those basic skills so that when they are in the classroom they [the students] are able to keep up with the teacher who is using a lot of technology in the classroom. And when the students go to a computer lab to work on a variety of projects, they will be able to keep up. That enables the teacher to be able to help a lot of students rather than having to focus on just one or two particular students who are struggling because they are so far behind in handling technology.

This class should focus on the basics and insure that all middle school students have computer and Internet practice before coming to the classroom. Matt also suggested a separate class during the connections or nonacademic class time. He stated, “If we

offered a connections class on computer literacy and again the three tiers with sixth-, seventh- and eighth-grade progressively getting more involved. Sixth grade should be very basic, seventh grade builds, and eighth grade would be more advanced." Janet also agrees:

> I think that it would be a very good idea for them [students] to go through a connections class so they could catch up with their peers so that by the time they get to high school and they make decisions about their futures they have the technological background. For me it is as important as learning math skills and learning reading skills.

The participants found constructivist instructional practices were important in helping students achieve the outcome of technological literacy. The instructional practices included (a) modeling and demonstration, (b) hands-on practice, (c) coaching or direct instruction, (d) providing opportunities for collaboration, (e) assessment as part of instructional practice and, (e) a separate computer class. The combination of instructional practices affords opportunities for students to increase their learning at the middle school level.

Challenges

All of the teachers stated that there are several challenges that make it difficult to use technology to help students become technologically literate. The challenges include different levels of student technology experience, availability of equipment, and time. These challenges are issues that the individual teachers had experience with or perceived as problems for other teachers.

Differing Levels of Student Experience

One of the challenges the teachers discussed was having students being at such different levels of technology experience. Nine of the teachers included this as one of the challenges in helping students achieve technological literacy. Specifically, Allison pointed out that it is difficult to manage a class with so much technological diversity. Allison expressed these ideas when she said:

> Having so many people with so many different levels of experience of technology is an obstacle because it's hard to manage. You do not know who knows how to do something and who does not. You do not want to keep going over something if the students already know how to do it or not teach the one who need the help.

When responding to a question about the obstacles or challenges for the teachers at the school, Matt also felt that the school had a large discrepancy in the levels of technological literacy of the middle school students. He described, "the range of literacy and experience because of the number of students without computers or without Internet access" as one of the major obstacles.

The teachers felt these large discrepancies in skills and knowledge of technology has been caused by the increased number of free and reduced students the school has experienced as well as the high numbers of students from other countries who do not have experience with technology. Blake related how having students at different levels of technological literacy was challenging to him. He felt that there were many situations such as socioeconomic situations outside the control of the students and the school system that can affect critical access to computers. Blake explained:

> I think again that the biggest obstacle that we have is the different technology literacy levels the kids are at. Some of the kids, just because of their family situation, cannot afford any type of technology in their homes. So they could get

> to our classes, to us and middle school, and have not really had more than one or two opportunities to ever be in front of the computer. A lot of our kids come from other countries and I don't know what the situation is in those other countries. But, I'm sure it is not much like what we have here. There may have not even been any opportunity for them to be in front of a computer and they will really be way behind.

He found that these students are the "ones that have to struggle to use the different programs that we use."

Sandy agreed, "I think there are a lot of kids that have a lot less experience based on socioeconomics. Those students do not have the socioeconomic conditions that allow them to have computer access." She felt that it impacted the difficulty students had with the ability to follow instructions and stay on task. She explained, "Not having that kind of access makes it hard for them to keep up with teacher instructions [when using technology], so they quit trying." So the challenge that the teachers had was finding ways to overcome these economic differences and improve upon the technological literacy of the students no matter what their level.

Availability of equipment

The category of availability of equipment included challenges that the teacher experienced trying to provide opportunities for the students to work with technology. All 12 of the teachers agreed that using the equipment was an important component for the middle school student to become more technologically literate; therefore, helping students find equipment to use was considered a priority.

In describing availability of equipment, teachers included the challenge of the students who do not have computers at home as discussed above and problems in trying to schedule a computer lab or the laptop carts because of the number of teachers trying to

schedule them. Although there was more equipment available this year, it still was not enough. In the response from Matt below, the number of classes that need to share the four labs for the school presents a scheduling problem. The problem is compounded when all classes are not given the opportunity to use the computer because there is no regulation of the sign up of the labs. Matt described the problem:

> We have mobile carts and we also have quite a few computer labs. I think there are four. It is real difficult to get all of our classes into those. To sign up for them is difficult because you can usually only sign up for a couple of hours. If I cannot do this with all my classes, I struggle with doing it with one of my classes because it puts the other classes behind. So, although we definitely have made strides with the LCD projectors, the mobile computer labs with the laptops, and the number of labs, it is still a problem.

Harry also describes the problem of having to schedule the computer labs so far ahead of time because of the number of teachers who wanted them. He relates that he does not always know what he will be teaching on a certain day. His classes move forward based on student needs. If he schedules weeks ahead and needs to move the day, the lab will probably already be booked. Harry related how this becomes a challenge:

> Scheduling the lab, I guess that is another constraint. It means thinking and scheduling it [computer laboratory time] and coordinating it [computer laboratory time]. I do not have plans that are so exact that on Monday I am doing this and Tuesday I am doing that. I may have no idea. I know where the students are and where I am. I see if they did well on this today than I do not need to do that. So, I don't do what I planned, instead I do something else. So, to schedule a cart of computers or computer lab for three weeks from now on a Tuesday, that does not work.

Allison also expressed her views on the difficulty of having equipment available because of scheduling problems. Both the teachers and the students like using the computer equipment. For this reason, if computer equipment was available, it could effectively be used every day. However, due to the need to reserve the labs well in

advance, the teachers are limited in their planning. She explained her challenges with scheduling:

> Scheduling is a big priority for me. You cannot always plan three months in advance what you are going to do. Like, I want the equipment next week. I have to give it up because I have had it for two weeks. It is not fair, but I can use it every day. I like it. The kids like it. That is the challenge because that's what we need to do to be successful with teaching technological literacy.

The teachers in the trailers thought that availability of equipment was more of an obstacle for them because the laptop carts can not be brought into the trailers. Joan points out that the physical layout of the trailer stairs and the weight of the laptop carts prevents her classes from having access to certain equipment:

> You have to have the right equipment as far as technology is concerned. I have not had the chance to actually let them work with the laptops because you can not get the cart into my trailer. So all I have ever been able to do is take them to the computer lab when it is available.

Mary shared Joan's point of view concerning location limiting her availability to have access to computer equipment. She also found that being in a trailer added an extra challenge because of being unable to get the laptop carts in her trailer. Joan feels these obstacles will not be overcome until computers are permanently in every classroom. She affirmed:

> The physical location obstacle will probably be taken care of when a new school is built. Until then I do not see the availability of equipment being overcome other than if you put the laptops inside the classrooms [trailers].

Matt also described how nonworking computers cause a problem with the availability of equipment once you are at the computer laboratories. Computer equipment can fail due to either mechanical or operational problems. In either case nonfunctioning

equipment can jeopardize the success of the class. He related the difficulty of not having someone to staff the laboratories:

> Once teachers arrive at the lab and have a problem with the equipment not working, there is usually no one available to help with those problems. If a teacher spends the time trying to work on getting the equipment up, then that becomes a management problem with the students who are waiting for equipment.

Teresa described how having the equipment functioning properly allows the teacher to spend class time facilitating technological literacy rather than troubleshooting technical problems. In other words, not having working computers available caused her to lose valuable class time. She commented on her experience:

> Unfortunately, the last time I was in the computer lab, we had a technology problem where you could not hear anything. So when I had actually planned a lesson and gone down there, the service was down. It finally came up, but all the time that we had was gone so I to plan another day for that lesson.

Allison agreed and described the problem when the availability of technical assistance is limited. In her specific case, having only two people in the school trained to fix problems with the equipment can decrease the availability of equipment. She reported the problem:

> The other obstacle is if something goes wrong with a computer that is less equipment for the students. I do not have the information or know how to manage the computer itself without having to do a hard shutdown and starting all over. We do not have access to the people that do know how to fix them. There are 200 people in the building and there are only two of them.

Because of these problems, Allison described her preference in using the media center. The media center in the school contains books for student reading and about 25 computers for research. In the media center, Allison has received extra help provided by the media specialist, Rob. The sheer number of students makes it difficult to manage a

class's needs in the computer lab. This is made more difficult when the teacher is not comfortable with the application. Allison feels much more comfortable as long as Rob gets her started with a lesson and provides support. Then, she is able to finish instructing the class with his guidance. She explained use of the media center for computer-based lessons:

> Practice is necessary for technological literacy but a lot of people are very uncomfortable taking 28 people to a lab or 26 people to a lab. It's hard to manage and teachers are not comfortable with the actual programs that they are trying to use. I really feel like there should be someone in the lab able to support the teacher and to help them. I know when I go to the media center "Rob" is always willing to help do the class if I am doing research or if I am doing something that I am not comfortable with like a specific website. He is always willing to help, to get it started, and I do not have a problem stepping into that after I know what to do.

Because the school has these difficulties with scheduling student use of equipment and considering the unevenness of the student populations access to technology at home, one of the teachers suggested that having a community school that allows students additional time before or after school with the equipment. She also suggested that parents and other member of the community be able to come in and learn to use the technology we have as an important way to help our population with technological literacy. A community school is when the school is used after regular instruction time for special programs. Pam suggested:

> I think we should put into place a community school where there is after school time, there is a computer, there is an actual computer teacher, a computer literacy teacher who can teach the students and even their parents how to work on the computer and not just the basic skills, that are offered after school, before school, and even on the weekends.

She reported that she has seen this work in other schools. It has been staffed by school staff and volunteers from the community who would not usually be able to help during school time. Pam stated, "I have visited other middle schools that let students come in before and after school, on the weekends, and have people in the media center who help them [community members] learn how to use the computers and the Internet.

Time

Time was also included as one of the challenging aspects of using technology. This includes time for planning and time for use of technology in the classroom. Middle school teachers have one planning period scheduled per day. Sandy described the planning period as essential in being prepared to teach her classes:

> I think time would be a big obstacle because, at least for me sometimes it is harder and takes longer to think of a lesson that really incorporates technology well. And then if you are looking at a teacher who doesn't even feel comfortable with using technology that would be even more time required.

When the comfort level does not exist, the time required to properly incorporate technology into the lesson is increased.

Occasionally, these planning periods are taken away for supervision of student activities. Most of the time the planning period is to be used for collaboration with the team, grade level meetings, curriculum meetings, parent meetings and phone calls, grading papers, writing lesson plans, or mandatory staff development. Six of the participants felt that their days were filled with numerous meetings. They thought that the school focus on using the planning time for meetings left very little time to be able to plan lessons that would make the best use of technology. Joan thought that the time during the planning period was used up so often that there was not time for planning. She

reported, “There is not enough time in the day, so we do not really have planning time for this [technological literacy]. There are always meetings for the school or with the parents and that makes it hard.”

Teresa also thought preparing good lessons for technological literacy takes time. She felt that time demands on the planning period leave little time to properly include technological literacy. Teresa recommends the school allow teachers adequate time to integrate technology into their lesson plans. She explained:

> With all of our other meetings, there is little time for technological literacy. One of the things that the school needs to do is to make sure that teachers have the time to plan their lessons to integrate technology. They are going to have to give us lessons already prepared or give us the time to do it. We can do it but it is the time element. If you want to prepare a really good lesson you cannot just pull it off the top of your head.

Karl felt time was needed for collaborative planning of technological literacy lessons. In order to have good instructional practices for technological literacy, he felt that teachers need to pool their ideas for instruction. He reported, “We need time for planning. A group of teachers get together in a grade level and work together to decide on those technological literacy skills.”

Ten of the teachers expressed amount of class time as a challenge to helping students become technologically literate even if teachers were able to schedule lab time when they needed it. The teachers felt that one of the time constraints was being responsible for helping the students learn content material for high stakes testing. Mary explained that curriculum calendars are used by the school to make sure that academic knowledge and skills and standardized testing instruction that the school considers important are given plenty of time. She described her challenges with class time:

> For me, as an individual teacher, an obstacle would be time constraints and needing to get through the material. I have a curriculum that I need to teach. I have the academic knowledge and skills (AKS) that I need to teach. I need to teach it to them [students] in a certain amount of time so I can test them on it and move to the next subject area. Because we have standardized testing and we have certain time limits set by the school to complete certain things that would be an obstacle for me.

Janet stated that focus on the Criterion Reference Competency Testing (CRCT) made it hard to find time for technological literacy. She stated, "It is hard when you are planning towards the CRCT to have time to expose the students to it [technological literacy]." Harry felt that he could not afford to take class time to go over everything needed for teaching technological literacy to the students. He felt for a lesson including technology to be effective all students need to be familiar enough with the computer to make the best use of class time. For example, he said:

> If I assign a lesson using computers and fifty percent of them do not know how to do it, then it takes class time to learn it. You just do not have the time to take four days to learn to do a report out of the science class when we need every day for content.

Another challenge was using class time to go to the computer lab. This is because the average class period is approximately 55 minutes. During this time, the teacher must change classes, take roll, have a 10 minute introductory activity for the students required by the school, and then go to the computer lab in the time remaining. Mary found that the amount of instructional time is limited. Twenty percent of the class time is lost getting them to and from the lab. She explained the difficulty:

> Another obstacle would be physical location for me because it takes maybe 10 minutes for me to walk from here to the closest lab on the pink hall then maybe we have 20 minutes left of class before we have to turn around and come back, so the physical location is an obstacle for me.

Amy felt that for students to become technologically literate exposure to the computer is necessary. The combination of time constraint and lack of equipment makes this difficult. Amy used humor when she describes the challenge of the lack of time to use the computer labs:

> If it becomes my job to help them [the students] become technologically literate, then the school needs more computer labs. Also, there needs to be something that addresses the people who can not use portable labs. I know the answer to that question would be that you need to reserve the lab. When am I going to make my sixth-grade students' legs longer so they could walk faster? I mean seriously there is not a lot that can be done there. I can not make them walk any faster. I am "drill sergeanting" them down the halls as it is. Therefore a 5 foot student, unless they run, they are not going to get there any faster.

All of the participants reported challenges that make it difficult to help students become technologically literate. The three challenges include different levels of student technology experience, availability of equipment, and time. Teachers stated that the challenges have limited the opportunity to provide a technology rich environment for the students. Overcoming these challenges was important to increase student learning.

School Support for Technological Literacy

The teachers' perception of school support for technological literacy included setting goals, administration support, and providing appropriate and up to date tools and technology resources.

Setting Goals

As part of the school support, the school should set technology goals that all teachers at school can use to support the technological literacy of their students. The teachers suggested that the goals should focus on developing the technological literacy of

the students. The teachers also felt that these goals should be clear to the teachers. Allison stated that not only do goals need to be developed, but they also must be communicated to the teachers:

> The school should have goals for the teachers and if our school in general has some goals for technological literacy, I do not know what they are. We have technology stuff in our rooms so I feel like they must have some goals. They just might not be clear as to what they are.

Four of the teachers felt these goals should be specific for each grade level and that everybody in a particular grade level should work toward those goals that have been specified for that grade level. Teresa found that goal setting allows technological literacy objectives to be consistent. She exemplifies this point:

> I think the only way you could make technological literacy objectives consistent is if you set goals. The system sets goals, schools set goals, just like you have in curriculum and you say okay , for example, the seventh grade math students have to know how to add, subtract, multiply, and divide. You should have something in your curriculum that says exactly what the students should have to do on the computer.

All of the teachers felt that it was the responsibility of the school, with teacher input, to take those goals and write objectives by grade level and provide a copy in writing for each of the teachers. Karl believed that when the school system sets objectives on technological literacy all teachers can use them to set goals in their individual classes. He stated:

> Well, first of all school systems need to set objectives that as a teacher we have to meet. Those objectives need to be tiered for us. Now there is really not a standard that says that my third-grade child will know 14 of the letters on the keyboard and be able to press them. Now there is no consistent way to assess them. If I set goals for my class, your goals may be totally different. So we are all teaching the same grade but have different goals or objectives [technology]. So need to have them ahead of time.

In addition to goals, the teachers would like administrative support.

Administrative support

One of the teachers suggested that it is important is to have administrator proficiency and support to show the teachers the importance of technological literacy at the school. Pam felt that the assistant principal should be technologically literate and support the teachers in getting the education or training needed to improve their technological literacy. Pam reported:

> I think that since teachers are going to be technologically literate they should have a boss, the assistant principal that is [technologically literate]. I think the assistant principal should already be technologically proficient. I think the assistant principal should talk one-on-one with that teacher and he or she should encourage the teacher to go back to school or get some sort of training with the local school technology coordinator to try to work on his or her skills. It [technological literacy] is absolutely needed.

She also suggested that administrators not only support the introduction of goals for technological literacy but they also model it in their own meetings. Pam stated, "Use of technology during school meeting shows the staff that administration values technological literacy."

Two other teachers suggested that the administration support student technological literacy by making sure teachers are focusing on it in the classrooms. Karl advised, "Administration should make sure that everyone is modeling use of the computer in the classroom and making sure the teachers are using the appropriate tools and technology and resources." He felt that administration can find this out by looking at teachers' lesson plans. He reported, "When we do our lesson plans, the administrators, I

know my administrator and the principal above him do, have to make sure we are using technology in the classroom."

Appropriate and Current Technology Resources

Because technology is continuously changing, the school needs to make sure the technology being used is current. Allison described wanting the school to keep the technology current and explains the problem when technology is not kept up to date. She reported that students who have home computers often work with the latest versions of software programs. The school should keep their software programs versions current to avoid confusion. She stated:

> Well, the first thing I would like to see are the programs being current because the students will go home and do their work on the computer. Then, the students will come back to school and the program they are using at home does not work with the Word program we're using at school because it [the school software] is too old. The students have the most current. So, I think being current or the most current we possibly could be is crucial because most of my kids have the most recent programs with the most recent information or technology at their houses.

Blake felt that keeping up with the newest advancements in technology made his job in helping students be more technologically literate because he would be teaching them the current skills. Technology is always advancing. These advancements help the teachers perform their jobs better. Additionally these advancements in technology improve student learning. He advised:

> For me personally, obviously we live in an age where technology is advancing all the time and it is important for the school to stay up with certain advancements and it is important for me to be able to do my job and also important in helping the students to learn. For the students, having more advanced technology equipment helps engage them and helps them stay more focused because they are so used to the computerized age.

Joan felt that the addition of the newest technology including a smart board would be important because the students can interact with the teacher during daily lessons. She thought the right technological tools were important in encouraging students to become more technologically literate. This daily practice was thought to be important to Joan in motivating students to use technology. She explained how she uses it with her students:

> Well, first of course you have to have the right tools as far technology to help motivate the students. Getting a smart board would be absolutely fantastic because the kids can come up to it and use it and learn how it works and how to save their work on it. It helps the students learn important problem solving skills and that is the important thing, helping them learn.

As the students learned how to use the smart board, they had the ability to save their work each day and try different solutions to problems. This was in contrast to working on problems on a traditional board that would have to be erased daily. Students would be learning how to use technology to facilitate problem solving.

School support was another important component the participants described to help teachers provide opportunities for students to improve their technological literacy. School support for technological literacy included setting goals, administration support, and providing appropriate and up to date tools and technology resources. With school support, teachers can implement a plan to increase student learning.

Evidence of Quality

Evidence of quality was established by using several of the methods that were described by Creswell (2003). First, the researcher clarified bias by describing her role as a sixth-grade teacher of middle school students and the importance she places on technological literacy in their lives.

Second, the researcher spent time looking at the transcripts, rereading them, and revised the questions in order to collect "rich, thick description" (Creswell, 2003, p. 196) that would contain enough information that would be applicable to the study. For example, the interview question, "How important is teacher technological literacy in helping students achieve technological literacy?" was difficult for the first teachers to answer and so it was modified to read, "Can you teach children to be technologically literate if you are not technologically literate?"

Third, the researcher also shared the first transcript and ideas for the others with her doctoral committee chair to get ideas on how to collect more in depth information from the participants. She encouraged the researcher to listen to the answers the participants were giving and use that information to ask them to include more description in their answers.

Fourth, the researcher used member checking for accuracy and credibility of the findings. As described by Creswell (2003), accuracy was determined by "taking the final report or specific descriptions or themes back to the participants and determining whether these participants feel that they are accurate" (p. 196). Copies of the findings were e-mailed to the interviewees' to see if they felt that the findings were reflective of what they had meant. None of the participants requested any changes to the data. The majority of the teachers responded with an e-mail reply that the findings sounded like them.

Fifth, peer debriefing described by Creswell (1998) was used to provide an external check for the study. A colleague at another school in the county was asked to read the findings and ask questions about the researcher's interpretations and how they

related to the research questions. This provided the researcher an opportunity to discuss the findings with someone who was not related to the study.

Summary

Chapter 4 presented the findings from the qualitative study on how teachers describe technological literacy outcomes. Phenomenological interviews from 12 teachers at the middle school level were conducted to explore teachers' perceived role in helping students achieve this literacy. Chapter 4 included data collection, methods of analysis, an introduction to the participants in the study, analysis of the data, and evidence of quality. This data collected from teacher perceptions will be used to answer the research questions.

Chapter 5 begins with an overview describing why and how the study was done and a brief summary of the findings that addressed the research questions. The study also relates the findings to the literature studied including the theoretical frame work. Implications for social change as and recommendations for further study are also contained in this section. Chapter 5 concludes with a reflection upon the experiences the researcher has had and the possible effects it had on the result of the study.

SECTION 5:

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Overview of the Study

The need for information on how to help students become technologically literate is an important topic for teachers in the middle school due to demands placed on the schools by society and legislators. Currently with little information about how to achieve technological literacy (e.g., Reeve, 2002; Pearson, 2004, 2006; Fletcher, 2006), data were needed to conceptualize a plan for implementation. This plan needs to take into account the needs of the middle school age group. Therefore, a qualitative phenomenological study of middle school teachers was used to explore the phenomenon of technological literacy.

The purpose of this phenomenological study was to explore the perspectives of middle school teachers to gain an understanding of how teachers describe technological literacy outcomes and their perceived role in helping students achieve this literacy. As a middle school teacher, this researcher is aware of the need for teachers to develop a description of technological literacy based on the middle school students' needs and abilities and instructional practices based on theories that educators have found to be successful in helping students achieve this literacy. The perceptions from the interviews in this qualitative study provided the information needed to answer the research questions and give ideas about how teachers can improve the teaching of technological literacy. The qualitative phenomenological study was conducted at a large middle school in Georgia. This chapter contains a review of the research design and methodology, the

findings related to the research questions, recommendations for action, recommendations for further study, implications for social change, and the conclusion.

Research Design and Methodology

Qualitative research using a phenomenological design was chosen to use an inductive approach to engage the participants in a discussion of the phenomenon of technological literacy and what it means to middle school student education. This research originated as way to collect information about teacher perspectives that would help this school to fulfill the mandate of No Child Left Behind Act of 2001(2002) that every child be technologically literate by the end of middle school.

Upon approval from the Institutional Review Board (IRB) from Walden University, data collection began. Potential participants were chosen from teachers the researcher felt had distinguished themselves among their peers by sharing technology ideas and work samples at curriculum and grade level meetings, attendance at professional staff development technology classes, time spent with students in the computer laboratories, and enthusiasm for helping peers with technological issues. These teachers were given an overview of the study and invited to take part in the study. Once the teachers indicated initial interest, they were contacted by the researcher, given a full explanation of the study and a copy of the consent form to read. When the researcher was certain the teachers understood all the information, they were asked to participate in the interviews. After the teachers signed proper consent, the interviews were scheduled at a place and time convenient to the interviewee. The interviews were conducted from February to April of 2008 and recorded by a digital recording device.

After transcribing the data, the researcher followed Hatch's (2002) typological model described for analyzing qualitative data. This method was chosen because, as Hatch related, this method is useful in analyzing data from interview studies when the "researcher had as his or her goal to capture the perspectives of a group of individuals around a particular topic" (p. 152). Following Hatch's steps, the researcher began by identifying typologies to be analyzed. These included both inductive categories arising from the data and predetermined categories chosen based on the research questions.

Research Questions and Interpretation of Findings

Research Question 1

How do middle school teachers describe current and desired technological literacy outcomes for their students?

The results of this study found that teachers described technological literacy based on the technology skills they thought a middle school age student should know. Basic computer skills such as being able to start a computer, put in a password, make use of the internet, and productivity programs such as Microsoft Word and PowerPoint were included. The teachers stated that the students should be able to open programs and maneuver using a mouse or keypad. The teachers felt that these basic computer skills should be consistent for all middle school students. They also found that these skills should be written as objectives that are specific for each grade. The skills the students learned in the sixth grade should be used as prior knowledge and built upon in the seventh grade and likewise in the eighth grade. These skills detailed under basic computer skills would be listed under Duggar's (2001) description of technological

literacy as using and managing technology. His description of technological literacy also included the ability to assess and understand technology (p. 513). The teachers discussed the ability to assess and understand technology in their description of technological literacy for middle school students. These more advanced skills were considered necessary for middle school students beyond basic knowledge of use of the computer.

In addition to these skills, the teachers felt part of the desired technological literacy outcomes would include using technology to be able to make use of the different resources that are available. They agreed with Russell's (2003) extension of the definition of technological literacy to include the ability to use technology for the purpose of problem solving, inventing, designing, and trouble shooting. In other words, students should be able to use the technology skills they have learned for critical thinking and problem solving in any area. Aronson (2007) agreed that the technologically literate student should be able to use the prior skills that he or she has learned to make use of the latest technology. Since technology is always changing, the ability to adapt to those changes will become a base for the technologically literate student to continue to leverage the advances that will be developed in the future.

Research Question 2

What practices are middle school teachers currently using or should be using to achieve the outcome of student technological literacy?

From the interviews, the participants described instructional practices they felt would improve the technological literacy of their students. These practices included modeling and demonstration, hands-on practice, coaching, collaboration, and assessment

as part of instructional practice. These practices when used in conjunction with computer-based technology are also supported by the ideas of Piaget (1969), regarding learning in general, that children need to take an active part in the learning so that they can increase their knowledge.

Judson (2006) acknowledged that these types of constructivist practices increased computer-based technological literacy. He found when teachers used constructivist practices, students build on what they have learned. This scaffolding of learning can help students increase their technological literacy.

Several studies support the participants' views on the importance of teachers' instructional practices in increasing student technological literacy (Bassett, 2005; CEO Forum, 2001; National Education Technology Plan, 2004; Wambach, 2006; Leu, 2002) including using different technology for modeling in the classroom, providing opportunities for practice, and exposure to equipment. The teachers also described the importance of using collaborative instructional practices with technology to increase learning opportunities. They recognized that exposure to collaborative practices can benefit middle school students' learning. This exposure can provide ways to improve student technological literacy. Judson (2006) acknowledged that computer-based technology used along with collaborative learning experiences enhances student technological literacy. He found that combining a technology rich environment with collaboration can "enable the dynamics of students constructing personal meaning, learning from one another, learning from experts, and creating unique interpretations" (p. 581). When students construct their own meaning, learning occurs.

The participants described instructional practices that would be considered constructivist in nature. They believed as Hirumi (2002) described that classes that combined the equipment with hands-on student centered instructional practices resulted in facilitation of technological literacy. These types of classroom environments were "designed to enhance students learning and performance by helping educators operationalize constructivist approaches to teaching and learning" (p. 497). Instead of lecture, the participants felt modeling and demonstration along with hands-on activities would engage the students and provide for the largest increase in technological literacy learning. Several studies (Brandtl, 2002; Huroni, 2002; Yoder, 2003) support the use of student centered constructivist classrooms to increase technological literacy. In other words, students need activities that require them to practice what they have seen and apply what they have learned. As Munby, Russell, and Martin (2001) proposed, "Application involves working with rules or procedures – the prescriptive features of practice whereby knowledge is translated into action in particular situations where such action in consider right or wrong" (p. 889). The participants felt teacher created environments where the students were assigned projects, which allowed them the ability to practice technology skills, fostered positive learning experiences in the classroom.

Leu (2002) found that it is important for educators to develop their own instructional practices to help students become technologically literate, either through trying out different instructional practices and seeing what works or conducting action research (p. 2). By seeing what works in their own classrooms, teachers can make informed decisions about which practices to use. He found if teachers waited for research

"the technologies will have changed and there'll be new skills, new strategies" (p. 2). The continuous change in skills and strategies makes it important for teachers to look at current practices and practices that they would like to implement.

Research Question 3

How do middle school teachers currently assess and propose that student technological literacy should be assessed?

The middle school teachers in the study proposed several methods to assess technological literacy. These included an on-line test, portfolio, computer connections class, project, or observation. Whatever method was chosen, the teachers felt that use of a rubric listing the requirements was essential to helping the student understand what to turn in.

The teachers stated that one option would be an on-line test that was similar to the one they took for certification of technological literacy given by the state of Georgia. The students would answer questions that would show the type of knowledge they had related to the different types of hardware and software. They might choose a location on a picture, open an e-mail, or tell what program they would use to complete a requirement. They would receive points for each correct answer. The students would be required to show a passing grade to document their technological literacy.

A portfolio was another choice pointed out by the teachers for assessment. The students could have a checklist of work that the teacher would like included and they would select the best example of that work. This would be a good way to show progression of learning for a set period of time. Hirumi (2002) suggested that portfolios

for technological literacy "consist of three items (a) assessment rubrics, (b) work samples, and (c) narrative description" (p. 497). The portfolio could be graded by the number of completed assignments or points assigned to the checklist.

Informal class assessment was considered an important component of assessing student learning. When teachers articulated their views on informal class assessment, observation to assess a student's technological literacy was the most mentioned practice. All of the teachers felt they could tell a lot about the literacy of the student by observing the students as they used technology to complete an assignment. The students with higher technological literacy could complete their assignment with minimal assistance while those who had lower technological literacy struggled.

The teachers also discussed an assessment to fulfill the No Child Left Behind Act of 2001 (NCLB, 2002) directive. Fletcher (2006) reminded us of the important provisions of NCLB that apply specifically to middle schools. NCLB has provisions that will require all students be technologically literate by the eighth grade. This provision promotes the idea that all grades in middle school should be working toward this goal and finding the best way to assess this progress. The teachers felt although any of the above methods could be used, the best way to assess technological literacy would be by an online test or a separate class with criteria for passing.

The option most of the teachers liked for assessing middle school student technological literacy was the idea of a separate computer class. This class could be taught during the students' connection class time. Connections classes are classes other than language arts, science, math, and social studies. The class would have specific

objectives for each grade level. This would allow the students to come into their other academic classes with the basic technological knowledge and skills they would need to use for problem solving or completing a project. This is somewhat of a change from the traditional thinking taught in teachers' preparation classes. The preparation classes recommended that students learn technology skills better when integrated with the academic subjects. The teachers in the study were not advocating stopping integration of technology into their subject matter. They were proposing a way to provide documentation of a student's technological literacy and to help students be on a level playing field when they enter their academic classes. Having students with a higher level of technological literacy would allow teachers in the academic classes to spend more time on the actual integrating of technology into the content area instead of helping students who are behind with basic computer competency. The class would also provide a way to document whether or not a student was considered technologically literate by the eighth grade. By passing the course, the student could show proficiency in certain technology skills. Castillo's (2007) study looked at designing an assessment to measure technological literacy. His study utilized a two-group post-test only design with a group of 272 sample participants. The results of the study found that eighth-grade students taking a separate class for technological literacy performed better than those who did not take the class. Castillo's findings suggested that taking a class in technology education as suggested by the teachers in this study could improve student technological literacy.

Research Question 4

What current and future issues can affect teachers' development of student technological literacy?

The study found there were several issues that can affect teachers' development of student technological literacy. These issues include focus on school support for curriculum standards and testing, rapidly changing complexity of technology, availability of equipment, time, student diversity, and lack of effective professional development (discussed in question 5). The importance teachers placed on these issues seemed to depend on whether the teachers were located in the main building or in the trailers. Teachers with classrooms in trailers stated that two hindrances cause them to have less access to equipment. One is the inability of bringing the laptop carts into their classrooms and the second is the additional distance from the computer laboratories in the school building. The teachers inside the school building do not have these same challenges.

While the majority of the teachers in the study recognized the need for student technological literacy, they reported that their current focus was on curriculum objectives of the school and county. The curriculum objectives are based on the state and county content standards for the improvement of standardized testing and tied to provisions of NCLB (2002). For the most part, these objectives are dictated by the county and prescribed in the form of an instructional calendar the teachers must follow. Daily instructional plans are written from this calendar. Additionally, at the end of the nine weeks, county benchmark testing is given to assess student knowledge of these objectives in the areas of math, social studies, language arts, and science. Teachers are asked to

provide reasons why their students, who do not pass the benchmark tests, did not learn the content. This stress causes teachers to focus on those objectives. However, this study found that even with the focus on the four academic subjects, the teachers want the middle school to look at ways to include technological literacy in instruction.

Wolf and Hall (2005) found that although schools are focusing on curriculum standards, schools are beginning to look at strategies to increase technology instruction because of national and state mandates that will become effective in the future. In other words, schools could lose funding unless they comply with the NCLB technological literacy mandate that takes effect in 2014. In fact, part of the reason middle schools are beginning to look at technological literacy is the NCLB (2002) mandate that middle school students must be technologically literacy by the end of the 8th grade. Gardner (2000) reported that although some schools are including technology so that state and federal requirements are met and schools receive proper funding, the school focus is more on meeting the curriculum standards rather than the outcome of technology literacy for the students. The participants said formulating school goals would be necessary to ensure there is school wide focus to help students complete the outcome of technological literacy instead of focusing on standardized testing.

Another issue the teachers reported is the difficulty with keeping up with the rapidly changing complexity of technology. They articulated the importance of staying current with the most updated technology to provide the best instruction for their students. In results from her mixed methodology study of 26 middle schools teachers, Heeren (2007) stated teachers felt as technology changes, so should teachers practices.

These practices should reflect the most current technology available. Reeve (2002) found that teachers must "continually evaluate and revise the curriculum so the student attainment and retention of technological literacy is sufficient to the needs of today's society" (p. 33). The teachers in the current study stated that these revisions should come in the form of goals from the school and be communicated to the teachers. Then teachers can take these goals and use them to develop instructional programs that work in their classrooms.

The teachers also reported availability of equipment as an issue that affects student technological literacy at the middle school. Without the access needed to technology, teachers cannot provide the practice they felt was necessary to increase technological literacy. Takkunen's (2008) study of 400 teachers using an online survey reported that teachers indicated that not having access to equipment was the most significant barrier to helping their students become technologically literate. Teachers in her study also found the inferior equipment schools received was a major impediment to successful achievement of technological literacy.

The teachers in this study did report that the addition of laptop carts with 20 computers each and projectors at the school has provided additional technological resources that has helped with the availability of equipment, but it has also led to several challenges. First, there is the question of how to use the new multimedia projectors in the best way to increase technological literacy and improve content retention. The multimedia projectors were placed in the school over the summer with only minimal instruction given on how to use them. Teachers were given the equipment and needed to

develop plans to use it in instruction. As Waters (2007) found," The greater challenge is helping teachers devise new teaching strategies that integrate the relatively vast resources these multimedia projector systems make available" (p. 43). Looking for ways to use the projectors in the classroom is something that will take time as the teachers learn new ways to use them with their students.

Second, there is the challenge of having equipment available at the needed time. The ratio of teachers to the computer labs or laptop carts makes scheduling difficult for teachers wanting to use them. Although, there was more equipment available this year, it still was not enough for the size of school. Additionally, nonworking computers in the labs can cause a problem with the availability of equipment for each student. Computer equipment can fail due to either mechanical or operational problems. In either case, nonfunctioning equipment can jeopardize the success of the class if there is not enough equipment for the students. VanHook-Schrey's (2008) statewide study of 154 teachers in North Carolina reported some of the same challenges stated by the teachers in this study. They stated limited access to computer labs and faulty computer lab equipment was a major barrier to providing a technology rich environment for students. Bauer's (2002) qualitative study of 30 teachers found similar challenges as the teachers in this study. Bauer stated although research has shown use of computer technology helps students become prepared for the digital age, teachers are hindered by both difficulty scheduling computer labs and technical difficulties occurred when using the equipment. The teachers reported the difficulty comes from being allowed infrequent use of the computer labs due

to the number of teachers wanting to use the labs and "mechanical difficulties and breakdowns" (p.101) of equipment.

Third, the teachers reported that lack of available equipment due to school location has lead to inequalities in the type of education that the students can receive. Teachers who are in portable classrooms do not have the easy setup with the projectors that teachers in the school have and they can not use the laptop carts because the carts can not go up the stairs of the portable classrooms. Even if ramps were built, the carts are so heavy, it would be difficult to get them into the portable classrooms. The teachers in those classrooms feel that this restricts modeling and exposure to as much technology as they would like for their students. It makes it harder for them to have students practice individually because their only choice is to take the whole class to the computer lab and even if it is available, it takes longer to reach the labs. It was noted by these teachers that the amount of instructional time lost going to and returning from the computers lab was counterproductive. Shelton's (2003) study of 14 teachers about their perceptions toward portable classrooms reported that the teachers in his study also found the extra time to get the students in and out of the building as an obstacle that led to loss of instructional time.

Niles (2006) qualitative case study of 13 teachers and 18 students who were in a school where they had access to laptops as part of a one-to one laptop initiative reported that it did have positive results. She reported changes in teacher pedagogy that resulted in student improvement in the way they learned. Niles felt that teachers changed to using constructivist practices that appealed to multiple learning styles and increased both curriculum content retention and technological literacy.

Conversely, Pitrelli (2007) used a 65 item questionnaire to survey a sample of teachers that included 217 middle school teachers. She found that although the schools these teachers were at had spent large amounts of money and ample equipment, it did not improve the widespread use of technology. She reported that it takes more than just having the equipment available. It takes an environment that supports teachers in using the equipment.

Teachers also reported time as an issue in helping students become technologically literate. This includes both time for planning and time for implementing lessons. On paper, the teachers in the middle school are given a block of time to use for planning. Occasionally, these planning periods are taken away for supervision of student activities. Most of the time the planning period is to be used for collaboration with the team, grade level meetings, curriculum meetings, parent meetings and phone calls, grading papers, writing lesson plans, or mandatory staff development. The teachers stated that with the school focus on using the planning time for meetings left very little time to be able to plan lessons that would make the best use of technology.

Amount of class time was reported as a challenge to helping students become technologically literate even if teachers were able to schedule lab time when they needed it. The teachers felt that by the time they took the students to the lab, turned on the computers, and directed the students to the programs, most of the available class time would be used. Even with use of the laptop computers, there would have to be time to unplug each computer from the cart, give them out to each student, and boot them up before instructions can begin. With such stringent class times, there is no flexibility in

extending a class that needs more time. Several other studies also reported time to provide a technology rich environment to increase technological literacy as an issue facing schools today (Edge, 2005; Heeren, 2007; Kuzmicic, 2006). They found that teachers are reluctant to include opportunities to use technology equipment on a regular basis for this reason. Kuzmicic's (2006) study of 16 elementary and middle school teachers found time was a major challenge in helping students become technologically literate. She found that this included both time for planning and time for integration of technology during the class.

Student diversity is another issue the teachers in the study reported. Having students at such different levels of technology experience provided challenges in helping all students become technologically literate. The teachers felt these large discrepancies in skills and knowledge of technology has been caused by the increased number of students in the lower socioeconomic groups who do not get the exposure to technology and the high numbers of students from other countries that have not had the same experiences with technology. Heeren (2007) also found that the teachers in her study reported students with differing levels of technological literacy as a challenge for middle school teachers. She agreed with the teachers in this study that this challenge can impact the way a teacher plans lessons using technology or even have the teacher avoid certain lessons.

Research Question 5

How do teachers evaluate the role of their own technological literacy in developing student technological literacy?

The majority of the participants in the study reported that teachers needed a higher level of technological literacy to help the students become technologically literate. Only two of the participants felt a lower level of teacher technological literacy was sufficient to help students become technologically literate. Evaluating the role of teacher technological literacy in developing student technological literacy provided the opportunity for the participants to reflect on their own technological literacy as well as that of their peers. The majority of the participants stated that their role in providing a technology rich environment was important in helping the students develop technological literacy. They said that the more teachers provided opportunities for the students to be exposed to technology whether by demonstration or hands-on practice, the more their technological literacy would increase. Therefore, in order to help develop technological literacy and provide the technology-rich environment needed, teachers should have the skills needed to effectively use technology with their classes. The teachers described the school's role in helping to provide staff development that would help the teachers improve their own technological literacy and keep up with the advances in technology.

Becker and Riel's (2002) study of 4,083 teachers found a higher level of teacher technological literacy may improve instructional practices for the development of student technological literacy. The study acknowledged that schools needed to provide professional development on how to use technology to increase technological literacy and encourage teachers to use these learning experiences with their students. By providing classes on how to accomplish technological literacy, teachers could develop a higher

level of technological literacy and be more likely to incorporate these practices into their classrooms.

Bagwell (2008) also investigated technological literacy using a multiple case study approach. He collected data using interviews, observations, and artifact examinations from eight teachers from primary through high school. His findings suggested that teachers recognized the importance of technological literacy for themselves as a conduit for student learning. The teachers' level of technological literacy could be positively impacted by professional development. He found that professional development provided information that teachers used to apply to classroom practices.

In her cross sectional study of 440 suburban high school teachers, Underwood (2007) reported that teachers do not have to have high levels of technological literacy to help their students. Her "data revealed that the high school teachers surveyed were integrating technology into their instruction at moderate to extremely high levels even though they possessed only moderate to high comfort and skills in their personal computer use" (abstract) in order to help their students become more technologically literate.

Recommendations for Action

The results of this study found that teachers need to have effective staff development to teach them how to help students achieve technological literacy. The teachers described the need for staff development that can help them learn how to include strategies for technological literacy with their curriculum. The administration should look into up-to-date staff development that includes small classes with more individualized

instruction, having the technology person work in the classroom with the teacher to come up with practices that are relevant for the middle school student, and having training from companies outside of the school system. All of these suggestions are areas that warrant further action.

In addition to the staff development needed to increase teacher technological literacy, the school needs to make sure that equipment is available for all the students. Increasing availability of equipment includes providing better ways to schedule the computer laboratories, staff to monitor the equipment, and equal access to equipment for trailer classrooms.

The teachers reported scheduling of the computer laboratories needed to be accomplished in a fair and consistent manner. While signing up for time slots on a computer calendar makes it easy to sign up, it does not ensure fair scheduling of the laboratories. Monitoring the scheduling of the computer labs would ensure the amount of time used by the teachers is divided fairly and that one teacher does not have the majority of the time slots filled.

Availability of equipment also includes having staff to make certain the equipment is working. The staff level to equipment ratio needs to be sufficient to keep the computer laboratories running at peak operational efficiency. Having labs that work will ensure that student time in the labs is spent effectively.

It also includes finding a way to allow the teachers in trailers to have access to the laptop computers. Because the laptop carts are not able to be transported into trailer classrooms, teachers in trailers have fewer opportunities to give their students hands-on

practice needed to increase technological literacy.

Another recommendation for increasing access to equipment for all students is to have the school consider a community school plan. This plan would include the community in development of technological literacy. Several of the teachers suggested that before and after school time could be used for students who did not have available technology at home. It was also suggested that this technology support be made available to parents and other members of the community. This recommendation for action could provide students who may not have access at home the opportunity to increase their technological literacy.

Recommendations for Further Study

There are several areas that the researcher would recommend for further study. First of all, the researcher did not get a lot of data on the current practices that teachers were using to help their students achieve technological literacy. Also, she did not get data on how using different types of technology for individualized instruction can help students achieve technological literacy. The majority of the information collected described actions teachers felt should be used with their students. Since the No Child Left Behind Act of 2001 (NCLB, 2002) states that teachers need to be responsible for the technological literacy of their students, than it is important to explore teachers current practices and report their perspectives on effective technological literacy solutions. Therefore, another study could investigate the current practices of other middle school teachers to see what practices they are implementing with their students both individually and collectively as a class to achieve technological literacy.

Second, since this study was limited to teachers who the researcher thought would be more likely to be knowledgeable in the area of technological literacy, further research could look at teachers who are not as knowledgeable or who rate themselves low in technological literacy. Their perspectives on how best to increase student technological literacy could be used for providing comparative data.

Third, because this study was completed in one middle school with a small group of teachers, this study could be repeated in other middle schools to gain the perspectives of a larger population.

Personal Reflection

When I began my journey to finish my dissertation, I was sure I would be doing a quantitative research project. I have always been interested in science and math. Science was my undergraduate major. Numbers always seemed to make the most sense to me. When one of my committee members thought my topic was more in line with qualitative research, I had no idea how to go about completing it. I knew I wanted to do a study about teaching and technological literacy outcomes for students. I was not sure whether I wanted to do this from a teachers' perspective or from the students' perspective at first. When I started looking into the subject, I found that numbers would not answer the questions I felt were so important for this issue. I needed the explanation of teachers' voices. I needed the description of what technological literacy looked like or should look like in the middle school classroom. I wanted to know how other teachers are facilitating the outcome of technological literacy with their students. This interest led me to a qualitative interview study of the phenomenon of technological literacy. I had the usual

questions about whether people would give me the amount of time needed to talk about technological literacy. Would I choose people who are knowledgeable about the subject and have enough to say to answer my research questions? When interviewing the participants, I learned that the teachers I asked were very generous with their time and very willing to help in any way they could. I also learned that the participants would share some personal things about themselves that I had not expected. I learned they shared many of the same challenges that I face every day in trying to help my students become more technologically literate. I also learned about some interesting practices and Internet sites that I did not know about before, but I will be trying with my own students. I am increasingly convinced that as a middle school teacher, I must keep up with technological changes to ensure that my students are getting the skills and knowledge they need to be prepared to go on to the next level. I am glad that our school added the laptops and the projectors. I began to use them last year, and I hope to continue incorporating better practices to help my students succeed in learning the social studies content and increasing their technological literacy. I realize the addition of new equipment is dependent on funding. I hope the decision-makers continue to feel schools and students need new and updated equipment to keep up with the latest developments.

Implications for Social Change

Teachers were given a NCLB (2002) mandate to ensure that middle school students be technologically literate by the end of middle school. Since teachers are charged with the goal of implementing practices for technological literacy and no one knows exactly how to put this program into place, the ideas of this group of teachers who

are confronting this issue can be a first step in finding ways to improve practices used by teachers in developing the technological literacy skills desired by employers in the future. This study asked the teachers' views about what the technological literacy outcomes should be, what they were already doing or thought they should be doing, and what the obstacles to success were. When schools are more effective at teaching technological literacy, then students will be better equipped to use the technological skills mastered in the schools. It is this level of mastery needed for the job market that may prepare them to be more successfully employed. This infusion of technologically literate employees may lead to a more productive society.

Conclusion

Duggar, Meade, Deland and Nichols (2003) have described technological literacy outcomes as important for the future development of students as any of the traditional academic subjects. Technology deeply impacts the business environment by improving the speed and communication of businesses. Businesses throughout the world are constantly leveraging new technology to meet the demands of the marketplace. The steady introduction of new technology into the business world has increased employee productivity and advanced the progress of companies around the world. It is the outcome of technological literacy that will prepare the students to be contributing team members in the workplace. Only by making technological literacy a priority, can we as professional teachers help our students become better equipped citizens for the future.

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APPENDIX A: PARTICIPANT CONSENT FOR INTERVIEW FORM

Exploring Technological Literacy: Middle School Teachers' Perspectives Consent Form

You are invited to participate in the research study called Exploring Technological Literacy: Middle School Teacher's Perspectives. This study looks at what technology literacy means from the middle school teachers' point of view. You were selected as a possible participant due to your status as a teacher of middle school students who has knowledge of technology. Please read this form and as any questions you may have before acting on this invitation to be in the study.

This study is being conducted by Jane M. Baker, a doctoral candidate at Walden University. Jane M. Baker is a sixth grade teacher in a large middle school in Georgia.

Background Information:
Conceptualization of student technological literacy will be explored from the teachers' perspective to help understand the relationship between practice and the outcome of technological literacy.

Procedures:
If you agree to be in this study, you will be asked to participate in an interview to collect data to be used in the study.

Voluntary Nature of the Study:
Your participation in this study is strictly voluntary. Your decision whether or not to participate will not affect your current or future relations with the middle school. If you initially decide to participate, you are still free to withdraw at any time later without affecting those relationships.

Risks and Benefits of Being in the Study:
There are no risks associated with participating in this study and there are no short or long-term benefits to participating in this study. In the event you experience stress or anxiety during your participation in the study you may terminate your participation at any time. You may refuse to answer any questions you consider invasive or stressful.

Compensation:
There will be no compensation provided for your participation in this study.

Confidentiality:
The records of this study will be kept private. In any report of this study that might be published, the researcher will not include any information that will make it possible to identify you. Research records will be kept in a locked file, and only the researcher will have access to the records.

Contacts and Questions:
The researcher conducting this study is Jane M. Baker. The researcher's faculty advisor is Dr. Marydee Spillett at mspillet@waldenu.edu. You may ask any questions you have now. If you have questions later, you may contact them via Jane_Baker@gwinnett.k12.ga.us. The Research Participant Advocate at Walden University is Leilani Endicott, you may contact her at 1-800-925-3368, extension 1210, if you have questions about your participation in this study.

You will receive a copy of this form from the researcher.

Statement of Consent:

☐ I have read the above information. I have asked questions and received answers. I consent to participate in the study.

☐ I have read the above information. I have received answers to any questions I have at this time. I am 18 years of age or older, and I consent to participate in the study.

Printed Name of Participant _____

Participant's Written or Electronic* Signature _____

Researcher's Written or Electronic* Signature _____

Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

APPENDIX B: INTERVIEW GUIDE

Exploring Technological Literacy: A Study of Middle School Teachers' Perspectives

Jane McEver Baker

Introduction to the Research

In my research study, I would like to collect information from your ideas that will help me and other teachers improve the way we try to help our students achieve technological literacy. I hope to find the following:

- your perceptions of technological literacy based on practices you are using now and what you see for the future
- ideas for assessing technological literacy
- your contributions will be in depth answers to the interview questions
- it is important to hear from you because you have experience working with this age group and you are the ones charged with the responsibility for seeing that students achieve technological literacy

Open-Ended Questions

1. Please share with me your educational background and teaching experience?

2. What does technological literacy mean to you?

3. Describe your expectations as to what is a minimum acceptable level middle school students should demonstrate with regard to technological literacy?

4. What is your view of how technologically literate your students are now (strengths and weaknesses)?

5. Can you think of some recent students-one who was technologically literate and one who was not? Would you describe them for me?

6. Can you give me examples of the practices you use (if any) to help students achieve the outcome of technological literacy?

7. What other practices do you think teachers in general and the school should implement to help students achieve the outcome of technological literacy?

8. What technological literacy goals do you think that you are successfully addressing/ developing and which ones not? Why?

9. What technological literacy goals do you think that the school in general is successfully addressing or developing and which ones not? Why?

10. How do you currently assess the outcome of technology literacy with your middle school students?

11. Can you give me examples of the practices you use (if any) to assess the outcome of student technological literacy?

12. How do you think the school as a whole (other teachers as a group) should assess student technological literacy?

13. How would you assess your own technological literacy (strengths and areas for improvement)?

14. How would you assess other teachers' level of technological literacy? If a teacher is considered to have low technological literacy, what is the problem?

15. If a teacher is considered to have low technological literacy, how might this be addressed?

16. How important is teacher technological literacy in helping students achieve technological literacy?

17. What are the obstacles or challenges to helping students achieve the outcome of s technological literacy for you as an individual teacher? For the whole school?

18. What do you think might be done to overcome these?

19. What support do teachers (currently or in the future) want or need from the school to help their students achieve technological literacy?

CURRICULUM VITAE

Jane M. Baker

Certification

Georgia T-5 Middle Grades (4-8) Certification in Language Arts, Math, Science, Social Studies
Valid to 06/30/2012
T-6 Certification 2007

Experience

Middle Grades Teacher, 1997 – Present
Gwinnett County, Georgia
- Team Leader for 10 years
- Experience teaching Social Studies, Language Arts, Drama, Foreign Language to 6th, 7th, and 8th grade.
- Worked with IGT (remedial students) for two years
- Organized cooperative learning activities.
- Tutored students seeking additional guidance with course work
- Assessed student performance throughout the term.
- Conducted individual student conferences.
- Chaperoned club activities.
- Member of various committees such as Media Center and Attendance Committee

Summer School Teacher 1997
Rockdale County, Georgia
- 6th grade Math

Student Teacher, 1996 - 1997
Clayton County, Georgia
- Science and Math

Education

- B.A., Biology/Chemistry, 1976
- Teacher Certification, 1997
  University of West Georgia, Carrollton, Georgia
- M.S. in Education with a specialization in Integrating Technology in the Classroom
  Walden University, 2004
- Completing Doctor of Education in Teacher Leadership
  Walden University 2005-2008

Volunteer Activities

- Soccer Coach, 1987-1995
  E State Soccer, Georgia Coaches License
- Sunday School Teacher 2nd, 4th, and 6th 1978-present
  Currently teaching 4 year old class