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An Examination of the Relationship Between K-8th Grade Teachers' Level of Technological Literacy and Their Perceptions and Integrations of Educational Technology

Emily Beth Norris

AN EXAMINATION OF THE RELATIONSHIP BETWEEN K-8TH GRADE TEACHERS' LEVEL OF TECHNOLOGICAL LITERACY AND THEIR PERCEPTIONS AND INTEGRATIONS OF EDUCATIONAL TECHNOLOGY

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By

Emily Norris

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ABSTRACT

While much is understood about the importance of developing technological literacy in students, little is known about technological literacy in teachers and how it is related to technology integration in individual classrooms. This correlative study sought to establish the relationship between K-8th grade teachers' level of technological literacy and their perception and integration of technology in the classroom. Teachers in southwest Missouri were chosen using nonprobability sampling and were sent an online survey to complete at their convenience. Data were analyzed using Chi-square, the correlation coefficient Pearson *r*, multiple regression equations, and moderation analysis. The results of the study indicated that although there was no difference in technological literacy among teachers based on grade levels or experience, there was a strong positive correlation between technological literacy and perceptions and integrations of technology in the classroom. The data also implied that the best predictor of student-centered integration was the level of technological literacy that teachers possess. The results of this study could perhaps inspire school administrators to take action in improving teachers' technological literacy.

KEYWORDS: educational technology, technological literacy, perceptions of technology, student-centered integration, correlation study

This abstract is approved as to form and content

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Ching-Wen Chang, PhD
Chairperson, Advisory Committee
Missouri State University

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Approved:

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Ching-Wen Chang, PhD

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Beth Hurst, PhD

_____
Eric Sheffield, PhD

_____
Julie Masterson, PhD: Dean, Graduate College

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TABLE OF CONTENTS

Introduction....1
- Rationale for the Study....1
- Purpose of the Study and Research Questions....3
- Research Design and Significance of the Study....4
- Assumptions and Limitations....5
- Definition of Terms....6

Literature Review....7
- Definition of Technological Literacy....7
- Developing Technological Literacy in Teachers....10
- Teachers' Perceptions of Technology....13
- Teachers' Integrations of Technology....16
- Summary....19

Methodology....20
- Research Design....20
- Site of the Study....21
- Participants and Ethical Considerations....21
- Data Collection Procedures....22
  - Instrumentation....23
  - Role of the Researcher....23
- Data Analysis....24

Data Analysis and Results....25
- Procedures for Analysis....25
- Demographic Data....28
- Current Levels of Technological Literacy....29
- Technological Literacy and Perception....31
- Technological Literacy and Integration....33
- Predicting Student-Centered Integration....34
- Summary....38

Discussion and Recommendations....40
- Summary of the Study....40
- Summary of the Results....41
  - Research Question 1....41
  - Research Question 2....41
  - Research Question 3....42
  - Research Question 4....42
- Discussion....42
- Recommendations for Future Research and Practice....45

References....48

Appendices....51
Appendix A. Informed Consent Letter to Principals....51
Appendix B. Survey Instrument....52
Appendix C. Informed Consent Letter to Participants....57
Appendix D. IRB Approval....58

LIST OF TABLES

Table 1. Grade levels taught by participating teachers 28

Table 2. Participants' total years in teaching 29

Table 3. Results of Chi-square test for technological literacy and grade levels 30

Table 4. Results of Chi-square test for technological literacy and number of years teaching 31

Table 5. Predictive model of student-centered integration 36

Table 6. Linear model of predictors of student-centered integration 37

LIST OF FIGURES

Figure 1. Relationship between teachers' levels of technological literacy and perceptions of technology use in the classroom 32

Figure 2. Relationship between teachers' levels of technological literacy and student-centered integrations of technology in the classroom 34

Figure 3. Simple slopes equations of the regression of student-centered integration on technological literacy at three levels of perception 37

INTRODUCTION

Educational technology is a growing field of interest in today's school system. American schools are using technology more frequently to present information to students and to increase learning and achievement. According to the National Center for Education Statistics (NCES) (2010), in 2009 almost 100% of public school teachers had computers that they could either bring into the classroom or were already provided in the classroom every day. However, only 40% of teachers reported using computers/technology often during instruction, and the programs that were used included mainly word processing and presentation software, as well as simple Internet access—tools that are basically replacements for pencils, paper, books and whiteboards.

When technology was brought into schools, it was touted as being able to improve test scores and increase students' interest in learning. It seems, however, that technology has grown faster than the level of technological literacy in teachers. There seems to be some difference in the perception of educational technology's usefulness in the classroom, as well as the integration of it into instruction, among educators in today's society. This study sought to find a correlation between a teacher's level of technological literacy and how technology is perceived and integrated into the classroom.

Rationale for the Study

The term *technological literacy* was defined by the International Technology Education Association (2007), or ITEA, as "...the ability to use, manage, assess, and understand technology" (p. 9). The technology standards presented by the ITEA have

been geared toward students to help them in becoming technologically literate individuals. It now seems common knowledge that students should be equipped to use technology in meaningful ways, which is why standards have been presented to lead students toward that end. However, little is understood about teachers' level of technological literacy and how it would affect their ability to assist students in becoming technologically literate. Some research has been conducted to explore how to improve teachers' level of technological literacy (Daugherty, 2003; Koehler & Mishra, 2005), implying that this type of literacy is important for teachers to possess. Its relation to teachers' integrations and perceptions of technology is for the most part still unknown.

A person who has worked or had experience in a school system for any length of time has more than likely encountered a broad range of opinions, or perceptions, of educational technology among teachers. It is commonplace to assume that age plays a factor in attitudes toward technology. Young people, it seems, pick up on technology quicker and therefore have a much more positive attitude towards it. However, a recent study suggests that school-level factors (not demographic factors) have a much stronger influence on a teacher's attitude toward educational technology (Perrotta, 2013). In light of these results, perhaps other elements could also be related to or influence teachers' perception of technology, such as their technological literacy.

As mentioned earlier, the latest research found that although almost all teachers in today's schools have access to a computer, only 40% have reported using technology often, and 29% reported using technology sometimes during instruction (NCES, 2010). At first glance, perhaps this percentage is not too discouraging. However, it is more discouraging to find that most of the technology is used for administrative purposes and

preparing/presenting instructional material (e.g., word processing applications, projectors, or document cameras) rather than for students' learning and use of higher order thinking skills. During the times when technology is used by the students for learning activities, it is mostly used for practicing already learned skills, conducting research, or writing text (NCES, 2010). In other words, technology, when used during instruction, is used mainly as another medium to replace books and pencil/paper. So it appears that teachers' integration of technology in the classroom is, for the most part, remarkably limited.

Finding whether or not a correlation exists between technological literacy and a teacher's perceptions/integrations of technology in the classroom could mean an improvement in both attitude towards and integration of educational technology. It could also have a significant impact on teacher training, both in pre-service education and professional development. After all, technological literacy is not an innate ability possessed by certain individuals. It is something that can be learned and taught. So if improving technological literacy means an improvement in perceptions and integrations of technology in the classroom, it would be appropriate for teachers to be regularly trained so that they can better educate students growing up in a fast-growing, technology-rich society.

Purpose of the Study and Research Questions

The purpose of the study was to establish the relationship between K-8th grade teachers' level of technological literacy and their perceptions and integrations of technology in the classroom. In this study, the following research questions were addressed:

1. What are K-8th teachers' current levels of technological literacy?

2. Do teachers with a higher level of technological literacy have more positive perceptions of technology use in the classroom than do teachers with a lower level of technological literacy?

3. Do teachers with a higher level of technological literacy have a more student-centered approach to integrating technology than do teachers with a lower level of technological literacy?

4. Can technological literacy and perception of technology predict whether a teacher will integrate technology in a more student-centered way?

In this study, the following hypotheses, as related to the research questions discussed above, were examined:

1. There will be no significant difference in the levels of technological literacy among teachers based on grade level and number of years of experience.

2. There will be a significantly more positive perception of technology among teachers with a higher level of technological literacy.

3. There will be a positive correlation between teachers' level of technological literacy and student-centered methods of technology integration.

4. Technological literacy and perception will be significant predictors of student-centered integrations of technology among teachers.

Research Design and Significance of the Study

This study was correlative in nature as it sought to find a relationship between three variables: technological literacy, teachers' perceptions of technology in the classroom, and their technology integration methods. It did not attempt to find a cause and effect among the variables. A survey was designed and distributed to K-8th grade teachers in the southwest Missouri area to be completed at their convenience, so a quantitative approach to data collection and analysis was used.

Understanding the relationship between technological literacy and perceptions/integrations of technology in the classroom is important to our schools today, where technology programs are consistently being implemented. The results of the study shed light on both strengths and weaknesses in teachers' technological literacy, which might guide the content for future trainings that highlight the improvement of technological literacy. Additionally, the findings could bring about a change in teacher education and professional development by putting more of an emphasis on developing teachers' technological literacy. If technological literacy improves among teachers, then perhaps an improvement can also be seen in student learning and achievement when technology is integrated.

Assumptions and Limitations

The following statements represent the assumptions that were made as a part of this study:

- Technology is an important aspect in today's schools and will continue to be a relevant feature in educational settings.
- Technological literacy is an important characteristic for teachers to acquire.
- Most teachers are integrating technology in some aspect in their classroom.
- Teachers have access to a computer and are willing to answer truthfully and accurately on the online questionnaire.

The following statements represent the limitations of the study:

- The sample size is small and can only be suggested as being representative of the population.
- Teachers of certain grade levels might be underrepresented due to the sampling procedure used.

- The schools chosen by the sampling procedure might not be equally represented, as the responses per school were not recorded.

Definition of Terms

The following are definitions of terms used in this research study:

- Computer literacy: having the ability to effectively use a computer for daily tasks and troubleshooting basic issues
- Pedagogical content knowledge (PCK): knowledge of best teaching practices and the application of them to a specific subject area
- Perceptions of technology: how a teacher views technology in terms of its benefit vs. risk
- Qualtrics: the online survey software used in this research project to create and distribute the survey
- Student-centered integration of technology: refers to when students use technology to communicate with peers, solve problems and create a product
- Technological content knowledge (TCK): knowledge of appropriate technologies that apply to a specific subject area
- Technological literacy: for teachers, it suggests the ability to combine pedagogy, content knowledge and technology to increase student learning
- Technological pedagogical knowledge (TPK): knowledge of how to apply classroom technologies in a useful way to strengthen student learning
- Technology: in classrooms, refers to computers/laptops and their components, as well as other instructional technologies, such as projectors, SMART boards, document cameras, and student response systems
- Technology integration: how a teacher uses technology in instruction

LITERATURE REVIEW

The purpose of this chapter is to examine the literature as it relates to technological literacy, perceptions of technology, and integrations of technology. The contents of this chapter include: (a) Definition of Technological Literacy, (b) Developing Technological Literacy in Teachers, (c) Teachers' Perceptions of Technology, (d) Teachers' Integrations of Technology, and (e) Summary.

Definition of Technological Literacy

It is a common misconception that being technologically literate is equated with being computer literate or merely knowing how to use a computer and its related devices. The definition of technology literacy goes deeper than simply being able to effectively operate an electronic device, though having this skill is essential in the 21st century classroom. Throughout the years, the definition of technological literacy has been revised, with new benchmarks and frameworks to guide teachers in preparing their students, as well as themselves, to become technologically literate.

Pearson and Young (2002) presented three categories of qualities that will be present in an individual who is technologically literate. These categories are "...knowledge, ways of thinking and acting, and capabilities" (p. 9). They include qualities that are rather broad in nature, such as understanding the widespread presence of technology, obtaining guidance in new and trending technologies, and being able to effectively troubleshoot on a basic level (Pearson & Young, 2002). In other words, technological literacy is not having specific knowledge of computers. Rather, it is being

able to apply knowledge of technology to everyday life. Ingerman and Collier-Reed (2011) expanded further on this definition of technological literacy and surmised that in order to properly apply technology to a particular situation, one must have adequate knowledge of that situation. Conversely, when technology is appropriately applied, more knowledge and capabilities are gained in the subject matter (Ingerman & Collier-Reed, 2011).

The International Technology Education Association (2007), or ITEA, defined technological literacy as, "...the ability to use, manage, assess, and understand technology" (p. 9). The ITEA developed standards that pertain to technological literacy in order to guide teachers in preparing their students to be technologically literate individuals. These standards were arranged in five categories with each specific standard deemed either a cognitive standard or a process standard (International Technology Education Association, 2007). Although the standards presented by the ITEA specifically aim toward students' knowledge, it can be applied to teachers as well.

Koehler and Mishra (2005) introduced a framework specifically geared toward teachers called technological pedagogical content knowledge, or TPCK (now TPACK). The researchers recognized that technology literacy needed to be set in the domain of both pedagogy and content in order to produce a change in the education system (Koehler & Mishra, 2005). Only with the interaction of technology, content and pedagogy do teachers achieve technological literacy. Cox and Graham (2009) implemented a conceptual analysis in order to better clarify the constructs of the TPACK framework introduced by Koehler and Mishra; that is, to give a specific definition for each construct, as none had been defined prior (Cox & Graham, 2009). Their research resulted in a

concise definition of technological pedagogical content knowledge. "TPACK refers to a teacher's knowledge of how to coordinate the use of subject-specific activities or topic-specific activities with topic-specific representations using emerging technologies to facilitate student learning" (Cox & Graham, 2009, p. 64). In other words, a technologically literate teacher is one who can use technology to more clearly represent an otherwise ambiguous concept to students.

To even better understand the TPACK framework, Koehler, Mishra, and Cain (2013) expanded further on the individual components of technological pedagogical content knowledge. The researchers argue that only at the merging of three components is TPACK formed in a teacher. The three components are: pedagogical content knowledge (PCK), technological content knowledge (TCK), and technological pedagogical knowledge (TPK).

Pedagogical content knowledge, or PCK, refers to translating pedagogy to a specific subject area. When a teacher understands the subject matter and in turn finds different ways to present that information to students in a tailored form based on students' knowledge, PCK has been achieved. Technological content knowledge, or TCK, is an understanding of the influence technology has in a particular subject matter. Koehler et al. (2013) stated that "teachers need to understand which specific technologies are best suited for addressing subject-matter learning in their domains..." (p. 16). So TCK has been achieved when a teacher can properly apply a technology in a way that is specific to her subject area. Finally, technological pedagogical knowledge, or TPK, suggests taking technology and applying it in a creative way to advance student learning. To achieve this, teachers need to "...develop skills to look beyond most common uses for

technologies, reconfiguring them for customized pedagogical purposes" (Koehler et al., 2013, p. 16). Therefore, an effective blending of these three components (PCK, TCK, and TPK) enables a teacher to achieve true technology literacy.

Developing Technological Literacy in Teachers

Recognizing what technology literacy is and that it is an important trait to have is only the first step in developing technological literacy. It is perhaps even more crucial to understand how an educator can obtain it. A few studies have presented ways in which teachers can further develop their technological literacy. In order to properly develop technological pedagogical content knowledge (TPACK) in teachers, Koehler and Mishra (2005) tested an approach called "learning technology by design" (p. 134). The theory behind the approach is that knowledge is only apparent when applied to real-life situations. So in the context of TPACK, the design approach enabled teachers to learn about technology and acquire technological literacy by responding to real-world circumstances.

In order to explore this design approach further, Koehler and Mishra (2005) conducted a study that included 13 students and four faculty members in a graduate-like course. The main function of the course was for students and faculty to collaborate to create an online distance-learning course that would be used the following year (Koehler & Mishra, 2005). Throughout the course, students and faculty were given opportunities to use different technologies in order to determine its practicality and usefulness in the online course that was being created, as well as its suitability with the course pedagogy and content. The researchers developed an online survey that the participants completed

four different times throughout the duration of the course. At the beginning of the course, the participants had an uninvolved view of technology's use in education; that technology was simply another means to translate information to the viewers and that pedagogy did not need to be altered. However, at the end of the course, the researchers discovered that the participants had a contrasting view; that pedagogy indeed needed to be changed when technology was being utilized. Also by the end of the course, the participants were experiencing the interaction between technology, content and pedagogy in their daily tasks. In this study, Koehler and Mishra concluded that technology literacy, as measured by the TPACK framework, could be achieved by implementing the "learning technology by design" (p. 134) approach (Koehler & Mishra, 2005).

Daugherty (2003) discussed a similar design approach to improve teachers' level of technological literacy through professional development. He stated, "To deliver appropriate content and experiences in the classroom, teachers of technology must be technologically literate" (p. 27). He argued that using design-based activities in the classroom assists students in developing problem-solving skills and in applying their knowledge (Daugherty, 2003). That being the case, the same outcome for teachers can be anticipated when design-based activities are used in a professional development environment. Employing certain design-based activities for teachers could improve their level of technological literacy and can also give them new pedagogical techniques to utilize in their own classrooms.

Technological literacy in teachers could also be improved by using an approach much like what was implemented in a school district in Indianapolis, IN. In 2002, district leaders implemented a literacy initiative that would take place throughout the subsequent

years and would help improve literacy achievement in their students (Heathman, 2004). Its aim was to "broaden the scope of literacy to include 21st century, digital age skills; implement a system wide professional development framework; and reinvent the district as a professional learning community" (Heathman, 2004, p. 12). The district added full time positions and employed over 30 individuals to act as literacy coaches on site for a resource to teachers in implementing the new literacy strategies. Success was seen in their first year of implementation in both test scores and in students' desire to learn (Heathman, 2004). Though this approach was geared toward improving students' literacy achievement, a form of it could be adapted for use in teachers' technological literacy improvement.

Efforts have been made to refine teachers' integrations and knowledge of technology. A teacher prep program at a southeastern public university had implemented a model, called STAIRS, to address the need for social studies teachers to learn how to incorporate technology into their instruction (Lipscomb & Doppen, 2005). In a qualitative study, the researchers found that the STAIRS model was indeed successful in improving students' technical skills and integration of technology in their field placement classrooms. In the search as to why it was successful, the researchers concluded that "...one of the most important attributes of this model is that it is rooted in the content area and the technology flows out of that content base" (p. 78). Based on the researchers' findings, incorporating technology strategies into specific content areas of study at the university level could improve the level of technological literacy for new teachers. In fact, Ritz (2011) found that technological literacy did improve in students who were enrolled in a technology-related course at a university, even though most of them had

never taken a technology course in high school. These results perhaps demonstrate the need to include courses at the university level that focus on technology and the practical applications of it in the classroom and workplace.

There are already a great number of teachers who have obtained technological literacy and apply the skills in their classrooms. A handful of these teachers were examined by Ertmer, Ottenbreit-Leftwich, and York (2007) to determine the value of different intrinsic and extrinsic factors that played a role in the success of outstanding technology-using teachers. The researchers chose names of teachers who had received an award for their outstanding use of technology in education and sent them a questionnaire that included questions pertaining to factors that influence their desire to utilize educational technology. Among the most influential factors pertaining to their success were the intrinsic factors such as "...inner drive and personal beliefs" (Ertmer et al., 2007, p. 57), and among the least influential were the extrinsic factors such as pre-service education, resources and time. The researchers discovered that even when extrinsic factors are limited, these teachers still could effectively use technology because of their drive and motivation to learn the process. Though intrinsic factors were more influential overall, the most influential extrinsic factor was professional development. So the researchers concluded that more attention should be given to intrinsic factors, like attitudes and confidence, during professional development trainings (Ertmer et al., 2007).

Teachers' Perceptions of Technology

Different factors can affect how a teacher perceives educational technology. Howard (2011) found in her study of risk perceptions of technology integration that

teachers' perception of educational technology can depend on the level of risk each teacher is willing to accept. Her study consisted of two phases, one in where a survey was given to teachers to determine the level of technology-related risk each is willing to take, and the other a case study in which eight teachers were chosen based on their responses to the survey; four who had more acceptability of technology-related risks (MAR) and four with less acceptability (LAR). Both MAR and LAR teachers perceived the same risks in integrating technology, such as being able to effectively troubleshoot when needed and understanding the value of technology in teaching. The difference came in the teachers' acceptability of that risk (Howard, 2011).

Findings also showed a negative correlation between computer-efficacy and technology-related risk perceptions; as computer-efficacy decreased, technology-related risk perceptions increased. Low computer efficacy was seen in LAR teachers and vice versa in MAR. Those teachers with low computer-efficacy did not see a value in educational technology and thought it was a hindrance to their teaching. The opposite was true with MAR teachers (Howard, 2011).

Perrotta (2013) studied how school-level and individual-level factors could influence a teacher's perception of educational technology. A survey conducted with 683 teachers in England demonstrated that teachers saw technology as having some sort of benefit to their instruction by providing access to more resources for learning and teaching. However, they felt technology did not necessarily have an impact on their students' greater understanding of the subject matter. Teachers who saw the greatest benefits of technology were in school districts where technology was highly supported by the leadership. Teachers of specialty subject areas, like special education and P.E., saw

more of an increase in student interest and motivation when technology was utilized than teachers of standard subjects, and therefore saw more of a benefit. Teachers who worked in schools that had a higher percentage of students on a free lunch program also saw more benefits to technology than their higher performing counterparts. The results suggested that school-level factors tended to have more of an influence on teachers' perceptions of technology than did demographic factors, such as gender and number of years teaching (Perrotta, 2013).

An and Reigeluth (2012) explored the beliefs and barriers of K-12 teachers in creating "technology-enhanced, learner-centered classrooms" (p. 54) and how that affects their perception of educational technology. They found that teachers generally had a positive view of technology integration and on student-centered instruction, though teachers felt that they needed more training when it came to combining the two together. Some of the barriers that were seen when trying to create a technologically enhanced learner-centered environment included lack of time and lack of technology, as well as technology-focused professional development that tended to be too broad and unspecific to teachers' needs. The researchers concluded that because of the lack of training in integrating technology and student-centered pedagogy, teachers were hindered from creating a more technologically, learner-centered classroom (An & Reigeluth, 2012).

While teachers tend to have a somewhat positive view of technology overall, certain technologies might produce a more negative perception among teachers. Capo and Orellana (2011) found in their study of 137 teachers in southern Florida that teachers' negatively perceived the use of Web 2.0 technology in the classroom, mainly arguing that technologies such as social networking sites would require much more regulation than

what they were comfortable with providing. It was also thought of as too difficult to integrate into the classroom. Although these negative perceptions existed, a small majority thought it could improve learning and collaboration with other students (Capo & Orellana, 2011). A general conclusion is that although potential could be seen with almost any form of technology, teachers' perceptions of its current usefulness could vary depending on the teacher's skills and the type of technology.

Teachers' Integrations of Technology

Regardless of a teacher's level of computer or technological literacy, or their perceptions of educational technology, the use of technology in the classroom is becoming ubiquitous. Teachers with all levels of technological literacy are, in some form, integrating technology into their classroom. Their technology practices in the classroom are often based on their personal philosophies of education and how they see the role of teacher and student (Pasco & Adcock, 2007).

According to the NCES (2010), in 2009 almost 100% of public school teachers had computers that they could either bring into the classroom or were already provided in the classroom every day. However, only 40% of teachers reported using computers/technology often, and 29% reported using technology sometimes during instruction (NCES, 2010). In the instances that technology was used by the teachers, the programs included mainly word processing and presentation software, as well as simple Internet access. During the times when technology was used by the students for learning activities, it was mostly used for practicing already learned skills, conducting research, or writing text (NCES, 2010).

Some other common themes are noticed when discussing how technology is integrated. A study done in South Dakota targeted K-12 teachers who had attended the Advanced Technology for Teaching and Learning Academy, and sought to determine how those teachers were using technology in their classroom (Gorder, 2008). The results showed that teachers felt confident in their use of technology to complete daily tasks and deliver instruction, but felt much less confident in their ability to actually integrate it into learning and teaching (Gorder, 2008). This study supports the idea that teachers often exhibit computer literacy and use technology simply as a replacement tool for pen and paper rather than applying pedagogy to its usage.

Computer literacy without technological literacy was also observed in a study done by Koc and Bakir (2010) at a United States university with 26 pre-service teachers. The most common uses of technology by these teachers included accessing the Internet and presenting information. These were also the types of applications the teachers were most comfortable with using. The researchers noticed that the teachers themselves perceived that they needed more instruction and training on how to integrate computers into their instruction to improve student learning. The teachers also recognized that technology is frustrating for them if they were not given enough support (Koc & Bakir, 2010). The researchers' conclusion paralleled that of Gorder's (2008), who noticed a presence of computer literacy without technological literacy. In general, the researchers concluded that students enter teacher training programs with a high level of computer literacy and knowledge of how to use computers in the "...objectivist model of teaching and learning" (Koc & Bakir, 2010, p. 20). However, more training is needed for pre-

service and in-service teachers in how to use computers to encourage students to participate in higher order thinking skills (Koc & Bakir, 2010).

There are a few factors that contribute to how technology is integrated into classrooms, one of which is the goal of technology use that is established by the school administration or teacher. De Koster, Kuipert, and Volmant (2012) conducted a multiple-case study in the Netherlands to determine what kinds of information and communication technology, or ICT, uses schools developed over a period of two years. The five schools that participated in the study were separated by 'traditional' schools and 'innovative' schools. De Koster et al. found that the 'traditional' schools used testing and word processing software, Internet, laptops/desktop computers, and interactive whiteboards mainly to increase students' motivation and to improve learning results. The activities mostly involved teacher directed instruction. The 'innovative' schools used more open-ended ICT tools, such as digital imaging software and digital cameras. In other words, these tools did not "prescribe a certain outcome" (p. 461), like word processing software or learning games would. These tools were not necessarily assigned by the teacher, but were available for students to use at their discretion in order to create engaging presentations and activities. Between the two types of schools, one main difference in goals for incorporating ICT into learning is that the 'traditional' schools used ICT to improve test results, but 'innovative' schools used ICT to help develop inquiry skills in their students (De Koster et al., 2012). Therefore, it could be concluded that technology integration is largely affected by the goals that are put in place by the schools or the teacher.

The grade being taught is another factor that can influence technology integration in classrooms. The ways in which technology is integrated in primary schools are perhaps different than that of secondary schools. Some research has discovered that teachers of younger grades use technology more for storytelling purposes and for learning drills and games (Lin, 2012), whereas teachers of higher grades use technology more for enhancing lectures, such as the use of presentation software and distance learning technologies (Al-Bataineh, Anderson, Toledo, & Wellinski, 2008; Zhang & Liu, 2006).

Summary

Technological literacy is a crucial component to integrating technology in the classroom. It involves more than computer literacy, but also understanding the pedagogy that is required to use technology to increase student learning. Improvement in professional development trainings and pre-service teacher education programs can increase an educator's level of technological literacy. Teachers' perceptions of educational technology can be affected by many factors, including a teacher's risk perception and external school-level factors. From the research discussed above and from observation of many teachers in today's classrooms, educators tend to integrate technology more as a replacement tool for books, paper and whiteboard rather than using it to enhance student learning on a deeper level. Due to the importance of technological literacy in today's teacher, this research attempts to explore the question of whether a high level of technological literacy results in a more positive perception of technology. It also explores the question of whether technology integration becomes more student-centered as a result of a high level of technological literacy.

METHODOLOGY

The purpose of this chapter is to detail the methodology used to conduct this research. The contents of this chapter include: (a) Research Design, (b) Site of the Study, (c) Participants, (d) Ethical Considerations, (e) Data Collection Procedures, and (f) Data Analysis.

Research Design

In order to choose an appropriate research design for the study, an examination of various research approaches was done primarily by consulting the text by Gay, Mills, and Airasian (2012). After consideration of all research approaches, a correlational research design was chosen for this study in order to establish a relationship among the variables of technological literacy and perceptions/integrations of technology in the classroom. The purpose of a correlational study is to "...determine whether, and to what degree, a relationship exists between two or more quantifiable variables" (Gay et al., 2012, p. 204).

Instead of a causal-comparative or experimental study, a correlational study was chosen for this project since no cause-effect relationship was established among the variables. Correlational studies also tend to explore variables that are thought to be related to a more complex variable (Gay et al., 2012). In this study, technological literacy was the complex variable to which the variables of technology perception and integration were related.

Site of the Study

The study took place within three school districts in southwest Missouri. All three school districts have at least one elementary school, one middle school and one high school in which a one-to-one technology program is being implemented in the middle and high school, and other technology programs implemented in the elementary schools.

These three towns have both similarities and differences in demographics to one another. All consist of over 90% White residents, with one town having the highest percentage at 95%, and the other two towns have a noticeable percentage of Latinos, 3% and 7% respectively. Two out of the three towns are urban cities, being located near a large metropolitan area, and have a household income that matches that of the nation. The third town is more rural in its location and generally has a household income that is lower than that of the United States. This demographic information and socio-cultural context could perhaps be important in especially understanding the teachers' perceptions of technology.

Participants and Ethical Considerations

The population for the study was all teachers of Kindergarten-8th grade who have technology available in their classroom. The target population was those teachers in southwest Missouri. The sample was limited to those teachers of area schools from which permission from the principal could obtained. Therefore, nonprobability sampling (specifically for this study, purposive sampling) was used. If the researcher was acquainted with a teacher in a certain school, an email was sent to the principal of that particular school asking for permission (Appendix A) to implement the study. These

principals were deemed by the researcher as most likely to be receptive to the study since there was a mutual acquaintance at the school. If the principal responded positively and was willing to aid the researcher in distribution of the survey instrument (Appendix B), that school was chosen for the sample. As suggested for a correlational study, the general sample was composed of at least 30 K-8th grade teachers. Specific demographic information on the individual participants was not obtained.

An informed consent letter (Appendix C) was placed at the beginning of the questionnaire to communicate to the participants the purpose and details of the study. The participants remained anonymous, which eliminated any bias on the part of the researcher. There was virtually no risk to subjects who participated in the study since the participants' answers were completely anonymous and there were no invasive questions. The questions were only concerned with their experience and opinions on technology in the classroom. The potential risks were not greater than those encountered when completing any online survey asking for opinions. The results of the study were represented in an honest and accurate fashion with no deception involved. To ensure that the researcher would adhere to these ethical considerations, an application was sent to the Institutional Review Board for approval (Appendix D) before the implementation of the study. The researcher met all requirements for the application.

Data Collection Procedures

The survey instrument was developed online using the Qualtrics software system and was sent by email in the form of an online link to the principals who agreed to have their teachers participate. The principals were then instructed to forward this link to their

teachers at a time that was convenient for them. After teachers agreed to the informed consent at the beginning of the questionnaire, they had the opportunity to complete the survey in as much time as needed. The teachers were given one month to complete the survey before the link was deactivated. Data were collected online through the Qualtrics system as each teacher completed the survey.

Instrumentation. The measuring instrument used was self-designed using the Qualtrics survey software with well-developed constructs. Technological literacy was assessed using three characteristics: PCK (pedagogical content knowledge), TCK (technological content knowledge), and TPK (technological pedagogical knowledge). There were three items in each of the sub-scales, resulting in nine items overall to measure technological literacy. Perceptions of technology were assessed by inquiring of teachers' opinions on technology on a low risk/high benefit scale. Seven items overall were used to measure perception. Finally, integrations of technology were assessed by gathering information on teachers' and students' uses of technology, with emphasis placed on student-centered integrations. For this study, an important limitation to consider is that the survey instrument was not tested for validity or reliability, but was developed with careful consideration of each variable that was assessed.

Role of the researcher. The researcher collected and analyzed the data from the online survey and had little interaction with the participants, except for a short email describing the purpose of the study. Because of the quantitative nature of the study, the researcher's reflections and personal views were not included in the results or data analysis.

Data Analysis

The four research questions were analyzed using descriptive statistics, which included the means and standard deviations. A Chi-square test was used to determine if there was a significant difference in the levels of technological literacy among teachers based on grade level and number of years of experience. Chi-square is a test of significance used to compare percentages between different groups of respondents (Gay et al., 2012).

Data were also analyzed using the correlation coefficient, Pearson *r*, determine if there was a significantly more positive perception of technology and a more student-centered approach to technology integration among teachers with a higher level of technological literacy. The Pearson *r* is a statistical test used to measure correlation, and is used when the variables are represented as either interval or ratio data. The correlation coefficient was represented as a decimal number from -1.00 to +1.00. A coefficient near -1.00 was interpreted as having a strong negative correlation, and a coefficient near +1.00 was interpreted has having a strong positive correlation (Gay et al., 2012). To determine if the correlational coefficient represented a result that occurred simply by chance, a significance level of $p < .05$ was set by the researcher.

In addition, a multiple regression equation and moderation analysis were used to determine the interaction effect between technological literacy and perception, and whether this effect played an important role in predicting the criterion variable, technological integration (Hayes, 2013). An alpha level of .05 or less determined statistically significant relationships.

DATA ANALYSIS AND RESULTS

The purpose of this study was to establish the relationship between K-8th grade teachers' level of technological literacy and their perceptions and integrations of technology in the classroom. This chapter will begin by discussing the procedures of the analysis, as well as the descriptive statistics of the demographics, such as the grade levels represented and number of years teaching. The results of the responses to each of the four research questions will also be examined: (a) What are K-8th grade teachers' current levels of technological literacy? (b) Do teachers with a higher level of technological literacy have more positive perceptions of technology use in the classroom than do teachers with a lower level of technological literacy? (c) Do teachers with a higher level of technology literacy have a more student-centered approach to integrating technology than do teachers with a lower level of technological literacy? (d) Can technological literacy and perception of technology predict whether a teacher will integrate technology in a more student-centered way? A summary of the findings will be presented at the end of the chapter.

Procedures for Analysis

The data were collected in one day from the survey instrument that was available to three school districts. The survey instrument was Internet based using the Qualtrics survey software. The survey (see Appendix B) first measured teachers' technological literacy using nine Likert-scale items; three items for each characteristic of technological literacy: PCK (pedagogical content knowledge), TCK (technological content knowledge),

and TPK (technological pedagogical knowledge). The responses to these items were measured using a 5-point scale: 1 = not at all confident and 5 = very confident. The three items measuring PCK were concerned with the respondents' level of confidence in (a) presenting information to students in an understandable way, (b) tailoring instruction based on student needs, and (c) applying current best teaching practices in the classroom. The three items measuring TCK were concerned with the respondents' level of confidence in (a) using a computer to complete daily tasks, (b) choosing technologies best suited for the subject matter, and (c) applying technology in the classroom. Lastly, the three items measuring TPK were concerned with the respondents' level of confidence in (a) using technology to increase student learning, (b) using technology in the classroom in new or creative ways, and (c) using technology to create a more learner-centered environment

Then, perceptions of technology were assessed using seven items inquiring of teachers' opinions of technology on a low risk/high benefit scale. The responses to these items were measured using a 5-point scale: 1 = strongly disagree and 5 = strongly agree. The items measuring low risk inquired of respondents' beliefs on the following statements: (a) I enjoy using technology in the classroom, (b) It takes me a long time to learn a new technology, (c) I feel comfortable troubleshooting technology problems that arise, and (d) I enjoy learning new ways to use classroom technologies. The items measuring high benefit inquired of respondents' beliefs on the following statements: (a) Using technology in the classroom encourages student interest in learning overall, (b) Using technology in the classroom can improve student achievement, and (c) Using technology in the classroom helps students become life-long learners.

Finally, teachers' integrations of technology were examined using ten items: the first four items represented a more teacher-centered approach to technology integration and the last six items represented a more student-centered approach. The responses to these items were measured using a 5-point scale: 4 = daily and 0 = never. The four items measuring teacher-centered integrations asked how often the teachers use technology to (a) deliver instruction via presentation software, (b) complete administrative tasks, (c) drill or review learned skills with students, and (d) communicate with students. The six items measuring student-centered integrations asked how often the students use technology to (a) conduct research, (b) learn or practice basic skills, (c) type out a paper/assignment, (d) create a product, (e) collaborate with peers, and (f) solve problems.

The sample size for this study was 45 teachers from three school districts. Data were collected from the respondents through the Qualtrics survey software and analyzed using SPSS (Statistical Package for Social Sciences), Version 22.0 for Mac software. The four research questions were analyzed using descriptive statistics, which included the means and standard deviations. The mean was used as a measure of central tendency to determine the standard score among the entire group. The standard deviations were used to determine the measure of variability among all the scores and to compare those scores (Gay et al., 2012). A Chi-square test was used to compare the levels of technological literacy among teachers based on grade level and number of years of experience. Data were also analyzed using the correlation coefficient, Pearson *r*, to determine if a relationship exited among the variables. In addition, a multiple regression equation and moderation analysis were used to determine the interaction effect between two of the variables, technological literacy and perception, and whether this effect played

an important role in predicting the criterion variable, technological integration (Hayes, 2013). An alpha level of .05 or less determined statistically significant relationships.

Demographic Data

The Qualtrics survey instrument asked three questions intending to produce demographic data of the 45 participants. The questions were primarily concerned with grade levels taught and number of years teaching, both in the current school district and overall. In the first question, the participants were asked to choose all grade levels they taught. Due to the limitations of the non-probability sampling procedure, it was not possible to acquire an equal number of participants in each grade level. In fact, no participant reported that they were teaching 3rd, 4th, 5th or 6th grade. Neither did any teacher report that they were teaching high school. Therefore, the 45 participants could be condensed down to two categories: elementary teachers consisting of PK-2nd grade, and middle school teachers consisting of 7th and 8th grade. Elementary school teachers consisted of 46.7% of the sample and middle school teachers consisted of 53.3% of the sample (see Table 1).

Table 1. Grade Levels Taught by Participating Teachers

Grade Level	Frequency	Percent
Elementary (PK-2nd grade)	21	46.7%
Middle (7th & 8th grade)	24	53.3%

The next two questions were concerned with the number of years the participants had been teaching, both overall and in the current school district. Only the number of

years teaching overall was considered in the data analysis. Seventeen of the respondents had been teaching between 10 and 15 years, representing the largest percent of the sample size at 37.8%. Participants with experience of 25+ years represented the smallest percent of the sample size at 8.9% (see Table 2).

Table 2. Participants' Total Years in Teaching

Number of Years	Frequency	Percent
0-3 years	6	13.3%
4-9 years	8	17.8%
10-15 years	17	37.8%
16-24 years	10	22.2%
25+ years	4	8.9%

Current Levels of Technological Literacy

The first research question focused on teachers' current levels of technological literacy. Technological literacy was measured using the three components described by Koehler et al. (2013). Nine Likert-scale questions were posed to the respondents measuring these components of technological literacy. The respondents answered the questions using a 5-point scale: *1=Not at all confident* to *5=Very confident*. The mean for each variable was calculated, as well as the standard deviations. These results were then used to categorize teachers into low and high levels of technological literacy. Teachers were considered as having a high level of technological literacy if the mean of all three variables was greater than or equal to 4.0.

The levels of technological literacy were evenly spread between the two groups, with middle school teachers having slightly higher levels of technological literacy (M=4.14, SD=.63, N=24) than did elementary school teachers (M=3.87, SD=.62, N=21). Although middle school teachers appeared to have higher levels of technological literacy, a Chi-square test showed that the level of technological literacy did not differ between elementary and middle school teachers, X^2 (1) = .52, p = .47. High levels of technological literacy were not associated with the grade level taught (see Table 3).

Table 3. Results of Chi-square Test for Technological Literacy and Grade Levels

	Level of Technological Literacy	
Grade Level	Low	High
Elem (PK-2nd grade)	11 (52.4%)	10 (41.7%)
Middle (7th-8th grade)	10 (47.6%)	14 (58.3%)

Note. X^2 = .52, df = 1. Numbers in parentheses indicate column percentages.
*p < .05

The difference in overall number of years teaching and the level of technological literacy was also analyzed using a Chi-square test. Similarly, although the respondents who had been teaching between 10 and 15 years represented the highest percentage of high technological literacy, the results showed that the level of technological literacy did not differ among the number of years teaching, X^2 (4) = 6.16, p = .19 (see Table 4).

Overall, the Chi-square results showed no statistically significant differences between technological literacy and grade levels. Neither did they show statistically significant differences among the number of years teaching. Therefore, the null hypothesis is accepted. There is no significant difference in technological literacy among

Table 4. Results of Chi-square Test for Technological Literacy and Number of Years Teaching

	Level of Technological Literacy	
# of Years Teaching	Low	High
0-3 years	4 (19.0%)	2 (8.3%)
4-9 years	5 (23.8%)	3 (12.5%)
10-15 years	4 (19.0%)	13 (54.2%)
16-24 years	6 (28.6%)	4 (16.7%)
25+ years	2 (9.5%)	2 (8.3%)

Note. $X^2 = 6.16$, df = 4. Numbers in parentheses indicate column percentages.
*p < .05

teachers based on grade level or number of years of experience.

Technological Literacy and Perception

The second research question focused on the relationship between teachers' levels of technological literacy and their perception of technology use in the classroom. The literature suggested that teachers' perceptions of technology could be assessed on a low risk/high benefit scale (An & Reigeluth, 2012; Howard, 2011; Perrotta, 2013). Therefore, the first four questions measured the teachers' opinions on the level of risk associated with using technology, and the last three questions measured their opinions on the benefits of using technology. Respondents answered seven items on a 5-point Likert-scale: *1=Strongly Disagree* to *5=Strongly Agree*. The mean for the seven items was calculated for each respondent in order to compare the results with those calculated for technological literacy.

To examine the research question, the correlation coefficient was calculated to determine if a relationship existed between technological literacy and perception. The analysis showed that there was a moderate positive correlation between the two variables, which was statistically significant at the $p < .05$ level ($r = .478$, $n = 45$, $p = .001$). A scatter plot summarizes these results (see Figure 1).

Overall, higher levels of technological literacy were correlated with positive perceptions of technology use. Therefore, the null hypothesis is rejected. Teachers with higher levels of technological literacy generally have a more positive perception of technology use in the classroom.

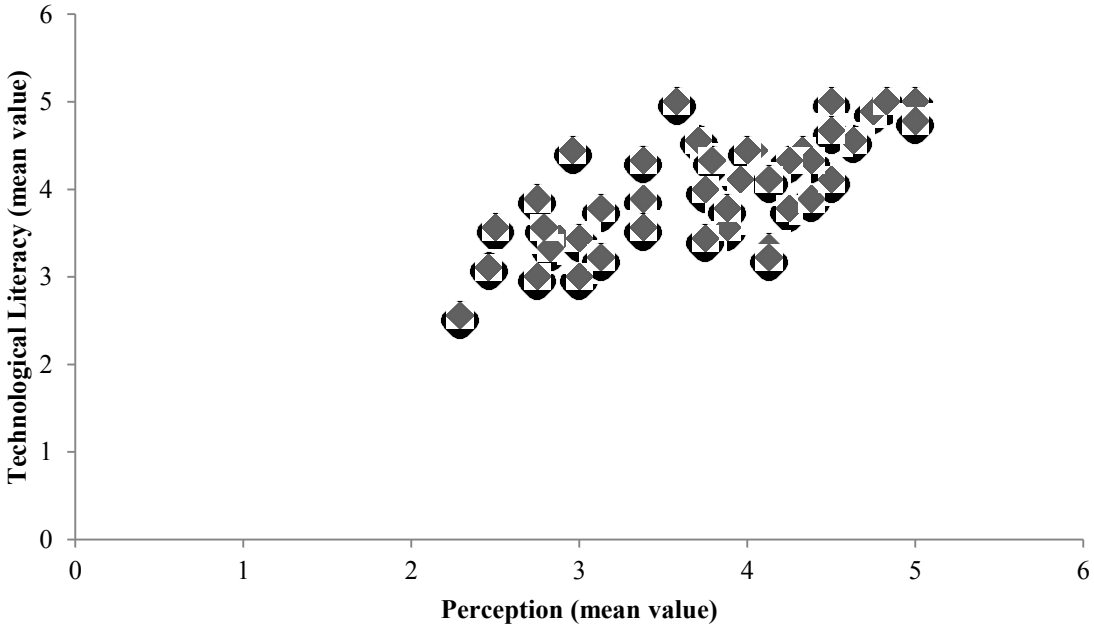

Figure 1. Relationship between teachers' levels of technological literacy and perceptions of technology use in the classroom. Pearson's r = .478.

Technological Literacy and Integration

The third research question focused on the relationship between teachers' levels of technological literacy and their integration of technology use in the classroom. Three respondents chose not to answer the last page of the survey that contained the questions related to integration; so 42 teachers' answers were recorded and used for data analysis. Respondents answered ten items on a 5-point Likert-scale indicating the frequency of technology use: *5=Daily* to *1=Never*. These questions assessed their integration of technology by categorizing the different integration strategies into teacher-centered and student-centered. Based on the literature, questions involving the use of technology to improve motivation or increase results were used to measure teacher-centered integration. Those involving the use of technology as a discretionary tool for students to complete projects or activities were used to measure student-centered integration (De Koster et al., 2012).

The mean for the six student-centered items was calculated for each respondent in order to compare the results with those calculated for technological literacy. To examine the research question, the correlation coefficient was calculated to determine if a relationship existed between technological literacy and student-centered integration of technology. The analysis showed that there was a moderate positive correlation between the two variables, which was statistically significant at the $p < .05$ level ($r = .612$, $n = 42$, $p < .001$). A scatter plot summarizes these results (see Figure 2).

Overall, higher levels of technological literacy were correlated with more student-centered integrations of technology. Therefore, the null hypothesis is rejected. Teachers with higher levels of technological literacy generally have a more student-centered

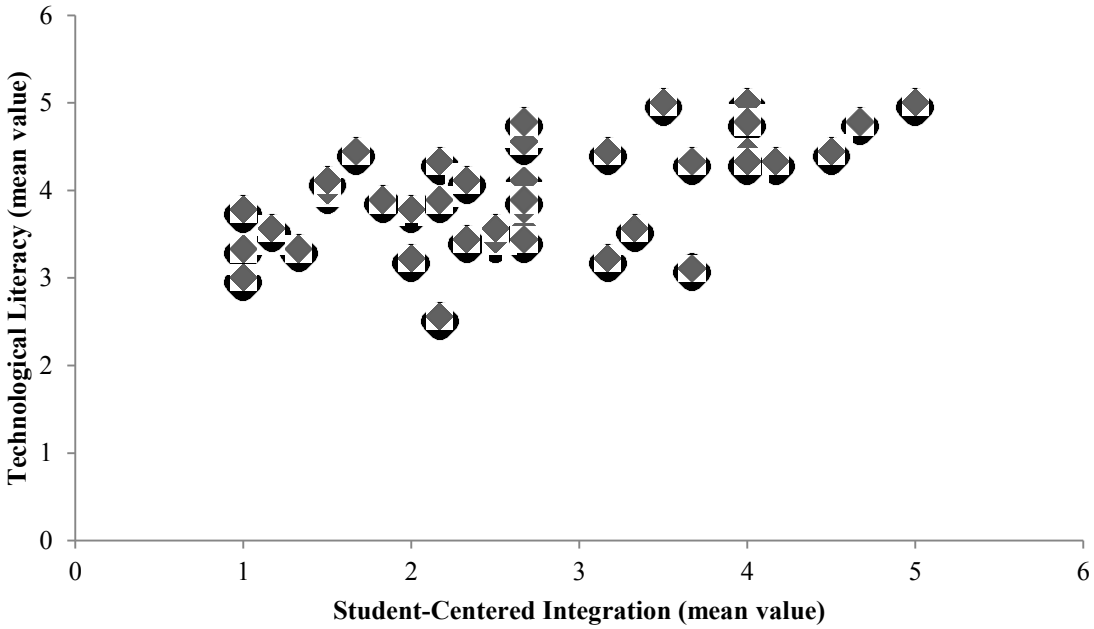

Figure 2. Relationship between teachers' levels of technological literacy and student-centered integrations of technology in the classroom. Pearson's r = .612.

approach to technology integration in the classroom.

Predicting Student-Centered Integration

The results above indicated that the level of technological literacy positively correlated with both perception of technology and student-centered integration. The fourth research question focused on which variable (technological literacy or perception) was the best predictor for student-centered integration. Before analysis was done, the respondents were separated into two categories: those who integrated technology in a more teacher-centered manner and those who integrated technology in a more student-centered manner. When the survey responses indicated a more frequent use of technology in at least three of the six student-centered questions, the respondent was considered as being more student-centered in technology integration. When the

responses indicated a more frequent use of technology in at least three of the four teacher-centered questions, the respondent was considered as being more teacher-centered in technology integration. The distribution of the two groups leaned more favorably in the teacher-centered category, with 30 teachers indicating a more teacher-centered approach to technology integration and 12 teachers indicating a more student-centered approach.

In order to examine the extent to which technological literacy and perception are correlated with student-centered integration, a multiple regression equation was used. A multiple regression equation is used with ratio or interval variables to determine the degree to which two variables are related (Gay et al., 2012). The results showed that technological literacy and perception accounted for 35.0% of the variance in student-centered integration of technology. Technological literacy was the strongest predictor of student-centered integration, with a *beta* weight of .48 and a low probability that the finding was due to chance, $p = .019$. In contrast, perception of technology was not a good indicator of student-centered integration, with a *beta* weight of .13 and a higher probability that the finding was due to chance, $p = .515$. Table 5 summarizes the results of the analysis.

Although perception played a smaller role in predicting student-centered integration, the question was posed if whether or not it could act as a moderator variable between technological literacy and integration. In other words, how does the perception of technology use affect the relationship between technological literacy and student-centered integration? In order to properly answer this question, a moderated regression equation was used. Moderation occurs when the relationship between the predictor and

Table 5. Predictive Model of Student-Centered Integration

	b	*SE B*	*ß*	*p*
Constant	-1.41	.37		$p = .001$
	[-2.18, -.64]			
Tech Literacy	.35	.14	.48	$p = .019$
	[.06, .64]			
Perception	.07	.11	.13	$p = .515$
	[-.16, .31]			

Note. $R^2 = .35$. Numbers in brackets indicate 95% confidence intervals.

outcome variable changes as a result of the moderator variable (Field, 2013).

Moderation analysis was conducted using the *PROCESS* command in SPSS, which was created by Andrew Hayes and Kristopher Preacher (Field, 2013). Perception of technology, which served as the moderator between technological literacy and integration, was added to the regression model. The interaction was statistically significant, $b = 2.52$, 95% CI [.17, 4.86], $t = 2.10$, $p = .03$, indicating that the relationship between technological literacy and student-centered integration is significantly moderated by perception of technology use (see Table 6).

To more thoroughly investigate the nature of the moderation, a simple slopes analysis was conducted. A simple slopes analysis is often used to investigate the relationship between a predictor and outcome variable at different levels of the moderator variable (Field, 2013). Figure 3 shows the simple slopes of technological literacy at low, mean and high levels of perception. High and low levels of perception were determined using one standard deviation above and below the mean value of perception.

Examination of the slopes analysis showed that at all three levels of perception

Table 6. Linear Model of Predictors of Student-Centered Integration

	b	*SE B*	*t*	*p*
Constant	23.15	15.46	1.49	$p = .13$
	[-7.15, 53.47]			
Perception	-10.13	5.12	-1.97	$p = .04$
	[-20.16, -.09]			
Tech Literacy	-6.25	3.91	-1.59	$p = .11$
	[-13.93, 1.42]			
Perception x Tech Literacy	2.52	1.19	2.10	$p = .03$
	[.17, 4.86]			

Note. Numbers in brackets indicate 95% confidence intervals.

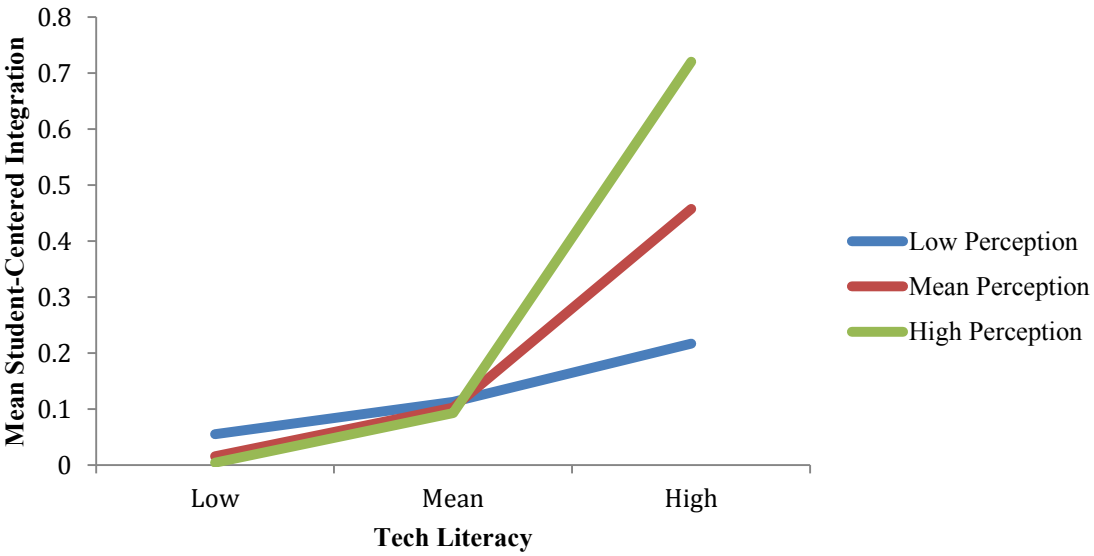

Figure 3. Simple slopes equations of the regression of student-centered integration on technological literacy at three levels of perception.

there was positive correlation between technological literacy and student-centered integration. When technological literacy was at a low to average level, the relationship between literacy and integration was similar at each level of perception. However, when

technological literacy was at an average to high level, the relationship between literacy and integration was exceptionally strong at average levels of perception, and even stronger at high levels of perception. Therefore, technological literacy always has a positive relationship with student-centered integration, but that relationship becomes even stronger with more positive perceptions of technology use in the classroom. The directional hypothesis is accepted that the level of technological literacy best predicts student-centered integration, and is highly moderated by the level of perception.

Summary

For this study, a survey was created for teachers to complete at their convenience at the participating schools. The survey measured teachers' technological literacy, their perceptions and integrations of technology, grade levels taught, and number of years teaching. Forty-five teachers participated in the study from three school districts. The statistical procedures included using a Chi-square test to compare the levels of technological literacy among teachers, the correlation coefficient to determine a relationship among the variables, and a multiple regression equation and moderation analysis to determine the interaction effect between the predictor and criterion variables. The focus of the study was to determine a relationship between technological literacy and perceptions and integrations of technology in the classroom.

The data suggest that there is a significant positive relationship between technological literacy and perception, as well as between literacy and student-centered integration. As technological literacy increases, so do the likelihood of positive perception and student-centered integrations of technology. The data also imply no

difference in technological literacy among teachers based on grade level or experience. Additionally, the results indicate that technological literacy is a strong predictor of student-centered integration, and that prediction becomes even stronger with more positive perceptions of technology. In the following section, a more thorough discussion of the findings will be presented, as well as recommendations for future research and practice.

DISCUSSION AND RECOMMENDATIONS

The purpose of this chapter is to present the results in a more practical context and to put forth recommendations for future research and practice. The contents of this chapter include: (a) Summary of the Study, (b) Summary of the Results, (c) Discussion, and (d) Recommendations for Future Research and Practice.

Summary of the Study

This study examined the relationship between teachers' level of technological literacy and their perceptions and integrations of technology in the classroom. The topic was chosen due to the gap in the literature on how these variables are related, although research is present on each variable individually (Daugherty, 2003; Koc & Bakir, 2010; Koehler & Mishra, 2005; Koehler et al., 2013; National Center for Education Statistics, 2010; Perrotta, 2013).

To determine a relationship among the variables, a correlational research design and quantitative approach to data analysis were chosen. The participants were selected among schools in southwest Missouri using nonprobability sampling, and they completed an online survey developed by the researcher. The survey measured technological literacy, perceptions of technology, and integrations of technology using well-developed constructs gleaned from the literature (An & Reigeluth, 2012; De Koster et al., 2012; Howard, 2011; Koehler et al., 2013; Perrotta, 2013). The data were analyzed using descriptive statistics, Chi-square, Pearson *r*, multiple regression equations, and moderation analysis. An alpha level of $p < .05$ was used to determine statistically

significant relationships.

Summary of the Results

Four research questions were examined in this study: (a) What are K-8th grade teachers' current levels of technological literacy? (b) Do teachers with a higher level of technological literacy have more positive perceptions of technology use in the classroom than do teachers with a lower level of technological literacy? (c) Do teachers with a higher level of technology literacy have a more student-centered approach to integrating technology than do teachers with a lower level of technological literacy? (d) Can technological literacy and perception of technology predict whether a teacher will integrate technology in a more student-centered way? The results of the data analysis of each research question are summarized below.

Research Question 1. The data showed that levels of technological literacy were evenly distributed between elementary and middle school teachers and there was no significant relationship between technological literacy and grade levels taught (see Table 3). Although the respondents who had been teaching between 10 and 15 years represented the highest percentage of high technological literacy (see Table 4), the data showed that there was no significant relationship between technological literacy and number of years teaching. Therefore, the null hypothesis was accepted.

Research Question 2. The results indicated that there was a strong positive relationship between technological literacy and perceptions of technology (see Figure 1). So teachers with higher levels of technological literacy tended to have more positive perceptions of technology use in the classroom. Therefore, the null hypothesis was

rejected.

Research Question 3. The third research question was answered similarly to the second. The results indicated that there was a strong positive relationship between technological literacy and student-centered integrations of technology (see Figure 2). So teachers with higher levels of technological literacy tended to have a more student-centered approach to technology integration. Therefore, the null hypothesis was also rejected.

Research Question 4. To examine the fourth research question, teachers were categorized into two approaches to integrating technology: teacher-centered and student-centered. Thirty teachers indicated a more teacher-centered approach to technology integration and 12 teachers indicated a more student-centered approach. The results showed that technological literacy, rather than perceptions of technology, was a good predictor of student-centered integration (see Table 5). Additionally, although the relationship between technological literacy and student-centered integration was strong, that relationship became even stronger with more positive perceptions of technology (see Figure 3). So, although perception alone played no significant role in predicting student-centered integration, it did significantly influence the relationship between literacy and integration.

Discussion

The first research question asked about teachers' current levels of technological literacy, and the hypothesis was that there would be no significant difference in the levels of technological literacy among teachers based on grade level and number of years'

experience. The literature implied that although the grade level taught and/or the amount of teacher experience could contribute to how technology is integrated into classrooms, these factors would not necessarily contribute to the level of technological literacy as much as other factors would (Al-Bataineh et al., 2008; De Koster et al., 2012; Ertmer et al., 2007; Koehler & Mishra, 2005; Lin, 2012; Lipscomb & Doppen, 2005; Perrotta, 2013; Zhang & Liu, 2006). The results showed that there was indeed no significant difference in the level of technological literacy based on grade level or experience. Teachers with an experience of 10 to 15 years did represent a larger portion of high technological literacy (Table 4). However, this could be due to the relatively low number of respondents, and therefore the underrepresentation of certain years of experience. So the conclusion is arguably still valid.

The second research question focused on the relationship between teachers' levels of technological literacy and their perceptions of technology use in the classroom. The hypothesis was that there would be significant positive relationship between the two variables. The literature gave much insight into how perception of educational technology could be measured and influenced (An & Reigeluth, 2012; Capo & Orellana, 2011; Howard, 2011; Perrotta, 2013). However, the relationship between perception of technology and technological literacy was rather unfamiliar, with the exception of some research that indicated a teacher's personal beliefs could contribute to the level of technological literacy (Ertmer et al., 2007). This study revealed that when teachers had more positive perceptions of technology, their level of technological literacy tended to be higher. The discovery of this relationship can greatly contribute to the existing literature by providing the basis for future research in the field of educational technology.

The third research question focused on the relationship between teachers' levels of technological literacy and their integrations of technology use in the classroom. More specifically, it focused on whether literacy was related to more student-centered integrations of technology. The hypothesis was that there would be a significant positive relationship between the two variables. The literature implied that not only is student-centered integration of technology preferred in order for technology to truly play a role in student success, but that technological literacy and student-centered integration are closely tied (An & Reigeluth, 2012; Gorder, 2008; Koc & Bakir, 2010; Koehler & Mishra, 2005; Koehler et al., 2013; Lipscomb & Doppen, 2005; Ritz, 2011). Similarly, the results of this study revealed that when teachers have more student-centered integrations of technology, their level of technological literacy tends to be higher.

The fourth research question narrowed in on which variable better predicts whether a teacher would integrate technology in a more student-centered way. The hypothesis was that both variables, technological literacy and perception, would be good predictors of student-centered integration. The results indicated that technological literacy was a good predictor of student-centered integration, but perception had a non-significant role. It was expected that technological literacy would be a good predictor, but it was surprising to find that perception was not a contributing factor. Upon finding this, the researcher decided to test whether perception at least played a somewhat influential role in the relationship between literacy and student-centered integration, since the literature suggests that perception of technology is a crucial component to technology integration (An & Reigeluth, 2012; Capo & Orellana, 2011; Howard, 2011; Perrotta, 2013). Interestingly, the results showed that the more positive perception of technology a teacher

possessed, the stronger the relationship between literacy and student-centered integration became. This discovery could certainly influence the way in which teachers are trained. Developing technological literacy is most important, but combining it with improving teachers' perceptions of technology could have even more of an impact on how technology is integrated in the classroom.

Additionally, when examining the fourth research question, the respondents were categorized into either teacher-centered or student-centered in their integrations of technology. A common theme present in the existing literature is that teachers often exhibit high computer literacy, but have a more difficult time applying that technology effectively in the classroom (Gorder, 2008; Koc & Bakir, 2010). Therefore, it came as no surprise that more respondents fell into the teacher-centered category of integration rather than the student-centered category, 30 and 12 respectively. It is interesting to note that some of the teachers with a more teacher-centered integration of technology still possessed high technological literacy, so certainly a deeper examination of the relationship between literacy and integration is needed.

Recommendations for Future Research and Practice

Because the survey was voluntary and the distribution required cooperation from principals, only 45 teachers from three school districts participated. So there were several schools, grade levels and experience ranges that were underrepresented. A good extension of this study would be to increase the sample and to include teachers from more diverse ranges of grade levels and experience. It would provide a greater collection of data that could improve the study. Rather than administering an online survey,

administering the survey in person at a faculty meeting could improve and increase the sample since teachers would be more readily available. Additionally, certain demographic information was not solicited from the participants, such as the teacher's school or subject area. A study that would request this information from participants could provide important insight into the differences among the demographic factors.

The constructs that were used to develop the survey questions for this study could perhaps be reevaluated. Although the constructs were well developed based on the literature, there could be other methods used to measure the variables of technological literacy, perception and integration. While a more broadened perspective in this area would be advantageous, the relationships that were found in this study could still be a good starting point to a causal-comparative study to better understand a cause and effect relationship among the variables. The information could be useful in focusing teacher-training programs on the skill or attribute that is needed to effectively integrate technology in the classroom.

This study included teachers who had both a teacher-centered and student-centered approach to technology integration. Only 12 teachers were categorized as student-centered in their integration of technology, which is certainly not ideal for analysis. Perhaps a research study that either focused on only one approach to technology integration or one that had a more balanced distribution of teachers in both categories would provide a better understanding of the relationship among the variables. Furthermore, it was found that some teachers with a more teacher-centered integration of technology still possessed high technological literacy. Therefore, a deeper understanding into the relationship between technological literacy and student-centered integration is

needed.

While there are limitations of this study as well as ways in which the study can be improved, there are still implications for practice for both teachers and administration based on the findings. It is clear that the relationships among high technological literacy, positive perceptions of technology, and student-centered integrations of technology are strong. That being the case, it would benefit the coordinators of pre-service and in-service training programs to focus on developing these attributes in their teachers. This is especially true since schools are implementing technology programs more frequently while also expecting higher student achievement. Certainly more research can be done on the extent of the relationships, as well as how to best improve teachers' abilities in these areas. Nevertheless, the results of this study are conclusive enough to inspire action from school leaders to make a conscious effort to improve technological literacy, perceptions and integrations.

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APPENDICES

Appendix A. Informed Consent Letter to Principals

Hi *(name of principal),*

I hope your first week of school is going smoothly! My name is Emily Norris and I am a graduate student at MSU. I believe *(name of contact)* has contacted you about a survey that I would like to send to your teachers near the end of the month for my thesis research. I really appreciate you being willing to accommodate my request to distribute a survey! I wanted to give you a little more info about the research and the survey.

Basically, I am looking into how teachers' level of technology literacy effects their perception and integration of technology in their classrooms. The survey will only take the teachers 5-10 minutes and it is completely anonymous and voluntary, though of course I would appreciate as many responses as possible.

The survey is in an online format, so the survey will be accessed via a survey link in an email. **This is where I would greatly appreciate your help!** If I send the survey link to you, do you mind forwarding it to your teachers? I would be happy to do this myself, however I've found from experience that teachers are much more willing to take a survey if it is sent on behalf of the researcher by an individual they know, rather than a complete stranger :) So your help in distributing the survey will be very beneficial to the response numbers.

I am awaiting IRB approval which should come in a couple of weeks. When the survey is approved, I will be sending the survey link at the end of this month, or beginning of September.

I can't express enough how much I appreciate your help and support in my research! Please don't hesitate to call or email me with any questions or concerns you may have. I am also more than willing to meet face to face with you at your convenience. My contact information is below in the signature.

Thank you again! Let me know if I can give any more information about my research.

Emily Norris
Educational Technology Graduate Student
Graduate Assistant for the Abstinence-based Education Grant Program
Missouri State University
norris514@live.missouristate.edu
931-217-6764 cell

Appendix B. Survey Instrument

Demographics

Select the grade(s) you currently teach (mark all that apply)

- ❑ PK (1)
- ❑ K (2)
- ❑ 1 (3)
- ❑ 2 (4)
- ❑ 3 (5)
- ❑ 4 (6)
- ❑ 5 (7)
- ❑ 6 (8)
- ❑ 7 (9)
- ❑ 8 (10)
- ❑ 9 (11)
- ❑ 10 (12)
- ❑ 11 (13)
- ❑ 12 (14)

How many years have you been a professional teacher?

_____

How many years have you worked at this particular school district?

_____

Technological Literacy

Here are some questions about your current teaching and technology practices. Please rank your level of confidence in...

	Not at all confident	2	3	4	Very confident
Presenting information to students in an understandable way	❍	❍	❍	❍	❍
Tailoring instruction based on student needs	❍	❍	❍	❍	❍
Applying current best teaching practices in the classroom	❍	❍	❍	❍	❍
Using a computer to complete daily tasks (e.g., emails, Internet searches, word processing)	❍	❍	❍	❍	❍
Choosing technologies best suited for the subject matter	❍	❍	❍	❍	❍
Applying technology in the classroom	❍	❍	❍	❍	❍
Using technology to increase student learning	❍	❍	❍	❍	❍
Using technology in the classroom	❍	❍	❍	❍	❍

in new or creative ways Using technology to create a more learner-centered classroom	❍	❍	❍	❍	❍

Perceptions

Here are some questions about your perceptions of technology use in the classroom. Please indicate whether you agree or disagree with each statement.

	Strongly Disagree	2	3	4	Strongly Agree
I enjoy using technology in the classroom.	❍	❍	❍	❍	❍
It takes me a long time to learn a new technology.	❍	❍	❍	❍	❍
I feel comfortable troubleshooting technology problems that arise.	❍	❍	❍	❍	❍
I enjoy learning new ways to use classroom technologies.	❍	❍	❍	❍	❍
Using technology in the classroom encourages student interest in learning overall.	❍	❍	❍	❍	❍
Using technology in the classroom can improve student achievement.	❍	❍	❍	❍	❍
Using technology in the classroom helps students become life-long learners.	❍	❍	❍	❍	❍

Integrations of Technology

How often do you use technology in your classroom to...

	Daily	Weekly	Monthly	Less than once a month	Never
Deliver instruction via presentation software?	❍	❍	❍	❍	❍
Complete administrative tasks (e.g., grade input, creating handouts)?	❍	❍	❍	❍	❍
Drill or review learned skills with your students?	❍	❍	❍	❍	❍
Communicate with students?	❍	❍	❍	❍	❍

How often do your students use technology in the classroom to...

	Daily	Weekly	Monthly	Less than once a month	Never
Conduct research?	❍	❍	❍	❍	❍
Learn or practice basic skills?	❍	❍	❍	❍	❍
Type out a paper/assignment?	❍	❍	❍	❍	❍
Create a product?	❍	❍	❍	❍	❍
Collaborate with peers?	❍	❍	❍	❍	❍
Solve problems?	❍	❍	❍	❍	❍

Appendix C. Informed Consent Letter for Participants

Purpose of the Study

This is a study in educational technology that will be used to fulfill requirements of a master's thesis. It is being conducted by Emily Norris, graduate student at Missouri State University in Springfield, MO. The purpose of this study is to examine teachers' perception and integration of technology in the classroom, and its effects on student learning.

What Will Be Done

You are asked to complete the following brief survey which will take only 5-10 minutes to complete. Nothing additional will be required of you. These questions will address your level of skill in using technology, your perception of using technology in the classroom, how you integrate technology into your instruction, and how your students' learning is impacted when technology is used.

Benefits of This Study

The information gathered will form the basis for future research in improvements in the classroom and teacher education, and may be used in scholarly publications. The information gathered in this study should provide more general benefits to educators and students.

Risks

Your participation is strictly anonymous and voluntary, and there is no cost or known risk to you if you choose to participate. You may skip any questions you do not wish to answer without penalty.

Confidentiality

The information gathered is anonymous. No one will know whether or not you participated in this study. Should the data from this questionnaire be published, it will be used in aggregate; individual participants cannot be identified. Individuals from the Institutional Review Board may inspect these records to ensure confidentiality.

Contact Information

If you have questions regarding the research, you may contact the researcher Emily Norris, or the research advisor Dr. Ching-Wen Chang. Emily Norris (931) 217-6764 norris514@live.missouristate.edu and Ching-Wen Chang, Ph.D. (417) 836-5353 cchang@missouristate.edu

Consent

If you choose to participate in this study, the participation is greatly appreciated. By checking the box below, you are voluntarily agreeing to participate. Thank you for your time and cooperation!

[ ] I agree to participate in this study

Appendix D. IRB Approval

To: Ching-Wen Chang Reading Foundations and Tech Springfield MO 65897-0027

Approval Date: 8/26/2014
Expiration Date of Approval: 8/25/2015

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Submission Type: Initial
Expedited Category: 7.Surveys/interviews/focus groups
Study #: 15-0064

Study Title: Effects of Classroom Technology on Teaching and Learning

This submission has been approved by the above IRB for the period indicated. It has been determined that the risk involved in this research is no more than minimal.

Investigator's Responsibilities:

Federal regulations require that all research be reviewed at least annually. It is the Principal Investigator's responsibility to submit for renewal and obtain approval before the expiration date. You may not continue any research activity beyond the expiration date without IRB approval. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.

You are required to obtain IRB approval for any changes to any aspect of this study before they can be implemented (use the procedures found at http://orc.missouristate.edu). Should any adverse event or unanticipated problem involving risks to subjects or others occur it must be reported immediately to the IRB following the adverse event procedures at the same website.

This study was reviewed in accordance with federal regulations governing human subjects research, including those found at 45 CFR 46 (Common Rule), 45 CFR 164 (HIPAA), 21 CFR 50 & 56 (FDA), and 40 CFR 26 (EPA), where applicable.

CC:
Emily Norris