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A Mixed-Method Study of One-To-One Mobile Technology Implementation in Math in a Rural Middle School

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Approval Page

This dissertation was submitted by Maxie N. Deaton Jr. under the direction of the persons listed below. It was submitted to the Gardner-Webb University School of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Gardner-Webb University.

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Abstract

A Mixed-Method Study of One-To-One Mobile Technology Implementation in Math in a Rural Middle School. Deaton Jr., Maxie N., 2017: Dissertation, Gardner-Webb University, Mobile Technology/Student Achievement/One-to-One/Math/Middle School

The purpose of this mixed-methods study was to examine the extent of one-to-one mobile technology implementation on student math achievement as measured by standardized test scores. A second focus was on the extent one-to-one mobile technology implementation has influenced teacher practices in math instruction. A final focus was on the extent that teacher lesson plans support or fail to support technology implementation.

The setting for the study was a small rural middle school in the Upstate of South Carolina. The participants consisted of males and females from several ethnicities and socioeconomic classes. A parallel/simultaneous method was used for the study.

The results revealed statistically significant differences in student achievement growth between grade levels. The areas of gender, ethnicity, and socioeconomic status did not result in any statistically significant differences. Teacher perceptions of technology and implementation varied. The teachers with greater technology proficiency had lower student growth. Teacher lesson plans included technology implementation to a great extent.

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Chapter 1: Introduction

Overview

The importance of a teacher in a student's life is second only to that of the relationship between parent and child. In the past, the teacher was the instrument through which students received the skills needed for success in life. Due to the diversity that exists in today's classrooms, effective teachers must incorporate a mixture of different instructional strategies when developing and implementing lessons of study. In today's technology-driven world, technology can provide students with instant access to a world of knowledge. Digital technology, however, is missing in many educational settings.

Students live in a world of video games, mobile devices, and entertainment at their fingertips; but they are expected to leave that as they enter the classroom. Students in today's schools are constant consumers of technology including internet searches, blogs, and social media. According to McNew (2008) in his dissertation researching the relationship between handheld devices and math, new technology requires new skills to assist students in acquiring, analyzing, and using information in order to be successful in the 21st century. Kristine Gullen, Educational Consultant for Oakland Schools in Waterford, Michigan, and Holly Zimmerman, English teacher in Birmingham, Michigan, coauthored an article in *Educational Leadership* that provided tips for saving time by using technology (Gullen & Zimmerman, 2013). The authors shared tips on ways to infuse technology with time-tested teaching strategies (Gullen & Zimmerman, 2013). Technology integration is most successful when teachers use the technology to improve and enhance current practices (Gullen & Zimmerman, 2013). Technology ingrained lessons require teachers to train on the technology and to effectively plan the lesson. In many one-to-one environments, these steps are omitted. As more and more schools and districts implement one-to-one programs, others can learn from their mistakes and their successes.

A school's goal is to develop the minds of its students. Due to challenging state and national standards, an intense focus has been placed on increasing student achievement. The Profile of a South Carolina Graduate lists rigorous English language arts (ELA) and math standards as top priorities for student knowledge (South Carolina Department of Education, 2015). The profile also lists creativity, critical thinking, communication, media, and research as other important goals. Students can use technology not only for the access of information but also for collaboration and communication with others outside of their classroom. The more students read, write, and discuss new learning, the more they will understand, remember, and be able to apply that knowledge. Classroom instruction should focus on higher order thinking skills such as analysis and evaluation in order to increase student achievement. According to Tomaszewski (2012), technology paired with supportive school culture and strategic implementation can have a significant impact on student achievement.

Statement of the Problem

Students in today's classrooms are technologically proficient and many are more advanced than their teachers. Cell phones, music players, tablets, and the internet are everyday resources that instantly provide information. Today's youth will leave home with almost nothing except their smart phone. They have a desire to stay connected to the digital world at all times. Students are exposed to games, videos, music, texts, and social media throughout the day. Houle (2014) stated, "If you are not changing the shape, nature, character, and form of your school system, you may not have one by 2020. If this sounds extreme, realize how much change you have already experienced as educators since 2010" (p. 17).

Public schools are moving to a one-to-one mobile technology environment. Mobile devices are provided or students are allowed to bring their own device. Does this technology at student fingertips increase student achievement? A myriad of research regarding the use of technology has been conducted, but only a small amount focuses on teacher implementation in classrooms (Rinelli, 2013). Dunn, Wilson, and Freeman (2011) discussed a teacher's stance on technology as either an approach or an avoidance. "Many teachers view technology as both a blessing and a curse. There can be great benefits, but at what cost?" (Dunn et al. 2011, p. 17). Due to the rapid technological advancements in today's society, students must also be trained to use technology so they will be better equipped when entering the workforce. According to Heitin (2015), by 2020, it is expected that there will be one million vacant computing jobs due to a lack of skilled workforce. This mixed-methods study examined the extent of one-to-one mobile technology implementation on student math achievement as measured by standardized test scores. A second focus was on the extent one-to-one mobile technology implementation has influenced teacher practices in math instruction. A final focus was on the extent that teacher lesson plans support or fail to support technology implementation. Due to student dependency on technology and the plethora of information made readily available, technology must be included in the school setting.

Theoretical Base

This mixed-methods study explored the extent to which one-to-one mobile technology implementation impacts student achievement and teacher practice. As such, it was based on the constructivist theory. The ideas of constructivism have foundations in Jean Piaget, John Dewey, Lev Vygotsky, and Jerome Bruner. This theory states learners construct knowledge through experiences and reflection (Liepolt & Wilson, 2004). New ideas are compared to current beliefs. The learner decides to accept or to refute the new information. Active techniques are used such as experiments and problem-based learning. Learning takes place through a spiral design where students use previous knowledge, add experiences, gain new information, and then create new experiences (Liepolt & Wilson, 2004). The teacher is still a vital part of the process as a guide and a wealth of knowledge. Learners do not create new information but examine current information and use that information to reshape their own ideas. The idea of constructivism is relevant to a one-to-one mobile technology classroom. Students have immediate access to the internet and to other forms of technology that can be used as tools to research, create, and construct their own learning. Technology will allow the learning to expand outside the four walls of the classroom and provide a wealth of information. Students can also use technological tools to analyze and synthesize the information they construct through various activities and learning experiences.

Research Questions

1. In what ways and to what extent has one-to-one mobile technology implementation impacted student achievement in math as measured by standardized test scores?
2. What are teacher perceptions of the ways and the extent to which one-to-one mobile technology implementation has influenced teacher practice and student achievement in math?
3. In what ways and to what extent do teacher lesson plans support or fail to support one-to-one mobile technology implementation in math instruction with fidelity?

Significance of the Study

The significance of this study stemmed from its potential contribution to the larger body of research devoted to one-to-one mobile technology in education. Future researchers can use information from this study to further investigate the impact of mobile technology on student achievement. McKeachie (1999) expounded on the idea that engaging students during class facilitates learning. McKeachie discussed many teaching techniques to engage learners including the use of technology, discussions, and lectures. School districts, district administrators, and practicing teachers can use the information to guide their own implementation of a one-to-one mobile technology program. Best practices for mobile technology implementation can also be acquired from the study. Education policymakers such as local and state boards of education may use study findings to assist in making informed decisions about one-to-one mobile technology implementation and support.

Definition of Terms

Criterion-referenced tests (CRTs). Assessments of student learning against a predetermined set of academic standards (Abbott et al., 2015).

Measures of academic progress (MAP). Computer-based program to assess students in academic areas that adapts to student progress during the assessment.

Mobile device. For this study, mobile device refers to a tablet with a keyboard that functions much like a laptop computer.

One-to-one mobile technology program. A program where each student is provided a web-enabled mobile device for use at school and home (Abbott et al., 2015).

Project-based learning. A teaching method requiring learners to research issues relevant to their lives and have their learning assessed through the project rather than traditional testing (Winebrenner & Brulles, 2012).

Student achievement. Measures of student learning and performance on various standardized tests and tasks (U.S. Department of Education, 2012).

Summary

This study focused on the extent to which a one-to-one mobile technology program impacts student achievement, teacher perspectives, and lesson planning in a rural middle school's math instruction. Technology is infused in our society and should be included in the classroom. Technology allows students to play an interactive role in the learning process. When this occurs, students are able to draw connections between the material taught and their lives. Chapter 2 reviews literature and other studies on the history of digital technology, implementation, training for teachers, and effects on student achievement.

Chapter 2: Literature Review

Introduction

Since the invention of the computer, technology's role has increased in the school setting. The impact of technology on student achievement is dependent upon the form and the degree to which it is implemented. The literature review focuses on five areas. The first section provides background on the history of technology in the educational setting. The second section describes mobile technology implementation in the school setting. The third section provides insight into technology training for teachers. The fourth section provides information on teacher perceptions of technology implementation. The fifth section focuses on the impact of technology on student achievement.

History of Digital Technology in Education

Since their invention over 70 years ago, computers have rapidly changed and advanced. From large devices that took up an entire room to the small handheld devices of today, the computer has revolutionized how we retrieve, store, analyze, synthesize, and process information. The early computers were not compatible to classrooms. It was not until the 1980s that devices became more widely used in education.

According to McNew (2008), the creation of supercomputers in the 1980s allowed computers to talk to each other. Once computers were integrated into the classroom, software production was vital. Basic word processing, internet browsers, and data analysis tools were a few of the types of software available (Williams, 2004). Personal computers have transformed into personal laptops and now tablets. Loading programs on computers started with floppy discs which changed over the years to compact discs and now to downloaded programs from the internet. Peacock and Breese (1990) interviewed students about their experiences with word processors. Students used the word processors in content classes to complete writing assignments. Interviews revealed that students were excited about using the word processors (Peacock & Breese, 1990).

Technology advancement moved at a rapid pace through the 1990s. The World Wide Web began commercial use and Apple Computer Inc. released the first Personal Digital Assistant (PDA) in 1993 (The Evolution of Technology in the Classroom, 2016). By 2009, 97% of American classrooms had computers, most with a ratio of five students to one computer. Research mainly focused on laptop computers (Kim, Holmes & Mims, 2005). In the late 1990s, interactive whiteboards were introduced. These devices allowed a blending of handwritten notes and interactive technology. Videos and links could be embedded into teacher presentations (Nguyen & Hughes, 2013).

Today's computers are smaller and faster than ever. These advancements created a change in educational technology. "Trends in educational technology generally follow those in society, because educational institutions are responsible for preparing their students to become productive citizens in that same society" (Davis, 1997, p. 77). This can be seen today with school districts embracing and using social media to promote their programs. Many schools began incorporating desktop computers into classrooms and creating computer labs with 20-30 stations. Computer-assisted instruction provided the means for individualized instruction. Technology transformed from film and overhead projectors to smart boards. Students were able to write directly on the board and save their annotations. Laptop carts became available, and teachers could bring the technology into the classroom rather than move students to a computer lab.

Over the last 10 years, one-to-one mobile technology implementation has taken place in classrooms. All students are provided with a tablet or small laptop for computing needs. “With one-to-one computing, students and teachers are immersed in technology tools that they use daily” (McNew, 2008, p. 28). Students can use the technology to create videos, podcasts, and presentations and to conduct research on the internet (“A brief history,” 2016). A complication for the implementation of one-to-one mobile technology is the cost and lack of infrastructural support, according to a report by Interactive Educational Systems Design and STEM Market Impact (Nagel, 2013).

In 2015, technology and virtual learning and reality became affordable for classrooms (“A brief history,” 2016). Molnar (1997) wrote about obtaining a deeper understanding of phenomena through virtual reality as early as 1997. Virtual reality goggles by Google and other companies were cost efficient and worked with cell phones. As the price of virtual reality devices decreased, the incorporation in classrooms increased.

One-to-One Mobile Technology Implementation

Montgomery (2007) described today’s students as “active creators of a new digital culture” (p. 2). Montgomery discussed the ways youth use digital technology and its effects on their development. *Digital natives* was the name coined by Prensky (2001) for this generation. *Net generation* was another name Tapscott (2009) gave to today’s students. “These students are accustomed to multitasking, random-access, twitch-speed, graphics-first, fun, fantasy, MTV, connected, active, and Internet” (Prensky, 2001, p. 4).

> Even though graphing calculators have been around for a long time and over 80% of high school mathematics teachers report using them for classroom instruction, over the past five years, there has been a push to introduce portable devices in most grades and in all subjects. (McNew, 2008, p. 30).

Providing students with the “ownership” of a device gives them access to information at any time of the day. According to Kim, Homes, and Mims (2005), three key factors for the need for one-to-one mobile technology in the education setting were

1. Convenience – allows users to access and use information during "down" times.
2. Expediency – allows users to share information and data anytime and anywhere.
3. Immediacy – allows users to store information in and out of the classroom.

The movement to provide a mobile computer to each student was encouraged by decreasing costs, increasing computer power and capabilities, growing wireless capabilities, increased access to the internet, and public awareness of the need for a technology-proficient workforce (Ellmore, Olson, & Smith, 1995). According to Apple Computer, Inc. (2005), the goals for one-to-one mobile technology implementation included student achievement, access to digital resources, workforce preparation, and quality of instruction. Microsoft (2015) provided an online guide for technology planning. Key ideas included defining the strategy for implementation, identifying requirements, purchasing technology, implementing training, maintaining devices, and continuing learning (Microsoft, 2015). Kobbeltvedt (2014) stated, "In my mind, two key 21st century emerging skills are global awareness and collaboration. Children want to connect with other people in the world; talk to them, learn from them and play games" (p. 31). "What is Successful Technology Integration" (2007) stated the following three signs of successful technology integration:

1. Routine and transparent.
2. Accessible and readily available for the task.
3. Supporting the curriculum, and helping students reach their goals.

A true sign of successful integration was when the use was second nature and the consumer did not stop to think they were using technology in the classroom ("What is Successful Technology Integration," 2007). Through technology integration, teachers provided students with up-to-date primary sources, data collection programs, online collaboration, multimedia presentations, authentic learning, and forums for publishing their work ("What is Successful Technology Integration," 2007). Based on the National Education Technology Standards for Students, the *Edutopia* article stated the following about technology integration:

> Effective integration of technology is achieved when students are able to select technology tools to help them obtain information in a timely manner, analyze and synthesize the information, and present it professionally. The technology should become an integral part of how the classroom functions – as accessible as all other classrooms. ("What is Successful Technology Integration," 2007, p. 1)

The *Edutopia* article also mentioned the following tools and practices for technology integration: online learning; blended classrooms; technology-enhanced, project-based lessons; game-based learning; mobile devices; student response systems; podcasts; online documents; and social media sites.

Herold and Doran (2016) focused on the new Ed-Tech plan by the United States Government. This plan focused on the areas of learning, teaching, leadership, assessment, and infrastructure. This new plan replaced the last plan that was presented in 2010 when one-to-one mobile technology implementation was a new idea and personalized learning was being developed (Herold & Doran, 2016). The 2010 plan focused on the divide between having or not having technology. The divide in 2016, focused on how to use the technology in the classroom (Herold & Doran, 2016). Herold and Doran stated that the document faulted teacher preparation and professional development programs for the lack of educators understanding how to effectively implement technology in the classroom. In the summer of 2015, a federal education law that included an amendment called I-TECH was approved by the United States Senate. This amendment provided federal funds for educating teachers on technology use. It did not get included in the Every Student Succeeds Act (ESSA) signed by President Obama (Herold & Doran, 2016). The new digital divide became those who knew how to implement technology in the classroom and those who did not.

Technology Training for Teachers

The findings of a 1999 national survey of over 2,000 public and private school fourth- through twelfth-grade teachers revealed that 60% of teachers reported receiving 5 hours or less of staff development in technology (Becker, 1999). Becker (1999) went on to say that the majority of the training was in technological skills, not instructional technology implementation. A study on digital teaching and learning by Davis (2010) stated,

> Broad leadership skills are required to implement such an extensive plan and that collaborative professional development with persistent commitment and vision are needed to overcome the teacher's sense of urgency, yet fear of failure, when striving to transform instructional methodology. (pp. 1-2)

Cowley (2013) studied one-to-one mobile technology implementation for students with disabilities. The research concluded with results for effective implementation. One such result stated that teachers must be trained effectively in order for a one-to-one mobile technology implementation program to be successful (Cowley, 2013). Many districts have integrated tier one support on a daily basis through the use of student technicians in an elective class. The students trouble shot problems for students and created student tutorials for teachers and students to use in class (Marcinek, 2015).

Developing teacher abilities to generate authentic assessments using the technological tools was also necessary. Tina Barrios, Ph.D. and a group of Florida educators served as a task force to determine the readiness for laptop education and made recommendations for the district (Barrios et al., 2004). One finding determined that one-to-one mobile programs "greatly enhance a teacher's ability to make authentic assessment part of day-to-day instruction" (Barrios et al., 2004, p. 13). The task force felt teaching and learning had to change and mirror the world around it. Teachers could use the handheld clickers to quickly assess student knowledge or to choose from one of the many online applications that could be played in game format.

Shaffhauser (2015) included productivity applications; mastering search, research, and internet literacy; connecting through social media; troubleshooting your own technology; finding and sharing files; embracing curiosity; using video; juggling multiple display devices; perfecting presentations; and managing learning and students. Veteran teachers may not have possessed these skills and would need successful training prior to classroom implementation. Digedu, a Chicago-based company assisting in the transition from textbooks to technology, conducted a survey of over 600 kindergarten through twelfth-grade teachers (Rochford, 2014). Fifty percent of these teachers reported a lack of assistance when implementing technology in the classroom, and 46% reported they lacked the training needed to implement the technology with their students (Rochford, 2014). Another survey by GfK on behalf of Samsung (2015) reported that 60% of educators wanted to implement technology effectively but did not feel prepared to do so. Samsung created a video to help design technology training for teachers.

A group of teachers participated in a Minecraft training at ISTE 2015. This game was a favorite among students and could be used to teach a wide variety of concepts. One lesson included using the game to create replicas of historical buildings. In math, students created architecture based on area and volume (Herold, 2015b). In 2015, USA Today reporter Greg Toppo wrote the book *The Game Believes in You: How Digital Play Can Make Our Children Smarter*. When interviewed about the book, Toppo shared benefits including increased student engagement and in some cases increased student achievement. He did not believe that games should replace all instruction, but they did have their place in the classroom (Herold, 2015a).

Teachers had to embrace the use of technology in their classrooms. Norris and Soloway (2010) predicted all students in kindergarten through twelfth grade would be using a mobile learning device in the next 5 years because mobile is bigger than the internet. Although this prediction did not prove true, there were steps made toward more one-to-one mobile technology implementation in schools. Norris and Soloway (2010) focused on mobile device use at St. Mary's City Schools in Ohio. Kyle Menchhofer, technology coordinator at St. Mary's City Schools witnessed teachers differentiating lessons based on student needs and learning styles (Menchhofer, 2010). Norris and Soloway (2010) also stated that students were more engaged, and the teachers were more engaged with the students.

Baltimore City Public Schools created a teacher student support (TSS) group to conduct professional development for teachers (Delaney, 2011). The TSS group discovered that administrator support and long term professional development were crucial to successful integration. The TSS group created a Retool Your School program that turned technology implementation into a 4-week coaching cycle (Delaney, 2011).

McCrea (2012) reported on strategies Western Heights School District in Oklahoma City used to help train teachers. Western Heights School District created four-part training sessions comprised of lecture, videos, assignments, and tests required before teachers could move to the next session. Teachers had to complete the training prior to the technology installations in the classrooms (McCrea, 2012).

Technology implementation was not about the technology but about the learning pedagogy (Norris & Soloway, 2015). Norris and Soloway (2015) stressed the importance of staying on the course when bumps in the road occurred during the transition from direct instruction to project-based learning with the assistance of digital technology. Teachers needed time to successfully implement technology.

Teacher Perspectives of One-to-One Mobile Technology

A group of researchers studied eight teachers from different schools with varying experience to investigate teacher perceptions of technology integration. ChanLin, Hong, Horng, Chang, and Chu (2006) determined that teacher personal beliefs and experiences determined the degree of technology implementation in their classrooms. The majority of teachers in the study attributed creative teaching as an important tool. Creative teaching did not require technology, but technology could enhance their creative teaching (ChanLin et al., 2006). Some of the teachers included in the study were concerned that students spent more time copying and clicking rather than analyzing and interpreting information.

According Pepe (2016), teachers valued the technology training they received but did not feel that all their individual needs had been met. Teachers felt proficient on the use of the device but needed more instruction on the use of applications and their integration into the classroom. Teachers did not perceive any issues with student use of the devices due to most students being technologically proficient. Pepe suggested targeting a small population of teachers for technology training and problem solving. By using a small group, a concentrated focus could be obtained allowing specific improvements in instruction.

A path model study by Inan and Lowther (2009) focused on teacher perceptions of factors contributing to technology integration. Teachers from 54 schools in Tennessee were included in the study. Teacher years of experience, age, proficiency, and beliefs were just a few of the indicators included. Teacher readiness and beliefs were found to be the biggest contributing factors in technology integration. The teachers wanted to be familiar with the technology prior to implementation. Teachers who felt more confident and prepared were more likely to implement the technology (Inan & Lowther, 2009).

Another study of teacher perceptions of technology in schools included a survey of 103 educators in north central Texas (Gentry & Lindsey, 2008). The study by Gentry and Lindsey (2008) noted that teacher perceptions of technology use could be dependent on years of teaching experience. Teachers with more than 10 years of experience were more likely to report they were excellent in instructional technology. Those with less than 5 years of experience reported they were inefficient with regard to technology; however, the participants reported they regularly used technology for instruction but listed email and paperwork (51%) as a priority. Instructional tasks (16%) and research (19%) were much lower in priority (Gentry & Lindsay, 2008).

Results from another study of teacher perceptions concluded that teachers use technology to deliver instruction more than integration into teaching and learning. According to this study, teachers in Grades 9-12 integrate technology more than those in kindergarten through fifth grades or sixth through eighth grades (Gorder, 2008). Teacher experience impacted their beliefs and perceptions of technology implementation.

Technology Impact on Student Achievement

An increase in student achievement required students to have access to the same tools used in the business world (Barrios et al., 2004). A large number of studies cultivated the same conclusion that instruction fused with technology implementation increases student achievement (Bain & Ross, 2000; Boster, Meyer, Roberto, & Inge, 2002; Koedinger, Anderson, Handly, & Mark, 1997; Mann, Shakeshaft, Becker, & Kottkamp, 1998). The end goal for any instructional decisions including curriculum, technology implementation, and teacher delivery was an increase in student achievement.

A study of prekindergarten through secondary school teachers by Rakes and Casey (2002) analyzed teacher concerns toward instructional technology. This task force felt teaching and learning had to change and mirror the world around it. Students needed the same tools used in the business world to increase student achievement. Positive teacher attitudes and technology efficiency were also required to increase achievement (Rakes & Casey, 2002). Teacher and student collaboration influenced student achievement (Marzano, Marzano, & Pickering, 2003). Students could be presented with information in a variety of forms; however, that does not ensure that learning was taking place.

Wenglinsky (2005) referenced a study of student computer use and test scores stating that quality was more important than quantity. Wenglinsky's study found that the use of computers to address higher order thinking skills was more effective than computers for routine tasks. This supported the importance of pushing students toward the higher thinking skills with or without the use of digital technology. Empirical Education conducted a study comparing students in four California school districts using

Fuse Algebra I, an online application, to others using a traditional textbook (Tomaszewski, 2012). On average, the students using online resources scored as well as those with a textbook. Results in one high school showed a nine-point percentile increase for those using the online technology (Tomaszewski, 2012).

According to Wagner (2008), the technology would not guarantee learning but would increase student interest. Students with access to mobile devices performed higher than those without devices in "writing, English-language arts, mathematics, and overall grade point average" (Holcomb, 2009, p. 50). Warschauer, Arada, and Zheng (2010) concluded that students "conducted more background research for their writing; they wrote, revised, and published more; they got more feedback on their writing; they wrote in a wider variety of genres and formats; and they produced higher quality writing" (p. 221). Warschauer (2008), when describing advantages of writing with mobile devices, stated,

> computer-based writing became more naturally integrated into instruction; the writing process became more interactive with students able to receive and respond to feedback better; writing became more public, visible, and collaborative; writing became more purposeful and authentic with students able to write things with real objectives; students took advantage of the formatting features of computers to write in multiple and diverse genres; by using computer based language and formatting tools and by revising their work for authentic audiences, students produce higher quality writing in which they took more pride; many students became more autonomous in their writing and even engaged in creative writing during their free time. (p. 3)

The classroom environment was more active in a one-to-one mobile technology school due to projects, collaboration, independent inquiry, teachers serving as coaches, and other student-centered strategies (Lowther, Ross, & Morrison, 2003). Students communicated, shared ideas, completed projects, and studied using technology. Cowley (2013) concluded that one-to-one mobile technology had a positive effect on all student learning experiences. Whiting (2009, as cited in Keengwe, Schnellert, & Mills, 2011) listed the following as benefits of one-to-one mobile technology implementation:

> Improved academic achievement, higher rates of attendance, better student engagement in the 21st century learning process, parental satisfaction with educational systems, improved teacher ability to prepare students for the 21st century, and a greater ability to meet the changing needs of students, teachers, and parents. (p. 9)

Microsoft Corporation launched a laptop program in 1996 and included more than 800 schools and 125,000 students by 2000. The program was evaluated multiple times with positive results on student achievement (Rockman et al, 1997, 1998, 2000). Some of the positive student outcomes included engagement, project-based learning, improved research skills, problem solving, and better collaboration. Students were able to apply knowledge to multiple disciplines. Positive teacher outcomes included teachers serving as facilitators rather than lecturers and a more constructivist approach to teaching as students became active participants in the learning process (Rockman et al, 1997, 1998, 2000).

The implementation of technology also aided in personalized learning. Personalization required teachers to address the learning needs, interests, and cultural backgrounds of each individual student. Schools provided students with a variety of pathways for learning (Personalized Learning, 2015). Cavanagh (2014) focused on the ambiguity of the term *personalized learning*. In the article, Andrew Calkins, Deputy Director of Next Generation Learning Challenges, had the following to say about personalized learning:

> The thing to understand about personalized learning is that it describes a methodology, rather than just a set of goals. The default perspective is the student's – not the curriculum, or the teacher. Schools need to adjust to accommodate not only students' academic strengths and weaknesses, but also their interests, and what motivates them to succeed. (Cavanagh, 2014, p. 2)

Several school districts tried work from home days for students. Students were allowed to log onto their digital devices and complete assignments in the comfort of their own homes. There were some downsides of virtual days such as seat time, burden for parents, lack of internet access, and poor online academic performance (Herold, 2016). Teachers had mixed feelings regarding the virtual day. Some preferred face-to-face classes so they could engage in conversations and base questions on student work. Other teachers enjoyed the online discussions that allowed students who might not speak out in class to share their thoughts (Herold, 2016).

Johnson (2015) stated, "using technology is one of the best means of adapting materials for diversity and gathering information about many cultures" (p. 81). Technology assisted teachers in incorporating cultural diversity into lessons in an engaging and practical way. Engaged students performed better; engagement is the key to student learning. Many factors contributed to the success of students. One-to-one mobile technology was only one factor leading to an increase in student achievement.

Summary

Technology was constantly changing and mobile technologies such as cell phones and tablets were the new tools in education. These one-to-one mobile technology devices were replacing the tools of the past such as chalk boards, whiteboards, worksheets, and even textbooks. Just as educational practices have changed over the years so has educational technology. Some classrooms incorporated virtual reality opportunities during lessons. Technology used in the classroom reflected the world in which the students lived. Teachers trained on new technology and had the opportunity to implement it in the classroom setting. The impact of the technology on student achievement should be monitored as with any instructional strategy to foster continuous improvement. Technology implementation must be carried out in a methodical, purposeful manner. This review of literature explored the ideas of a one-to-one mobile technology implementation including the history of technology, teacher technology training, teacher perceptions, and technology's impact on student achievement. Chapter 3 provides an explanation for the methodology of the study.

Chapter 3: Methodology

Introduction

The purpose of this mixed-methods research was to study the impact of one-to-one mobile technology on student achievement and teacher perceptions in a rural middle school. Students were provided mobile devices to use at school and at home. Students brought devices to school each day for integration in all classes. Students completed online assignments, projects, and research based on each teacher expectations. Students had access to online math programs and tutorials for enrichment and remediation. Student achievement data, teacher perceptions, and lesson plans were used to analyze the impact of the technology. Student engagement was vital to student achievement. According to the National Center for Biotechnology Information, student attention spans have decreased from 12 to 8 seconds since 2000 (Fernandez, 2015). Based on an article by Keengwe, Pearson, and Smart (2009), technology integration helped increase student attention and engagement in the learning process, but the results relied on the effectiveness of teacher implementation. This research focused on the ways and to what extent one-to-one mobile technology implementation has impacted student achievement in math as measured by standardized test scores. It examined teacher perceptions of the ways and extent to which one-to-one mobile technology implementation has influenced teacher practice and student achievement in math. Finally, it addressed the ways and to what extent teacher lesson plans support or fail to support one-to-one mobile technology implementation in math instruction with fidelity.

Research Design

The research design was based on the parallel/simultaneous mixed design by Tashakkori and Teddlie (1998). A parallel/simultaneous design utilizes both quantitative and qualitative data collected simultaneously, analyzed separately, and then compared. This design followed some of the historical ideas of the multitrait-multimethod matrix of Campbell and Fiske (1959). They believed correlations could be determined from studying multitrait quantitative data (Campbell & Fiske, 1959). Researchers further developed their idea by joining quantitative and qualitative methods centered on the same sample in one design (Creswell, 2014). The parallel/simultaneous mixed method approach compared and related both the quantitative and qualitative data but did not require the same sample. Quantitative and qualitative data comparison strengthened the study by incorporating multiple techniques and methodologies (Holtzhausen, 2001). This research examined quantitative data in the form of student achievement on assessments and qualitative data in the form of teacher interviews and lesson plans. The figure below was adapted from Tashakkori and Teddlie and provided a visual diagram for the research design (p. 44).

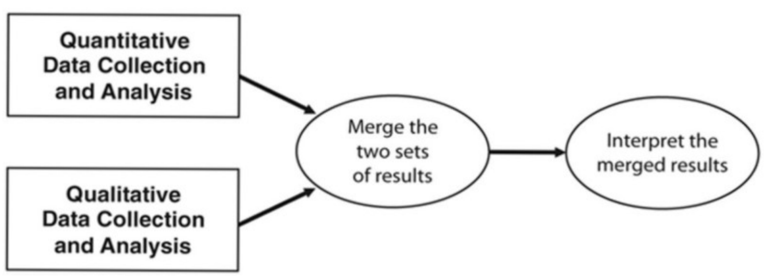

Figure 1. Parallel/Simultaneous Method Design Graphic.

Setting

This study was conducted with the permission of the district superintendent, Appendix A, in a rural middle school in the Upstate of South Carolina. The middle school housed approximately 220 students in sixth through eighth grades and was one of two middle schools in the district. Seventy-five percent of the population attended the same elementary school. Fifteen percent of students attended another district elementary school, and the other 10% were transplants from other districts and towns. The middle school fed into one district high school with approximately 900 students. The small school had a rich history and stayed active in community events.

Participants

The students were in the same school system with the same teachers for the year included in the study. The sample for the quantitative portion of this study consisted of a total of 213 students: 73 students in sixth grade, 65 students in seventh grade, and 75 students in eighth grade. Participant demographics were 113 males and 100 females with ethnicities of the population consisting of 181 White, 21 African-Americans, four African-American and White, three Asian, and four Native. Ninety-six students received free lunch and 10 received reduced lunch. Sixty-two students received special education services through an individualized education plan (IEP) or a 504 plan. School personnel collected all data to ensure student anonymity from the researcher. The data were organized by student numbers. These numbers were assigned to students when they first registered for school. For the purpose of this study, all data were presented based on these numbers rather than any identifying information such as student name. Student data included grade level and demographics. The final summary of the data was provided to the researcher.

The teachers included in the qualitative portion of the study consisted of a first year math teacher in sixth grade, a teacher with over 30 years of experience in seventh grade, and a teacher with 4 years of experience in eighth grade. All three teachers taught in the same rural middle school for the duration of the study. Each teacher was housed in the same building and under the supervision of the same administrator. The teachers had equal access to a teaching and learning specialist to assist in technology integration in the classroom. The teachers also met monthly with a district math coach to discuss curriculum and best practices. Teacher lesson plans were submitted electronically each Monday morning.

Instrumentation

The mixed-methods study included quantitative data in the form of standardized test scores. MAP was an online multiple-choice assessment provided by the Northwest Evaluation Association (NWEA). MAP was a norm-referenced assessment that adjusted questions as students answer correctly or incorrectly. The assessment provided each student with a Rasch Unit or RIT score. This score was used to compare student progress to peers across the school, district, state, and nation. Student growth throughout the year was also determined by the RIT score. Students also received RIT ranges for the following sections of the test: (a) operations and algebraic thinking, (b) real and complex number systems, (c) geometry, and (d) statistics and probability. After the fall assessment, MAP provided students with a growth target they should have met on their spring assessment. The data from the three assessments indicated if growth occurred throughout the year. Based on the RIT score, a teacher could review the DesCartes Scale that provided the established skills at each RIT band and indicate what skills needed more development and those skills needed to move to the next RIT band.

NWEA (2011) followed the Standards for Educational and Psychological Testing developed by the American Educational Research Association, American Psychological Association, and the National Council on Measurement in Education. "To ensure test reliability, validity, and fairness across all populations tested, the NWEA research team regularly conducts a variety of studies and analyses such as: pool depth analysis, test validation, comparability studies, and Differential Item Functioning (DIF) analysis" NWEA, 2017, research para. 2). Traditional reliability methods could not be used to determine test reliability for MAP since the same exact test was not given to any student. Questions were based on student responses to a previous question on the same specific content.

> Test-retest reliability of MAP tests is more accurately described as a mix between test-retest reliability and a type of parallel forms reliability, both of which are spread across several months – a much longer time frame than the typical two or three weeks. (NWEA, 2011, p. 55)

The second administration of the MAP test was comparable to the first in structure and content but differed in difficulty of test items (NWEA, 2011).

Concurrent validity was determined by the extent that one assessment's results compared to another assessment of the same content. "This form of validity was expressed in the form of a Pearson correlation coefficient between the total domain area RIT score and the total score of another established test designed to assess the same domain area" (NWEA, 2011, p. 184). To test the concurrent validity, both tests were given to the same students in a 2- or 3-week period. Correlations in the mid .80's indicated strong concurrent validity. Correlations for the MAP math test were .849 for sixth, .839 for seventh, and .833 for eighth (NWEA, 2011).

Based on the structure of the test, all students heard the same directions and followed the same testing procedures. There was no time limit for completion of the test. Due to test security, a copy of the assessment could not be included.

The qualitative data included in the study consisted of interviews with three math teachers and samples of their lesson plans. The interview questions, Appendix B, were written by the researcher to obtain teacher perspectives on the manner in which one-to-one mobile technology implementation had influenced their practice and student achievement. The style of questions was patterned after teacher questionnaires included in a study on teacher retention (White, 2015). Lesson plans, due electronically on Monday mornings, included direct instruction, guided practice, and independent practice as well as lesson openers and closures. Lesson plans were submitted in OneNote notebooks to the administration each week. One-to-one mobile technology implementation used during the week was included in the correct area of the lesson plan such as direct instruction, guided practice, or independent practice. Due to each teacher having over 50 weeks of lesson plans, a sampling was included in the study.

Quantitative Data Collection and Analysis

The group of students included in the study took a standardized test in September 2015 and March 2016. Students completed an assessment, MAP from NWEA in math. This assessment was taken in the fall and spring with scores being available within 24 hours. MAP scores were collected for fall and spring administrations. Students had taken the assessment for at least 3 years prior to the year of data included in the study. The multiple-choice assessment was given over a 2-day period. The test was administered by a trained faculty member in their math classroom. The test was not timed and students were familiar with the process and procedures during administration of the assessment. The data were collected and compiled by a school official who shared results with the researcher.

MAP data assigned students a growth target based on the first assessment. If students had a successful year of growth, they would have met this target or shown growth toward the target on the last assessment. The data were analyzed using a one-way analysis of variance named ANOVA. A one-way ANOVA *t* test of dependent samples compares the mean difference between two paired scores (Ary, Jacobs, & Razavieh, 2002). Students' fall and spring assessment scores were analyzed with a one-way ANOVA. The quantitative data also included the percentage of students who did not meet target growth but showed growth over the course of the year and the percentage of students whose score decreased from the fall to spring.

Qualitative Data Collection and Analysis

Teacher interviews were conducted to obtain teacher perspectives on one-to-one mobile technology implementation and its impact on teacher practice and student achievement. The participants received an invitation to participate, Appendix C, and a consent form, Appendix D, prior to the interview. Interviews were conducted according to the interview protocol by Creswell (2014). The protocol, Appendix C, included directions, opening questions, study questions, closing questions, and a general thank you. The detailed protocol ensured that each interview was administered in the same manner. Teachers met with the researcher in a school office and were interviewed one at a time. The interviews were recorded, and the researcher took notes on teacher responses to questions.

A sample of electronic lesson plans were collected for the study. One weekly plan for each 9 weeks of the year for each teacher was included in the study. A school official printed copies of the plans and submitted them to the researcher. Technology implementation in instruction follows the district's technology plan. This plan provides specific guidelines for teacher implementation of technology.

According to Creswell (2014), once the qualitative data were collected, several steps in the analysis process occurred. The researcher first reviewed each piece of qualitative data and began focusing on specific information. As more pieces of data were analyzed, themes emerged. The data were condensed into five to seven themes. The themes were coded or represented by one word. The coding followed Tesch's Eight Steps in the Coding Process and assisted the researcher in analyzing the data (Creswell, 2014).

Tesch's Eight Steps in The Coding Process:

1. Read all of the transcripts – interviews and lesson plans.
2. Pick one document and consider its underlying meaning and write thoughts in the margin.
3. After completing number 2 for several documents, make a list of topics and cluster similar topics into columns.
4. Abbreviate the topics, and review all documents. Add the abbreviations by the appropriate topics in the documents.
5. Use the most descriptive wording for your topics and create categories. Reduce your total list of categories by grouping topics that relate.
6. Make a final decision on the abbreviation and alphabetize the codes.
7. Assemble the data for each category in one place and perform a preliminary analysis.
8. If necessary, recode your existing data.

The themes were compared with the context of the qualitative data, interpreted, and then validated. A visual for the analysis of qualitative data is below (Creswell, 2014).

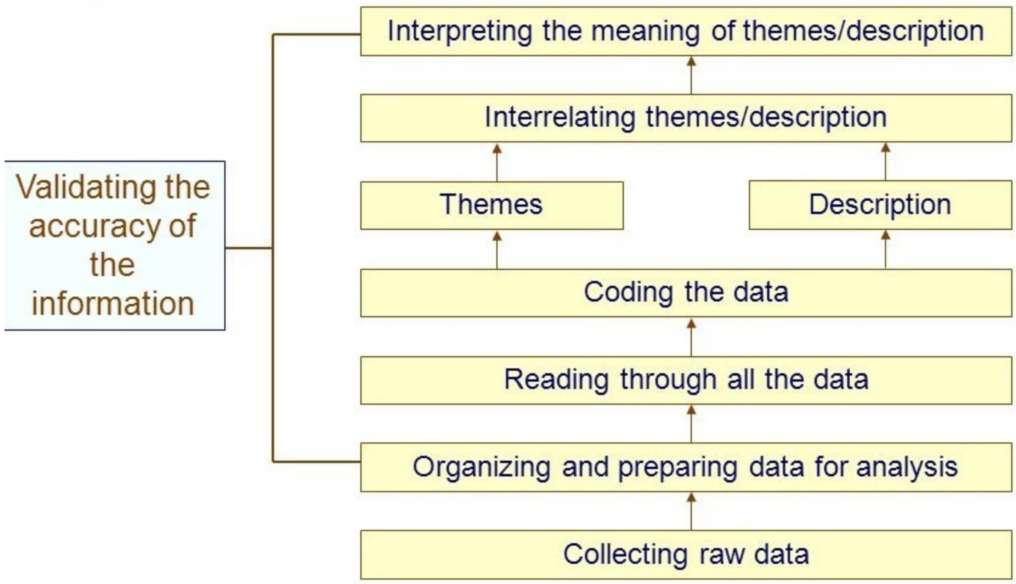

Figure 2. Analysis Procedures for Qualitative Data.

Subjectivity Statement

A researcher must accept and understand his/her personal prejudice toward the topic of study. Subjectivity could guide a researcher's topic, methodology, and data analysis (Ratner, 2002). The researcher must be aware of how his/her values and his/her objectives affect the research (Ratner, 2002).

As an educator, the researcher has worked in the setting of this study for 17 years. The researcher began as a teacher and then moved into administration. His long-term investment in the school system and the community provided insight into the goals and missions of the district. The researcher acknowledged potential bias for the district but remained as neutral as possible while completing the study. The findings of the study, positive or negative, were used to improve the one-to-one mobile technology program where possible and potentially provided guidance for other technological implementations.

The participants in this study were currently in their second year under the researcher's leadership. Their years of experience were in other districts in the state. The interviewees willingly participated in the study. Their voluntary participation had no bearing on their teaching positions or their status in the school or district. Their current role as teachers under the researcher's leadership impacted their decision to participate. The interviews were carried out in a nonthreatening environment to assist in limiting any reservations by the interviewees. During the interviews, the role of principal took a backseat to the role of researcher.

The researcher's background including education, experience in the classroom, and administration of a one-to-one mobile technology program shaped the interpretation of the results (Creswell, 2014). The researcher's knowledge as a scholar assisted in minimizing the influence of personal experience as an administrator and a leader of the school when analyzing the qualitative data and drawing conclusions in the study.

Limitations

There were several limitations to the study. The sample consisted of 213 sixth- through eighth-grade students in a small, rural middle school. Due to the small sample size, the results might not have been consistent in studies with larger samples. The sample also consists of students in a rural school with low socioeconomic status. The results only represented samples from that same socioeconomic status and not those of more affluent populations. The collected data were over a 1-year period in three different grades, so student maturation may have impacted results. Students respond differently to teachers, and that could have affected student learning. The student-teacher relationship and student preference for one subject to another could have also altered the results on the math assessment. Test anxiety for some students could have played a role in the results. Anxious students could have become nervous and not performed as well under pressure. Some students performed well in the class but not on assessments. Information gained from conducting interviews may have limited the results of the research. Interviewee perspectives, information gathered outside of the natural setting, and the researcher's presence may have caused bias (Creswell, 2014).

Summary

One-to-one mobile technology implementation was becoming more common in public schools. The impact of one-to-one mobile technology on student achievement and teacher practice was valuable in making decisions about technology implementation. The information provided in this section could have allowed further researchers to recreate this study in other populations or regions. The outcomes of this study were based on the population and the guidelines listed here; other studies may not have resulted in the same conclusions. Chapter 4 provides an explanation of data collected in this study.

Chapter 4: Results

Introduction

One-to-one technology implementation programs are the current trend in education. This trend is the focus of many studies to determine technology program effectiveness on student achievement, real world applications, and teacher quality. Many students leave the classroom without a firm grasp on the use of technology in education and the world around them. Instead, they see technology as a source of entertainment through videos, music, and social networking. The inclusion of technology in education helps students prepare for life in college and the workplace. To become productive members of society, schools must provide students with the skills needed for success. Those skills range from collaboration to problem solving to critical thinking to technology usage. These skills are a key piece of the profile of a South Carolina graduate (South Carolina Department of Education, 2015). This parallel/simultaneous mixed methods research focused on one-to-one technology implementation and its impact on student achievement, teacher perspectives, and teacher lesson plans. The following research questions guided this study.

1. In what ways and to what extent has one-to-one mobile technology implementation impacted student achievement in math as measured by standardized test scores?
2. What are teacher perceptions of the ways and the extent to which one-to-one mobile technology implementation has influenced teacher practice and student achievement in math?
3. In what ways and to what extent do teacher lesson plans support or fail to support one-to-one mobile technology implementation in math instruction

with fidelity?

The quantitative and qualitative data collected in this study are analyzed and then merged to determine the extent of impact of the one-to-one technology program. The findings are organized by research question and then merged.

Quantitative Findings

The research studied the extent to which one-to-one mobile technology implementation impacted student achievement in mathematics. The quantitative data used in this study consisted of math MAP scores over a 1-year period. A fall or pre-score and a spring or postscore were included. Student growth from the fall to spring was calculated by subtracting the fall score from the spring score. In some cases, the growth was negative. In this work, a one-way ANOVA and the independent sample t test were used to study the difference between the selected factors and student growth. A one-way ANOVA was used due to the fact that the study factors (lunch, grade level, gender, and race) had subgroups.

Students growth rates ranged from -15 to 31. The overall average student growth was 3.77. The average growth by grade level was 2.96 for the 73 sixth-grade participants, 5.58 for the 65 seventh-grade participants, and 2.99 for the 75 eighth-grade participants. Of the 213 participants, 12 scored the same in the fall and spring.

A one-way ANOVA was used to compare the growth between the sixth, seventh, and eighth grades. There was a significant difference between the sixth and seventh grades (p=.044). The Tukey post hoc test revealed that the sixth-grade growth was significantly statistically different than the seventh-grade growth. The significant difference between the sixth and eighth grade was greater than 0.05 (p=1.0). The growth of the sixth grade was not significantly statistically different than the growth of the eighth grade. The statistical difference between the seventh and eighth grades was less than 0.05 (*p*=.045). This result based on the Tukey post hoc tests shows that there was a statistically significant difference in the growth of the seventh and eighth grades. Table 1 displays the significant difference in growth based on grade level.

Table 1

One-Way ANOVA Comparing Growth by Grade Level

(I) Grade	(J) Grade	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
6	7	-2.62571*	1.08878		-5.1957	-.0557
	8	-.02776	1.04968	.044	-2.5055	2.4500
7	6	2.62571*	1.08878	1.000	.0557	5.1957
	8	2.59795*	1.08192	.044	.0441	5.1518
8	6	.02776	1.04968	.045	-2.4500	2.5055
	7	-2.59795*	1.08192	1.000	-5.1518	-.0441

Note. *The mean difference is significant at the 0.05 level.

The participants represented the five different ethnic groups White (W), African-American (AA), African-American and White (AA & W), Asian (A), and Native (N). The statistical differences between each ethnic group were greater than 0.05. This means there were not statistically significant differences in student growth from fall MAP to spring MAP based on ethnicity. Table 2 compares the significant difference in growth based on ethnicity.

Table 2

One-Way ANOVA Comparing Growth by Ethnicity

(I) Ethnicity	(J) Ethnicity	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
W	AA	-1.56619	1.43739	.812	-5.5217	2.3893
	AA & W	.81425	3.28065	.999	-8.2136	9.8421
	A	1.23091	3.77780	.998	-9.1650	11.6269
	N	-3.68575	3.28065	.794	-12.7136	5.3421
AA	W	1.56619	1.43739	.812	-2.3893	5.5217
	AA &W	2.38043	3.51543	.961	-7.2935	12.0544
	A	2.79710	3.98339	.956	-8.1646	13.7588
	N	-2.11957	3.51543	.975	-11.7935	7.5544
AA& W	W	-.81425	3.28065	.999	-9.8421	8.2136
	AA	-2.38043	3.51543	.961	-12.0544	7.2935
	A	.41667	4.95620	1.000	-13.2221	14.0554
	N	-4.50000	4.58855	.864	-17.1270	8.1270
A	W	-1.23091	3.77780	.998	-11.6269	9.1650
	AA	-2.79710	3.98339	.956	-13.7588	8.1646
	AA &W	-.41667	4.95620	1.000	-14.0554	13.2221
	N	-4.91667	4.95620	.859	-18.5554	8.7221
N	W	3.68575	3.28065	.794	-5.3421	12.7136

Note. *The mean difference is significant at the 0.05 level.

Students are classified into three groups by socioeconomic status; free pay, reduced pay, and full pay. The one-way ANOVA test was used to compare the growth of each socioeconomic group. Based on the results of the Tukey post hoc test, the significant differences were all greater than 0.05. There were no statistically significant differences between the socioeconomic group growth. Table 3 compares the significant difference in growth based on socioeconomic status.

Table 3

One-Way ANOVA Comparing Growth by Socioeconomic Status

(I) Lunch Status	(J) Lunch Status	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Full Pay	Reduced	-.41495	2.14854	.980	-5.4865	4.6566
	Free	.07671	.91340	.996	-2.0793	2.2328
Reduced	Full Pay	.41495	2.14854	.980	-4.6566	5.4865
	Free	.49167	2.15903	.972	-4.6046	5.5880
Free	Full Pay	-.07671	.91340	.996	-2.2328	2.0793
	Reduced	-.49167	2.15903	.972	-5.5880	4.6046

Note. *The mean difference is significant at the 0.05 level.

The last comparison of student growth was based on gender. There were 115 males and 93 females included in the study. The average growth of females was 0.13 of a point higher than that of the males. The statistical significance was greater than 0.05 (p=.89). This means there was not a significantly statistical difference in the growth of males versus females. Table 4 is a comparison of growth based on student gender.

Table 4

One-Way ANOVA Comparing Growth by Gender

Gender	Number	Mean	Std. Deviation	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Male	115	3.7130	6.47907	.60418	.89	2.5162	4.9099
Female	98	3.8367	6.48661	.65525	.89	2.5363	5.1372
Total	213	3.7700	6.46753	.44315	.89	2.8964	4.6435

Note. *The mean difference is significant at the 0.05 level.

The quantitative findings show there was positive growth from fall to spring with an average growth of 3.77 points. Based on the one-way ANOVA, there were no statistically significant differences between gender, socioeconomic status, or ethnicities. There was a statistically significant difference between seventh grade and both sixth and eighth grades. There was not a significant difference between sixth and eighth grade. These results will be compared to the qualitative findings.

Qualitative Findings

Teacher interviews were conducted to address Research Question 2, "What are teacher perceptions of the ways and extent which one-to-one mobile technology implementation has influenced teacher practice and student achievement in math?" When analyzing the data, the teachers are referred to as Teacher 1, Teacher 2, and Teacher 3. Teacher 1 is a first year math teacher in sixth grade; Teacher 2 has 4 years of experience in eighth grade; and Teacher 3 has over 30 years of experience in seventh grade.

Question 1 asked teachers to describe their decision to teach math including their first impressions. Teacher 1 was influenced by a college professor who inspired her to teach. Her first impression led her to question teaching, realizing how much work was involved. Teacher 2 liked how her eighth grade math teacher taught by making connections in math. Teacher 2 wanted to make a difference and show students the importance of math in their lives. Her first impression led her to realize that it was much more difficult and the students did not want to learn as much as she did at that age. Teacher 3 also had great influences in her own personal education that led her into teaching. She said, "I like the structure of math, ability to quickly see if there is an understanding or not and to see growth over time."

Question 2 focused on teacher impressions of technology in education. Teacher 1 said technology had its place in classrooms and should be used as a tool. Teacher 2 stated there was a time and place for technology but pencil and paper were still important in the math classroom. Teacher 3 stated, "I do believe it has a great place in education, in the classroom."

The researcher asked the interviewees how they would describe the school's one-to-one mobile technology program to others. Teacher 1 used the phrase "up and coming-well on its way." The ability for students to carry the devices home was a benefit and allowed teachers to flip lessons using videos. Teacher 2 described it as one-to-one with every student having their own laptop to use every day. A follow-up question asked about Teacher 2's experience with one-to-one mobile technology in other schools. She replied that one school did not have one-to-one mobile technology and one school used Chromebooks. Teacher 3 described the use of Edmodo, the ability to stay in contact with students, sharing information and videos. She also liked the protection and firewalls used by the district to protect students.

Question 4 asked teachers to describe any professional development experience they had with technology implementation. Teacher 1 majored in technology education, attended several education technology conferences, and subscribed to blogs, edtech, and twitter. Teacher 2 could not recall any professional development based on technology implementation. She stated, "I google lessons and see what others have blogged about." Teacher 3 attended workshops on Microsoft Office and Edmodo. Based on their staff development experiences, they were asked what changes in instructional practices they implemented. Teacher 1 added video lessons with embedded questions and tiered lessons to her instructional practices. Teacher 2 incorporated Desmos because it showed students relationships and Delta Math because the program describes what the student did wrong allowing them to learn independently from their mistakes and gain immediate feedback. Teacher 3 stated, "In the math class I haven't used it as much. I used it a lot when I taught ELA. If I had to choose one weakness it would be with technology and the use of it and my lack of trying to use it."

When asked about the greatest impact of technology implementation on math instruction, Teacher 1 stated individualization and Teacher 2 mentioned immediate feedback. Teacher 3 stated the use of 3D images in geometry, tools for every student that the school cannot afford, an understanding of math in the real world, and video games. The next question asked if the teacher believed technology implementation impacted student achievement. Teacher 1 had always taught with technology and stated, "Without technology they are engaged on me. With technology, there is an increase in engagement." Teacher 2 replied, "I think it helps them take their time. They want to get the answer right the first time. They see the relationships and see how the math works." Teacher 3 felt the technology helped some students' achievement. She believed it depended on their personality and learning style because some students liked pencil and paper.

The teachers were asked to describe how they implemented technology into their daily lesson plans. Teacher 1 used Khan Academy for remediation and review. She also included video platforms on Edpuzzle which allowed students to put in an answer and get feedback without penalty. Teacher 2 incorporated technology into her Power Up or bell work, Edmodo for assignments, and implemented one technology activity per week. Teacher 3 used a document camera to show students examples to review and provide immediate feedback.

When asked what advice the teachers would give the director of technology implementation in their district, they had this to say. Teacher 1 would emphasize a focus on project-based learning, college and career readiness, and more about content, not the device. Teacher 2 would request more professional development on ways to incorporate things into the classroom. Teacher 3 would ask for low-impact instruction during professional development giving teachers a comfortable setting to share information and things they learned.

Research Question 3 asked, “To what extent did teacher lesson plans support or fail to support one-to-one mobile technology implementation in math instruction with fidelity.” Lesson plans for 1 week per grading quarter were collected for all three teachers, September 21-25, 2015, November 16-20, 2015, January 5-8, 2016, and April 18-22, 2016.

For the week of September 21-25, 2015, in the first grading quarter, Teacher 1 used an online program, Edpuzzle, to incorporate a video into the lesson. Students used applications on their mobile technology device to complete a project over the course of the week. Teacher 2 only used one internet activity that week. Teacher 3 used an online question bank, Core Bites, each day for bell work and included one video during one lesson that week.

During the week of November 16-20, 2015, in the second grading quarter, Teacher 1 used a google doc 4 days for bell work; a quiz type game, Kahoot, for review; a reflection on Edmodo; and two online activities for extra practice, Edpuzzle and Classworks. Teacher 2 incorporated an online activity and a video during the course of the week. Teacher 3 used the Core Bites online program for bell work and a video to explain a mathematical concept.

In the third grading quarter, from January 4-8, 2016, Teacher 1 used an internet site for students to research vocabulary words. She also used the online programs Edpuzzle twice, Go Formative once, and Quizizz once. Students had to complete and submit one assignment electronically that week. Teacher 2 had students use the Delta

Math online program to practice translations. Teacher 3 used Core Bites 4 days for bell work and also included a video once during the week.

From April 18-22, 2016, in the fourth grading quarter, Teacher 1 used Core Bites for bell work all 5 days. She also incorporated two videos, BrainPop and ratios; and four online programs, HRW tutorial, EdPuzzle, Quizizz, and Socrative. Teacher 2 used one video. Teacher 3 used Core Bites each day for bell work.

Table 5 summarizes the types of technology implementation stated in teacher lesson plans during the 4 selected weeks.

Table 5

Types of Technology Implementation Included in Selected Lesson Plans

	Video	Online Program	Online Application
September	1	2	10
November	2	5	10
January	10	5	5
April	3	5	10

Summary

The study attempted to answer three questions on the effects of one-to-one technology implementation on math achievement.

1. In what ways and to what extent has one-to-one mobile technology implementation impacted student achievement in math as measured by standardized test scores?
2. What are teacher perceptions of the ways and the extent to which one-to-one mobile technology implementation has influenced teacher practice and student achievement in math?
3. In what ways and to what extent do teacher lesson plans support or fail to

support one-to-one mobile technology implementation in math instruction with fidelity?

In this study, both quantitative and qualitative data were collected. The quantitative data analyzed student growth in math based on a fall and spring MAP test. The growth of subgroups in socioeconomic status, gender, ethnicity, and grade was also compared. Only one of the subgroup comparisons showed a statistically significant difference in growth. Seventh grade student growth was statistically significantly different than that of their sixth- and eighth-grade peers. The seventh grade also had the largest average growth of 5.58 points, more than 2.5 points higher than the average growth for sixth (2.96 points) and eighth (2.99 points) grades.

The qualitative data focused on interviews with three teachers of differing years of teaching experience and technology proficiency. All three teachers believed there was a place for technology in the math classroom but that it should be used as a tool. Teachers submitted lesson plans for 4 weeks during the school year. The plans were analyzed to see what technology implementation had taken place. The teachers used technology more in the winter and spring including more online applications. When comparing the qualitative and quantitative data, Teacher 3 who had the most teaching experience but the least experience with technology taught seventh grade. This grade had the greatest growth over the course of the year based on the fall and spring MAP tests. Teachers 1 and 2 who had technology experience had lower growth averages for the year.

Based on the lesson plans provided, there were more opportunities for students to use online applications during the winter and spring. The plans shared types of programs and applications used in the math classroom but did not explain the details of the applications. The use of the various applications and programs was not consistent across the three grades.

The implication of findings, recommendations, and final conclusions are explained in the next chapter.

Chapter 5: Discussion

Introduction

A study on teacher perceptions of technology use in schools by Mundy, Kupczynski, and Kee (2012) found that technology use in the classroom provided an engaging, hands-on experience requiring active thinking, unlike that of a traditional textbook-based lesson. This study examined the impact of one-to-one mobile technology on math achievement in a rural middle school. Student achievement based on student growth on a pre and posttest, teacher perspectives of one-to-one mobile technology implementation, and teacher lesson plans were data sources examined in this study. Using student growth, the characteristics of grade, ethnicity, socioeconomic status, and gender were also compared. The implications of findings are summarized and discussed in the next section.

Implications of Findings

Research Question 1. In what ways and to what extent has one-to-one mobile technology implementation impacted student achievement in math as measured by standardized test scores?

Student growth on the MAP math assessment was used as quantitative data in this study. Student achievement increased by an average of 3.77 points based on the pre and posttest. One-to-one mobile technology may have been one cause for the increase. Students used laptops to complete assignments and master content. The MAP assessment was also given electronically. Growth for each grade, ethnicity, socioeconomic status, and gender was compared to determine any statistically significant differences. Based on data, there were not statistically significant differences in student growth based on ethnicity, socioeconomic status, and gender. These outside factors did not cause a difference in student achievement growth. This implies that all students are achieving at the same rate regardless of their gender, race, or socioeconomic level. The growth between Grades 6 and 8 was not statistically different either; however, both Grades 6 and 8 were statistically significantly different from Grade 7. The average growth for Grade 7 was almost 2.5 points higher than that of Grade 6 and Grade 8. This difference is based on the grade level and not other identifiers used in this study. One or more variables resulted in higher growth in seventh grade.

Research Question 2. What are teacher perceptions of the ways and the extent to which one-to-one mobile technology implementation has influenced teacher practice and student achievement in math?

Three teachers were interviewed for this study. Teacher 1 taught sixth grade and had 1 year of experience; Teacher 2 taught eighth grade and had 4 years of experience; and Teacher 3 taught seventh grade and had over 30 years of experience. All three teachers believed there was a place in the math classroom for technology. Each teacher had been provided with some professional development for one-to-one mobile technology implementation. Teacher 3, with the greatest teaching experience, had the least experience with technology and did not implement it into the classroom to the extent of Teachers 1 and 2. Teacher 3 stated in the interview that paper and pencil computation was still important and needed in the mathematics classroom. Teacher 3 taught seventh grade which had the greatest increase in growth based on the pre and posttest. The teachers with the greatest technology proficiency and implementation in instruction had lower student achievement. The implemented instructional technology may have taken away from the acquisition of content. The instructional methods used by Teacher 3 were more effective than those of Teacher 1 and Teacher 2.

Research Question 3. In what ways and to what extent do teacher lesson plans support or fail to support one-to-one mobile technology implementation in math instruction with fidelity?

Teacher lesson plans were collected for all three teachers for the same 4 weeks throughout the year. The lesson plans were analyzed for the frequency and type of technology implementation used in the math classroom. Based on the data, online applications were used twice as much as videos and online programs. Overall, there were 68 instances of mobile technology implementation during the 4 weeks of lesson plans. The number of mobile technology instances is high for only 4 weeks of instruction. The majority of the technology was implemented by Teacher 1 and Teacher 2. These two teachers had lower student growth than Teacher 3. Teacher expectations for technology implementation are based on the guidelines found in the district's technology plan. According to the district's technology plan, teachers are expected to "create effective learning environments and experiences supported by technology."

Conclusions

The theoretical base for this study centered around the ideas of constructivism. Learners construct knowledge through experiences and spiral review in order to reshape their own thinking (Liepolt & Wilson, 2004).

The findings in this study suggest that student demographics such as gender, ethnicity, and socioeconomic status did not cause a difference in student growth based on math achievement. Both males and females of various ethnicities and economic backgrounds exhibited similar growth based on the pre and posttest. The results for ethnicity may not be consistent with that of other populations due to the imbalance in the number of students of each ethnic group.

The difference in the growth rates of grade levels may suggest that implementation of instruction, grade-level standards, and teacher experience are the cause for higher growth averages in seventh grade. The quantitative data collected did not support the idea of constructivism. The data were based on a summative multiple-choice assessment. It did not provide the opportunity for students to research, create, and construct new learning.

Teacher perceptions of technology implementation paralleled teaching experience. Teacher 3, with over 30 years of experience, expressed concern over technology implementation and referred multiple times to the importance of pencil and paper practice in the math classroom. Teachers 1 and 2, with 5 years of experience combined, were more technology proficient and implemented more technologically enhanced lessons in the classroom. Teachers who grew up during the technology age are more comfortable using it. Teacher perspectives did support the idea of constructivism. Students used the technology to create new learning based on their previous experiences.

The teacher lesson plans revealed that a variety of instructional technology was implemented using the one-to-one mobile devices. The majority of technology was online applications. The type of technology implemented could cause a different result in student achievement. Online applications that provide students with opportunities to practice basic skills will not yield increased growth in applications of math. Students need a variety of instructional strategies including those technology-enhanced practices. The strategies included in lesson plans supported the idea of constructivism. Students used the online videos and applications to take previous knowledge and learning to analyze and synthesize new ideas. They would construct their own learning from several forms instruction.

The quantitative data failed to support the theoretical base; however, the qualitative data supported the idea of constructivism. Students were able to obtain knowledge from several sources including instructional technology, personal experience, and direct instruction. The instructional technology allowed students to expand their learning outside of the four walls of the classroom and develop their own pathways of learning.

Recommendations

This study presented data on the impact of one-to-one mobile technology on math achievement in a rural middle school. The following recommendations are based on the data presented in the study.

A follow-up study comparing multiple seventh-grade classes taught by teachers of multiple technology proficiencies is recommended to determine what may have caused the increased growth in seventh grade compared to sixth and eighth grades. Differences in other factors such as ethnicity, gender, and socioeconomic status should be kept to a minimum between the classes. Data on the seventh graders in this study should be examined at the conclusion of their eighth-grade year to see if the increased growth was a result of specific students or the specific grade level. Another recommended study would compare two teachers with over 20 years of teaching experience but varying technology proficiencies.

The population of this study focused on 213 sixth, seventh, and eighth graders in a rural middle school. A larger population or participants in a suburban or urban school may reveal different results. The majority of the population was White. A more diverse population could give a better picture of the differences in the results based on ethnicity.

It is recommended that additional individual and group interviews with the three teachers be carried out to gain their perspectives on the differences in growth. A thorough group discussion may reveal more insight into teacher preference in technology implementation.

The teacher lesson plans revealed that a variety of instructional technology was implemented using the one-to-one mobile devices. The majority of technology was online applications. A future study giving specific parameters for the types of technology implemented may provide further insight into the impact on student achievement. A study comparing students in one-to-one mobile technology classrooms to those in traditional classrooms could provide a stronger case for the impact of one-to-one mobile technology on math achievement.

Teacher practices can also impact student achievement. A study focusing on teacher practices when implementing one-to-one technology could provide data on the most effective types of instructional technology for the classroom.

To prepare students for our rapidly changing world, students must be provided with real world application of concepts and skills. This can be achieved by one-to-one mobile technology. For this to occur, teachers have to embrace the use of technology in their classrooms.

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Appendix A

Research Permission

[redacted] Max Deaton Wed 2/1

RE: Research Request

You replied to this message on 2/3/2017 8:52 AM.

Bing Maps + Get more apps

Your request is approved.

[redacted]

From: Max Deaton
Sent: Tuesday, January 31, 2017 6:05 PM
To: [redacted]
Subject: Research Request

[redacted]

I am working on my Doctorate of Education in Curriculum and Instruction at Gardner-Webb University. I would like to request permission to include [redacted] student data, teacher interviews, and lesson plans in my study for my dissertation. The district, school, teachers, and students will not be identified. [redacted] technology implementation and its progression over the last few years is ahead of other schools in the area. My study will focus on the extent that one-to-one implementation has impacted student math MAP achievement, teacher perceptions, and teacher lesson plans. My dissertation will be finished this semester and my graduation will occur in May or August. Thank you for your consideration of this request.

Max Deaton

Appendix B

Interview Protocol

Interview Protocol

Date:

Place:

Interviewer:

Instructions:

Thank you for your willingness to participate in this interview about mobile technology implementation in math. I am Max Deaton, a doctoral candidate with Gardner-Webb University, and I will be investigating the implementation of mobile technology, laptops, in math and its possible impact on student achievement and teacher perceptions. An audio recording will also be used for accuracy purposes. I anticipate that this interview will take approximately 30 minutes of your time. During the course of this interview, you will be asked to respond to a series of questions about your experience as a math teacher. Please respond to the questions completely and honestly to provide as accurate a description of your experience and its effects upon you as possible. If, at any point, you desire to withdraw from the interview, you may do so by simply not responding. When this study is published, pseudonyms will be used in place of your names to maintain confidentiality.

Questioning Route:

Opening Question:

1. Please tell me your name, what you teach, and why you decided to become a teacher.

Introductory Question:

1. Describe your decision to teach math. What were your first impressions when you started teaching math?

Transition Question:

2. Think about your teaching experience. What are your impressions of technology in education?

Key Questions:

3. How would you describe the school's technology implementation program to others?
4. Describe any professional development experience based on technology implementation you have attended?
5. Describe any changes you may have made in your teaching practices as a result of the professional development.
6. What do you believe is the greatest impact of technology implementation on math instruction?
7. Do you believe technology implementation has impacted student achievement? Justify your answer.
8. Describe how you integrated technology into your daily lesson plans.

Ending Questions:

9. If you had a chance to give advice to the director of the technology implementation program, what advice would you give?
10. *(At this point in the interview, the researcher will provide a brief oral summary of this discussion and give the participants an opportunity to verify or amend the summation.)* How well does this capture what was said here? If you were asked to summarize the conversation, what would you change?

11. What did I miss? Is there anything we should have discussed but did not?

Note: The interviewer may ask interviewees to elaborate upon or clarify their responses, if necessary. Furthermore, if interviewees veer away from the focus of the question, the interviewer will use prompts as a refocusing tool.

Thank you:

Thank you for your time and participation in this research project. Your responses shall remain anonymous and are valuable as we explore the impact of technology implementation on student achievement and teacher practices.

Appendix C

Letter to Potential Participants

Dear Educator:

During the spring of 2017, I will be conducting research focusing on mobile technology implementation in math. The title of my study is "A case study of one-to-one mobile technology implementation in math in a rural middle school." My research will be guided by the following three questions: (1) In what ways and to what extent has one-to-one mobile technology implementation impacted student achievement in math as measured by standardized test scores? (2) What are teacher perceptions of the ways and extent which one-to-one mobile technology implementation has influenced teacher practice and student achievement in math? (3) In what ways and to what extent do teacher lesson plans support or fail to support one-to-one mobile technology implementation in math instruction with fidelity?

Please consider participating in my component of this unique study if you meet the following criteria:

- o You taught math during the 2015-2016 school year.
- o You administered math MAP during the 2015 – 2016 school year.
- o You are willing to participate in a focus group interview. The focus group interview will take approximately one half hour. The data gleaned from your participation will help to inform this study.

Participation will be completely voluntary. Furthermore, participants have the right to withdraw from this study at any time. A pseudonym will be used in place of participant names for the purpose of anonymity. All participants will be treated with respect and professionalism

If you have any questions about this study, please feel free to contact the researcher, Max Deaton, by e-mail at XXXXXXXXXXX. Furthermore, if you have any questions about Gardner-Webb University's research requirements, you may contact my dissertation chair at cbingham@gardner-webb.edu. If you are interested in participating in this study, please send a response within 5 days of receiving this email. Upon the indication of your interest, I will provide you with additional information and a consent form. Thank you in advance for your assistance in this study.

Sincerely,
Max Deaton
Doctoral Candidate, Gardner-Webb University

______ I am interested in participating in this study. Please send me additional information.

______ I am NOT interested in participating in this study.

Name:

Appendix D

Participant Consent Form for Research

Consent Form for Research

By signing this consent form:

1. I voluntarily agree to participate in the study entitled "A case study of one-to-one mobile technology implementation in math in a rural middle school."
2. I understand that I may withdraw from this study at any time without consequence.
3. I understand that the interview will be transcribed and recorded for documentation purposes; the minutes and records from this study will remain confidential. I acknowledge that in the researcher's final document, a pseudonym will be used in place of my name to maintain confidentiality.
4. I agree to participate in an individual interview. The individual interview will last approximately half an hour.
5. I agree to report to the note location here at insert time on insert day and date.

If you have any questions about this study, you may contact Max Deaton by phone (XXXXXX) or by e-mail (XXXXXXXX). You may also email Dr. Bingham, my dissertation chair, by e-mail (cbingham@gardner-webb.edu).

____
Printed Participant Name

______________________________________ _______________
Participant Signature Date

______________________________________ _______________
Researcher Signature Date

Note: A copy of this consent form will be returned to you.