Summer 2022

Exploring Technology Integration at a Public Middle School: A Descriptive Research Study on Integration Perceptions, Factors, and Barriers

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Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Education in

Curriculum and Instruction

College of Education

University of South Carolina

2022

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DEDICATION

For my children – Leah and Zari. You are my inspiration and the reason why I do so many things. You have turned out to be beautiful, smart, kind, and caring individuals. Please know that I am your biggest cheerleader and ready to support you in reaching your dreams. I will always love you to the moon and back.

For my parents – Geraldine and Earl Jeffreys. Thank you for your love, support, and guidance. You have truly been examples of hard work and perseverance. Your love and kindness have reached farther than you will ever know. Thank you for giving me everything I needed to be the person I am today.

ACKNOWLEDGEMENTS

I would like to extend my gratitude to my dissertation chair, Dr. Michael Grant, for the continuous support, feedback, and guidance on this journey. I appreciate your guidance and encouragement. Thank you so much.

ABSTRACT

The purpose of this action research was to explore mathematics teachers' current instructional practices and perceptions of technology integration, as well as the perceived barriers that influence their technology integration in the classroom. Teacher perceptions of technology integration at this public middle school. Across the country, states have partnered with federal efforts, taking an active role in building a technology-rich learning environment in their states (Education Superhighway 2017). Teachers have access to a wide range of tools and practices that involve using and creating appropriate technological processes and resources to facilitate teaching, engage students, and improve learning outcomes (Richey & Klein, 2008). This research study focused on three research questions: (1) What are mathematics teachers' current practices of technology integration in classrooms at Magnolia Middle School?, (2) What are mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?, and (3) What are the barriers that influence mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School? The setting of this study was at a public middle school, and the study took place over a sixteen-week period. Five mathematics teachers served as participants. These mathematics teachers delivered face-to-face in-person instruction to students in a regular education classroom setting. Data were collected through online surveys, in-person interviews, and classroom observations. Quantitative data were analyzed through descriptive statistics. Qualitative data were analyzed using inductive analysis. Findings indicated that teachers possessed different

levels of technology skills and incorporated a variety of instructional practices to integrate technology in the classroom. The primary barriers perceived by included lack of adequate professional development specific to their instructional content, lack of time to properly integrate technology in the classroom, technology malfunction issues related to technology integration, and issues related to students' use of technology. Teachers with high levels of technological skills were observed to incorporate the use of technology in the classroom with more comfort and confidence.

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CHAPTER 1

INTRODUCTION

National Context

According to the National Center for Education Statistics (2018), achievements in student performance in mathematics continued to be a struggle. The most recent reports revealed that 70 percent of eighth-grade students performed at or above basic in mathematics, 34 percent performed at or above proficient, and only 10 percent performed at the advanced level. The percentage of eighth-grade students who performed at or above basic was lower in 2017 than in 2015 but was higher than the percentage in 1990. Student performance on standardized assessments was a result of what and how teaching practices were used in the classroom. Teachers were able to use technology to facilitate the learning process and employed different resources to engage different learners (Ahmadi, 2018). Teachers and their teaching practices were the single most influential variable in student learning (Sutherland, Lewis-Palmer, Stichter, & Morgan, 2008). Cozad and Riccomini (2016) analyzed studies on students' ability to improve mathematics fluency in basic arithmetic calculations and concluded that technology integration was beneficial for students with mathematical difficulties due to various presentations, timings and error correction procedures.

Hutchison and Reinking (2011), in their survey of 1,441 U.S. educators, found a significant gap between teachers' perceptions of the importance of integrating technology and their instructional practices. The success of technology integration in teaching and

learning depended vehemently on teachers' positive perceptions of it (Celik & Keskin, 2009). There was a significant correlation to teachers' integration of technology in the classroom and their self-efficacy (Li, Worch, Zhou, & Aguiton, 2015). Educational technology in recent years has become an integral part of student learning. Computer software has been developed to meet the needs of today's students. Educational technology included the use of online programs in the classroom or online courses that have replaced classroom instruction. "Online learning is becoming a popular alternative to traditional face-to-face courses, as supported by a 2014 study that showed over 5.7 million students are taking distance education courses in the United States" (National Center for Education Statistics, 2018). As more and more technology has been integrated into mathematics education, the successful and effective integration of technology into instructional practices remained important. Technology in mathematics education has allowed the instructor to assume the role of facilitator. Some mathematics programs were able to assess the students' current level of knowledge and tailor a series of skill practice activities to provide practice in areas that were lacking. The use of online technology in classrooms engaged students so that they were active participants in their learning. The U.S. Department of Education (2017) found the use of technology in online classrooms allowed teachers to manage their time more effectively, cut costs related to instructional resources, and increase the degree of learning.

Another important facet of using technology in student learning was the way in which technology was integrated into lessons. Teacher perceptions of technology greatly impacted what and how students learned. Cope and Ward (2002) contend that in order to successfully integrate technology to enhance student learning outcomes, the teachers

should perceive technology as part of a student-centered and constructivist approach. Teachers adopting a constructivist approach tend to use educational technologies more frequently in their classes and try to include their students more in the process of teaching (Ertmer, 2005). Therefore, understanding teachers' perceptions and their use of technology were critical in the development of effective mathematics instruction in the classroom. Teacher perceptions of technology integration as a resource needed further investigation in order to produce the desired outcome. In order to measure how successfully technology has been integrated into classrooms, it was imperative to investigate the acceptance and use of technology by teachers and students (Gu, Zhu & Guo, 2013).

Local Context

This study explored the practices and perceptions of teachers regarding technology integration. Pseudonyms were used for the school's name and district. Any state-specific citations, references, and data have been removed for the purposes of protecting participants' identity. A mixed methods action research study was conducted with Magnolia Middle School mathematics teachers as the participants in this study. I taught at Magnolia Middle School for fifteen years and there has always been a focus on student achievement. The state mandated assessment of curriculum standards was used to measure student progress and achievement across the state for all middle school students. Information obtained from the state mandated assessment of curriculum standards indicated that only 17.9% of mathematics students were able to meet the state expectations on this assessment. This statistic showed a deficit in student achievement in the area of mathematics. Mathematics is a subject in which the content knowledge was

progressive. Throughout my years of teaching mathematics, I observed first-hand the difficulties students faced to achieve success mainly because they failed to retain previously learned skills and failed to master new skills. As a teacher, I integrated technology to my courses to assist students in practicing mathematics skills. I thought it was a valuable resource that allowed the student to practice the skills necessary to achieve a level of mastery. The use of technology rewarded students for their accomplishments and provided them with immediate feedback. From the perspective of the teacher, I used technology to track student progress and gather information to drive further instruction. I observed that technology allowed me to discover gaps in student learning. For example, some software programs provided valuable feedback through student diagnostic assessments. I used this data to conduct a data analysis on student responses. I administered intervention and remediation to individual students to address their specific learning gap or deficiency. The use of technology gave teachers the ability to generate student progress reports for students, parents, and administrators.

Until now, mathematics teachers' instructional practices, perceptions of technology integration, and perceived barriers to technology integration at Magnolia Middle School were unknown. The local school district mandated that mathematics teachers use technology in the classroom. Despite this regulation, no records existed on how mathematics teachers were incorporating the use of technology for mathematics instruction. Furthermore, mathematics teachers' perceptions of technology integration remained a significant factor in providing students with technological enhanced learning experiences.

According to the most recent school report cards on student achievement in mathematics at Magnolia Middle School, students' performance on state mandated standardized tests were deemed below average. With the intention to improve student achievement in mathematics on state mandated assessments, a change in instructional practices needed to be implemented. Knowing more about the perceptions of mathematics teachers, and their practices of using technology in the classroom, may lead to insights for how to improve student achievement in mathematics. Finally, as a part of the action research study, barriers that influence teachers' perceptions were explored. The study included information gathered through teacher surveys, interviews, and classroom observations.

Statement of the Problem

All mathematics teachers at Magnolia Middle School were not integrating technology consistently in their classrooms. The belief that teaching strategies used in the classroom greatly impact student learning was confirmed by Richards (1991), as he argued that, "students will not become active learners by accident, but by design" (p.38) "and a structured plan is needed to guide students' learning." Summerlee (2010) contended that a plan needed to be designed to encourage students to take control of their learning both inside and outside of the classroom. A study conducted by Ertmer (2005) indicated a numbered of barriers impacted whether the teachers chose to use the available technology in their instruction. Therefore, teachers' perceptions of technology integration played a key role in facilitating student learning. Spektor-Levy and Gronot-Gilat (2012) determined that students who were taught in an environment which allotted one device for each student outperformed students who were taught in a more traditional classroom

when given a complex, computer-based learning task. Mathematics students at Magnolia Middle School were performing below grade level, and new instructional practices may have been able to provide support for these students. Establishing mathematics teachers' practices and perceptions of technology integration in their classrooms may have served as a strong first step in investigating this problem. The teacher perceptions towards technology integration, and the barriers affecting those perceptions, may have directly impacted what and how students learned mathematics in middle school classrooms.

Purpose Statement

The purpose of this action research was to explore mathematics teachers' current instructional practices, and teachers' perceptions of technology integration, as well as teachers' perceived barriers that influenced their technology integration in the classroom.

Research Questions

Three research questions guided this study:

(1) What are mathematics teachers' current practices of technology integration in classrooms at Magnolia Middle School?

(2) What are mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?

(3) What are barriers that influence mathematics teachers' technology integration in classrooms at Magnolia Middle School?

Statement of Research Subjectivities and Positionality

By incorporating the best practices for education and the use of effective learning tools, I worked hard to help my students become successful. I know that a part of their success rested on my shoulders. I am currently in my fifteenth year as an eighth-grade

teacher at Magnolia Middle School. I taught pre-algebra to students who were advanced, below grade level, and on grade level. Teaching has helped me realize that I possessed the ability and the expertise to make a difference in the lives of individuals. In preparation for my career in teaching, I obtained a Master of Arts in Teaching Degree. I continued my education to further my understanding of how students learn. My goal was to become the subject matter expert with regards to educational systems in education technology. I hope to one day become a designer of instructional materials and created interactive lessons to engage and educate learners.

My beliefs aligned closely with the transformative worldview because many of my students came from families of a low socioeconomic status. A transformative worldview states that research inquiry needed to be intertwined with politics and a political change agenda to confront social oppression at whatever levels it occurs (Mertens, 2010). The social oppression my students encountered was through their economic status and educational disadvantages. These disadvantages oftentimes included lack of educational support within the home, peer pressure, and social and emotional trauma. The action research study I conducted may have the potential to improve my students' lives by enhancing their learning experiences.

A mixed methods action research study was conducted with Magnolia Middle School mathematics teachers as the participants in this study. Since I was a teacher at Magnolia Middle School and shared the same experiences as my colleagues, I had a unique inside perspective of the school's instructional norms. I used technology as part of my instructional practices and therefore had my own perception of technology integration

in the classroom. I had first-hand knowledge of the school's environment, culture, and student population at Magnolia Middle School.

As a researcher, a mathematics teacher, and a user of technology, I inherently possessed a bias towards teachers' perceptions of technology integration in the classroom. It was incumbent upon me to follow the procedures of the study to avoid misrepresenting the data. It was my responsibility to collect data and report the findings regardless of my own perceptions. With the awareness of this bias, I was objective throughout the research study. Data collection through a survey served as one way in which my own perspective did not influence the participants. I allowed the data to reveal the teachers' perceptions of technology use and the barriers that influenced its use in the classroom. As the researcher, I was not in a position of authority to the participants. The participants were my colleagues.

In order for this information to be useful and valuable to Magnolia Middle School, the integrity and support of the participants played an integral role in completing this study. Any information disclosed by participants was kept confidential. To ensure anonymity, no names of participants were disclosed nor was damaging information revealed. Bonner and Tolhurst (2002) recommended that insider researchers possess the benefits of "(a) having a greater understanding of the culture being studied; (b) not altering the flow of social interaction unnaturally; (c) having an established intimacy which promotes both the telling and the judging of truth are considered to increase the credibility of the insider research." The overall goal was to improve student achievement in mathematics at Magnolia Middle School. A necessary part of achieving this goal was

to explore teachers' current practices and perceptions of technology integration classrooms and identify perceived barriers to technology integration teachers faced.

Definition of Terms

The following terms as related to this research study were defined as follows:

Teacher beliefs. Teacher beliefs about technology integration can be defined as expressing feelings about skills to integrate technology and representing these feelings through their classroom instructional practices (Berg et al., 1998; Ertmer et al., 2001; Hew & Brush, 2007).

Teacher Perceptions. As defined for this research study, teacher perceptions are representations of teachers' understandings of their own professional identity (cf. Atkinson, Smith, & Hilgard, 1987).

Technology. Technology is defined as an electronic device that stores, retrieves, and processes data and can be programmed with instructions (National Center for Education Statistics, 2010).

Technology Integration. Technology integration is the use of electronic devices in the classrooms for the enhancement of the educational environment, as a supplement that drives instruction, and provides students with visuals for learning (Dockstader, 2008; Ahmadi and Reza, 2018; Coleman, 2015; Rehmat and Bailey, 2014).

Title I School. A Title I School receives federal funds based on the large concentrations of low-income students are enrolled. The supplemental funds assist in meeting the students' educational goals.

CHAPTER 2

LITERATURE REVIEW

At the national level mathematics education has seen a decline in student achievement. In order for learning to take place, students must be active participants in the learning process. The focus on instructional practices in the classroom must be student-centered where the student was responsible for his or her own learning. The teacher was there to facilitate learning and maintain a learning environment conducive to learning. Technological advances were options teachers decided to use in the classroom to aid students in learning. There are computer software programs and devices that were capable of presenting mathematical concepts that parallel real-life problem solving, and advance student communication of mathematical thinking, and in addition to teaching the appropriate use of technology. The curriculum emphasized balancing different types of instruction (including collaborative learning), using various methods for skills practice, remediation of mathematics skills, and problem-solving strategies. Previous research has revealed that the use of technology in classrooms is able to help students understand the application of mathematics skills (Dixon & Brown, 2012). Middle school students needed a strong mathematical foundation in order to succeed on the pathway to the successful completion of algebra as well as other mathematics courses in middle and high school.

Based on the research questions, four main variables were used to guide the literature search: (1) barriers that influence teacher perceptions, (2) technology integration, (3) the relationship between teacher perceptions, and (4) instructional

practices. The resources for this literature review were collected through online database searches. I conducted a search for research articles that were directly relevant to my purpose statement and research questions. Electronic databases included, ERIC, Google Scholar, and JSTOR. The database searchers were restricted to the most recent, peer reviewed published articles using the following keywords: "teacher attitudes", "teacher perceptions", "teacher beliefs", "technology integration", "instructional practices," and "relationship between teacher beliefs and instructional practices." Variations to these keywords were also used to generate additional research search reports. I limited the date range to years 2014 – 2020 to obtain reports of the most recent articles. Research articles were also discovered by mining the references of collected articles regarding the relevant literature topics. I also noted the number of times that article had been cited in other articles as evidence of its high quality. Organization of the research articles were catalogued and saved in the reference manager, Mendeley.

Organization of the three major components of this literature review are as follows: (a) mathematics teachers' instructional practices, (b) theoretical framework for technology integration, and (c) teacher perceptions of technology.

Technology Integration in the Mathematics Classroom

Technology integration in the field of education continued to advance and progress rapidly as time passes. Teachers and students are forced to keep up with the ever-changing innovations that time brings. Many years ago, inventors have searched for new techniques to accomplish tasks or find easier ways to solve problems. These individuals were visionaries because they planned the future by using their imagination. One such visionary, H. G. Wells explored possibilities lead to the optimistic imagination

of modern technology. Educational technology was born out of theoretical knowledge and practical experience. This combination would undergo a metamorphosis that encompassed science and technology in the 19th and 20th centuries. Technology has continued to evolve well into the 21st century.

According to the National Center for Education Statistics (NCSE), at the beginning of the 21st century 99% of American public schools had internet access. At the federal, state, and local levels of government, technology integration has been the trend since before the start of the 21st century. Government leaders have made a concerted effort through government spending and accountability procedures to push for technology integration in the field of education. Leaders supported initiatives and programs for improvements in education, particularly in mathematics and other education content areas. Significant gains in mathematics are necessary if the United States intends to compete on a global level (Slavin & Lake, 2008, p. 427).

In the 21st century, technology integration has become an integral part of education with a focus on the Science, Technology, Engineering and Mathematics (STEM) initiatives. Awareness of the evolution of the role of technology in education has progressed over time provided a background and an overall view from the beginning of the 21st century until modern times.

Instructional Practices Related to Mathematics Education

Instructional practices that include remediation of previously learned content, skills practice that reinforced new content learned, acquisition of new knowledge, and problem-solving skills required students to construct knowledge. The constructivist approach to learning required learners to be active participants in the learning process.

Students constructed new knowledge by actively making sense of material and experiences presented to them. This active engagement of students in the learning process was essential.

Constructivist, student-centered activity might be one use of technology that was considered effective (Kopcha, Neumann, Ottenbreit-Leftwich, & Pitman, 2020). The construction of knowledge may not be the same for every student. Remediation of mathematics concepts may require students to develop a new way to conceptualize the content that is reviewed. For example, it may be in the form of applying different mathematical knowledge to solve a problem. Knowledge was constructed when students engage in skill practice activities. Various types of problems are presented when students practice a skill to hone their understanding of a concept. In other words, the learner possesses knowledge, but must also use cognitive skills to find the solution. The constructivist learning theory may best lend itself to mathematics instruction as it involves teaching complex skills, such as problem solving or critical thinking skills (Tam, 2000).

Teacher Knowledge and Instructional Practices

Previous research has indicated that subject knowledge for teaching is complex and multi-faceted (Stevenson, 2020). One study explored the relationship between teachers' knowledge for teaching mathematics and instructional practices and revealed that there is a positive association between knowledge and instructional practices (Lee & Santaga, 2020). According to Shulman (1986), teachers' mathematical knowledge consists of knowledge of mathematics, and teacher pedagogical knowledge. Teachers' mathematical knowledge refers to knowledge of mathematical concepts, definitions and

properties, different types of mathematical connections. Additionally, teachers must be able to apply the knowledge to solve problems. Next, teacher pedagogical content knowledge is an understanding of the learner, with respect to their aptitude, learning style, abilities and potential.

Technological pedagogical content knowledge. Technological pedagogical content knowledge (TPACK) is defined as the teacher knowledge required for successful technology integration (Salas-Rueda, 2020). It was developed from the idea of Pedagogical Content Knowledge, which is the teacher's knowledge with regards to content-specific pedagogy. In addition to other subject content areas, TPACK studies in mathematics education have gained momentum in recent years as the integration of technology has increased. Students need concepts that can be represented and adapted to meet their interests and abilities (Juhji, 2019). Teachers bridge the gap for students to learn by incorporating teacher mathematical knowledge and technological pedagogical content knowledge. Technological pedagogical mathematics knowledge (TPMK) has indicated that teachers need to engage in extensive collaborative design to integrate constructivist-oriented use of technologies in classroom learning (Lim, Ang, & Koh, 2016). Previous studies have been conducted to describe the association between a teachers' pedagogical knowledge and technology integration. One study, (Taimalu & Luik, 2019). One study aimed to identify the impact of teacher knowledge technology integration in the classroom, and concluded pedagogical knowledge had a significant effect on technology integration to analyze the design and implementation. Another study (Salas-Rueda, 2020) examined an online application considering the TPACK (Technological Pedagogical and Content Knowledge) model and concluded the TPACK

model facilitates the implementation of technological tools and construction of educational virtual spaces through technological, content and pedagogical knowledge. An effective model teacher can utilize technology integration as essential to integrating technology in the classroom. It is very specific to the discipline of mathematics in that mathematics teachers must consider the students' ability, level of understanding and mathematical capabilities when designing learning experiences for students.

Theoretical Framework for Technology Integration

Technological, Pedagogical, and Content Knowledge (TPACK) is a framework used to describe the connection between technology pedagogy and content knowledge that is essential to effective technology integration. The TPACK model is a framework of reference that allows the creation of active strategies for teaching and learning through the use of technology. Research conducted by Khan (2014) supports the TPACK model as part of teachers' professional development Content Knowledge framework. Contributors to the development of this framework include Bloom (1956) and Schwab (1972). The framework was further developed with contributions made by Mishra and Koehler (2006).

The TPACK is a framework that supports teachers in maximizing their knowledge of technology integration for their students. This framework combines three essential areas of knowledge, technology, pedagogy and content teachers must possess in order to constructively integrate technology in today's classrooms. The use of technology in the classroom requires more than using hardware and software as tools to enhance learning, but the use of technology must be integrated effectively. Mouza, Karchmer-Klein, Nandakumar, Ozden, and Hu (2014) identified ways to encourage the

technological and pedagogical skills of teachers so as to maximize the impact technology integration has on student achievement. Altun and Akyildiz (2017) contend technology integration involves (1) having a deep understanding of the concept of technology use, of pedagogical technique (2) using technologies in constructive ways to generate teaching content (3) technology has the potential to make learning easy or difficult, and (4) it can be used to address the problems students face. Schmidt, Baran, Thompson, Mishra, Koehler, and Shin (2009), revealed that knowledge in these three areas are all significant predictors of teachers' preparations for using technology for teaching. Therefore, it is incumbent upon teachers to broaden their knowledge in the areas outlined in the model.

Content knowledge includes the amount and organization of an educator's knowledge concerning their subject matter. The knowledge of processes and methods of teaching and learning represents pedagogical knowledge, which also includes an overarching understanding of educational values and aims (Shulman, 1987). Technology knowledge has been added to Shulman's PCK framework as both a knowledge area and technological tools (Mishra & Koehler, 2007).

Previous research studies have been conducted regarding the use of the TPACK framework and its impact on teachers' technological practices in the classroom. One study (Chua & Jamil, 2014) aimed to assess the level of competency among instructors by evaluating their professional knowledge according to the TPACK model and found that instructors acquired professional knowledge by attending professional development programs either through On-Job Training or Off-Job Training. One study (Ozudogru & Ozudogru, 2019) examined the technological pedagogical content knowledge (TPACK) levels of mathematics teachers in an effort to enhance students' engagement and

motivation in learning mathematics and found that male teachers perceived their technological knowledge significantly higher than female teachers. Another study (Urban, Navarro, & Borron, 2018) explored the transferability of the technological pedagogical content knowledge model (TPACK), originally used for technology integration for the effective integration of concepts into content-specific courses and found that pedagogy, and content, rather than knowledge area provided more adequate preparation for technology integration in the classroom. Previous research studies on TPACK demonstrates different levels of effectiveness in the area of technology integration for teachers.

Instructional Technology Integration in Mathematics

Educational technology includes any tool, piece of equipment or device that can be used to help students accomplish specific learning goals (Davies, Sprague, & New, 2008). A study conducted by Kulik and Fletcher (2016) found that intelligent tutoring systems typically raise student performance well beyond the level of conventional classes and even beyond the level achieved by students who receive instruction from other forms of computer tutoring. One study (Craig et al., 2013) showed that students who utilized a computer assisted tutoring program required significantly less assistance in mathematics from teachers to complete their daily work. According to one study (Nye et al., 2018) some technology systems have been designed to provide explanations to students so that they are able to work independently. The many features of the technology integration tool have allowed teachers to meet the needs of students on a personal level, advance student understanding of mathematical content, and provide traditional classroom instruction.

Remedial mathematics. Mathematics remediation is defined as the intention to correct or improve one's skill in mathematics. Remediation in mathematics is crucial for students who lack the necessary skills to progress forward in their math education. Mathematic is a discipline where content builds from a precious concept learned. Students who struggle to learn mathematics oftentimes have gaps in their understanding of the previous concepts. For some students, remediation instruction is needed (Jimenez, Sargard, Morales, & Thompson, 2016); Whole group direct instruction is not able to meet the needs of all students with deficiencies in different mathematical concept areas. It is difficult to accommodate instructional needs of students with different levels of prior knowledge and different rates of learning (Slavin, 1999). Research has proven to be effective in diagnosing and addressing student decencies by rendering one on one remediation (Van Orden, 2020). Addressing each students' deficiency may present a challenge to teachers who have time and resource restrictions in the classroom.

Skills practice. Haelermans and Ghysels (2017) found that students who spend more time practicing a skill perform better academically. One study (Mikula & Heckler, 2017) focused on the identification of target skills and student difficulties with these skills in mathematics and found that simple computer-based mastery practice was an effective and efficient way to improve a set of basic and essential skills among students. One study, (Wijaya,Ying, & Purnama, 2020) aimed to test the effectiveness of mathematical software in teaching mathematics and found that students who were able to understand learning are supported by the software better than those who are learning better than the traditional teaching instructional delivery method. Other studies attest to the value of skill practice in mathematics and the usefulness of this instructional practice.

Acquisition of content knowledge. Technology enhanced tutoring systems can provide mathematics instruction to students that is equal or superior to traditional classroom instruction. Some studies have revealed that the use of technology for mathematics instruction has been more successful than traditional instruction in teaching mathematics (Ma Adesope, Nesbit, & Liu, 2014).

Use of various instructional integration technology for teachers may aid instruction of mathematical content that is effective, innovative and engaging for students. One study (Wijaya, Ying, & Purnama, 2020) aimed to study the effectiveness of a software program teachers used in comparison to traditional teaching and found that the software program was able to improve the students' mathematical understanding. Another study examined the impact of educational performance as a result of integrating technology and revealed students performed well when studying mathematics as opposed to a subject that did not incorporate mathematics (Buckley, Seery, Power & Phelan, 2019). One study (Fang, Ren, Hu, & Graesser, 2019) conducted a meta-analysis to assess the effectiveness of an online tutoring mathematics learning program and revealed that the mathematics program was not superior to traditional classroom teaching. Overall, the use of technology incorporated into mathematics education curricula can help teachers introduce new mathematical concepts though it is not sufficient enough to replace traditional classroom mathematics instruction.

Problem solving. Mathematics problem solving is defined as the use of abstract models, numbers, mathematical figures, and objects that symbolize abstract ideas; the ability to handle long chains of reasoning, to discover a promising idea and draw out its implications, and to recognize significant problems and solve them (Maker, 2017).

Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems (NCTM, 2014).

The use of technology for problem solving has been incorporated in the student curriculum. Teachers are advised to provide students with opportunities and support to engage in struggling with mathematical ideas and relationships. One-way teachers may integrate technology into their instructional practices is to have them use mathematical reasoning for problem solving. One study identified dimensions of powerful mathematics classrooms that help students to become knowledgeable, flexible, and thinkers and problem solvers (Schoenfeld, 2020). The National Council of Teachers of Mathematics (2000) recommends that teachers provide students with engaging tasks that promote mathematical reasoning and problem solving and allow for various solution strategies. One study integrated theoretical perspectives to develop a comprehensive set of instructional practices and found that individual participation in mathematical activity was significant for mathematics instruction, (Rasmussen, Wawro, & Zandieh, 2015). When teachers use instructional practices that promote problem solving it encourages students to be active participants in their learning and use mathematical reasoning. The integration of technology is simply a tool to assist in the problem-solving process.

Research on various types of technology integration

Technology integration in the classroom may incorporate many different types of devices and technological tools. Technology may include the use of video tutorials and online tutoring programs.

Online tutoring videos. Research Studies using online tutoring technology (Schez-Sobrino, Gmez-Portes, Vallejo, Glez-Morcillo, & Redondo, 2020; Boyce, & O'Halloran, 2020). One study (Moreno, Palacios, Barreras, & Pascual, 2020) where teachers sometimes incorporated technology into their instructional practices was through the use of mathematical videos. The aim of one research study was to determine the impact of perceived Teachers' Digital Competence (TDC) on how well math teachers prepare the educational videos needed to put the flipped classroom. The study found that teachers did not perceive the videos to be of high quality and were less than satisfactory. Teachers related that the videos were deficient in the content areas related to their pedagogical and math instructional components. For this study, the integration of technology for mathematical instructional focused on teachers' perception of the quality of the instructional content.

Online tutoring programs. Studies have been conducted to determine the effectiveness of Intelligent Tutoring Systems a to improve student performance in mathematics. One study (Hagerty & Smith, 2005) examined Assessment and Learning in Knowledge Spaces (ALEKS) systems to improve the mathematical skills of struggling students. This program found that students who utilized ALEKS required significantly less assistance in mathematics from teachers to complete their assignments. One study (Rholetter, 2020) examined an intelligent tutoring system IXL that focused on the ability of the technology to replace traditional mathematics instruction. It aimed to determine the impact the program had on the students' math achievement. The results showed that students who did not receive IXL for mathematics instruction were significantly higher than those who did. The intelligent tutoring system did not appear to benefit the students

who used the technology. Another study (Kelly, 2018) examined Khan Academy tool for mathematics remediation to determine its impact on student math achievement. This study found that there was no significant difference between students receiving regular instruction only and those receiving regular instruction along with Khan Academy for math remediation. The use of online mathematics integration has revealed mixed results regarding the use of online tutoring designed for student achievement in mathematics.

The Teachers' Role in Mathematics Technology Integration

In the theoretical framework for mathematical technology integration researchers have acknowledged the role of the teacher as an important barrier in the technology integration process. Teachers are facilitators of the learning that will take place and must communicate clear directions and expectations for technology integration in the classroom (Bradford, Mowder, & Bahte, 2016). Not only must teachers possess conceptual understanding and procedural fluency, but they must also possess the skills to communicate mathematical ideas (Jacques & Drury, 2018). The focus of one study was to understand the integration of technology to improve technology use in education and found that teachers should be motivated to use technology and create situations where students should integrate technology (Najdabbasi, & Pedaste, 2014). Another study (Lee & Santagata, 2020) affirms teachers may provide students with the knowledge and understanding needed to master mathematical content, but students are responsible for applying that knowledge.

Teachers act as facilitators in the learning process. The teacher's role is to facilitate students' thinking to achieve the learning outcome (Gek, 2020). Teachers select instructional content teachers are the primary decision makers in classrooms (e.g., Shin,

2015). The mathematical content that teachers select must fall within the guidelines as set forth by officials at the local, state and government levels. Teachers are provided with state standards of which they are held accountable to teach. The curriculum is based on state standards. Students are assessed on their performance on state mandated assessments for K-12 schools. International Society for Standards in Education (ISTE) standards (2017) advised that teachers design engaging student-centered learning activities and facilitate high levels of learning with technology to challenge students. While teachers may face restrictions regarding the content of what they are allowed to teach, teachers decided how the content is taught.

Teachers are responsible for the presentation and delivery of what and how students learn the classroom. In order to better understand how teachers' decisions impact instructional delivery of mathematical content insight may be gained through previous research. One research study (Haas, Lavicza, & Kreis, 2020) investigated teachers 'decision making process for technology integration and formulated the Teacher Responses Model. This model incorporates three elements that researchers found to be part of teachers' decision-making process. According to the TAM model, teachers' decision to integrate technology into the classroom is influenced by: (1) value driven, (2) embedded in a dynamic system, and (3) a product of a teacher's perception of what is possible. (Kopcha, Neumann, Ottenbreit-Leftwich, & Pitman, 2020). Another study (Watson, 2019) investigated the role of mathematics teachers' thinking and decision making in the classroom and revealed most of the decision making in the classroom was based on algorithmic reasoning. Algorithmic reasoning is reasoning that comes from experience and practice. (Stanovich et al., 2011, p. 107).

The impact technology has on student achievement. The Elementary and Secondary Education Act (ESEA) is an accountability system in place to hold schools accountable for meeting state standards. In 2002, President George W. Bush signed the No Child Left Behind (NCLB) act, an update of the Elementary and Secondary Education Act, into law. This provided another level of accountability on the part of the schools and the government agencies. School accountability was reflected in the form of state mandated assessments. Ultimately, curriculum for the tested subjects placed more emphasis on test preparation which was deemed a reflection of student achievement. Because teachers' main focus was preparing students for high-stakes assessments, less time in the classroom was spent for exploratory, hands-on, or other effective learning strategies (Zhong & Xia, 2020; Thuneberg, Salmi, & Bogner, 2018). NCLB advocated for the improvement in student achievement by using technology. Student achievement and performance on standardized tests is an indication that the time spent learning in the classroom is critical to improving student achievement. Mathematics is one component of state standardized assessments.

Teacher Perceptions of Technology

The National Center for Education Statistics (NCES) is the primary federal entity responsible for collecting and analyzing data related to education in the U.S. and other nations. Although the use of instructional technology in classrooms has been growing rapidly, the quality and effectiveness of the technologies remain limited, and research has revealed limited positive effects of technology on learning (Snyder & Dillow, 2015; U.S. Department of Education, 2017). For twenty-first century teachers, technology used in the classroom is now a fundamental part of teaching. Teachers are expected to use

hardware such as Promethean boards, computers, the internet, mobile devices, chrome books, interactive whiteboards and document cameras and other emerging technologies.

The Relationship Between Teachers' Perceptions and Technology Integration

Mathematics teachers' decision to use technology as part of their instructional practices to enhance student learning may be impacted based on how mathematics technology integration is perceived. Therefore, technology integration as part of teachers' instructional practices determines whether teachers use technology in the classroom. The following section discusses the relationship between teacher perceptions and technology integration.

Teachers must use various software programs to operate these devices. Additionally, teachers must use technology for student instruction to create assignments, give assessments and provide enhanced learning experiences for students. There are both advantages and disadvantages to using technology in the classroom. With technology use being a fundamental feature in modern day classrooms, it is important to understand teachers' perceptions of technology use in the classroom. What does the latest research say about teachers' perceptions of technology and its use in the classroom? Teachers' perceptions of factors such as teachers' demographic characteristics, beliefs and attitudes, availability of and access to technology and support have been identified as factors that significantly affect technology integration. For example, study analyzed teachers' perceptions of technology use in the classroom found that, teachers perceived a significant increase in the areas of student engagement, student excitement, student acceleration of learning and student proficiency with computer technology (Mundy, Kupczynski, & Kee, 2012). Teachers' personal beliefs are represented by their classroom

instructional practices (Berg et al., 1998, Ertmer et al., 2001). Teachers' beliefs about technology in the classroom determine how, how often and in what capacity it will be used.

The way in which teachers think about using technology to teach students seem to be formed by various barriers. The following section will discuss barriers that influence perceptions teachers hold regarding the use of technology. These barriers include (1) teacher beliefs, (2) teachers' self-efficacy about technology (3) support from administration, (4) teacher professional development knowledge, and (5) teacher characteristics.

Teacher Beliefs

Pajares (1992) and Rokeach (1968), define teachers' beliefs as the assumptions about teaching and learning held by teachers. They believe these beliefs are further distinguished by a system of attitudes and values. This system then guides their behaviors about teaching practices (van der Scaaf, Stokking, & Verloop, 2008). Teacher beliefs are vital to understand because they shape teachers' thoughts and impact the instructional strategies and therefore impact classroom instructional practices (Rubie-Davies et al., 2012). Research indicates that teacher beliefs have a significant impact on their instructional practices in the classroom. One case study (Heath, 2017) used the phenomenological method to analyze data collected through observations, and interviews, and concluded that a teachers' positive beliefs about technology is a determining barrier regarding technology integration. A similar study (O'Neal, Gibson, & Cotten, 2017) employed a qualitative approach to explore teacher beliefs using a focus group and found that the group's discussion about their beliefs regarding the role of

technology generally centered around the understanding that technology is a tool to enhance student learning. One study (Vongkulluksn, Xie, & Bowman, 2018) combined hierarchical linear modeling and multilevel path modeling to examine how teachers' value beliefs about technology affect the way they internalize actual technology access. This study found that teacher beliefs impacted the degree to which they integrated technology in their classrooms. These studies reveal what is known about how teacher beliefs impact not only what students learn in the classroom but also how student learning is enhanced by using technology.

Teacher beliefs and technology enhanced instructional practices. Zachara (2003) contends that it is important to understand the beliefs and attitudes that contribute to how teachers behave in order to promote a transformed instructional practice. Teachers who held positive attitudes toward a use of a technology tended to incorporate that technology into their instructional practices. The opposite is also true. Teachers who held negative attitudes about the use of a technology were more reluctant to use that technology (Kriek & Stols, 2010). All research does not associate teacher beliefs with instructional practices (Haukas, 2016). One study explored technology integration and the role of teacher beliefs in this integration and found that teacher beliefs did have an impact on instructional practices regarding technology integration (Chand, Deshmukh, & Shukla, 2020). Another study (Ifinedo, Rikala, & Hämäläinen, 2020) investigated the barriers, (including teachers' beliefs) influencing technology integration and found that no one barrier should be considered, but a combination of barriers combined influence a teachers' instructional practices of technology integration. Another study (Taimalu, & Luik, 2019) identified the impact of the beliefs had on technology integration and

concluded that integration had a direct effect on technology integration. Previous research as to whether teachers' beliefs are related to the integration of technology has yielded no definitive association. Gaps in qualitative research exist regarding teacher knowledge teacher beliefs impact their instructional practices.

Self-efficacy. Definition of self-efficacy refers to "the teacher's personal belief in ability to plan instruction and accomplish instructional objectives" (Gavora, 2010, p. 18). An individual's actions are predicated on their beliefs, especially their beliefs about their own abilities. (Bandura, 1977, p. 53), writes, "People's beliefs in their self-efficacy affect almost everything they do: how they think, motivate themselves, and behave." If an individual believes that they can accomplish a goal, the motivation is derived from their set of personal beliefs. Individuals who are considered to have a low sense of self-efficacy may display symptoms such as depression, anxiety or feelings of helplessness. Low self-efficacy is also characterized by low self-esteem or holding a negative view of the world. This may lead them to believe they are not able to successfully accomplish their goal. Individuals who harbor a negative view of the world are usually not very motivated to accomplish tasks. Alternatively, according to Bandura (1977), individuals with a high sense of self-efficacy believe that they can successfully accomplish a challenging task. Their view of the world is positive and just the opposite. Self-efficacy is a motivational construct based on how an individual perceives their ability rather than the ability they possess (Tschannen-Moran & Hoy, 2007, p. 946).

Teacher self-efficacy and technology integration. A body of research exists on the self-efficacy of teachers regarding technology use in the classroom. One study (Heath, 2017) conducted a two-year case study that explored teachers who demonstrated

a strong sense of self-efficacy in implementing technology in their classroom and concluded that the implementation of technology using one-on-one initiatives was successful due to teachers' beliefs in their own abilities. A similar study (O'Neal, Gibson et al., & Cotten, 2017) used qualitative data collected from a focus group consisting of nine teachers and found that teacher beliefs about having inadequate technology skills sets impact their instructional practices and causes them to be reluctant to integrate technology in using technology in the classroom. One study (Vongkulluksn, Xie et al., & Bowman, 2018) used a hierarchical linear model and multilevel path model to examine teachers' value beliefs, and results of this study indicates that teachers who lack the ability and skill set to use technology will view this as a barrier. Barriers such as self-efficacy in using technology, lack of professional development regarding technological innovations, and lacking confidence in implementing technology affect the perceptions teachers hold regarding the use of technology in the classroom. Results of these studies support research that building teachers' self-efficacy by providing professional development increases the likelihood that they will integrate technology into their instructional practices.

Support from administration. Support from school administration regarding use of technology related issues in the classroom is a barrier that contributes to teachers' perceptions of technology integration in the classroom. The integration of technology at the local level, the school, impacts the teacher perceptions as in the form of support for technology integration or lack thereof. While administrators play a role at the school implementation of technology use in the classroom, they decide and implement school wide policies regarding technology use. Policies may include restrictions such as when,

where and how students and teachers are allowed to use technology. One study (Boatwright, 2016) explored the beliefs, attitudes and perspectives of teachers and found that lack of administration was revealed to be a barrier to technology integration. Another study (Francom, 2020) investigated teachers' perceptions of how barriers to technology integration change over time, and how barriers may not be the same across school settings. Results of this study revealed higher administrative support for some schools. One study (Edannur, & Marie, 2017) examined student teachers' perceptions about technology integration and results indicated perceptions to be positive perceptions. Key administrative support was present and contextual resources were insignificant barriers affecting teachers' technology adoption decisions. The role of local school administration plays a key role in teachers' decision to integrate technology in the classroom.

Professional development. The definition of professional development includes the process and activities designed to enhance the knowledge, skills, and understanding of educators in order for them to advance student achievement (Guskey, 2009). Multiple studies have indicated that teachers' perceptions of support provided for the integration of technology in the classroom has been an important barrier that contributes to the use of technology in the classroom.

Teacher self-efficacy and professional development. Teacher self-efficacy toward technology integration can be changed. Previous research has proven to have an impact on teacher self-efficacy. One study by Sandholtz and Ringstaff (2013) examined the extent to which teachers' participation in a professional development program enhanced their level of self-efficacy and another study found that participation in the professional development showed significant increases in teacher self-efficacy (Saunders,

2014). Letwinsky (2017) sought to understand mathematics teachers' decisions to integrate technology and revealed a significant relationship between teachers' attitudes toward using technology and personal self-efficacy using technology. One study (Willis, Weiser, & Smith, 2016) explored teachers' experiences with modeling of technology integration and found that teachers gained understanding and awareness of practices in teaching, thereby increasing their teaching self-efficacy. These studies show how professional development can impact teacher self-efficacy regarding technology integration.

Professional development influences on teacher perceptions. A study (O'Neal, Gibson, & Cotten, 2017) explored teacher beliefs among focus group participants, and found that teacher beliefs on training and support increased their use of technology. One study (Vongkulluksn, Xie, & Bowman, 2018) examined how teachers' perception of technology integration support impacted their instructional practices and found that this barrier impacted how much and how often teachers integrated technology in the classroom. These studies agree that teacher beliefs regarding the lack of professional development provided for technology use in the classroom hinders their ability to effectively integrate technology into their instructional practices. Results of these studies are evidence that by providing teachers with adequate professional development positively influences their decision to use technology in the classroom.

Teacher Characteristics

Teacher characteristics are a barrier that influence technology use in the classroom. These teacher characteristics are at times an obstruction or an advancement toward the use of technology. Characteristics such as teacher age, years of teaching

experience, level of comfort with technology use in the classroom, gender all influence whether teachers decide to use technology in the classroom.

The prior years of teaching experience is a barrier that influences teacher perceptions of using technology in the classroom. The years of prior teaching experience can be separated into the two subcategories (1) teachers with more years of teaching experience and (2) teachers with less years of teaching experience. This characteristic has been included in many research studies of which a few will be reviewed in this research literature review. One study investigated barrier that influence teachers' usage of technology integration into the classroom and found that teachers with fewer years of teaching experience are more likely to use technology in their classrooms (Nikolopoulou, Gialamas, Lavidas, & Komis, 2021). A study investigated the interrelationships of the technology within the four knowledge dimensions and found that teachers who have more teaching experience had significantly higher self-efficacies than teachers who do not (Chai, Jong, Yin, Chen & Zhou, 2019). The implication is that teachers with higher efficacies of integrating technology are more confident integrating technology in the classroom. One study designed to identify the combination of barriers that pertain to the implementation of technology in the classroom, found that years of teaching experience did not play a significant role in the classroom technology used by teachers (Tweed, 2013). Results of these studies are teachers' prior teaching experience that impacts their decision to use technology as part of their instructional practices in the classroom.

Although gender differences with regards to technology integration among teachers is an area in research that has not widely been explored, some research is able to shed light on the topic. One study investigated the differences between male and female

teachers' technology integration practices and found some significant differences between male and female teachers' instructional strategies (Almekhlafi, Ismail, & Al-Mekhlafy, 2017). One study investigated barriers that influence teachers' usage of technology integration into the classroom and concluded that gender did not impact the use of technology in the classroom (Nikolopoulou, Gialamas, Lavidas, & Komis, 2020). Another study was conducted to determine the mathematics' teacher's technology integration based on gender and found that gender was not a critical barrier for mathematics teacher integration of technology (Bakar, Maat & Rosli, 2020). Results of these studies indicate that there are mixed results regarding the relationship between teachers' gender and their decision to use technology in the classroom.

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Literature Review Summary

The review of literature related mathematics teachers' perceptions of technology integration and its influence on instructional practices has been presented to acknowledge what is already known about the topic. The literature review began with an exploration into the progression of technology integration in the 21st century and the theoretical literature that supports mathematical teaching and learning. The TPACK framework advanced the understanding of mathematics technology by making the connection between technology pedagogy and content knowledge required for integration into instructional practices.

The term instructional practices have the potential to be perceived differently because it is a broad term that can incorporate a variety of classroom activities. Therefore, a clear and precise definition is provided for the purposes of this research study and discussed in this literature review. This literature review focused on the mathematical technology instructional practices of remediation, skill practice, acquisition of knowledge and problem solving.

The literature review noted the role of the teacher with regards to mathematics instruction. Previous research studies attest that the teachers' role significantly impacts what and how students learn. Teacher perceptions are influenced by barriers such as their beliefs, level of confidence regarding technology integration, mathematical content knowledge, and their personal characteristics. Finally, to fortify the understanding of mathematics technology integration, empirical research studies are presented. These studies examine the relationship between teachers' perceptions and various types of technology integration.

CHAPTER 3

METHOD

The purpose of this action research was to explore mathematics teachers' current instructional practices and perceptions of technology integration, as well as the barriers that influenced their technology integration in the classroom. I was in a unique position as I was aware of my own perceptions as a teacher integrating technology, but this action research aimed to reveal the perceptions of other mathematics teachers, their integration of technology in the classroom, and barriers that influence their decisions to integrate technology at Magnolia Middle School.

Research Design

Action research was best suited for this type of research study because of my role as both an educator and a researcher who worked as a classroom teacher. This placed me in the role of a teacher-researcher, which allowed me to reflect on my teaching practices, enhance my understanding of teaching through research, and equip me with the knowledge to incorporate best practices to technology integration in my classroom. I gained an understanding of teacher perceptions that can bring about a positive change in how technology is used in the classroom. To bring about a positive change, it is necessary to understand teachers' beliefs and their influence on the implementation of technology in the classroom (Barak, 2014). The findings of this study enlightened my awareness of fellow teachers' perceptions of technology integration in the classroom, how others incorporate its use, and factors that contributed to teacher perceptions.

Interactions with teachers provided rich detailed descriptions of technology integration experiences in the classroom as revealed by teachers. As a teacher who works at Magnolia Middle School, I was considered a researcher and an insider within the organization. This provided a unique advantage as opposed to a researcher who was not a member of the organization. Bonner and Tolhurst (2002) identified three key advantages of being an insider-researcher: (1) having a greater understanding of the culture being studied, (2) not altering the flow of social interaction unnaturally, and (3) having an established intimacy which promotes both the telling and the judging of truth. Additionally, Bonner and Tolhurst (2002) contended that insider-researchers generally know about the cultural norms of the organization, not only the formal hierarchy, but also how the organization routinely operates.

Many researchers have offered definitions of action research. According to Pascual (2017), "action research (1) often utilizes a qualitative research method, (2) focuses on what happens during everyday teaching action (concerning classroom interactions), and (3) is used to identify which aspects need to be improved and how to change them" (pp. 88-105). Lewin (1948) defined action research as "comparative research on the conditions and effects of various forms of social action, and research leading to social action" (pp. 202–203). Lewin also developed the steps of action research: identifying and defining a problem through group discussion, investigating its roots and possible solutions, planning action to take, evaluating results, revising the plan, and taking another cycle of action (Adelman 1993; Gordon 2009; Pine 2009). Hines and Conner-Zachocki (2015) refined the term to explain that action research "is based upon the assumption that teachers are already experts with a keen knowledge of children and

content matter cultivated from experience, local knowledge, and pedagogical training" (p. 348). Action research was well suited to investigate teacher practices and perceptions of technology integration in classrooms.

This research study also employed a quantitative component. Quantitative research is both analytical and descriptive in nature. Bryman (2012) defined quantitative research as, "A research strategy that emphasizes quantification in the collection and analysis of data" (p. 35). Survey data collection provided data that were measured numerically. For example, teachers were asked to indicate the number of times per week technology was integrated in their classrooms. The quantitative research method revealed information about the frequency of technology use in the classroom. Quantitative research was able to answer the question of how many and to what extent an event happened (Rasinger, 2013).

Setting and Participants

The setting of this action research study was Magnolia Middle School, a Title I Middle School. Magnolia Middle School operated within the Cherokee County School District. Title I is part of the Elementary and Secondary Education Act (ESEA), which provides financial assistance to local educational agencies (LEAs) and schools with high numbers or high percentages of children from low-income families. Teachers who worked at Title I schools were required to have a "highly qualified" level of certification. To obtain this level of certification, teachers received a passing score on the Praxis test. Because federal and state funds provided support to Title I schools to ensure that all children meet challenging state academic standards, teachers have access to the latest technological advances for use in their classrooms. All classrooms at Magnolia Middle

School are equipped with interactive whiteboards that project images from a computer. Teachers and students can interact with the projected content. Interactive whiteboards allow individuals to write, erase, and manipulate objects and text, show videos, and create enhancements to lessons. Peripherals can be added to engage learners and thereby elicit student input.

Cherokee County Schools provides each teacher with a laptop, iPad, and Chromebook. All students at Magnolia Middle School receive a Chromebook to use for instructional purposes. Students and teachers are trained in the proper maintenance and use of technological devices. Students are allowed to use peripherals to accompany the Chromebook to include a mouse, USB storage devices, and headphones. Printers that print in color and 3-D are also available for use for students and teachers.

Magnolia Middle School serves a diverse population of students. This includes students with learning disabilities, in addition to audio and visual impairments. Assistive technology is also available for students to use in the classroom. Students with visual impairments have access to technological devices such as portable CCTV projectors in the classroom. Students with auditory impairments are provided with headsets and access to software with text to speech features. Other types of technology provided to students are basic four function calculators and graphing calculators for use in mathematics classes.

Participants

The participants in this research study were all mathematics teachers of grades employed at Magnolia Middle School during the 2020–2021 school year. For this study, I invited classroom math teachers who taught grades sixth through eighth grade to

participate. Eight mathematics teachers were invited to participate in this study. One teacher taught both seventh and eighth grade. I excluded three Magnolia Middle School math teachers who were not in the building as they taught virtually. Teachers interested in participating completed a teacher consent form at the end of a regularly scheduled professional development meeting. The consent form included a brief explanation of the study, its purpose, an explanation of what participation entails, and how information would be stored and used to report study findings.

Five teachers completed the consent form and agreed to participate. Descriptions were based on demographic information provided in the survey instrument, approximations made of the participants during classroom observations, and information gathered through interviews. Survey items and interviews questions provided valuable data about the participants' teaching experiences, level of education, and technology integration proficiency. All participants were assigned a pseudonym and the non-binary pronoun *they* have been used to protect their identities. Table 3.1 provides an overview of the five participants followed by a more detailed description of each. Detailed participant descriptions are presented in Chapter 4.

Table 3.1 *Participants Overview*

Participant Pseudonym	**Description**
Adam	• Sixth grade teacher • Four years of teaching experience • High level of technology proficiency
Dawson	• Eighth grade teacher • Over twenty-six years of teaching • experience • High level of technology proficiency

Participant Pseudonym	Description
Green	• Sixth grade teacher • Over twenty years of teaching • experience • Low level of technology proficiency
McDonald	• Seventh grade teacher • Two years of teaching experience • High level of technology proficiency
Wenger	• Eighth grade teacher • Ten years of teaching experience • High level of technology proficiency

Adam was between 20-30 years old and held a bachelor's degree with Middle Level Math Certification and was working on a master's degree. Adam had been teaching for 5 years and began teaching middle level mathematics at a public middle school. Adam has been working at Magnolia Middle School for four years. Adam’s teaching style was hands-on. Adam believed in the importance of building a relationship with students to teach them. Adam stressed that classroom management was key to maintaining a productive classroom learning environment.

Dawson was between 41-50 years of age and held a master's degree plus 30 additional graduate hours. Dawson was certified to teach middle level math. Dawson had been teaching for over 20 years and had always taught middle level math. Dawson taught math at all middle school grade levels but enjoyed teaching 7th grade the most. Dawson’s style of teaching was non-traditional.

Green was between 41-50 years of age and held a master's degree plus 30 additional graduate hours with Middle Level Math Certification. Green had been teaching for over 20 years at least fifteen of those years has been at Magnolia Middle School.

Green taught math at all three middle school grade levels. Green was also certified to teach another subject at the middle school level. Green's style of teaching was traditional. Green expressed the importance of maintaining a safe and well-structured learning environment. Green said that students learn through human interactions with the teacher.

McDonald was between 20-30 years of age and held a bachelor's degree in Education. McDonald was certified to teach middle and high school level math. This was McDonald's second year of teaching. McDonald was new to the teaching profession, having graduated from college recently. McDonald's teaching style was informal yet highly structured with rules and procedures. McDonald believed that technology should be used as a tool and that students learned best through interactions with the teacher.

Wenger was between 41-50 years of age and held a master's degree plus 30 additional graduate hours. Wenger was certified to teach middle level math. Wenger had been teaching math for eleven years in the public system. Wenger had taught math at all middle school grade levels. Wenger's style of teaching was traditional and highly structured. Wenger created a well-structured and comfortable space for students to learn. Wenger's classroom management was shown in how the students behaved.

These teachers provided grade level instruction to regular education students and special educations students in an on-campus middle school classroom setting. The school district mandated that all middle school mathematics teachers use the same instructional materials and technology for math instruction. All mathematics teachers were expected to use the same instructional materials and technology provided by the school district to deliver mathematics instruction.

Teachers who hold a professional teaching certificate were required to adhere to technology competency standards. Teachers must have demonstrated proficiency to these standards as part of their professional development plan. A total of 30 hours was needed to maintain technical proficiency and could be earned by attending technology-related training offered by the district. All participants in the action research study held a professional teaching certificate and were considered proficient in the use of technology. Technology proficiency was a requirement for teacher certification for teachers at Cherokee County Schools. All mathematics teachers were mandated to participate in professional development for mathematics instruction and to use Carnegie Learning instructional materials and teacher created mathematics resources.

Data Collection

To answer the research questions of this proposed action research, I used three data collection methods, including survey, interviews, and observations. Both qualitative and quantitative data contributed to this study. Each of these data collection methods is described in detail below. Table 3.2 illustrates alignment between the research questions and data collection methods.

Table 3.2 *Research Questions and Data Collection Methods*

Research Questions	**Data Collection Methods**
RQ1: What are mathematics teachers' current practices of technology integration in classrooms at Magnolia Middle School?	• Survey • Interviews • Observations
RQ2: What are mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?	• Survey • Interviews

Research Questions	Data Collection Methods
RQ3: What are the barriers that influence mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?	• Survey • Interviews

Survey

I used a survey (see Appendix A) to explore teachers' use of technology in the classroom, teachers' perceptions of technology integration, and barriers that contribute to these teacher perceptions. The survey data collection method allowed me to collect data to answer all three research questions and recruit participants for interviews and classroom observations.

Two surveys were combined to collect information about teacher technology integration and teacher perceptions about technology use in the classroom. The first part of the survey was the Technology Integration Survey (see Appendix B), and second part of the survey was the Technology Perception Scale (see Appendix C).

The Technology Integration Survey (Kopcha, 2012) was created to examine teacher perceptions of the common barriers to technology integration. Survey items were rated using a standard five-point Likert-type scale ranging from strongly agree (4) to strongly disagree (0). The survey contained 15 items. Survey items were written such that teachers could report on the extent to which they used technology and encountered technological issues. The items with higher scores represented the presence of conditions that facilitated technology integration. Items with lower scores represented the presence of conditions that made technology integration more challenging for teachers. Items were based on Clark (2006) Delphi study where teachers, administrators, researchers, and

policyholders identified practices and issues associated with effective technology integration. The recommendations made by Patten (2001) were used to establish face validity. Cronbach's coefficient alpha for the final version of the survey was 0.93 or more. Cronbach's alpha within each barrier was also above an acceptable level of 0.70.

The Teacher Perception Scale (Karaca, Can, & Yildirim, 2013) section of the survey focused on four aspects of teacher perceptions to technology integration in the classroom: Principal Support, Colleague Support, Attitude and Beliefs, and Lack of Time. Twenty-eight items were rated on a five-point Likert-type scale ranging from “strongly agree” (4) to “strongly disagree” (0). Principal Support focused on the principal's support of teachers by encouraging their use of technologies and providing sufficient access to instructional technologies, technical support, and professional development opportunities. Colleague support related to teachers' support from colleagues, such as sharing instructional media and materials, helping each other, and modeling technology use. Attitude and beliefs involved questions related to teachers' perceptions of the value of technology use in the classroom. Lack of time involved items about teachers' problems allocating time for using new technologies and designing and implementing relevant lessons. During the development of the Teacher Perception Scale a pilot study was conducted with a convenience sample of 218 teachers. During this step, the questionnaire was checked for validity, reliability, poorly worded items, and necessary revisions. Exploratory Factor Analysis (EFA) was conducted to establish the construct validity of the factors. The scales for all the factors showed high internal consistency values ranging from .85 to .94 (Hair et al., 2006).

The survey consisted of three parts: (1) demographic information, (2) technology integration practices, and (3) perceptions about technology integration. Table 3.3 shows the alignment between the research questions and the survey items.

Table 3.3 *Table of alignment between research questions and survey items*

Research Questions	Survey Items
RQ 1 What are mathematics teachers' current practices of technology integration in classrooms at Magnolia Middle School?	• I was expected to use technology to support content objectives. • The technology available was, for the most part, useful for teaching. • It is easy to design learning activities that incorporate computers. • The training I received could be easily applied in my classroom. • I had enough opportunity to share technology lessons with other teachers. • Integrating technology took less time than I thought it would.
RQ 2 What are the mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?	• I felt adequately trained on the skills needed to use technology. • I felt adequately trained on the skills needed to use technology. • In our school, teachers help each other with technology use. • Teachers share technology-based instructional materials in our school. • The use of technology increases students' interest to the lesson. • The use of technology positively impact students' achievement in the lessons. • The use of technology increases students' participation to the lessons. • Technology use makes the lessons more student centered.
RQ 3 What are the barriers that influence mathematics teachers' perceptions of technology integration in	• The technology available was, for the most part, reliable. • The demands/goals placed on me for using technology were reasonable.

Research Questions	Survey Items
classrooms at Magnolia Middle School?	• I received help fixing technology problems in a timely manner. • There was strong administrative backing for using technology. • I was given time to learn to integrate technology into my lessons. • I had enough time to plan and prepare lessons that use technology.

Interviews

The qualitative method allowed the researcher to gain an up-close and detailed understanding of how mathematics teachers perceive technology integration at Magnolia Middle School. The interviews gave the participants the opportunity to express their attitudes and beliefs about technology integration that were not addressed in the survey. For example, participants provided information in the form of past experiences in working with technology in the classroom. Interviews also allowed participants to reveal specific types of technology integration hardware and software that was used in their classrooms. The mixed method approach is appropriate in that it fits the need for smaller but focused samples, which allow a researcher to organize data into patterns for reporting results (Yin, 2002). Interviews gave participants the opportunity to respond to questions or concerns they may have about integrating technology. Interviews are a direct, personal means of qualitative data collection and help to uncover underlying motivations, beliefs, attitudes, and feelings (Malhotra, 2004).

Three semi-structured individual interviews were conducted face-to-face. These interviews took place after school in the participants' classrooms at Magnolia Middle School. The interview sessions were recorded, and notes were taken so that accurate

details were documented. An interview protocol (Appendix D) served as a guide for the interview, and additional probing questions were asked to gain a more complete understanding of the participants' experiences and the influences that impacted their personal perceptions. I gathered information pertaining to teachers' use and perceptions of technology usage in the mathematics classroom at Magnolia Middle School through 30-minute interview sessions.

I developed these research questions to learn what technologies teachers were using in their classroom and to learn about teachers' experiences with using technology. This question also provided insight into any barriers teachers encountered while using technology as part of their instructional practices. Table 3.4 illustrates alignment between the research questions and the interview questions.

Table 3.4. *Research Questions and Initial Interview Questions Alignment*

Research Questions	**Interview Questions**
RQ1: What are mathematics teachers' current practices of technology integration in classrooms at Magnolia Middle School?	• Describe an experience in which you used technology in a classroom. • What technology did you use in this experience?
RQ2: What are mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?	• Discuss the professional development and technology training you were provided to prepare you to integrate technology into the classroom. • How do you feel about the support you received from administration regarding technology integration in your classroom?
RQ3: What are the barriers that influence mathematics teachers' perceptions of technology integration at Magnolia Middle School?	• Describe any barriers you have encountered regarding technology integration in the classroom.

Observations

Classroom observations were another method of data collection used in this study. Marshall and Rossman (1989) defined observation as "the systematic description of events, behaviors, and artifacts in the social setting chosen for study" (p. 79). They also contended that observations enable the researcher to describe existing situations using the five senses, providing a written photograph of the situation under study (Erlandson, Harris, Skipper, & Allen, 1993). Observations provide insight of teachers' teaching methods and help to "gain insider views and subjective data" (Creswell, 2013, p. 167). Data obtained through observations attests to the physical and social environment in which the teachers use technology in their classrooms. Classroom observations add distinctive details to understanding teacher experiences. Observations were important in this study because they provided a way to check for nonverbal expression of feelings, determine who interacted with whom, grasp how participants communicated, and check for how much time was spent on various activities (Schmuck, 1997).

Classroom observations were conducted during the 2020-2021 school year, amid the COVID-19 pandemic. Magnolia Middle School followed the Center for Disease Control (CDC) recommendation that students maintain at least three feet of physical distance from one another. Desks were arranged in groups of four with Plexiglas partitions between the desks. Classrooms were designed to seat between 20 to 25 students. Students wore masks throughout the class periods and remained seated during instruction. Classroom observations were conducted during regularly scheduled school days for grades sixth, seventh, and eighth grades.

Data from each observation were collected using the LoFTI observation instrument (Friday Institute for Educational Innovation, 2015). Merrian (1988) suggested researchers utilize an observation guide in which to compile various elements to be recorded in field notes. The LoFTI observation instrument was printed as a PDF and used to aid the observation of technology integration in the classroom. This observation tool was designed to assist in the observation of technology integration and learning. Notes recorded during observations included verbal and nonverbal gestures such as facial expressions and mannerisms, and interactions between teachers and students. The use of technology in the classroom setting was of particular interest to the researcher.

Two observations were conducted per grade level for grades six, seven, and eight. The observation lasted the whole class period of fifty-five minutes. The LoFTI observation tool allowed the observer to record the details about the observation such as the date, time, classroom learning environment, characteristics of the learners, classroom learning environment, hardware, software, and levels of student engagement. The data obtained from observations using the LoFTI instrument provided insight as to technology integration participants use in the classroom, as well as the instructional practices of the participants. Observation notes captured how and what technology was used and by whom, in addition to the participants' instructional practices. I recorded handwritten notes on the LoFTI observation instrument that were later transferred to an electronic document (Appendix D). These notes were labeled with a pseudonym to conceal the teachers' names. The data represented six observations of general education classes.

Data Analysis

In this mixed-methods research study, three sources of data were analyzed: (a) surveys, (b) interviews, and (c) observations. The quantitative data collected was analyzed with descriptive statistics, and the qualitative data were analyzed with inductive analysis. Table 3.5 provides an overview of the research questions, the data sources, and the data analysis method that was used for each data collection source. A thorough description of each method of analysis is provided later in Chapter 4.

Table *3.5 Research Questions, Data Sources, and Analysis Methods Alignment*

Research Questions	**Data Sources**	**Analysis Method**
1. What are mathematics teachers' current practices of technology integration in classrooms at Magnolia Middle School?	• Surveys • Interviews • Observations	• Descriptive Statistics • Inductive Analysis • Inductive Analysis
2.What are the mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?	• Surveys • Interviews	• Descriptive Statistics • Inductive Analysis
3. What are the barriers that influence mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?	• Surveys • Interviews	• Descriptive Statistics • Inductive Analysis

Procedures

This action research study took place during Spring 2021 and consisted of three main phases. The phases included Phase 1: Permissions and Participant Recruitment, Phase 2: Data Collection, and Phase 3: Data Analysis.

Phase 1: Permissions and Participant Recruitment

In Phase 1, I obtained approval and informed consent from the IRB. Next, I completed the Research and Information Sharing Agreement as required by Cherokee County Schools to conduct research at district schools. After permission to conduct research within the school district was granted, I contacted my school's principal. I conducted a brief meeting with Magnolia Middle School's principal and was granted written permission (Appendix F) to conduct the action research study. An email describing the action research study was sent to all math teachers at Magnolia Middle School. The email included a document and link to a consent form that included the study details, disclosure of the purpose of the study, and its significance to Magnolia Middle School. At the conclusion of a regularly scheduled professional development meeting teachers were reminded of the research study and invited to participate. Interested teachers complete the consent form (Appendix D). Once the consent form was completed teachers were then allowed to take the survey. The survey was administered via Google Forms. Teachers were allowed to access Google Forms using their district-issued laptop and Google login information.

Phase 2: Data Collection

The last items of the teacher survey asked teachers to indicate if they were willing to participate in teacher interviews and classroom observations. Teachers who agreed to be interviewed were scheduled for interviews. The interview sessions lasted approximately thirty minutes to an hour and were recorded using a password protected laptop. The identities of the interviewed teachers were kept anonymous to ensure confidentiality. The researcher obtained consent to record the interview sessions at the beginning of each

interview. The recorded interview sessions were transcribed by the researcher and uploaded into the Delve software for analysis. Three teachers agreed to participate in the classroom observations that were scheduled by the researcher. Classroom observations lasted 55 minutes or from the beginning to the end of an entire class period. The observations were unannounced and took place in the third week of data collection. The LoFTI instrument was used to aid in the collection of observation data. Upon completing each observation, using the LoFTI instrument as a guide, notes were uploaded into the Delve software. The observation notes were stored electronically on a password-protected laptop.

Phase 3: Data Analysis

After data were collected through surveys, interviews, and observations, the data were analyzed. Given the small sample size, survey data were analyzed for descriptive statistics. Qualitative data were uploaded into the Delve qualitative data analysis software and the first cycle of coding began. All data were analyzed to determine common themes among participants. I conducted subsequent interviews and member checks with participating teachers using transcripts to confirm that I accurately captured their meanings.

Timeline

This section outlines the timeline of procedures in this action research study. I conducted this research during Spring 2021. Data collection for this study lasted approximately six weeks. This frame of time allowed the researcher access to teachers who have been teaching mathematics inside the classroom. Table 3.6 provides a time allocation for the duration of each phase as well as key activities of the study.

Table 3.6 *Timeline for Procedures*

Phase	Activities	Timeframe
1: Permissions and Participant Recruitment	• Requested and secured permission to conduct a research study at Magnolia Middle School at the district level • Requested and secured permission to conduct research from the school principal • Presented the research topic, purpose, and process to the teachers to recruit participants	• 2 weeks
2: Data Collection	• Emailed surveys to participants • Conducted interviews • Conducted classroom observations	• 6 weeks
3: Data Analysis	• Describe the data collected from observations and surveys using descriptive statistics • Analyzed interview and observation notes from transcriptions • Created and applied codes • Conducted member checking • Triangulation	• 8 weeks

Rigor and Trustworthiness

Trustworthiness and rigor in qualitative research methods equate to the quality of the reliability and validity of the quantitative data. I used various strategies to ensure the

rigor and trustworthiness of my research. These include narratives with rich, thick descriptions, member checking, triangulation, and peer debriefing.

Rich, Thick Description

Creswell (2003) suggested providing a "rich, thick description to convey the findings" as a method for increasing trustworthiness. I presented participants' narratives of their experiences and their perceptions through descriptive vignettes. Vignettes are scenarios and examples of situations, people, or individuals and their behaviors that are written about that provides the reader with specific instances of an event or experience (Braun & Clarke, 2013; Finch, 1987; Hall, 1997; Renold, 2002). These narratives provided the reader with first-hand accounts of the teachers' experiences as told by the teachers. The findings revealed personal experiences of mathematics teachers related in the form of a detailed story. Shared experiences provided enlightenment and insight that can benefit research participants and other educators at the study site.

Member Checking

Member checking is a method whereby participants are given the opportunity to check certain aspects of the interpretation of the data they provided (Doyle, 2007; Merriam, 1998). It is a "way of finding out whether the data analysis is congruent with the participants' experiences" (Curtin & Fossey, 2007, p. 92). I participated in informal discussions with participants to clarify my understanding and interpretations of my transcriptions and observation notes. I also shared with them my analysis for their review. This discussion gave the participants an opportunity to provide additional information or clarify any misunderstandings. Subsequent discussions with participants did not require changes to the initial data collected. One participant, Green, repeated some of the same

sentiments stated during the initial interview. Furthermore, that was their time to clarify, elaborate, or delete their own words from the narratives. Guba and Lincoln (1989) regarded member checks as “the single most critical technique for establishing credibility” (p. 314). Member checking ensures participants are represented accurately.

Triangulation

Triangulation involves to using multiple sources of data to prevent misanalysing events in simplistic, incomplete, or erroneous ways (Herr & Anderson, 2005). I triangulated the various sources to confirm the correctness of my data. This study used both teacher survey responses and teacher interviews to verify accuracy of my evidence. The qualitative data were collected through interviews. I found that the participants in this research study were overall consistent with previous research regarding teacher technology use but provided details were the personal experiences of these participants. For example, teachers discussed instances of device malfunctions during instruction such as broken whiteboards, students' inability to log into software to complete assignments, and loss of internet access. According to Ertmer (1999) these were examples of a first-order barriers to technology integration, yet they are detailed examples of teachers’ experiences with technology in the classroom. The benefits of using triangulation also included various ways to understand and reveal the results of the study (Fraenkel et al., 2012; Mills, 2014). By completing teacher survey items about teacher perceptions of technology integration, interview corroborated with their what was revealed in the surveys. These qualitative findings were also triangulated with observational data to verify alignment between teacher classroom practices and perceptions of technology

integration. Methodological triangulation is the process of tying together multiple sources of information to establish consistency of the facts (Mertler, 2017).

Peer Debriefing

Finally, Sandelowski (1993) defined peer debriefing as using an experienced colleague to reanalyze some of the data as a way of ensuring that the researcher has analyzed the data correctly. Additionally, Lincoln and Guba (1985) described peer debriefing as the process of exposing oneself to a disinterested peer in a manner paralleling an analytic session and for the purpose of exploring aspects of the inquiry that might otherwise remain only implicit within the inquirer’s mind.

Throughout the process of designing my research study, collecting, and analyzing resulting data, my major professor at the University of South Carolina routinely monitored my progress during weekly meetings and provided ongoing written feedback. During peer debriefing sessions, I discussed the coding process, themes that emerged from data collections, data analysis methods, and findings. As a result of peer debriefing, I realized that some categories could be combined into one. For example, initially when grouping together codes related to what teachers were doing in the classroom hardware and software were two separate categories. I realized that that these categories should be combined as they served similar purposes for technology integration. According to Greenaway (2007), debriefing increases awareness of other perspectives. Peer debriefing served to make explicit parts of the research study that may have remained implicit to the researcher and allowed the peer to ask probing questions.

Plan for Sharing and Communicating Findings

Information obtained in this study will only be shared with mathematics teachers who participated in the research study. Further communications of any participant questions or concerns would be sent via email to the researcher. Participants will have up to two weeks to request any necessary changes before a final report of the study will be drafted.

I plan to share the findings from this study with the administrative team at Magnolia Middle School. Participant information will not appear in any published reports. Findings may be used to guide future mathematics technology integration practices at Magnolia Middle School. Recommendations may include changes to instructional practices such as increased use of technology, changes to professional development for teachers who use technology in the classroom, or effective implementation advisements for technology use in the classroom. Additionally, this study will provide teachers with insight into how colleagues perceive the use of technology and guide future decisions of other teachers on technology integration in the classroom.

I will also share the findings of this study with the academic specialists at the district-level via email. Information revealed from this research study may serve to inform future implementation of instructional mandates for mathematics instruction at the district support level. Since teachers and their teaching practices are the single most influential variable on student learning (Sutherland, Lewis-Palmer, Stichter, & Morgan, 2008), this action research study can enlighten the understanding of teacher perceptions at Magnolia Middle School, as well as other middle schools in the district. If permission is granted by the school's administrative team, I plan to present these findings at a

mathematics department meeting to other colleagues, instructional coaches, and educators who may be interested in the findings.

CHAPTER 4

ANALYSIS AND FINDINGS

The purpose of this action research was to explore mathematics teachers' current instructional practices and perceptions of technology integration, as well as the perceived barriers that influence their technology integration in the classroom. Teacher perceptions of technology integration at this public middle school. Teacher perceptions of technology integration influence what and how technology is integrated in the classroom. The findings revealed in this study may reveal what teachers think about integration technology and how this may impact instructional planning at this middle school. This chapter presents findings from both a quantitative measure (i.e., teacher survey) and qualitative measure (i.e., participant interviews and LoFTI observational tool).

Data collection was guided by three research questions:

1. What are mathematics teachers' current practices of technology integration in classrooms at Magnolia Middle School?
2. What are mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?
3. What are the barriers that influence mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?

Part One of this chapter reports quantitative results and findings collected from participant surveys. Part Two of this chapter presents the findings and explains the three

themes that emerged from analysis of the qualitative data collected from interviews with participants.

Quantitative Findings

Participants completed a survey to respond to questions about their demographic information. The survey was a combination of two separate surveys, the Technology Integration Survey, and Technology Perceptions Scale. Part I of the survey included questions regarding teachers' technology integration practices, Part II of the survey included questions regarding teacher perceptions of the barriers to technology integration. Part I, the Technology Integration Survey, focused on teachers' perceptions of the common barriers to technology integration.

Technology Integration Survey. The technology integration section of the survey was comprised of five aspects of technology integration in the classroom: Vision, Access, Beliefs, Professional Development, and Time developed by Kopcha (2012). Fifteen items were rated on a five-point Likert-type scale ranging from "strongly agree" (4) to "strongly disagree" (0). Higher scores represented the presence of conditions that facilitated technology integration. The lower scores represented the presence of conditions that made technology integration more of a challenge for the participants. Descriptive statistics were used to develop the findings presented. Mean and standard deviation were provided for each survey item. Data reflected responses from teacher participants $n = 5$. The recommendations made by Patton (2001) were used to establish face validity. Due to the small number of participants, internal reliability could not be calculated.

The data presented in Table 4.1 are significant to the research study as they use descriptive statistics to reveal barriers to technology integration as perceived by my teacher participants. The vision section shows teacher participants agree with the statement that they are expected to use technology to support their learning objectives and that administration supports teachers' use of technology. The access section reveals that teachers indicated that the demands or goals placed on them for using technology are unreasonable. While more than half of teacher participants indicated technology is useful for teaching, less than half of the teacher participants survey indicated they received help to address their technology problems. The beliefs sections show that less than half of the teachers indicated using technology increased student learning, designing learning activities using technology was easy, and it made teaching easier. The time section shows that teacher participants indicated they did not have enough time to integrate technology, to learn to integrate technology, to plan for and use technology.

Table 4.1 *Mean Rating and Standard Deviation by Barrier and Survey Item (n = 5)*

Barrier and Survey Description	***M***	***SD***
Vision		
I was expected to use technology to support content objectives.	3.00	1.73
There was strong administrative backing for using technology.	2.80	1.64
Access		
The demands/goals placed on me for using technology were reasonable.	2.20	1.10
The technology available was, for the most part, useful for teaching.	3.20	0.84
I received help fixing technology problems in a timely manner.	2.60	0.89
The technology available was, for the most part, reliable.	3.00	1.71

Barrier and Survey Description	***M***	***SD***
Beliefs		
I believe using computers with students increases their learning.	2.20	1.10
It is easy to design learning activities that incorporate computers.	2.20	1.48
I believe that technology makes my job as a teacher easier	2.60	0.89
Professional Development		
The training I received could be easily applied in my classroom.	2.00	1.41
I felt adequately trained in the skills needed to use technology.	2.00	1.22
I had enough opportunity to share technology lessons with other teachers.	2.40	1.48
Time		
Integrating technology took less time than I thought it would.	2.60	1.82
I was given time to learn to integrate technology into my lessons.	2.40	1.14
I had enough time to plan and prepare lessons that use technology	2.00	1.48

Technology Integration Survey Findings. The data presented in Table 4.2 represented teachers' instructional practices and their technology integration in the classroom. Higher scores indicated the presence of conditions that facilitated technology integration while lower scores indicated the presence of conditions that made technology integration more challenging for teachers. The vision subscale showed that teachers received inadequate support for technology integration in their content area and from administration (*M=2.9*). The access subscale showed that teachers believed technology was not moderately useful, reliable, and properly maintained to facilitate instruction in the classroom (*M=2.67*). The beliefs subscale showed that teachers did not believe

technology increased student learning or that lessons using technology made their jobs easier (*M=2.33*). The professional development subscale showed that teachers did not believe they were adequately trained in using technology in the classroom or given opportunities to share technologically enhanced lessons with their colleagues (*M=2.00*). The time subscale was rated the lowest among teachers, which showed teachers were not given enough time to plan and prepare lessons using technology (M=1.33).

Table 4.2 *Technology Integration Survey Means and Standard Deviation Subscales (n=5)*

Subscale & Items	***M***	***SD***
Vision (1-2)	2.90	1.60
Access (3-6)	2.67	0.79
Beliefs (7-9)	2.33	1.17
Professional Development (10-12)	2.13	1.29
Time (13-15)	1.33	1.29

Technology Perception Scale. Part II of the survey, teacher perception scale, focused on four aspects of teacher perceptions to technology integration in the classroom: Principal Support, Colleague Support, Attitude and Beliefs, and Lack of Time as identified by Karaca (2013). Twenty-eight items were each rated on a four-point Likert-type scale ranging from "strongly agree" (4) to "strongly disagree" (0). The Technology Perception Scale was analyzed using descriptive statistics. Mean and standard deviation are provided for each item rated by the participants $n = 5$. Due to the small sample size, internal reliability could not be calculated.

The data presented in Table 4.3 are significant to the research study as they reveal barriers to technology integration in the classroom as perceived by teacher participants.

The data from the principal support show that administration supports teachers' use of technology in their lessons, their use of devices, and provides support through professional development opportunities and access to all technologies in the school. The data also indicated that support from administration was not conveyed to teachers verbally or through written documentation. The colleague support section shows teachers perceived they were supported by their colleagues. This support may have been in the form of sharing technology-based instructional materials, lessons or helping with technology use. The attitude and belief sections show teachers' perceptions of technology use regarding its use with students. Teachers perceive technology use with students to increase student participation in the lessons, garner more interest in lessons from the students, and make the lessons more student centered. The lack of time section shows teachers moderately indicated that preparation to use technology takes too much time. The curriculum load did not seem to be a significant factor in using technology in lessons.

Table 4.3. *Mean Rating of Teacher Perception by Scale Item (n = 5)*

Teacher Perception Scale	***M***	***SD***
Principal Support		
School administrators are generally supportive of teachers' technology use in lessons.	4.60	0.54
I don't have much difficulty accessing the internet at school.	4.80	0.44
When I come across a technology-related problem at school, I can easily obtain technical assistance.	4.20	1.10
School administrators are role models in using technological devices effectively.	2.60	0.89
Whenever necessary, I can readily use all the technologies in our school.	3.60	1.34
In our school, I don't have any difficulty accessing instructional software and ready-made materials.	3.00	1.22
Adequate technical support is provided in our school.	3.80	0.84

Teacher Perception Scale	*M*	*SD*
All technological devices in our school are kept in good working condition and updated regularly.	3.00	1.22
Adequate in-service training opportunities are provided in our school.	3.20	0.83
Whenever necessary, I can use IT classes	2.80	0.84
Several facilities (i.e., trainings, workshops, sample lessons) that encourage teachers' technology use are offered in our school.	2.60	1.40
There are sufficient technologies in my class to fill my needs.	3.40	0.89
The school administration rewards teachers verbally or in a written way for using technologies effectively in their courses.	1.80	0.84
Colleague Support Scale		
In our school, teachers help each other with technology use.	4.40	0.54
Some teachers are role models who use technological devices effectively in their lessons.	4.40	0.54
Most teachers in our school are supportive of technology use in lessons.	4.00	0.71
Teachers share technology-based instructional materials in our school.	4.00	1.22
Attitude and Beliefs Scale		
I want to have more information about technology use in lessons.	4.20	0.84
I find technology supported lessons so entertaining.	3.80	0.84
The use of technology increases students' interest to the lesson.	3.80	1.30
The use of technology increases the permanency of the learning.	2.80	0.84
The use of technology positively impacts students' achievement in the lessons.	3.20	0.83
The use of technology increases students' participation in the lessons.	3.40	0.89
Technology use makes the lessons more student centered.	4.00	0.70

Teacher Perception Scale	*M*	*SD*
Lack of Time Scale		
Preparation for technology supported lessons takes too much time.	3.20	1.79
Using technology in the lessons takes too much time.	3.00	1.58
Due to a heavy curriculum load, I can’t allocate adequate time to use technologies in lessons.	2.80	3.0
I can’t find enough time to learn how to use technologies in lessons.	3.00	1.58

Teacher Perception Scale Findings. The data presented in table 4.4 is significant to this research study as it reports teachers' perceptions of the barriers to technology integration and classroom instructional practices. Teacher responses reflect their decisions of technology integration derived from these perceptions. Higher scores showed teachers perceived they were supported. Lower scores showed that teachers perceived the support was inadequate or there was a lack of support in these categories. Teachers perceived the support from their principal and administration as moderate (*M=3.34*). They also hold moderate perceptions toward technology integration (*M=3.34*). The data shows that teachers perceive they were supported by their fellow colleagues (*M=4.40*). The lowest category teachers were lack of time. Teachers perceived the time spent on planning for technology integration as inadequate (*M=2.85*).

Table 4.4 *Teacher Perception Scale Mean and Standard Deviation Subscales (n=5)*

Subscale & Items	*M*	*SD*
Principal Support (1-13)	3.34	1.20
Colleague Support Scale (14-17)	4.00	0.77
Attitude and Beliefs Scale (18-24)	3.60	0.96
Lack of Time (25-28)	2.85	3.45

Qualitative Data Analysis, Findings, and Interpretations

Findings that provide rich, thick descriptions are revealed through interviews and classroom observations. To protect the identity of the participants the use of pronouns is omitted. Teachers are referred to as "participant" or "participants." Pseudonyms are used for verbatim statements and quotes from participant interviews. In this section, the qualitative interview data are presented in three ways: a description of the data collected, the detailed process used to analyze data, and examples of the coding process. I analyzed the notes obtained from classroom observations and participant interviews using a process of inductive analysis. A full description of the data analysis process is also provided.

Description of Data

Surveys, interviews, and classroom observations were used to collect data about participants, their use of technology in the classroom, and perceptions of technology integration

The survey collected demographic information about the participants and included two separate surveys, the Technology Integration Survey (see Appendix A) and the Technology Perception Scale (see Appendix B). The Technology Integration Survey used a four-point Likert scale to assess skills across five sectors of technology usage. The Technology Perceptions Scale used a four-point Likert scale to assess four aspects of teacher perceptions about technology integration. The LoFTI Observational Tool was used to collect observational data by the researcher. The data derived from observations using the LoFTI Observation Tool was significant to the research study as it allowed the researcher to observe and note instructional practices in participants' classrooms with

both standardized prompts and observer anecdotal notes. These observation descriptions included the types of technological integration used and how it was used for instruction delineated by the behaviors of the teachers and students. I summarized the data sources and the number of codes applied, such as Table 4.5 displays the data sources and numbers of codes applied to each.

Table 4.5. *Summary of Qualitative Data Sources*

Types of Qualitative Data Sources	**Number**	**Total Codes Applied**
Survey	1	5
Interviews Transcripts	3	44
LoFTI Observational Tool Notes	10	38

Data Analysis Process

Inductive analysis. The first step in analyzing qualitative data was transcribing the audio recordings of the participant interviews and rewriting the notes recorded during the classroom observations. I listened to each recording and transcribed the interview using Google Document. A separate Google Document was used for each interview transcription. I then read through each transcription and simultaneously listened to the recording to ensure the interview was transcribed accurately. The interviews were transcribed approximately one week after the recording was created. The recorded notes taken during classroom observations were transferred onto a Google Document approximately one week after each observation was conducted. Each set of observation notes were written on a separate Google Document. Notes for each teacher participant were written on the same Google Document. In other words, observation notes for each

participant observed were written on one Google Document. Each Google Document was labeled with the participant's pseudonym.

Interview transcripts and researcher observation notes were loaded into a separate page in Delve, a computer-aided qualitative data analysis tool, the qualitative data were analyzed using inductive analysis. According to Saldana (2014) descriptive codes are clustered into similar categories to detect such patterns as frequency (i.e., categories with the largest number of codes), interrelationship (i.e., categories that seem to connect in some way). Descriptive codes were assigned to each line, segment, or phrase of the interview transcripts and observation notes. The segments of data were identified to form patterns. The repeated patterns were placed into categories, which evolved into dominating themes. The themes that developed from the data provide vivid descriptions of research (Creswell, 2017; Mertler, 2017; Saldana, 2016).

Open coding was used to evaluate each line of data for each transcript or observation document loaded in Delve. Coding of the qualitative data was completed in three cycles of coding. In the first cycle, I read all the transcripts and observation documents. No changes were observed between the two rounds of observations. I read the transcripts and observations a second time, certain words, phrases, and sentences were highlighted. These highlighted words, phrases, and sentences were organized into descriptive codes. The codes included actions, instructional practices, examples of technology integration, concepts, expressions of teacher opinions, or other pieces of data the researcher deemed relevant. Figure 4.1 is an example of interview data that has been coded in Delve.

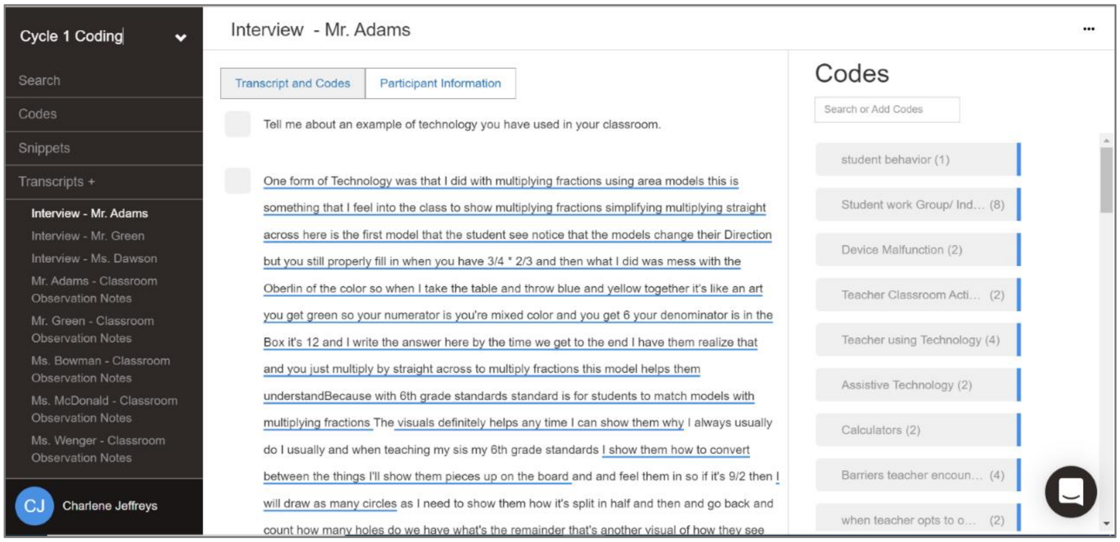

Figure 4.1 *Example of transcript coding from the first cycle of coding using Delve software.*

In many instances, multiple codes were assigned to words, phrases, or sentences to make sure that the codes were applied evenly to all sections of the transcripts and observations notes. Saldana (2016) refers to this as simultaneous coding. Figure 4.2 shows an example of simultaneous coding. In this example, a participant is discussing barriers encountered while integrating technology in the classroom. This segment of data references (a) barriers, (b) the type of technology used for instruction, (c) the type of software used in the classroom, (d) the purpose for which technology is used in the classroom, and (e) a statement of the participant's opinion.

Also, A barrier is the capabilities of the student devices. The software program we use for math instruction may not be compatible to work efficiently of student devices. Mathia is a software that students use in class. We use it for the first ten minutes of each class period. Lately, the software has not been loading. I think it is because the software uses a lot more RAM memory than the student Chromebooks are able to process.

Barriers to technology integration | How technology is used | Software used in the classroom | Statement of teacher opinion | Technology malfunction

Figure 4.2 *Example of Simultaneous Coding*

First-cycle yielded a total of 87 codes. During the second cycle coding, the codes from the first cycle are regrouped and reconstructed to develop categories, themes, and concepts using the researcher's imagination and judgment. Different types of codes can be used for this stage of coding (Sigauke & Swansi, 2020). The second cycle involved reading the transcripts and observation notes again, combining codes that were similar or repetitive and at times deleting codes that were applied the least. After codes were re-organized and applied, the second cycle resulted in 27 codes. Descriptive codes were created to capture technology use in the classroom. Use of descriptive codes allowed me to group together concepts that were similar. Table 4.6 shows the list of codes obtained from interview transcripts and observation notes from the first cycle. After the second cycle, peer-debriefing with Dr. Moore was conducted to enhance the trustworthiness of this research study. This evaluation of second-cycle codes resulted in a final list of 22 codes that resulted in third-cycle codes. These codes were assigned to reflect my interpretation of the participants' actions, and relevant meanings regarding technology integration in the classroom.

Table 4.6 First-cycle Codes for Classroom Technology Integration

Codes	**Number of Times Codes Applied**
Hardware teachers use in the classroom	12
How hardware is used	4
Software teachers use in the classroom	22
Purpose for software use	2
Technology use as a tool	1
Instructional content delivery	4
Non-digital use	9
Teacher created resources	2
Use of technology	20
User-friendly technology	5

After the peer debriefing with Dr. Moore and upon further examination of these codes, I concluded that some codes should be combined. For example, the codes “How hardware is used” and “Technology use as a tool” should be combined. Codes that were broad such as, "Use of technology” were broken down into more specific codes such as “Hardware” and “Software.”

The third cycle codes were then grouped according to topics that formed categories. Five categories were formed (see Figure 4.4). Codes within categories were evaluated and given more descriptive names as some codes were able to ascribe to more than one category. Special attention was given to ensure that the codes described examples of the category they were a part of. The researcher identified six categories which described the codes drawn from the data: 1) instructional practices, 2) classroom management, 3) hardware and software, 4) teacher frustrations and concerns, 5) teacher opinions of technology integration, and 6) teacher characteristics. The categories were

organized to yield three themes that resonated in the data: 1) Teachers use a combination of different software and hardware along with their instructional practices to integrate technology in the classroom all while managing the classroom environment, 2) Teachers encounter frustrations and concerns and thus form their own perceptions and opinions about integrating technology, and 3) Teacher personalities compelled by their personal characteristics contribute to their use of technology in the classroom (see Table 4.7).

Table 4.7 *Themes that Emerged from Categories*

Categories	**Themes**
Instructional Practices Classroom Management Hardware and Software	What teachers are doing in the classroom
Teacher Frustrations and Concerns Teacher Opinions of Technology Integration	Teachers' thoughts on technology integration
Teacher Characteristics	Teacher Attributes

Participant Descriptions

The following features the descriptions of the five participants of this study. Descriptions were based on demographic information provided in the survey instrument, approximations made of the participants during classroom observations, and information gathered through interviews. Survey items and interviews questions provided valuable data about the participants' teaching experiences, level of education, and technology integration proficiency. All participants have been assigned a pseudonym to protect their identities.

Adam was between 20-30 years old and held a bachelor's degree with Middle Level Math Certification. Adam had been teaching for 5 years and began teaching middle level mathematics at a public middle school. Adam had taken on additional roles in his

teaching profession such as a web designer. They oftentimes offered to assist colleagues with technical issues, such as using new hardware and software, setting up teacher websites, and sharing instructional materials. Adam regularly attended district level meetings to keep abreast of information about middle school math directives. Adam's teaching style was hands on. Adam believed in the importance of building a relationship with students to teach them. They created a safe and supportive learning environment in the classroom by having students sit in groups of four. This arrangement allowed Adam to navigate around the room easily and reach students who needed assistance. This also gave students a chance to collaborate while working on assignments and seek assistance from nearby classmates. Adam spoke slowly, clearly, and with confidence when teaching. Classroom activities such as warm-ups, group assignments, and independent student work progressed at a steady pace as each was allotted a certain amount of time. In Adam's classroom observation, they moved from a warm-up activity to a group work activity, where students seemed to know what to do and were focused on completing their assignments. During an interview Adam explained the importance of setting up expectations for students and having students adhere to those expectations. They also stressed that classroom management was key to maintaining a productive classroom learning environment.

Green was between 41-50 years of age and held a master's degree plus 30 additional graduate hours with Middle Level Math Certification. Green had been teaching for over 20 years. They began teaching middle level mathematics at a public middle school upon graduation. Green taught math at all three middle school grade levels. Green was also certified to teach another subject at the middle school level. Green's style of

teaching was traditional. Desks were arranged in rows and columns with the teacher's desk at the front of the room. Green sets structure and clearly outlined guidelines for students to follow. Students were made aware of the classroom rules, expectations, and consequences for violating classroom rules. During an interview Green expressed the importance of maintaining a safe and well-structured learning environment. Green said that students learn through human interactions with the teacher. Green contended that technology should be used as a tool and the curriculum standards as a guide for student learning. Although Green's teaching style may have seemed old-fashioned, their lessons were connected to real life situations. During an observation in Green's classroom, technology was used in the classroom to engage students with the instructional content. Green stated technology was used to, "Grab the students." Green said that if students were engaged in the lesson, they were less likely to cause behavior problems/disruptions during class. Green displayed confidence and spoke in an authoritative tone. Students seemed comfortable enough to ask questions to one another and to Green. Green had created a safe, comfortable, and engaging classroom environment, which was evident in students' behaviors.

Dawson was between 41 – 50 years of age and held a master's degree plus 30 additional graduate hours. Dawson was certified to teach middle level math. Dawson had been teaching for over 20 years and had always taught middle level math. Dawson taught math at all middle school grade levels but enjoyed teaching 7^{th} grade the most. Dawson's style of teaching was non-traditional. Desks were arranged in groups of four. Due to the large class size, this arrangement left little room for movement around the classroom. Dawson had a desk and podium at the front of the room. During an interview,

Dawon revealed the importance of building relationships with students. The relationships were evident by many displays of student work and photos with students that were displayed around the classroom. During a classroom observation, students seemed calm and comfortable enough to ask Dawson questions about the lesson. Dawson's interactions with students seemed friendly. Dawson contended that using technology as a tool can be beneficial for teaching but there were drawbacks to using technology at times. The use of technology should not replace learning basic math facts.

Wenger was between 41- 50 years of age and held a master's degree plus 30 additional graduate hours. Wenger was certified to teach middle level math. Wenger had been teaching math for eleven years in the public system. Wenger had taught math at all middle school grade levels. Wenger's style of teaching was traditional and highly structured. Student desks were arranged in groups of four and spaced apart which allowed for ease of mobility. During an observation, students showed a high level of respect for one another and their teacher. For example, at the beginning of the class, students entered quietly and immediately began working on the warm-up problem displayed on the interactive whiteboard. When prompted by Wenger, students raised their hands to offer a solution to the problem. After a short discussion, the lesson began where students actively participated in the lesson. The classroom learning environment seemed orderly and calm. Wenger created a well-structured and comfortable space for students to learn. Wenger's classroom management was shown in how the students behaved.

McDonald was between 20-30 years of age and held a bachelor's degree in Education. McDonald was certified to teach middle and high school level math. This was McDonald's second year of teaching. McDonald was new to the teaching

profession, having graduated from college recently. McDonald's teaching style was informal yet highly structured with rules and procedures. Student desks were arranged in groups of four with the teacher desk located at the back of the classroom. During an observation, students worked independently on an assignment using a workbook and their notebooks. Upon completion, students were instructed to use their Chromebook with an online tutoring program. The classroom learning environment was calm and relaxed. McDonald monitored students at they completed the workbook assignment. McDonald can be described as gentle and patient when working with students.

Three themes emerged from the analysis of the data collected (See Table 4.8).

Table 4.8. *Themes, Assertations, and Categories from Qualitative Data*

Themes	Assertations	Categories
What teachers are doing in the classroom	Participants use selected instructional practices along with classroom management when using technology in the classroom.	• Instructional Practices • Classroom Management • Hardware and Software
Teachers' thoughts on technology integration	Participants encounter frustrations and have concerns when integration technology in the classroom.	• Teacher Frustrations and • Concerns • Teachers' Opinion of Technology Integration
Teacher Attributes	Participants' personal characteristics impact their use of technology in the classroom.	• Teacher Characteristics

Through teacher interviews and classroom observations, participants revealed (a) technology that is used in the classroom, (b) their thoughts on technology integration in the classroom, and (c) their personal characteristics that impact technology integration in

the classroom. Each of these themes is explained in detail. Participants are referred to using pseudonyms to ensure confidentiality. Any quotations are verbatim from participants' verbal interview responses. The researcher notes documented observations made during classroom visits.

Theme 1: What teachers are doing in the classroom. For this study, what teachers are doing in the classroom referred to (a) participants' instructional practices used when teaching a lesson and tools selected to transfer knowledge and understanding to learners, (b) classroom management that teachers use in the classroom during instruction, and (c) specific hardware and software used in the classroom to facilitate learning. The categories were grouped together because they provide insight into what is currently happening in the classrooms, how the teacher manages the classroom environment and sets the tone for learning, and the tools that are used to facilitate learning. This theme was developed through conversations with teachers and classroom observations.

Instructional practices. Instructional practices were methods of instruction participants employed to facilitate learning in the classroom. For the purposes of this study, I defined instructional practices as tools, techniques, and processes teachers used in the classroom to present instructional material to help students achieve a desired learning outcome. Participants were asked to describe an example of a technology they used in their classrooms. Some of the examples were created by the teachers themselves whereas others were resources provided by the school district. One participant shared an example of technology used to teach a lesson along with details regarding student engagement, evidence of student learning, and student work samples. I observed the

instructional practices used in the classroom. Another teacher participant used textbooks to review instructional content for an exam. This is an example of a non-electronic form of technology used in the classroom. Although participants were mandated to follow a structured curriculum provided by the school district, participants were given the freedom to choose how to present instructional material. For example, one participant used videos to introduce a lesson on exponent rules. Another participant used Carnegie Learning workbooks, PowerPoints, workbook pages, and the online tutoring program. and provided by the district. Participants were provided with instructional materials, resources, and guidance from instructional coaches.

The instructional practices category of this theme is important because what teachers do in the classroom directly impacts what and how students learn. Previous research shows that participants who possess a certain level of confidence are influenced by the type of practices used to deliver instruction (Rubie-Davies et al., 2012). Teachers who are highly confident in their ability tend to use more innovative instructional practices whereas teachers who are less confident do not (Anderman, Patrick, Hruda, & Linnenbrink, 2002; Rubie-Davies et al., 2012).

Hwang, Riccomini, and Morano (2019) found that using multiple representations to teach can be a significant instructional component to consider when designing math instruction. Previous research has found that technology can be used to increase the adaptivity of teaching and learning processes (Pielmeier, Huber, & Seidel, 2018; van de Pol, Mercer, & Volman, 2019) such as the facilitation of formative assessment (e.g., using game-based learning platforms; Wang & Tahir, 2020; Zhu & Urhahne, 2018) or by

providing individualized learning activities (e.g., using intelligent tutoring systems. Aleven, Roll, McLaren, & Koedinger, 2016).

In the interviews, participants were asked to describe their experiences using technology in the classroom. Observations revealed that participants used technology to present instructional materials in the form of videos, PowerPoint presentations, interactive learning activities, independent assignments, digital assessments, and projects. For example, one participant showed me a PowerPoint he created to teach students how to multiply fractions. It provided students with a visual model of what happens when fractions are multiplied. He explained the procedure students use to multiply fractions. First, the numerator of two fractions is multiplied then the denominators are multiplied. He stated that students will notice that the models change their direction after multiplication. Another participant indicated that he used technology to show videos related to the lesson. He also assigned a project where students had to create a slide show. Segments of their observation debriefs are included below.

> Adam: One form of technology that I used was while presenting a lesson on multiplying fractions. I used area models to show the class multiplying fractions. Also, when I need to show them how to divide, I draw as many circles as I need on the board, then split them in half. I go back and count how many circles we have, and they can see the remainder. That is another visual.

> Green: I show students videos related to the lesson. Another example of when I used technology in the classroom is when I made the kids do a project.

> The kids had to create a presentation on Google Slides. They used textbooks and information they researched on the internet.

These examples show how teacher participants use technology in the classroom to present instructional content, model concepts, enhance the lesson with visual images, and engage their students. Teacher participants model presentations for students who were then asked to create their own presentations in the form of a project assignment. Technology was used as a tool to conjunction with instructional content to facilitate learning.

Classroom management. Participants were responsible for creating the classroom learning environment through classroom management strategies and determining the most effective ways to engage and instruct students. Evertson and Weinstein (2006) define classroom management as "the actions teachers take to create an environment that supports and facilitates both academic and social-emotional learning" (p. 4). Research conducted by Klem and Connell (2004) found that highly engaged students perceived their teachers as caring and supportive, with a well-structured classroom who possess lofty expectations. Classroom management is a vital component of effective teaching (Bandura, 1997). For the purposes of this study, I defined classroom management to include building relationships with students by establishing routines, maintaining clear expectations, and fair consequences.

According to Morrison et al. (1999), technology can be integrated without dramatically changing the instruction, but not without making shifts in classroom management processes. Previous research has found that teachers must employ task-specific strategies, individual learning support, and task-general strategies, to integrate

technology in the classroom (Baumert et al., 2010; Fauth, Decristan, Rieser, Klieme, & Büttner, 2014; Hugener et_al., 2009; Kunter et al., 2013; Praetorius, Klieme, Herbert, & Pinger, 2018). For example, throughout the course of a lesson, teachers perform formative assessments to monitor student learning toward an identified learning goal. Technology integration allows students to perform interactive tasks thus providing teachers and students with immediate and accurate feedback on student learning.

In the interviews, teachers mentioned specific ways they incorporated classroom management along with integrating technology. For example, Adam discussed his classroom expectations for technology integration with students at the beginning of the school year. He said, students were expected to actively participate in the lesson and use their Chromebook for academic purposes only. He monitored technology use in the classroom by using the software program Net Support. Net Support was a software program that allows the teacher to monitor student activity. This program allowed the teacher to view the students' screen and the applications they were using, websites they were visiting, what they were typing, and with whom they were collaborating. This software included features to lock student computer screens, send students individual messages, and restrict students' access to websites. Part of classroom management was to keep students on task. Teacher participants have different ways of ensuring students remain in task while integrating technology in the classroom. For example, Adam described how Net Support helps him monitor students:

> Adam: I'll just go and block them [websites] and put it on my restricted list any time students visit inappropriate websites. My restricted list is blocks

[websites] so they can’t go to it anyways. Plus, I use Net Support if I feel I’ve got wondering eyes.

Adam stated that he walks around the classroom to monitor student activity. He kept students focused on the lesson as he moved around the classroom and wrote on the interactive whiteboard. In another example, Green also walked around the classroom to monitor students when using technology. Dawson agreed that students sometimes do not stay on task while using technology and must be closely monitored. These segments of their interviews exemplified their uses of classroom management:

> Green: We have technology where I can look at computers and I can see what all the kids are doing on their computers, but I don’t have it hooked up. It is easier for me to stand at the back and look at their screens.
>
> Adam: I also have an active slate that allows me to freely walk around the room, so I am not stuck at my computer. I am able to keep them in close proximity and on task.
>
> Dawson: Kids will look up things they are not supposed to. They will find ways to cheat.

Green encountered similar classroom management issues with technology integration in the classroom. He contended that classroom management was an essential part of using technology in the classroom. He said:

> Green: You have to be able to be a good teacher, be able to effectively deliver instruction, and manage children. With technology, they [children] have a tendency to drift onto the wrong website. If they do that, my response is to

tell them to get back to work. If there is a problem, then the discipline issue is for me to handle.

Green also stated that using technology helped with classroom management. When students were actively engaged and participating in the learning process, students were less likely to misbehave or be off task in class. He stated that as he talks about the lesson, the students have to do the work as well using the computer. He said:

> Green: It [technology] allows me to kind of show kids. I am a boy. Boys are visual learners. If you can grab [the attention] of the boys with the eyes a lot of times the girls get sucked into whatever the boys are into. Then, the boys aren't pestering the girls.

The statements made by these teacher participants agree with previous research (Harrell & Bynum, 2018) in that classroom management is needed to effectively integrate technology in the classroom.

Hardware and software. The participants used a variety of hardware, software, and non-electronic tools to integrate technology in their classrooms. The school district provided much of the hardware and software provided to teachers for use in the classroom. Teacher laptops were used by teachers for recording and reporting students' grades and progress, creating instructional materials, accessing district approved accounts, participating in professional development events, communications, in addition to many other tasks. Teacher laptops work in conjunction with Promethean boards (i.e., interactive whiteboards) that were installed in every classroom. Active Inspire is the main software that is used to operate the interactive whiteboard and its features.

Software can facilitate mathematics teaching and achieve the targeted learning outcomes (Piskin Tunc et al., 2012; Zengin, Kagizmanli, Tatar & Isleyen, 2013). In previous research, classroom teachers determined the adoption of digital technologies and associated applications in classrooms, more so than availability on its own (De Grove, Bourgonjon, & Van Looy, 2012; Flewitt et al., 2014; Reid & Ostashewski, 2011). As highlighted by Cheung and Slavin (2012), however, use of digital technologies in classrooms is most successful when partnered with teacher instruction. Stern (2014), Flewitt et al. (2014) and Reid and Ostashewski (2011) suggest that careful consideration must be given to both interaction-based elements and content-based material, when designing content for presentation on digital devices. Furthermore, they suggest that the design should support both interactive and independent learning experience, that feedback be clear, immediate, and rewarding, and that distractors that divert attention from the primary content must be minimized. This research is significant because it confirmed the belief that teachers must be strategic and intentional when designing and integrating technology in the classroom. Technology is a tool used by teachers to enhance the learning experiences for students.

Classroom observations revealed the hardware and software teacher participants used in their classrooms. For hardware, they used laptop computers, interactive whiteboards, and active slates (i.e., tablets connected to the interactive whiteboards) in the classroom. They also used a variety of software programs for math instruction. The hardware and software used by the teacher participants seemed to be a major component in the teachers, instructional practice. Teachers relied on technology to facilitate interactions between the instructional content and the student. Teachers checked student

understanding by playing interactive games with students and creating assignments for students. Teachers used the interactive tutoring program, Mathia, to provide students with immediate feedback. Teacher participants received from students that informed the teacher if additional remediation was needed on a concept. Teacher participants also used the online tutoring program to provide differentiated instruction to students as well as to review previously learned concepts.

For example, during an observation in Green’s classroom, students played a game of Kahoot to evaluate algebraic expressions with exponents. Kahoot is an online game-based student response system where educators can create, share, and quiz students on educational content. A student sat at Green's desk and used a computer to host the game as other students in the class played along. One question at a time appeared on the interactive whiteboard and other students in the class responded using their Chromebooks. The students appeared to enjoy playing the game, and upon completion of the game, asked to play again. After the game, students worked on a worksheet to reinforce their understanding of how to apply exponent rules. Initially students worked independently. Some students had difficulty completing the independent assignment and asked Green for help. After helping five students individually, Green then went to the interactive whiteboard and demonstrated for the whole class how to complete the worksheet. This example is significant because it shows how the teacher participant used technology in the classroom to formatively assess students’ understanding of exponent rules. As students responded to question items in the game, they received immediate feedback about their answer choices. The teacher participant was able to use data collected from the Kahoot game to make decisions about subsequent instruction.

In another example during an observation of Bowman's classroom, I observed the teacher participant stand at the front of the classroom. As she worked on a laptop, she instructed students to log into the online tutoring program Mathia. Students worked in Mathia for the first fifteen minutes of class. Next, students were instructed to log into their Edpuzzle account and access a (Math Antics) video on exponent rules. Edpuzzle is an online video editing and formative assessment tool that allows teachers to cut, crop, and organize videos assigned for students to view. Students watched the video using their Chromebook and headphones. This example is significant because it showed how the teacher participant used technology to deliver instructional content to the students. Students were able to work at their own pace. This personalized delivery of instructional content also allows students to replay parts of the video they may need to view again. Delivery of instructional content using videos forces the learner to actively engage in the learning process. Furthermore, teachers can ensure that their students have really watched the assigned videos because they must respond to prompts to proceed to the next video segment.

Lastly, during an observation of McDonald's classroom, I observed students work on assigned textbook pages that were posted on the interactive whiteboard. Although student desks were arranged in groups of four, students worked independently. Some students used handheld calculators. One student used a closed-circuit projector to assist her as she worked on the assignment. This device is assistive technology used to aid visually impaired students in the classroom. McDonald worked on her laptop and occasionally walked around the classroom to observe student work. Students who finished their textbook pages were instructed to use their Chromebook to work on the

online program Mathia. This example is significant because it presented another type of hardware technology teacher participants used in the classroom. Assistive technology is defined by the Individuals with Disabilities Education Improvement Act (IDEIA) of 2004 as any item, piece of equipment, or product system that is used to increase, maintain, or improve functional capabilities of a child with a disability (IDEIA, 2004). According to Netherton and Deal (2007), one of teachers' major responsibilities is to provide children, regardless of their disabilities, with successful learning experiences and assistive technology can help teachers to reach this goal.

Theme 2: Teachers' Thoughts on Technology Integration. The second theme states teachers' thoughts on technology integration in the classroom. Teacher participants encountered frustrations and have concerns when integrating technology in the classroom. This theme described the private opinions teachers held regarding technology integration, their experiences, perceptions about technology integration, and thoughts about using technology as part of their instructional practices.

Ertmer et al. (2006) suggested barriers to technology integration can be viewed as intrinsic and extrinsic to the teacher. First-order barriers to technology integration are described as being extrinsic to teachers and include adequate access to hardware and software, insufficient time to plan for instruction, inadequate training, and lack of support for technology integration. Second-order barriers include beliefs about teaching, beliefs about technology integration, and the willingness to use technology.

Categories that were included in this theme were teacher frustrations and concerns, and teachers' opinions of technology integration. Table 4.9 Categories and Codes, shows alignment of the codes that correspond to each of these categories.

Examples of codes for teacher frustrations and concerns included technology malfunctions, district expectations for technology integration, barriers to technology integration, lack of teacher support, and codes for teachers' opinions on technology integration comprised statements of teachers' opinions, and positive and negative perceptions of technology use in the classroom.

Table 4.9 *Theme 2 Categories and Codes*

Categories	Codes
Teacher frustrations and concerns	tech malfunctions student misuse of technology district expectations for teacher technology integration barriers to technology integration lack of teacher support
Teachers' beliefs on technology integration	statement of teachers' opinion teacher perception positive perceptions of technology integration negative perceptions of technology integration continual changes regarding hardware and software how teachers feel using technology how teachers perceive student knowledge of technology technology user friendly feelings about teacher expectations

Teacher frustrations and concerns. Teachers who use technology in the classroom inherently encounter frustrations and concerns. Teacher participants expressed frustrations that arose from their own perceptions of technology use and from technology integrations in the classroom. Some technology integration issues were due to circumstances beyond the teachers' control such as device malfunctions. Teacher frustrations present first-order barriers to technology integration as they are factors that influence technology integration. Ertmer (1999) categorized barriers into first-order and

second-order barriers based on external and intrinsic factors. First-order barriers are outside factors that inhibit technology use such as access, training, time restrictions, and policies. Second-order barriers include internal factors such as teacher beliefs and perceptions of technology that prevent technology use even when first-order barriers have been addressed. During interviews, teachers were asked to describe any barriers regarding technology integration in the classroom.

During one observation, Green was only able to use he interactive whiteboard to project images. He stated that he was not able to write on it and that it had not worked all year. A similar instance occurred in Wenger's classroom. The interactive whiteboard failed to operate properly at the beginning of class. Wenger requested help from the media specialist to assist her in the classroom and adjust the whiteboard. These examples show that hardware sometimes malfunctions during instructional times. During an interview, Dawson discussed frustrations she experienced once when she planned a lesson but was not able to proceed with the lesson because the internet was not working. Similarly, during an interview Adams stated:

> One concern I have is when technology fails to work properly. For example, this week students have been experiencing difficulty logging in to work on assignments. Also, a barrier [to technology integration] is the capabilities of the student devices. The software program we use for math instruction may not be compatible to work efficiently on student devices. Mathia is a software that students use in class. We use it for the first ten minutes of each class period. Lately, the software has not been loading. I think it is because the software uses a lot more RAM memory than the student Chromebooks are able to process.

Instructional time is limited, and teachers depend on hardware and software to work effectively. Teacher participants experienced frustration when they were unable to proceed with their lesson as intended.

Another frustration teacher participants encountered were instances where students used technology inappropriately. During interviews, teachers were asked "What frustrations or concerns do you have while using technology in the classroom?" Teacher participant Dawson stated, "It is frustrating when kids look up things they are not supposed to, and cheating. They will find a way to cheat." According to Dawson, her students are expected to write notes in their notebooks, study the content presented, complete the activities and assignments to learn the material. She considers it cheating when students look up the answers during a test instead of using their knowledge and understanding to respond to assessment items. She also stated that frustrations arise when students come to class without their Chromebook or when their devices are not fully charged. These examples present barriers for Dawon when lessons require the use of Chromebooks to assist students in learning. The experiences of these teachers impacted their ability to utilize technology in the classroom as part of their instructional practices.

Additionally, teachers described frustrations and concerns they experienced based on their level of confidence using technology in the classroom. Green stated, "Most of the time it's me. Most of the time the technology issues are not between the kid and the technology, it's between me and the technology, and getting it [the assignment] out to the kids." Furthermore, he stated:

> Professional development we receive does not make me feel confident. I have had to learn as I go. They've [students} grown up with this stuff [technology]. They

> sat around and played with the computer for hours on end and knows what this does and knows what that does. Sometimes I have to ask a kid how do you do this and how do you do that? My aggravation is that it changes so fast. The problems I encounter is that I am not proficient enough to do what I want to do.

Green gave an example of an instance where he used technology to enhance a lesson, he said," I am still learning how to use Google Classroom. For example, I had to edit my assignment today and I just got lucky because I had played with it enough to edit it." This example shows the frustration Green experienced with technology integration. He did not always feel confident in his ability to use technology in the classroom. In other words, Green questioned his own level of confidence regarding technology integration in the classroom. The professional development provided did not alleviate his frustrations or build his level of confidence in using technology.

One concern expressed by teacher participants was the pace at which teachers were expected to adapt to the changes to technology integration. Green expressed concern about the speed at which he was expected to learn new technologies. Green stated, "My concern is they are going to take Google Classroom from us in a couple of years and make us learn something else. My aggravation with it [technology] is that it changes so much, and it [technological change] is so fast... I've had to learn as I go. And I am trying to adapt... Teachers are expected to be experts in using computers." Similarly, Dawson stated," I feel like I've been trained so much I feel like I've been trained on too much. I would rather be trained on just a couple of things and be good at those couple of things, like the Nearpod and Pear Deck. I feel like I had a little bit of training on a lot of

things.” The statements reflected teachers’ concerns and expectations placed on teachers regarding their use of technology in the classroom.

Teacher participants' statements illustrated first order barriers in that the teachers expressed the intrinsic factors that impact technology integration in the classroom. These examples are significant because they illustrate frustration and concerns held by the teacher participants. Previous research on a teacher’s comfort level with technology has been associated with technology use (e.g., Valtonen et al. 2020; Spiteri and Rundgren 2020; Anderson & Putman 2020).

Teachers’ beliefs on technology integration. Teachers’ beliefs on technology integration included discussions that revealed what teachers thought about using technology in the classroom, positive and negative perceptions about using technology, how teachers feel about the continual changes of hardware and software, how teachers perceive technology use impacts student learning, technology that is user friendly, and their feelings expectations placed on teachers regarding technology use. Beliefs about teaching and learning play an important role in technology integration in the classroom (Ertmer, 1999). Attitudes toward technology also influence teachers’ classroom uses of technology (Yildirim, 2000). These teacher beliefs were determined to be positive, negative, or neutral. Ardic (2021) found that attitudes of mathematics teachers towards technology were positive, which had a positive effect on using technology in lessons. During interviews teachers expressed these positive attitudes about the use of technology in the classroom. Many of the positive attitudes about technology integration were centered around how technology integration enhanced student engagement, allowed

teachers to efficiently facilitate teaching practices, and incorporated user-friendly technology features.

Adam: I use technology to make the lessons engaging and interesting...I use my Promethean board, my active slate, and my computer usually when I take a poll, I'll either do Mentimeter it's just quick [a quick assessment]. It's just a virtual exit ticket or a virtual starter to with my presentations. You can see where your class is as a whole so it's very easy for them to sign into it, you just click. It just gives them a quick little link [to] answer with two little buttons depending on how you want to set up, or the type of question you can use. You can use it as a warm-up or an exit ticket... I use it for GT [the gifted and talented class]. I was using [it to] compare negatives and positives. There is Menti.com [where students can] just type in the minty code and it pops them right into the question and response. It's live so you can watch them. The great thing about it is that once they submit their response you can change it to how many responses per person. I use the Pear deck capability with the agree vs disagree. You can watch all of them [student responses] move within the classroom, so they are seeing their work move with everyone else's.

Green: I personally believe good teaching still matters. You just can't come in and give the kids a bunch of technology-based curriculum and expect them to learn. You will never be able to eliminate the human part of education in my opinion. I personally believe it [technology] should be used as a tool... There's a lot of things I like about it [technology]. It allows me to

> differentiate the lessons, I can make a more visually stimulating, realistic lesson...I use Mastery Connect [test administration software] because it grades it for me.

These examples illustrated the positive beliefs expressed by teacher participants as to the usefulness of technology and its usefulness as a tool in combination with the human element of teaching.

Many of the negative beliefs about technology integration were centered around technology that was not user friendly, barriers to integrating technology in the classroom, and technology malfunctions related to technology integration. For example, Adam and Green stated the following:

> Adam: Education is moving more toward online learning. For math, there does not seem to be adequate virtual manipulatives available for online math instruction... Time becomes a concern when I have to spend additional time on my own to figure out features of software programs. Time is also a concern when students are out when a new technology is introduced, and I may have to go back and teach them what to do or to catch a student up.

Green: We have the technology [where] I can look on the [students'] computer and I can see what all the kids are doing on their computer, but I don't have it hooked up because it is such a hassle to hook up. You have to bring every Chromebook up to your desk and type in a code before you can use it, so it is easier just for me to stand in the back of the room and look at their screens. Even though it would be nice if I could see the screen [seated at my desk] and look at their screen.

Dawson agreed with Adam and Green that when students visit inappropriate websites when using technology in the classroom it is a negative aspect of technology integration. These examples show negative teacher participants' opinions regarding technology integration in the classroom.

Theme 3: Teacher Personalities. The third and final theme states teachers' personalities impact their use of technology in the classroom. This theme is multifaceted because it involves several teacher participants with many diverse backgrounds, levels of education, years of teaching experience, levels of technology proficiency, ages, and perceptions of technology integrating technology at a middle school. The teachers discussed their attitudes, perceptions of technology and experiences towards integrating technology in the classroom. Table 4.10, *Theme 3 Category and Codes*, shows the alignment between the category and codes for theme 3. The codes are examples of teacher attributes. Examples of codes include level of comfort using technology, professional development, teacher support in/outside system classroom, teacher classroom management skills and ability to manage student use of devices in the classroom.

Table 4.10 *Theme 3 Category and Codes*

Category	Codes
Teacher Characteristics	level of comfort using technology professional development district expectations for teacher technology use teacher support system teacher classroom management skills ability to manage student use of devices

Teachers' characteristics. Teacher characteristics include attitudes and perceptions, teacher's level of technological proficiency, teachers' support system, and teachers' demographic information. Teachers' individual characteristics are factors that influence a teacher's decision to use technology in the classroom (Inan & Lowther, 2010). Additionally, teachers' previous teaching experience using technology, level of education, and level of comfort and confidence are also factors that influenced their decision to use technology (Liu et al., 2017).

Teachers' attitudes and perceptions. Teacher attitudes and perceptions of technology are a significant factor in whether technology is used in the classroom. Teacher belief and attitudes towards technology use are their perception of the value of technology and its use (Karaca et al. 2013). Nelson and Hawk (2020) revealed that beliefs about the importance of technology were a strong predictor for technology use. Teachers' beliefs are linked to the teaching methodology that they apply in their classroom (Alsaied, 2016). In other words, if the teacher has a positive perception of technology integration, the teacher is more likely to adopt this methodology and apply it effectively.

Teachers' perception of the use of technology in class is also a key factor that affects technology integration. Research conducted by Hsu and Kuan (2013) found a positive and strong relationship between teachers' perception of technology effectiveness in terms of value and efficiency and technology integration. Teacher participants' attitudes were reflected in statements made about how they feel about using technology. During interviews teachers were asked to discuss how they feel about using technology as part of their instruction. During interviews teacher participants discuss their perceptions of using technology in the classroom. Adam stated, "The effectiveness of

technology can be used to enhance student learning. Education is moving more toward online learning. For math, there does not seem to be adequate virtual manipulatives available for online math instruction." Similarly, Green stated,

> I would say that technology enhanced my lesson. I don't want to admit it, but it does. There's a lot of things I like about it. It allows me to differentiate the lessons. I make more visual, stimulating, realistic lessons. If I'm just using a book, talk about it [math concepts], makes sense. It is easier for me to grab the kids [engage the kids]. It's [math concepts] not so boring. It can be boring, but the technology allows me to make it not so boring.

In these examples, teacher participants reveal that technology enhances their lesson and engages the students more than if technology were not used in the lesson. Instructional content remains the main focus of the lesson and technology is used as a tool.

Teachers' experience with technology. Liu et al., (2017) concluded that one of the strongest predictors of technology integration was teacher experience with technology. Teachers who use technology frequently are more likely to incorporate technology into their instructional practices. During interviews with the teacher participants were asked to describe examples of the technology used in the classroom. Adam stated,

> A lot of good technology integration I've done has been through Pear Deck and that's been with teacher and student paced modes. One Pear deck is integrated with Google Slides and it's quick and easy. I also have an active slate that allows me to freely walk around the room, so I am not stuck at my computer. I am able to keep them in proximity and on task that is so I'm not too stressed about keeping

> up with them. I use my Promethean board, my active slate, and my computer usually when I take a poll [as a formative assessment]. I'll do Mentimeter [an interactive presentation tool that that displays students' responses in real time]. It is just a virtual exit ticket or a virtual starter.

Green stated,

> I use the Promethean Board, Booklet, and Edpuzzle. I use YouTube all the time, Discovery Ed [online program that facilitates instruction through activities and assessments], and Mathia [one on one math tutoring software]. I like the Chromebooks now because they are so digital. I used Classworks [an online program that delivers math instruction and tracks student progress]. Last year, the kids could type on their computer and work a math problem and it would show up on the board [interactive whiteboard]. The kids liked it.

These examples illustrated what technologies were used by Adam and Green, in addition to how they were used in the classroom. These teacher participants used devices to monitor students as they worked on independent assignments and present instructional content, and websites to formatively assess student understanding.

Teacher support system. An important contributor to technology integration in the classrooms is the availability of support staff to help resolve technology-related issues. Nelson et al. (2019) state that technological support is an essential ingredient to the technology use of teachers. Teacher support in using technology may be in the form of professional development provided by district personnel, support from colleagues who are knowledgeable about technology, or the school's media specialist. In some instances, students may help teachers with technical issues. Ardic (2021) found that the attitudes of

teachers towards technology did not change according to the training they received on using technology in lessons. During an interview Green stated,

> I guess my aggravation is I was born twenty years too early. If I would have been born 20 years later this technology thing wouldn't be so difficult but the kids actually know more than I do. That's what bugs me about it. Sometimes I have to ask a kid, "How do you do this and how do you do that?"

In this example, the teacher participant compared their own skill set in using technology to those of the students. The teacher participant contended that the students have more experience in terms of using technology, and therefore, have an easier time adapting to technology use. The participant admitted to asking students for help using technology.

Professional development provided by the district has not been completely helpful to the teacher participants. For example, Green stated, "The professional development that we receive does not make me feel confident after only one professional development [workshop]." Adam stated,

> I feel adequately prepared to integrate technology in the classroom. We are provided with professional development that is a help, but I must admit, I have to spend additional time on my own to figure out features of software programs.

Similarly, Dawson stated,

> I feel like I've been trained on so much. I feel like I've been trained too much. I would rather be trained on just a couple of things and be good at those couple of things like the Nearpod and Peardeck. I feel like I had a little bit of training on a lot of things.

These statements are teacher participants' opinions that illustrate how teachers feel about the professional development provided to support their classroom instructional practices.

Support for technology also comes from other sources such as the school's media specialist and teacher colleagues. During one classroom observation in Wenger's class, I observed an interactive whiteboard malfunction. The school's media specialist adjusted the wiring to resolve the problem. During an interview, Green revealed that the interactive whiteboard had been only used to display instructional content. This teacher participated was not able to write on the whiteboard or show demonstrations all year. The school's media specialist oversees helping teachers with technology related issues. Green said he reported the whiteboard malfunction to the media specialist. The issue had not been resolved. Green stated, "I don't know what else to do."

Teacher demographic information. According to the National Center for Education Statistics (2016), demographic characteristics such as age, level of education, years of previous teaching experience and level of comfort using technology may affect technology use.

A teacher's age is a factor that influences their decision to use technology. Previous research has suggested that older teachers view the use of technology as a tool to foster student learning as less valuable and perceive more potential problems integrating technology in teaching practices than their younger colleagues (Scherer et al., 2015). Further research suggests, younger teachers have had access to and started using digital technologies earlier than older teachers, which may influence the ways as well as confidence with which they transpose such use in the profession (Lucas et al., 2021). For example, Green's experiences as a student growing up without using technology were

contrasted against the experiences of the students who grew up using technology. Green said,

> They [students] have grown up, sat around, and played with the computer for hours on end and know what this does and knows what that does. I didn’t. I have had to learn. I have to learn as I go. And I am trying to adapt. I'm like pushing 50 here. I am an old man.

Green, who has been teaching for 20 years and was moderately proficient in the use of technology, shared an experience using technology as part of a lesson,

> I did old school and new school yesterday. I would say that technology enhanced my lesson. I don't want to admit it. It's a good tool... I feel jealous of these younger teachers because they grew up on this stuff. I feel like they are much more ahead of the game even though I have been teaching 20 years. I feel like I am looking to them sometimes with technology integration.

Green used the term *old school* in reference to having students use the textbook. The teacher participant used the term *new school* to refer to how students used technology. The teacher participant compared teaching a lesson using the textbook to integrating technology into the lesson and revealed that technology enhanced the lesson. The participant expressed appreciation of technology because technology was used as a tool to enhance the learning experience for students. This example also shows a comparison made between Green and other colleagues who are younger teachers. Green perceives the younger teachers as more knowledgeable about using technology because they have “grew up” using technology.

Similarly, another participant who was between 20 – 30 years of age, had been teaching for about four years, and was described as very proficient in the use of technology. Adam posed the question, “How exactly are you engaging them [students]with it [technology]?” Adam further elaborated, “If you're just putting something up that is a naked problem, such as something like that [shows me an example of a math problem], that is not really engaging. We go through it [a math problem], but the way that we go through it, how you present it, you can change something not so engaging. You can build it up and make it engaging. It's all about how the teacher wants to make it work for their students.” This example showed that Adam recognizes that the instructional material itself does not engage the students. This teacher participant used their technological skills to enhance the lesson and make it more interesting and engaging for students. Adam was young and new to the teaching profession but was highly proficient in using technology to teach students. This is evidenced through the examples of instructional materials created for instruction such as Pear Decks and Google Slides in addition to devices hardware and software used in the classroom. These examples were significant because they provided evidence of how the participants’ characteristics impacted their use of technology.

Chapter Summary

One purpose of this descriptive research study was to describe teachers’ perception of technology integration. To achieve this purpose, a combination of quantitative and qualitative data was gathered and analyzed through the administration of surveys, instructional observations, and interviews. The Technology Integration Survey collected participant data about the instructional practices of mathematics teachers. The

Teacher Perceptions Scale was used to collect data about factors that contribute to teacher perceptions. Information gathered from these survey items was used to provide descriptive statistics. The mean and standard deviation of survey items were calculated to present teachers' overall responses to survey items. The LoFTI observational tool was used to collect information about participant instructional practices and provided details about participants in the classroom setting. Observations captured the implementation of technology by the participants that included their verbal and nonverbal mannerisms, behaviors, and gestures. Finally, the participant interviews gave the participants an opportunity to discuss their experiences and thoughts about technology integration in their classroom.

In this chapter, each of these data points were analyzed, interpreted and presented as findings. Inductive analysis was used to analyze data from participant observations and interviews. Codes were created and applied throughout participant transcriptions and observation notes. These codes were later grouped into categories. These categories were then organized and interpreted into themes. The themes were presented along with excerpts from participant interviews and observations. The findings and themes drive the discussion, implications, and limitations of the next chapter.

CHAPTER 5

DISCUSSIONS, IMPLICATIONS, AND LIMITATIONS

The purpose of this action research was to explore mathematics teachers' current instructional practices and perceptions of technology integration, as well as the perceived barriers that influence their technology integration in the classroom. The goal of this chapter is to discuss the significance of the research findings regarding the research questions. Implications were formulated and synthesized from findings gathered through surveys, interviews, and observations. The discussion section of this chapter provides a response to each of the three research questions and concludes with a final summary. Next, implications are discussed specific to the research site. Recommendations for exploring future technology integration instructional practices among teachers are made, and implications for further research. The final section of this chapter discusses the limitations of this research study.

Discussion

Research Question 1: What are mathematics teachers' current practices of technology integration in classrooms at Magnolia Middle School?

The literature suggests several technology instructional practices for which math teachers integrated technology in the classroom. According to Hsu (2016), teachers used technology in the classroom for pedagogical purposes, primarily for visualizing concepts, using virtual manipulatives, and differentiating instruction. Kirikcilar and Yildiz (2018), studied three middle school math teachers' TPACK and found that all three types of

knowledge were used to create learning activities for students. This section was composed of (1) teachers' instructional practices, (2) hardware and software teachers used, and (3) how and why teachers integrated the technologies in the classroom.

Teachers' instructional practices. The aim of this question was to explore the instructional practices of the teacher regarding technology integration in the classroom. Mailizar and Fan (2021) revealed that the instructional practices that incorporated technology in the classroom and subject levels were closely related to the type of tasks they set in their lessons. Teachers created interactive learning environments using a digital tool to make it possible for learners to actively influence their own learning process (Hillmayr et al., 2020). Learners can manipulate presented information and interact with learning environments that enable them to act as sense-makers in constructing their own knowledge (Hillmayr et al., 2020). Studies on technology use and TPACK have yielded consistent results. Teachers' experience in using technology is positively associated with TPACK (e.g.,Lee & Tsai, 2010). In my research study, teacher participants used technology to enhance learning materials to make the lessons more engaging for students. During an interview, one teacher participant stated, "The effectiveness of technology can be used to enhance student learning." This participant also described how a math problem about multiplying fractions can be transformed by using technology to model what happens when fractions are multiplied. The participant emphasized, "How you present it [a math problem] can change something not so engaging and make it engaging." This teacher used technology to transform mathematical content to enhance student learning. During an interview, another teacher participant admitted, "Technology enhanced my lesson. Technology allows me to differentiate the

lessons." This participant used technology to transform the lesson and make it more visually stimulating for students. Observations revealed participants used technology to present instructional material, formatively assess student understanding, deliver personalized instruction, and provide students with interactive engaging lessons. Participants engaged students by playing interactive games, using interactive whiteboards to demonstrate how to solve math problems, and to provide students with visual models to aid in understanding math concepts. The findings in this research study agree with the literature in that technology in the classroom was used as a tool to enhance and engage student learning.

Hardware and software. Previous literature about hardware and software technology integration in teaching mathematics shows technology integration has made a significant impact on math instruction. One study, Das (2019) explored the role of the application of information and technology tools in mathematics teaching. This study revealed that teachers used a combination of hardware, software, multimedia, and delivery systems for math instruction. In another study, De Vita, Verschaffel, and Elen (2018) explored the use of interactive whiteboards and its impact in mathematical educational environments. Altun (2013) also found that teachers who used educational software in classes at all times had significantly higher TK, TCK, TPK, and TPCK than did those who never used it in classes. This study examined how teachers' modeling processes and students' exploring activities can easily be executed by using interactive whiteboards. Furthermore, the study showed how the interactive whiteboards acted as a useful instrument for students' discussion and collective construction of mathematical knowledge. I observed how teacher participants used interactive whiteboards to display

instructional content, provided students with demonstrations on how to solve math problems, and made lessons more interactive for students through gamification. During a classroom observation one teacher participant wrote an equation with variables on both sides on the whiteboard. Students solved the problem independently then the solution was discussed as a whole class activity. After a brief discussion, the teacher participant demonstrated how to solve the equation. During another classroom observation students played a game of Kahoot to practice previously learned math concepts. The hardware and software teachers used included interactive whiteboards, laptops, and incorporated student Chromebooks as part of their instructional practices. Teachers used math interactive math tutoring programs, edited videos, websites, and games. The findings in this study agree with previous literature that shows that teachers used hardware and software as an interactive tool in the classroom.

Implementation of technology integration in the classroom. Teachers have integrated technology in the classroom to address various facets of mathematical learning. According to previous research, technology integration allowed teachers to design individualized learning experiences to target learning gaps for specific students (Azid et al., 2020). Additionally, one study conducted by Schuetz et al. (2018) found that effective differentiation can be achieved using technology in the mathematics classroom. During an interview, a teacher participant stated, “It [technology] allows me to differentiate lessons.” Teachers used technology to provide students with math remediation of basic skills. Classroom observations revealed teachers played games such as Kahoot, Classworks, and Booklet to remediate previously learned math concepts. Teacher participants admitted that they used software such as MasteryConnect for

formative and summative assessments of student understanding. These are all examples of technology teachers used in the classroom to aid students in remediation of basic math skills. Additionally, teacher participants used the online tutoring program Mathia designed to deliver one on one math instruction for students. One teacher participant stated, "Mathia is a software that students use in class. We use it for the first ten minutes of each class period." These examples show the types of technologies teachers use in the classroom and how they are used by teachers to differentiate, remediate, and assess math content. The findings in this research study follow previous research that emphasizes the importance of how technology is implemented in the classroom.

Research Question 2: What are mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?

Teachers' perceptions of the use of technology in the classroom are a key factor that affects technology integration. Previous literature shows that teachers' beliefs are directly linked to the teaching methodology they apply in their classrooms (Alsaied, 2016). Teachers' ability beliefs and value beliefs have been identified as major belief factors that are consistently and strongly associated with teachers' practices of using technology in classrooms (Chaaban & Ellili-Cherif, 2017; Vongkulluksn et al., 2018). The decision about the types of technology and whether to use technology in the classroom often depends on the perceptions of the teacher. Boonmoh, Jumpakate, and Karpklon (2021) investigated how teachers use technology in their classrooms and their perceptions of the use of technology. The findings of this study showed the perceptions held by teachers as they utilized technology in the classroom. Decisions about whether to use technology were influenced by a number of factors. These factors include (1) factors

that influence teacher perceptions about technology integration, (2) frustrations and concerns teachers have about technology integration, and (3) teachers' beliefs and attitudes about technology integration in the classroom.

Factors that influence teacher perceptions about technology integration. Teachers' perceptions towards technology integration for math instruction are influenced by a number of factors. The process of achieving technology integration into classroom teaching is slow and complex and influenced by various factors (Inan & Lowther, 2010). Teachers' beliefs and attitudes have been identified as a significant factor that affects their use of technology. Research conducted by Önalan and Gökçe (2020) explored factors that influence technology integration practices of teachers and found that teachers who felt confident in adopting technologies for teaching purposes frequently use technology for personal use. Overall, teachers' attitudes toward integrating technology in the classroom were positive. However, teachers showed negative feelings about technical and instructional support. Those who feel competent to integrate technology in classrooms may be motivated to do so more frequently and to use technology in a more sophisticated manner (Willis et al., 2019).

The results found in this research study are consistent with previous research on the teachers' perceptions of technological integration. The results showed teachers' perceptions regarding technology integration were closer to higher ranks (M = 4.2, SD = 1.1). One teacher participant described themselves as highly proficient in using technology. The participants stated that they spent additional time learning about technology beyond the professional development provided. Teacher participants indicated they felt confident in their use of technology in the classroom. Teachers who

described themselves as less skilled in using technology expressed a reluctance to integrate new technologies in the classroom.

During subsequent interviews, participants reported that the level of professional development provided to teachers did not equip them with the knowledge to integrate technology specific to their content area. Professional development provided to participants oftentimes was not useful when teaching math. One participant stated, “I feel like I've been trained on too much. I would rather be trained on just a couple of things and be good at those couple of things.” Classroom observations showed one participant using technology with a high degree of comfort and confidence to model solving linear equations using the whiteboard. The findings of this research confirm the results of the study conducted by Prasojo et al. (2019) that showed inadequate professional development was a factor that contributed to teacher perception.

Frustrations teachers experienced. The integration of technology has caused teachers concerns and frustrations on various occasions during different phases of technology integration in the classroom. A study conducted by Regan, Evmenova, Schwartzer, Chirinos, and Hughes (2019), explored teacher attitudes and perceptions regarding technology use. Teacher participants described frustrations that include feelings of discomfort in using technology, challenges of using technology with students, expectations placed on teachers to incorporate various software into lessons, time constraints of integrating technology, and instances where technology malfunctions occurred during instruction. Furthermore, this study revealed that technology was positive for certain students, differentiating instruction, and technology use in the enhanced learning opportunities for students. Another study conducted by Bonet (2021)

evaluated factors that facilitated and hindered the use of technology. Furthermore, participants revealed the various levels of frustration of some teachers who used technologies with low levels of training or with self-generated content.

Teacher participants in my research study reported some of the same frustrations expressed by teachers in previous research studies. In data collected from interviews, teacher participants indicated they felt inadequately prepared to integrate technology in the classroom. One participant stated, “The professional development that we receive does not make me feel confident.” This participant also stated, "Most of the time the technology issues are not between the kid and the technology; it's between me and the technology and getting it [technology enhanced lessons] out to the kids.” During classroom observations, I noted instances where technology malfunctioned during classroom instruction. This interruption caused the teacher and students to lose valuable instructional time. Some teacher frustrations were expressed through survey responses as well.

Teachers’ beliefs about technology integration in teaching math. Teachers' perceptions about the usefulness of technologies affect whether and how they will use them (Ertmer & Ottenbreit-Leftwich, 2010). Teachers’ beliefs and attitudes about the relevance of technology to students’ learning have been perceived as having the largest impact on student success (Ertmer, 2010). Technology is considered successfully integrated when its use enhances the learning processes of students and establishes more effective, efficient and/or attractive learning experiences (Farjon, Smits, & Voogt, 2019). Furthermore, research also showed that attitudes and beliefs are crucial factors in how

teachers plan and implement technology in the classroom (Admiraal et al., 2017; Ertmer et al., 2012; Ottenbreit- Leftwich et al., 2010).

Teacher participants in my research study expressed their attitudes and beliefs about technology integration. In data collected from interviews, teacher participants indicated positive and negative attitudes about using technology. One participant stated, “The effectiveness of technology can be used to enhance student learning.” This participant added, “You can change something not so engaging, build it up, and make it engaging.” Researcher notes made during a classroom observation of a teacher using technology as part of a lesson revealed, “Students were engaged and responded to teacher questioning.” In response to the survey item, “I believe that technology makes my job as a teacher easier” three of the five teachers surveyed agreed that technology use made their jobs easier, one teacher strongly agreed with this statement, while one teacher disagreed with this statement. Teacher participants also indicated negative attitudes and beliefs about using technology in the classroom. In response to the survey item, “The use of technology increases the permanency of learning.” Teachers indicated their responses using a scale from one to five that ranged from strongly disagree (1) to strongly agree (5). Of the five teachers surveyed, an average of their scores indicated that teacher participants believed that using computers with students did not increase their learning. Negative beliefs expressed by teachers were centered around students' misuse of technology and technology instances when failed to facilitate targeted learning objectives. For example, one teacher participant expressed that while administering as assessment, students have used technology to “look up things they are not supposed to.” The findings in this research study agree with the findings of previous studies in that

teachers' attitudes and beliefs about technology use impact whether and how technology is used in the classroom (Li, Garza, Keicher, & Popov, 2019). Teacher beliefs found in this study are similar to teacher beliefs found in literature in that technology can be used as a tool to enhance lessons and engage students (Elmahdi, Al-Hattami, & Fawzi, 2018). Hsu et al. (2017) examined the relation between value beliefs and TPACK and found that there were positive correlations of value beliefs and TPACK components. The findings in my research supports the findings of previous research with regard to teacher beliefs and TPACK (e.g., Hsu et al. 2017; Lehtinen, Nieminen, & Viiri, 2016). This study found that teachers expressed both positive and negative beliefs about technology integration. Overall, teachers revealed that technology that was user friendly made it easier to accomplish tasks such as enhancing lessons to engage students.

Research Question 3: What are the barriers that influence mathematics teachers' perceptions of technology integration in classrooms at Magnolia Middle School?

Ertmer (1999) distinguished between two types of barriers that impacted teachers' use of technology in the classroom. First-order barriers were defined as those that were external to the teacher. These barriers included resources such as hardware and software, professional development training, and support. Second-order barriers were internal to the teacher and included teachers' confidence, beliefs about how students learned, and the perceived value of technology related to teaching and or learning process. Inan and Lowther (2010) examined the relationships between first- and second-order barriers with technology integration. Their results showed that technical and administrative support influenced teachers' beliefs and readiness for technology integration, while these internal barriers then mediated the effects of the external barriers on teachers' technology

integration. This section focused on the first- and second-order barriers teachers encountered while integrating technology in the classroom.

First order barriers to technology integration. As stated above, first-order barriers are those external to the teacher and typically beyond her control (Ertmer, 1999). The first-order barriers addressed in my study included professional development training and support, lack of technological proficiency, and time constraints.

Professional development training and technical support include the instruction provided to teachers for effectively using technology tools and resources to support learning, in addition to assistance provided for setting up and maintaining technology hardware and software (Hew & Brush, 2007; Inan & Lowther, 2010). A lack of high-quality professional development training and technical support for technology integration can impede the use of educational technologies in the classroom (Hew & Brush, 2007; Kopcha, 2012). Teachers who are self-motivated may spend additional time learning about technologies not provided at the school or district (Jones & Dexter, 2018).

My research findings were similar to the findings of Jones and Dexter (2018), for example one teacher participant stated, “We are provided with professional development that is a help, but I must admit, I have to spend additional time on my own to figure out features of software programs.” Professional development training provided to teachers did not adequately prepare teachers to integrate technologies in the classroom. Oftentimes, the professional development training provided was not specifically designed to meet the needs of math teachers. One teacher participant stated, “The effectiveness of technology can be used to enhance student learning. Education is moving more toward

online learning. For math, there does not seem to be adequate virtual manipulatives available for online math instruction."

Another barrier teachers encountered was the lack of technological proficiency among students and the students' lack of responsibility on the part of the student when working with technology. Hsu (2016) found that aside from students' lack of computer skills, a lack of training and exposure to technology was the most frequently reported barrier to technology integration. During an interview one teacher participant reported a barrier to integrating technology in the classroom, the participant stated a barrier as, "When students come [to class] without a Chromebook." A teacher participant noted, "Another barrier is intermittent internet availability when using Chromebooks with students.

Lack of support for technological device malfunctions presented a barrier for teachers integrating technology in the classroom. During a classroom observation, the teacher stated that the interactive white board in the classroom was defective and could only be used to display material. This barrier shows a lack of support in maintaining or repairing technology devices used for classroom instruction.

Time constraints were another barrier teachers encountered when integrating technology in the classroom. A lack of time to plan new learning experiences that integrate technology is often cited as a major barrier to educational technology use (Kopcha, 2012). Although professional development training may provide teachers with knowledge about available technology to use in the classroom, time constraints may not allow teachers to adequately plan technology enhanced lessons. Time pressures upon teachers can lead toward teacher-centered, rather than student-centered technology use in

the classroom, as teachers are unable to invest the time needed to support more in-depth learning with technology (Tondeur et al., 2017).

Another research study investigated barriers for technology integration into the teaching-learning process (Tarman, Kilinc, & Aydin, 2019). Various research has indicated that time limitations and/or a lack of time to integrate technology into the curriculum presented barriers to technology integration for teachers (Tarman, Kilinc, & Aydin, 2019). During an interview, one teacher participant was asked, “What barriers if any do you face when integrating technology in the classroom?” The participant responded, “Time is one barrier. There are times when students are out when new technology is introduced, and I may have to go back and teach them what to do or to catch a student up. I may have to take the time to show a student how to use a particular software we are using in the classroom.” Time constraints are a barrier to technology integration and align with previous research (Hew & Brush, 2007) in that teachers lack time to adequately plan for technology use in the classroom.

Second order barriers to technology integration. As discussed above, second-order barriers are those internal to the internal and within the teacher’s influence (Ertmer, 1999). Second-order barriers in this study included teacher beliefs and perceptions about technology integration and teacher demographical characteristics, such as age, experience, and technical proficiency.

Mathematics teachers’ beliefs and perceptions about technology integration was a second order barrier that may impact technology integration in the classroom. Multiple previous studies have concluded that achieving technology integration into classroom instruction is a slow and complex process that is influenced by many factors (Ertmer et

al. 2001). Teachers' beliefs and attitudes are factors that significantly affect technology integration (Chen 2008). Teachers' beliefs about the detrimental effects of teaching with technology, which point out that beliefs about the risks of technology use are less central than beliefs about the potential benefits of technology (Thurm & Barzel, 2022). For example, during an interview a teacher participant described an instance where area models were used to show students to multiply fractions. The teacher commented, "If I feel like I've got a lot of wandering eyes, I'll just go and block them [place restrictions on the student's device]." This example shows that the teacher believes that using technology to model this lesson is beneficial to instruction, even though some students may use the technology inappropriately.

Teacher demographical characteristics, such as a teacher's age, teacher's level of technological proficiency, and previous teaching experience, are factors that influence teachers' decisions about technology integration in the classroom (Inan, & Lowther, 2010). In contrast, Teo and Zhou (2016) conducted a study that discovered teachers whose attitudes were not influenced by gender, age, or experience using computers and did not sway teachers' intentions to use technology in teaching. One study found that teacher characteristics presented barriers to technology in the classroom include the teacher's age, years of teaching experience (Gil-Flores, Rodríguez-Santero, & Torres-Gordillo, 2017). For example, older teachers' low computer skills and self-confidence influenced their decisions to use and integrate technology in the classroom (Inan & Lowther, 2010; Peeraer & van Petegem, 2011). Younger teachers tend to be more open to using technology in the classroom (Inan & Lowther, 2010). Years of teaching experience is at times a barrier to technological integration as it influences the teachers' knowledge

and level of proficiency. Experienced teachers may not be as technology-minded as their less-experienced younger peers (Nelson et al., 2019).

This research confirms the results found in my research. In my research study, it was revealed during an interview that a teacher's age was a factor that influenced teachers' decisions whether to use technology in the classroom. One participant stated, "I feel jealous of these younger teachers because they grew up on this stuff [technology]. I feel like they are much more ahead of the game even though I have been teaching for 20 years... I've had to learn as I go. I am trying to adapt. I'm like pushing 50. I am an old man." This participant described an instance where their use of technology was impacted by their abilities. This teacher participant revealed that they were less proficient in using technology compared to younger, more technology proficient colleagues. This example shows how this teacher's age and abilities impacted their perception of use of technology in the classroom.

Summary

The process of answering each of the three research questions presents a snapshot of teachers' perceptions about technology integration in the classroom and the barriers teachers encounter that impact their technology use in the classroom. Most teachers perceive the professional development training as adequate but not practical for use in the math classroom. Self-motivated and teachers who are confident in their ability to use technology with students are willing to spend time on their own learning about hardware and software to use in the classroom to enhance learning experiences for students. Teachers with lower level of confidence in their abilities or feel they need additional support when using technology may use technology less frequently than their

counterparts. Findings from the interviews and classroom observations show teachers agree that their greatest barriers to technology integration were lack of adequate professional development trainings specific to math instruction, lack of technological proficiency, and time constraints. Teachers also expressed barriers due to their perceptions and beliefs about technology integration. These descriptions are further validated by classroom observations and teacher surveys that showed teachers used technology as a tool to enhance the learning experiences for students.

Implications

This research holds implications for me as a classroom mathematics teacher who is a strong advocate for technology integration. In this section, implications are addressed in sections: personal implications, recommendations for further developing technology integration, and implications for future research.

Personal Implications

I began this program as a mathematics teacher, transitioned to a virtual teacher, and returned to my home school as the math interventionist. In this role I am tasked with using my knowledge of the appropriate grade level curriculum and developmental needs of students to provide relevant learning experiences. My job is to promote student learning by addressing individual learning differences and using effective instructional practices to fill the students' learning gaps. Most importantly, I must collaborate with grade level math teachers to systematically gather, analyze, and use data to measure student progress. Teachers can then use the data to further guide classroom instruction. This action research study yielded two implications for me as a math interventionist that I will continue to practice and foster when working with my colleagues. These

implications are to advocate for more professional development training that is specific to math instruction and ensuring that technology is used effectively as a tool to enhance learning for students.

On more than one occasion teachers stated in survey and interview responses that the professional development training provided to support their use of technology in the classroom was rather broad and did not target their specific content area. For example, Dawson stated “I feel like I've been trained so much. I feel like I've been trained on too much. I would rather be trained on just a couple of things and be good at those couple of things... I feel like I had a little bit of training on a lot of things” and Green echoed, “With technology, it [technology] is so much of it and it changes so fast.” Adam added, “For math, there does not seem to be adequate virtual manipulatives available for online math instruction.” This action research study confirms my belief that professional development training and support should adequately prepare teachers to integrate technology in the classroom in an effective way. Previous research has demonstrated that teacher professional development is critical to any successful change in educational practice (Shulman & Shulman, 2004). My belief is also backed in research as noted by Barr and Stevenson (2011) who identified a major area of need in relation to teacher professional development that includes explicit, ongoing training and support for teachers. Additionally, teachers are expected to develop innovative ways to use technology as a tool to enhance the learning environment and to effectively support their teaching and students' learning with technology (Drent & Meelissen, 2008). Teachers' beliefs revealed during interviews confirmed the findings of previous studies, for example Green stated,

“I would say that technology enhanced my lesson.” Adam agreed, “The effectiveness of technology can be used to enhance student learning.”

If I were to return to teaching only eighth grade math, it would be imperative to gain insight into the technology that is best suited to address the curriculum standards for my students. This research has better equipped me with the knowledge needed to advocate for math teachers and take on a leadership role in the school’s math department. I have become more knowledgeable about the experiences and perceptions of technology used among math teachers. The personal implications of this action research study dictates that my beliefs about my role in enhancing the learning experiences for students through technology integration are valid and require that I maintain competency in both current technology trends and instructional best practices.

Recommendations to Foster Technology Integration in the Mathematics Classroom

Recommendations for technology integration in the classroom in my action research study were based on both prior research and current findings. These recommendations include discussion of the importance of addressing the first-order and second-orders barriers (Ertmer, 1999) to technology integration. First-order barriers included resources such as hardware and software, professional development training, and support. Second-order barriers were internal to the teacher and included teachers’ confidence, beliefs about how students learned, and the perceived value of technology related to teaching and or learning process.

First, teachers identified through survey and interview responses barriers they encountered when integrating technology. The school district provides hardware Chromebooks to students and access to software such as Mathia, Google suite

Nearpod, and Pear Deck for mathematics instruction. Teachers reported barriers to technology integration occurred when these devices malfunctioned and were not available to facilitate instruction. According to Ertmer et al. (2012), certain attitudes and beliefs toward technology, as well as current levels of knowledge and skills, were the strongest barriers preventing teachers from using technology. My first recommendation is that administration, instructional coaches, and teachers collaborate and align the grade-level standards, professional development training, instructional practices, and learning objectives. In other words, professional development training and instructional practices should support the learning objectives that address grade level curriculum standards. By providing teachers with strategically planned professional development training that aligns with curriculum, technology can be better used as a tool to enhance learning. Professional development training that equips teachers with knowledge, builds confidence, and bolsters skills can overcome the obstacles to effectively integrating technology in the classroom.

Second, findings in my study indicated that there are time constraints that prevent teachers from taking advantage of professional development opportunities or adequately planning to incorporate technology into instructional lessons. From my own experiences as a classroom teacher, I can attest that teacher participants in this action study have two forty-five-minute planning periods daily that are often spent attending meetings, making phone calls, grading student assignments, and planning lessons. Oftentimes teachers perform these same tasks outside of work hours. Similarly, previous studies have found that teachers expressed concern about the amount of additional time and effort necessary to use technology in meaningful ways (e.g., Ertmer et al., 2012; Kim et al., 2017). For

example, teachers stated that they have spent time outside of school to learn how to use technology programs, to create activities with technology, and to find ways to enhance their lessons. Time is a major factor that impacts teachers' decisions about technology integration in their lessons. Research suggests that providing the opportunity to learn about technology integration by designing curriculum materials can be a strategy (Lee & Lee, 2014). I recommend that the administration set aside dedicated planning time for teachers for the sole purpose of planning lessons. Each grade level should be given an instructional planning day where all same grade level math teachers and their instructional coach plan for upcoming lessons. Teachers should also use this time to explore technology presented during the professional development training. Teachers should also use this planning time to explore technological resources available to teach various lessons. This way teachers who teach the same content could work together to create lessons and support fellow colleagues who possess various levels of technological proficiency.

Implications for Future Research

According to the National Council of Teachers of Mathematics ([NCTM], 2010) educational decisions made by teachers, school administrators, and other professionals have important consequences for students. Technology integration is an essential component of teaching and learning mathematics as it influences the mathematics that is taught and enhances students' learning. Magnolia Middle School is a Title 1 school that receives federal funding to provide students with the latest in technological equipment and professional development training opportunities for its teachers. An intense focus has been placed on math teachers at this school in an effort to improve student achievement

and performance on standardized tests. Classrooms are equipped with interactive whiteboards, each student is given a Chromebook, teachers receive laptops and an Apple iPad, and students and teachers have access to other hardware and software for use in the classroom. Student academic performance is an indication that the time spent learning in the classroom is critical to improving student achievement. The motivation behind my action research study came from the need to explore teachers' perceptions about technology integration. With an understanding of math teachers' perceptions known, a systematic schoolwide plan can be developed to effectively use technology to enhance mathematical achievement. The implications of this research study are important as they lend themselves to expanding the schoolwide plan to other Title I schools like Magnolia Middle School.

Future research is needed to address first-order barriers that are beyond teachers' control such as student use of devices, immediate support for device malfunctions that occur during instructional time, and ways to foster positive perceptions of technology integration among all math teachers. Currently, interviews, classroom observations, and surveys show that there is no systematic plan in place and math teachers at this research study site integrate technology in different ways.

The Association for Mathematics Teacher Educators (AMTE) committee proposed the TPACK Mathematics Teacher Standard, which provides a framework for guiding instructional practices that support effective mathematics teaching and learning. "The four main themes are Teaching, Learning, Curriculum and Assessment, and Access. The Standard Proposals for TPACK Mathematics Teachers included: (1) The teacher designs and develops environments and authentic learning experiences that combine the

resources and tools of the digital age that are right for optimizing mathematics learning in context (2) The teacher implements a curriculum plan that includes methods and practices by applying the right technology to optimize the learning and creativity of students in mathematics (3) The teacher uses the right technology, to facilitate various effective assessments and appropriate evaluation practices and (4) Teachers utilize technology to increase their productivity and professional practice." Access to technological resources and strategically planned professional development training provided to teachers based on the findings of this study can be used to design an instructional plan teachers can uniformly follow to enhance learning for students.

Teachers indicated that the professional development training the school provides is not specifically designed for their specific math instructional needs. Most of the school-based professional development is characterized as train-and-hope practice (Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009). This type of professional development rarely leads to gains in teacher' skills and students' learning (Darling-Hammond, Hyler, & Gardner, 2017). At this research site, the administration selected professional development training for the teachers. There seems to be a disconnect between what the teachers deem is valuable for instruction and what administrators deem as important for math teachers. The implication is that there needs to be a needs assessment done for teachers and administrators to determine the specific types of professional development needed for math instruction to improve student achievement.

Much of existing research on technology integration has focused on teacher perceptions. This action research study included middle level math teachers and their experiences integrating technology in the classroom. However, first-order barriers

teachers identified were students' lack of proficiency in working with technology and students' misuse of technology during instruction. Further research is needed to understand middle school math students' perceptions of technology integration in the classroom. This suggests future research must also examine factors that influence students' perceptions of technology integration in the classroom.

Finally, teacher participants indicated that technology was used as a tool to enhance learning and engage students. Some research has shown that technology in teaching math leads to improved student learning (Ertmer et al., 2012; Smirnova & Bordonaro, 2014). Others have shown the importance of professional development when teachers use interactive technology in teaching mathematics (Hofer et al., 2016). My recommendation is that more research needs to be conducted at this research study site, that is measurable, to determine the effectiveness of the teacher professional development training and technology tools used in the classrooms of this research site.

Limitations

This research study has unique limitations that affected the research process and thereby prevented generalizations from being made on a broader scale. These limitations are organized into (a) research study site (b) timing of the study, and (c) the researcher.

The location of this study was confined to a single research site. The site location included a small number of teachers and students which limited the number of participants. The class sizes were reduced to approximately half the number of students who attend classes at the school during a regular school year. The number of total possible participants was further reduced as not all mathematics teachers participated in the research study. This limitation reduced the volume of data collected for this study.

Another limitation that should be noted is the effect the COVID-19 pandemic had on the data collection phase of the study. Teacher surveys, observations, and interviews were scheduled and conducted during the second semester of the 2020-2021 school year. One limitation to this study was the number of interview questions included in the interview protocol. There were eight interview questions posed to participants during interviews which allowed the participants to speak freely. The number of questions was limited because interviews were conducted after school on the teachers' personal time. Due to the restrictions in place during the COVID-19 pandemic, observations included groups of students who attended school face to face on certain days and e-learning on other days. The class sizes were reduced and movement within the classrooms was restricted. Therefore, authentic data collected during classroom observations represented a limitation. Qualitative data collected through classroom observations were an important source for this research study as it contributed to understanding what and how teachers use technology in the classroom.

Finally, I may have contributed additional limitations as the researcher. My researcher positionality was one of insider as I am employed as a math teacher in the school. I have strong connections to the school and have worked alongside the teacher participants involved in the research study. As the researcher I was mindful of how my own biases and assumptions may have influenced my observations of participant classrooms (Fleming, 2018). However, member checking (Creswell, 2017) of transcripts and findings was also used to ensure accuracy in representing the perceptions of participants. Additionally, participants may have been reluctant to respond honestly to

interview and survey questions. My position as the researcher may have impacted participant responses during the data collection phase.

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APPENDIX A

TEACHER SURVEY

Introduction to Study and Consent

Thank you for considering participation in this research study. I am completing research for the Curriculum and Instruction, with an emphasis on educational technology, educational doctorate program at the University of South Carolina. This study will fulfill my degree requirements. I would like to invite you to participate in this study to collect information that may be used to recommend ways to improve technology integration and student achievement a[redacted]

This study will collect information regarding three key aspects of technology integration in the classroom. The three key aspects in the survey include: your current practices of technology integration, your perceptions of technology integration, and the barriers that influence your perceptions of technology integration. The survey will also include a demographic information section to ascertain the characteristics of the survey participants.

Participation is anonymous, which means that no one will know what your answers are. To ensure anonymity, your name and email address is not included in the demographic section of the survey. You do not have to answer any questions that you do not wish to answer. The results of the study may be published or presented at professional meetings, but your identity will not be revealed.

Your participation is voluntary. You are under no obligation to participate and there are no negative consequences if you withdraw from the study.

I will be happy to answer any questions you have about the study. You may contact me at [redacted] and email me [redacted] my faculty advisor [redacted] If you agree to participate, please click next to begin answering the survey questions. It will take approximately 20 minutes to complete the survey. There is nothing else you need to do when you finish answering the survey questions.

With kind regards,

Charlene Jeffreys
[redacted]

* Required

Demographic Information

APPENDIX B:

TECHNOLOGY INTEGRATION SURVEY

Technology Integration Survey

Items
Vision
I was expected to use technology to support content objectives.
There was strong administrative backing for using technology.
The demands/goals placed on me for using technology were reasonable.
Access
The technology available was, for the most part, useful for teaching.
I received help fixing technology problems in a timely manner.
The technology available was, for the most part, reliable.
Beliefs
I believe using computers with students increases their learning.
It is easy to design learning activities that incorporate computers.
I believe that technology makes my job as a teacher easier.
Professional Development
The training I received could be easily applied in my classroom.
I felt adequately trained on the skills needed to use technology.
I had enough opportunity to share technology lessons with other teachers.
Time
Integrating technology took less time than I thought it would.
I was given time to learn to integrate technology into my lessons.
I had enough time to plan and prepare lessons that use technology.

APPENDIX C:

TECHNOLOGY PERCEPTION SCALE

Technology Perception Scale

Items

Q: Please, rate your perceptions about the below statements. (1 = Strongly Disagree to 5 = Strongly Agree)

Items of "Principal Support Scale"

1. School administrators are generally supportive of teachers' technology use in lessons.
2. I don't have much difficulty accessing the internet at school.
3. When I come across a technology-related problem at school, I can easily obtain technical assistance.
4. School administrators are role models in using technological devices effectively.
5. Whenever necessary, I can readily use all the technologies in our school.
6. In our school, I don't have any difficulty accessing instructional software and ready-made materials.
7. Adequate technical support is provided in our school.
8. All technological devices in our school are kept in good working condition and updated regularly.
9. Adequate in-service training opportunities are provided in our school.
10. Whenever necessary, I can use IT classes.
11. Several facilities (i.e., trainings, workshops, sample lessons) that encourage teachers' technology use are offered in our school.
12. There are sufficient technologies in my class to fill my needs.
13. The school administration rewards teachers verbally or in a written way for using technologies effectively in their courses.

Items of "Colleague Support Scale"

1. In our school, teachers help each other with technology use.
2. Some teachers are role models who use technological devices effectively in their lessons.
3. Most teachers in our school are supportive of technology use in lessons.
4. Teachers share technology-based instructional materials in our school.

Items of "Attitude and Beliefs Scale"

1. I want to have more information about technology use in lessons.
2. I find technology supported lessons so entertaining.
3. The use of technology increases students' interest to the lesson.
4. The use of technology increases the permanency of the learning.
5. The use of technology positively impact students' achievement in the lessons.
6. The use of technology increases students' participation to the lessons.
7. Technology use makes the lessons more student centered.

Items of "Lack of Time Scale"

1. Preparation for technology supported lessons takes too much time.
2. Using technology in the lessons takes too much time.
3. Due to a heavy curriculum load, I can't allocate adequate time to use technologies in lessons.
4. I can't find enough time to learn how to use technologies in lessons.

APPENDIX D

SEMI-STRUCTURED INTERVIEW PROTOCOL

Time of interview:

Date:

Place:

Interviewer:

Interviewee:

Introduction

Good afternoon! Thank you for participating in this research study. This interview will take approximately 30 minutes. While no risks are anticipated as a result of your participation, you have the right to stop the interview or withdraw from the research at any time.

General Information

1. Describe an experience in which you used technology in a classroom.
2. What technology did you use in this experience?

Technology Integration in the Classroom

3. What factors influenced your decision to use this technology?
4. What concerned you the most about using technology in the classroom?
5. Discuss the professional development and technology training you were provided that prepared you for integrating technology in the classroom.
6. Tell me about any support you received regarding technology in your classroom.
7. Describe any barriers if any you have encountered regarding technology in the classroom.
8. Do you have any final comments or thoughts about technology integration at Berea Middle School?

Once again, thank you for your participation in this research study.

APPENDIX E

LOFTI OBSERVATION CHECKLIST

THE WILLIAM & IDA FRIDAY INSTITUTE FOR EDUCATIONAL INNOVATION

NC STATE UNIVERSITY COLLEGE of EDUCATION

Looking for Technology Integration (LoFTI)

Looking for Technology Integration (LoFTI)

Purpose: LoFTI is a tool to aid in the observation of technology integration into teaching and learning. The data gathered through the use of this instrument should be helpful in building-level staff members as they plan and/or provide professional development in instructional technology.

1. **Please enter the date and time:**

   Date (mm/dd/yyyy): ___________

   Time (hh:mm): ________________

2. **Observer Name:** ___________________________

3. **Which school is being observed?** ___________________________

4. **Teacher Name:** ___________________________

For all items, check any and all which apply to the activities being observed.

5. **Grade level:**

☐ Pre-K	☐ 3	☐ 7	☐ 11
☐ Kindergarten	☐ 4	☐ 8	☐ 12
☐ 1	☐ 5	☐ 9	☐ 13
☐ 2	☐ 6	☐ 10	

6. **What track is this class?**

☐ Special Education	☐ Honors
☐ Remedial	☐ Advanced Placement
☐ General Education	☐ Other (please specify):________________

7. Is technology in use?

☐ Yes
☐ No

8. How many students are...

In class_______?
Using technology?_______________
Comments:

____
____
____

9. Student Arrangement:

☐ Tables, Centers, Pods
☐ Circle or U
☐ Cubicles
☐ Rows
☐ Other (please specify): _________________

10. Learning Environment:

☐ Auditorium
☐ Cafeteria
☐ Classroom
☐ Gymnasium
☐ Lab
☐ Media Center
☐ Multi-Purpose Room
☐ Outside
☐ Virtual Environment
☐ Other (please specify):____________

11. Student Grouping:

☐ Independent Work
☐ Learning Center
☐ Pairs
☐ Small Groups
☐ Whole Groups
☐ Workshops
☐ Other (please specify):__________

12. Instructional Collaborators:

- ☐ Administrator
- ☐ Assistant
- ☐ Curriculum Specialist
- ☐ Media Coordinator
- ☐ Other Teacher
- ☐ Outside Consultant
- ☐ Special Education Teacher
- ☐ Student
- ☐ Technology Facilitator/Coach
- ☐ Volunteer
- ☐ None
- ☐ Other (please specify):__________

13. Core Subject:

- ☐ Arts
- ☐ Career/Technical
- ☐ Computer/Technology Skills
- ☐ English/Language Arts
- ☐ English as a Second Language
- ☐ Guidance
- ☐ Health
- ☐ Physical Education
- ☐ Library/Media Skills
- ☐ Mathematics
- ☐ Foreign Languages
- ☐ Science
- ☐ Social Studies
- ☐ Other (please specify):__________

Technology includes such things as computers, laptops, software, iPods, iPads, interactive whiteboards, digital cameras, document cameras, video cameras, the Internet, clickers, 3D virtual space, etc.

14. Teacher Activities:

(check only if technology is being used for…)

☐ Activating prior knowledge	☐ Providing feedback
☐ Assessments	☐ Questioning
☐ Cues, questions and advance organizers	☐ Reinforcing/recognition
☐ Demonstration	☐ Scaffolding
☐ Differentiated instruction	☐ Setting objectives
☐ Facilitation (guiding)	☐ Summarizing
☐ Lecture	☐ Other (please specify):__________

15. Assessment Methods:

(check only if technology is being used)

☐ Oral Response	☐ Selected response
☐ Product (e.g. project with rubric)	☐ Written response
☐ Performance (e.g. presentation, demonstration	☐ Other (please specify):__________

16. Technology is being used as a tool for…

(Check either Teacher or Student or both)

	Teacher	Students
Problem Solving (e.g. graphing, decision support, design)	□	□
Communication (e.g., document preparation, email, presentation, web development)	□	□
Information Processing (e.g., data manipulation, writing, data tables)	□	□
Research (e.g., collecting information or data)	□	□
Personal Development (e.g., e-learning, time management, calendar)	□	□
Group Productivity/Cooperative Learning (e.g., collaboration, planning, document sharing)	□	□
Formative Assessment	□	□
Summative Assessment	□	□
Brainstorming	□	□
Computer-assisted instruction	□	□
Face to face classroom discussion	□	□
Face to face group discussion	□	□
Asynchronous discussion	□	□
Drill and practice	□	□
Generating and testing hypotheses	□	□
Identifying similarities and differences	□	□
Project-based activities	□	□
Recitation	□	□
Summarizing and note-taking	□	□

17. Technology hardware is in use by…

(Check either Teacher or Student or both)

	Teacher	Students
Assistive Technology	□	□
Audio (e.g., speakers, microphone)	□	□
Art/Music (e.g., drawing tablet, musical keyboard)	□	□
Imaging (e.g., camcorder, film or digital camera, document camera, scanner)	□	□
Display (e.g., digital projector, digital white board, television, TV-link, printer)	□	□
Media Storage / Retrieval (e.g., print material, DVD, VCR, external storage devices)	□	□
Math / Science / Technical (e.g., GPS, probeware, calculator, video microscope)	□	□
Desktop computer	□	□
Laptop computer (including tablets)	□	□
Other (please specify): ____________________	□	□

18. Technology software is in use by…
(Check either Teacher or Student, or both)

	Teacher	Students
Administrative (e.g., grading, record-keeping)	□	□
Assessment / Testing	□	□
Assistive (e.g., screen reader)	□	□
Computer-Assisted Instruction / Integrated Learning System	□	□
Thinking tools (e.g. visual organizer, simulation, modeling, problem-solving)	□	□
Hardware-Embedded (e.g. digital white board, GPS/GIS, digital interactive response system)	□	□
Multimedia (e.g., digital video editing)	□	□
Productivity Software (e.g., database, presentation, spreadsheet, word processing)	□	□
Programming or web scripting (e.g., Javascript, PHP, Visual Basic)	□	□
Graphics / Publishing (e.g., page layout, drawing/painting, CAD, photo editing, web publishing)	□	□
Subject-specific software	□	□
Web Browser (e.g., MS Internet Explorer, Netscape, Firefox)	□	□
Web Applications		
Course management software (DyKnow, etc.)	□	□
Database systems	□	□
Discussion boards	□	□
Libraries, E-publications	□	□
Search engine	□	□
Video, voice, or real-time text conference	□	□
Web lobs, blogs	□	□
Web mail	□	□
Wiki	□	□
NC-Specific Web Resources		
Learn NC	□	□
NC Wise Owl	□	□
SAS in School	□	□
Other (please specify): ____________________	□	□

For the following items, please indicate the percentage of students in the classroom showing positive student engagement.

19. Student engagement is shown by…

Positive indicator of ***Engagement***	*Circle your best estimate of the percentage of students showing each positive indicator of engagement*						*The opposite is* ***Disaffection***
Sustained behavioral involvement	100%	80%	60%	40%	20%	0%	Tendency to give up easily in the face of challenges
Positive emotional tone—cheerful, calm, communicative	100%	80%	60%	40%	20%	0%	Negative emotional tone—boredom, depression, anxiety, anger, withdrawal, or rebellion
Selection of tasks at the border of their competencies	100%	80%	60%	40%	20%	0%	Selection of tasks well within their comfort zone
Initiation of action when given the opportunity	100%	80%	60%	40%	20%	0%	Passivity, lack of initiative
Exertion of effort and concentration	100%	80%	60%	40%	20%	0%	Laziness, distraction

****OPTIONAL ADDITIONAL ITEMS****

20. How was technology used in this classroom? (RAT framework; Hughes, et al., 2006; Adapted from Wilder Research's Technology Integration Observation Protocol, Maxfield, Huynh, & Mueller, 2011)

(CHECK ALL THAT APPLY and type a brief description in the corresponding text box)

☐ **Replacement.** "Technology used to replace and in no way change established instructional practices, student learning processes, or content goals. The technology serves merely as a different means to the same instructional end. Most of the learning activities might be done as well or better without technology." (*Example*: Using an interactive whiteboard for the same purposes as a chalkboard)

☐ **Amplification.** "Technology used to amplify current instructional practices, student learning, or content goals, oftentimes resulting in increased efficiency and productivity. The focus is effectiveness or streamlining, not fundamental change." (*Example*: Using a word processor rather than written materials for instructional preparation)

☐ **Transformation.** "Technology used to transform the instructional method, the students' learning processes, and/or the actual subject matter. Technology is not merely a tool, but rather an instrument of mentality. The focus is fundamental change, redefining the possibilities of education. Most technology uses represent learning activities that could not otherwise be easily done." (*Example*: Using Google drive or any cloud based applications for student collaboration on a project.)

21. Classroom Agenda:

22. Other comments regarding teacher (e.g. demeanor, comfort with technology, interactions with students):

23. Other comments regarding students (e.g. comfort with technology, peer interactions):

24. Other comments regarding learning environment:

APPENDIX F

PERMISSION TO CONDUCT RESEARCH FROM THE DISTRICT

[redacted]

RESEARCH & INFORMATION SHARING AGREEMENT

[redacted]) [redacted]
[redacted]) [redacted]

This Research & Information Use Agreement (the "Agreement") by and between t[redacted]
[redacted]
with principal offices at **<Requestor Address Here**[redacted],
is entered into as of the date last written below ("the Effective Date")
<Requestor Name or Company Name Here[redacted]
will be collectively known as "Requestor" where appropriate.

This Agreement consists of the complete signature page, and the following attachments that are incorporated into this Agreement and made a part hereof by this reference:

1. Attachment 1: Research & Information Use Agreement Terms and Conditions
2. Attachment 2[redacted]

This Agreement is the complete agreement between the parties hereto concerning the subject matter of this Agreement and replaces any prior oral or written communications between the parties. There are no conditions, understandings, agreements, representations, or warranties, expressed or implied, which are not specified herein. This Agreement may only be modified by a written document executed by the parties hereto. Any disputes arising out of or in connection with this Agreement shall be governed b[redacted] law without regard to choice of law provisions.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be duly executed. Each party warrants and represents that its respective signatories whose signatures appear below have been and are on the date of signature duly authorized to execute this Agreement.

*If you are requesting to conduct research as a student, a university sponsor must be included as an individual. The sponsor, by signing below acknowledges s/he has read and approves this request for Research and Information Sharing [redacted] and understands that supervision of this project rests with the sponsor. The privilege of conducting future studies [redacted]s co[redacted]ioned upon the fulfillment of such obligations. Violation of this statement of agreement will be considered a breach of contract.

[redacted]	[redacted]
Title	
[redacted]	
Date 1/22/21	Date 1/21/2021
	[redacted]

APPENDIX G

PERMISSION TO CONDUCT RESEARCH FROM SCHOOL PRINCIPAL

[redacted]

February 17, 2021

To Whom it May Concern,

I am giving permission for Charlene Jeffreys to conduct her research at [redacted]. I will assist her with any necessary information that she may need to finish her research. Please let me know if there is anything else that I need to provide for her to conduct her research.

Thank You,

[redacted]

[redacted]

APPENDIX H

PARTICIPANT CONSENT FORM

CONSENT FORM

UNIVERSITY OF SOUTH CAROLINA

CONSENT TO BE A RESEARCH SUBJECT

Exploring Technology Integration at a Public Middle School: A Descriptive Research Study on Integration Perceptions, Factors, and Barriers

KEY INFORMATION ABOUT THIS RESEARCH STUDY:

You are invited to volunteer for a research study conducted by Charlene Jeffreys. I am a doctoral student in the Department of Education, at the University of South Carolina. The University of South Carolina, Department of Education is sponsoring this research study. The purpose of this action research will be to is to explore mathematics teachers' current practices of technology integration, mathematics teachers' perceptions of technology integration, and the factors that influence mathematics teachers' perceptions of technology integration. You are being asked to participate in this study because you are a mathematics teacher. This study is being done at [redacted] and will involve approximately six volunteers.

Mathematics teachers' perceptions of technology integration and its ability to assist students in mathematics achievement as determined by state mandated assessments are unknown. This action research study will explore how mathematics teachers use technology in the classroom as part of their instructional practices and their perceptions of technology use. Teachers' perceptions of technology integration play a key role in facilitating student learning.

This form explains what you will be asked to do, if you decide to participate in this study. Please read it carefully and feel free to ask questions before you make a decision about participating.

PROCEDURES:

If you agree to participate in this study, you will do the following:

1. Be interviewed virtually via Google Meet Sessions for approximately thirty minutes about your perceptions of technology integration in your classroom, having your interview recorded in order to ensure the details that you provide are accurately captured. A transcription will be provided. You will be sent the transcript and given the opportunity to correct any factual errors. The transcript of the interview will be analyzed by Charlene Jeffreys as the researcher. Access to the interview transcript will be limited to Charlene Jeffreys and university academic advisors with whom she might collaborate as part of the research process. Any summary interview content, or direct quotations from the interview, that are made available through academic publication or other academic outlets will be anonymized with a pseudonym so that you cannot be directly identified, and care will be taken to ensure that other information in the interview that could identify you is not revealed. The actual recording will be stored on a password-protected computer for the duration of the research and permanently deleted upon the conclusion of the research project. Any variations of the above conditions will only occur with your further explicit approval
2. You would work with me, the researcher, for a period of six weeks. I will seek to understand and measure your technology use in the classroom. I will conduct observations lasting fifty-five minutes. This will take place over the course of three weeks during one of your instructional classroom instructional periods.
3. Finally, the last two weeks will involve checking with you via a shared Google Document to ensure that the information you provided has been presented accurately.

DURATION:
The entire study will last for approximately fourteen weeks. The survey, interview and observation phase will last for six weeks and require three and a half hours of contact time per week. All but one of these hours each week will take place during your regular workday.

RISKS/DISCOMFORTS:
Loss of Confidentiality:
There is the risk of a breach of confidentiality, despite the steps that will be taken to protect your identity. Specific safeguards to protect confidentiality are described in a separate section of this document.

BENEFITS:
You may benefit from participating in this study by becoming aware of the role your perceptions play in the use of technology in the classroom.

COSTS:
There will be no costs to you for participating in this study.

PAYMENT TO PARTICIPANTS:
You will not be paid for participating in this study.

CONFIDENTIALITY OF RECORDS:
Unless required by law, information that is obtained in connection with this research study will remain confidential. Any information disclosed would be with your expressed written permission. Study information will be securely stored in locked files and on password-protected computers. Observation results will be recorded under pseudonym teacher names and the data will be aggregated for reporting. Results of this research study may be published or presented at seminars; however, the report(s) or presentation(s) will not include your name or other identifying information about you.

VOLUNTARY PARTICIPATION:
Participation in this research study is voluntary. You are free not to participate, or to stop participating at any time, for any reason without negative consequences. In the event that you do withdraw from this study, the information you have already provided will be kept in a confidential manner. If you wish to withdraw from the study, please call or email the researcher listed on this form.

I have been given a chance to ask questions about this research study. These questions have been answered to my satisfaction. If I have any more questions about my participation in this study, or a study related injury, I am to contact Charlene Jeffreys at [redacted]

Concerns about your rights as a research subject are to be directed to [redacted]

I agree to participate in this study. I have been given a copy of this form for my own records.

By signing this form, I agree that:

- ☐ I am voluntarily taking part in this project. I understand that I don't have to take part, and that I can stop the interview at any time
- ☐ The transcribed interview or extracts from it may be used as described above
- ☐ I have read all of the information above
- ☐ I understand I will not receive any benefit or payment for my participation
- ☐ I will receive a copy of the transcript of my interview and may make edits I feel necessary to ensure factual accuracy and the effectiveness of any agreement made about confidentiality
- ☐ I have been able to ask any questions I might have, and I understand that I am free to contact the researcher with any questions I may have in the future.

Printed Name: ___________________________________

Participant's Signature: ____________________________ Date: _________________

Researcher's Signature: ____________________________ Date: _________________