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Effects of 1:1 Computing by SES on Student Motivation, Engagement, and Literacy Achievement

Bryan Appleton
Harding University

EFFECTS OF 1:1 COMPUTING BY SES ON STUDENT MOTIVATION, ENGAGEMENT, AND LITERACY ACHIEVEMENT

by

Bryan Appleton

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Dissertation Advisor	Date
Dissertation Reader	Date
Dissertation Reader	Date
Dean of the Canon-Clary College of Education	Date
Provost	Date

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And if I have prophetic powers, and understand mysteries and all knowledge,

and if I have all faith, so as to remove mountains, but have not love,

I am nothing. -1 Corinthians 13:2

It takes a small village to raise a child, and I believe this may also be said of writing a dissertation. During the fall semester of my junior year at Evangel University, a discussion took place between Dr. Drake, Dr. Hardy and myself that ended with a goal of me working towards the completion of this degree. I had tremendous support from many individuals from the end of that conversation to the writing of the last paragraph on the last page.

My wife, Victoria, has provided unbelievable support as I pursued this goal. She is the embodiment of humility and grace; she is my best friend. My daughter, Claire, has been the greatest influence on my beliefs about learning. I thank her for the daily reminders that life is truly about the little things. Her smiles and laughter are two of the most precious things in my life. Additionally, my parents, who provided a childhood of stability and support that was the foundation of the completion of this degree.

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Sanctus, Sanctus, Sanctus, Dominus Deus Sabaoth.

Pleni sunt coeli et terra gloria tua. Osanna in excelsis.

ABSTRACT

by
Bryan Appleton
Harding University
December 2016

Title: Effects of 1:1 Computing by SES on Student Motivation, Engagement, and Literacy Achievement (Under the direction of Dr. Bruce Bryant)

The purpose of this dissertation was to investigate the effectiveness of the combination of 1:1 computing with collaborative instructional strategies. In the first and second hypotheses, exposure to a 1:1 computing environment in a literacy classroom (participation versus no participation) and SES (participating versus not participating) were the independent variables. The dependent variable for Hypothesis 1 was positive student motivation. The dependent variable for Hypothesis 2 was positive student engagement. Hypothesis 1 revealed that the interaction between the independent variables was significant. In the two groups participating in the 1:1 Program, the students not participating in the free and reduced lunch program, in general, demonstrated a statistically higher positive student motivation compared with the students participating in the free and reduced lunch program. In addition, in the two groups participating in the free and reduced lunch program, the students not participating in the 1:1 Program, in general, demonstrated a statistically higher positive student motivation compared with the students participating in the 1:1 Program. There were no statistically significant

interaction or main effect results for the second hypothesis, participation in 1:1 computing and SES on positive student engagement.

The third hypothesis determined if any predictive effects of student efficacy, 1:1 technology participation, and gender predicted literacy achievement as measured by the MAP assessment. It was discovered that SES was a significant predictor of literacy achievement. This study took place in three junior highs in Northwest Arkansas. Much of the related literature show significant findings in the ability of 1:1 computing environments to increase student achievement. The related literature also showed significance in the effects of poverty on learning.

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CHAPTER I

INTRODUCTION

The implementation of computers and technology within schools is an endeavor that has not been matched in cost and initiatives in recent years. Schools in the United States spend approximately 56 billion dollars on technology yearly, with about 36% of that being spent on classrooms within K-12 school districts (Johnson, 2011). As schools are required to do more with less money, decision makers need to know about different types of technology, how to use best their technology dollars, and how to maximize teaching and learning through the use of technology.

The invention of the computers during the 1970s changed the role of educators and the way students learn. Until the beginning of the 21st century, little technology was used within a school, and even less of that technology was for teaching and learning. During this time, beyond the computer hardware, access to the Internet was limited. At the dawn of the 21st century, most public school classrooms in the United States had access to the Internet (North Central Regional Educational Laboratory, 2005). Penuel (2006) stated that much research existed on the use of instruction strategies in the classroom before 2005, but little of that research discussed how technology could enhance teaching and learning. Further, the research that did exist regarding computers as a tool for learning was neither robust nor of good quality (Penuel, 2006). The increased number of computers in schools provided an opportunity for a greater number of studies.

The idea that 1:1 computing provided an opportunity for an increase in student achievement grew rapidly. Bebell and Kay (2010) reported that 50% of public school technology leaders planned to create 1:1 computing environments within their schools by the year 2011. During this time, several studies examining the effect of 1:1 computing on student achievement were conducted. Many studies found that 1:1 computing environments had a statistically significant impact on student achievement when students were compared with their peers who were not participating in 1:1 computing environments (Dunleavey & Heinecke, 2007; Gulek & Demirtas, 2005; Shapely, 2008). The success that these early studies had prompted decision makers and educational leaders to explore 1:1 computing initiatives across a range of classrooms (Bebell & Kay, 2010). One of the 1:1 computing initiatives that originated during this time was the 21st-century grant program.

Statement of the Problem

This study focused on the impacts of 1:1 computing on teaching and learning within the 21st-century grants (21-C program), a program in a school district in Northwest Arkansas. The 21-C program awards applying teachers with grants used to fund laptop carts to provide a 1:1 computing environment within the teachers' classrooms. In the summer, the grants also provide teachers with a symposium and ongoing professional development on how to combine a 1:1 computing environment with teaching and learning, specifically cooperative learning and problem-based instruction strategies. This study analyzed the effects of the 21-C 1:1 computing initiative in the areas of student engagement and student motivation measured by the Motivation and

Engagement Scale (MES) and literacy achievement measured by the Measures of Academic Progress (MAP) assessment.

Therefore, the purposes of this study were three-fold. First, the purpose of this study was to determine by SES the effects of students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 instruction on positive student motivation as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas. Second, the purpose of this study was to determine by SES the effects of students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 instruction on positive student engagement as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas. Third, the purpose of this study was to determine the predictive effects of student efficacy, participation in 1:1 technology instruction in literacy classrooms, SES, and gender on literacy achievement as measured by the MAP assessment for eighth-grade students in three junior highs in Northwest Arkansas.

Background

Power of the Effective Teacher

Throughout a K-12 experience, students have between 40 and 60 teachers. When asked to identify the teachers that made a difference, the vast majority of individuals identified 2-3 teachers, meaning that approximately 5% of teachers made a substantial contribution to the development of the student (Hattie, 2009). The research showed that the teachers who made an impact developed within their students a passion for the subject (Hattie, 2009).

Hattie (2009) described the effective teacher as one who taught methodically, provided intervention in a way that was meaningful and concrete, and offered students multiple opportunities and ways to learn the content. Further, students identified their best teachers as those who committed to helping students master content (Sizemore, 1981), established meaningful relationships with students (Batten & Girling-Butcher, 1981), and developed and modeled different student-tools for learning and mastering content (Pehkonen, 1992). The most effective teachers were those who possessed interpersonal communication skills. Hattie (2009) noted that although every teacher does not fit this description, those who had the greatest impact on learning manifested these attributes. An integral theme throughout the research was that the characteristics of the effective teacher magnified the impact of the research. Goe (2007) stated that it was often difficult to identify what enhanced student learning. Regardless of the overall effects of the research, the teachers within the sample who upheld the qualities proposed by Hattie (2009) and others, influenced student achievement at a greater level compared to the sample.

Technology Implementation

Over the past decade, educators and researchers have examined the relationship between technology and student achievement. Kuyatt, Holland, and Jones (2015) found that much of the research on technology in the classroom focused on how the teacher used technology as a teaching tool rather than how students used the technology as a learning tool. The Gates Foundation (2012) found that this led to studies that measured student achievement, but some of the studies failed to control for the quality of teacher training and teacher implementation. To be effective in the implementation of technology, teachers needed to be conscious of whether or not the strategies they used worked, and they also needed the skills to adapt if what they were doing was not effective. Johnson (2012) noted that implementation of technology had to be more than using a computer to replace a textbook. Technology had to meet the needs of the generation, which required the application of technology in a way that developed the skills students needed to be successful outside the walls of the school.

There were many uses of technology in the classroom, but the literature examined provided no clear advantage for the use of technology in a particular grade or content area. It was possible that the use of computers led to greater learning in some circumstances, but there was not a direct link between the use of computers and student achievement. Hattie (2009), through his examination of multiple meta-analyses, identified six contributions made by technology that enhanced learning in the classroom.

The first contribution was the use of multiple teaching strategies. Hattie (2009) found that when the computer supplemented other types of instruction, student performance was enhanced. However, he suggested that computers should not be a substitute for teacher instruction. Second, when teachers received instruction on the use of computers as a tool for teaching and learning, there was an increase in student achievement. Most teachers used computers, but for personal use rather than in the classroom (Cuban, 2001). Effective teachers consistently received instruction in how to implement computers as a tool for learning and teaching. Hattie (2009) found that more than 10 hours of instruction was needed for teachers to be productive and that 1 to 10 hours of instruction was counterproductive. Third, computers enhanced the learning experience when multiple opportunities for learning were available. An interesting finding was that drill and practice, although unpopular with some educators, was still an important method of learning. Drill and practice with the aid of a computer were found to be more engaging for the student.

The fourth contribution of computers on learning was that they assisted students in taking control of their learning (Hattie, 2009). Abrami et al. (2006) concluded that it was important for the student, not the teacher, to be in control of the technology to maximize learning. Similarly, Torgerson and Elbroune (2002) found that students were more engaged when they took control of their learning with the aid of a computer, specifically in the area of writing. The fifth contribution of technology to learning was that it facilitated peers learning from their peers (Hattie, 2009). Kagan and Kagan (2009) found that peer to peer learning was the single most influential learning strategy. Learning was enhanced when students used computers to collaborate with one-another. A final contribution of computers to teaching and learning was that computers facilitated prompt feedback to students from teachers. From examining the studies, Hattie (2009) found that teachers responded to students quicker and in a more equitable manner when they responded to students via computer. Hattie concluded that the computer is not a replacement for quality teaching; however, the correct use of the computer may enhance teaching and learning. In summarizing these findings, it seemed that student success was not based upon the use of technology but the effective teacher.

Technology as a Tool for Teaching and Learning

The research explored the relationship between technology, teaching, and learning. Kagan and Kagan (2009) stated that when the computer is used as a learning tool within a collaborative protocol, the learning experience for the student is enhanced.

However, although the use of computers enhances learning for students, this does not imply an increase in student achievement occurs. Two collaborative approaches to learning are Problem-based learning (PBL) and cooperative learning, which have similarities and also differences.

Problem-based learning. Originally a pragmatic solution to prepare medical students for real-world scenarios, PBL migrated from medical schools and into colleges throughout the latter half of the 21st century. Barrows and Kelson (1993) began implementing PBL within K-12 settings, starting with mathematics and science classrooms, during the 1990s. The premise of PBL was that learning occurs when solving real-world issues. Those who embraced PBL also advocated life-long learning and the idea that learning occurred through solving problems. Hung, Jonassen, and Liu (2008) stated that PBL originated from constructivist ideas. These ideas included concepts such as knowledge is constructed through real-world experiences; multiple perspectives exist within every idea; and knowledge becomes applicable to the contexts of human experiences. Johnson (2012) noted that PBL allowed students to link instruction with personal application. Johnson argued that PBL gave students an opportunity to apply their learning to real-life situations in a manner that linked content and skills.

Successful implementation of PBL was dependent upon adherence to a particular methodology. Hung et al. (2008) established five characteristics of high-yield PBL environments. First, PBL focused on solving a problem. Learners began the learning sequence by addressing a real-life problem that created an opportunity to build knowledge that was applied back to the problem. Second, PBL was student-centered. Teachers were facilitators of learning, not the center of learning. Student direction through collaboration was the third characteristic of PBL. Fourth, PBL was self-reflective. Students self-reflected and adjusted the learning process to fit their personal needs. Finally, PBL viewed teachers as facilitators who supported the process of learning by promoting collaboration and deep thinking. Larmer and Mergendoller (2010) added a sixth characteristic: student presentations of their work. As a part of the presentation, Larmer and Mergendoller noted that students should answer questions and offer the next steps they might take in their study or implementation of the specific topic.

Research also explored the relationship between the use of computers and PBL. Bellanca and Brandt (2010) found that the implementation of 1:1 computing within the PBL environment had the opportunity to enrich and deepen the student learning experience. Larmer and Mergendoller (2010) identified seven essentials needed for PBL. They found that 1:1 computing had the ability to enhance some of those attributes: student voice and choice, 21st-century skills, inquiry and innovation, feedback and revision and a publicly presented product. Ak (2011) stated that the implementation of a computer learning environment enhanced the engagement, collaboration, and learner-focused components of PBL. Further, the developers of the 21-C grant program stated that, when students were able to learn in ways they preferred, student engagement and student motivation were likely to increase. The use of computers within PBL had the potential to enhance learning and was used to foster, not replace, attributes of the PBL experience.

Cooperative learning. Another collaborative strategy is cooperative learning. One of the key components of the successful integration of computers with learning strategies was that the computer was a tool that supported, not replaced, what was already occurring within the classroom. Cooperative learning is a highly flexible, easily integrated strategy within preexisting structures of the classroom. However, it was critical that cooperative learning was viewed as more than a group of students talking about content. Slavin (2014) stated,

> An efficient cooperative group is not a collection of kids thrown together for a short activity. It's a team composed of diverse students who care about helping one another learn—and about the success of the team itself. All members must know they can depend on one another for help. (p. 22)

Cooperative learning began with a classroom culture that was about the learning of all and not the learning of one. Kagan and Kagan (2009) stated that cooperative learning was a widely researched learning strategy that yielded statistically significant results. However, when and how cooperative learning was used were pivotal to its success as a learning strategy.

Cooperative learning was more than a high-yield learning strategy. Dean, Hubbell, Pitler, and Stone (2012) stated that students who participated in cooperative learning developed some skills that included peer-to-peer social skills that were critical to their success in school and beyond. The decision of when to use cooperative learning within instruction was just as critical as implementation, however. Frey, Fisher, and Everlove (2009) stated that cooperative learning was a strategy best used to facilitate students' clarification, understanding, and synthesis of information by building upon the learning of their peers; discussion and collaboration among peers; and positive interdependence as a team. Although team performance was critical, individual accountability was a key attribute of successful cooperative learning. Slavin (2014) noted that successful cooperative learning included the mastery of content and skills by each student, and team success was dependent on the success of each student's learning, which facilitated the collective work of the team.

The successful integration of technology in cooperative learning maximized the effectiveness of both hardware and the instructional strategy. Lou, Abrami, and d'Apollonia (2001) stated that, when students were working with computers within groups, it was critical that the learning sequence promoted collaboration. Hattie (2009) found that, when students worked with computers with their peers in small groups, they were used more efficiently compared to when used either alone or in a large group. PBL and cooperative learning combined with computers were tools of learning that maximized the effectiveness of one another.

Socioeconomic Status (SES)

Students do not come to school equally prepared to learn. Harris (2006) stated that the relationships students had with other students, adults, and family members had a greater impact on students' performance in school than previously thought. Gunnar, Frenn, Wewerka, and Van Ryzin (2009) found that students needed the following to grow up emotionally healthy: safe environments; a caregiver who was consistent and provided love; and 10-20 hours of reciprocal, positive interactions per week. Jensen (2009) found that children who grew up in poverty were far less likely to have these things. When these attributes were not present in the home from birth, Jensen noted that children developed relational deficits that inhibited cognitive processing and the development of social skills critical to the learning process.

The effects of poverty on the learning process cannot be overly stressed. Smerdon et al. (2000) found the following:

> Technology can have a particularly significant impact on the schooling of economically disadvantaged students, whose experiences frequently have stressed repetitious rote drill on lower-order skills, with relatively little attention to the areas of comprehension, problem-solving, composition and mathematical reasoning that will support both higher education and effective functioning in the real world. (p. 4)

Further, Miller (2015) stated that children from poverty were likely to have a significant deficit in language and literacy skills. Miller believed that the intensive, individual instruction that was provided by the use of the computer as a tool for learning was critical in correcting achievement deficits. Miller found that technology provided the individualized instruction required to facilitate students from poverty in progressing at the same rate as their peers. The initial review of literature supported the claim that technology could have a positive effect on student learning, particularly on students from poverty. The subsequent literature referenced indicated that participation in a 1:1 computing environment could have a positive outcome on student motivation, engagement, and student achievement. For these reasons, the researcher generated the following hypotheses.

Hypotheses

1. No significant difference will exist by SES between students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 instruction on positive student motivation as measured by

the MES for eighth-grade students in three junior highs in Northwest Arkansas.

2. No significant difference will exist by SES between students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 instruction on positive student engagement as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas.
3. The combination of positive student motivation, positive student engagement, participation in 1:1 technology instruction in literacy classrooms, SES, and gender do not significantly predict the literacy achievement of eighth-grade students in three junior highs in Northwest Arkansas as measured by the MAP assessment.

Description of Terms

1:1 computing. Bebell and Kay (2010) defined 1:1 computing refers to the ratio of students to a computer. A 1:1 computing environment was one defined as one computer for every student in the learning environment.

Achievement. Kagan and Kagan (2009) defined achievement at the level of student academic performance.

Computer. Hattie (2009) defined a computer as any computing device, including desktop, laptops, mainframes and any mobile computing device, including a tablet.

Cooperative learning. Slavin (2014) defined cooperative learning as an instructional method of interdependent student groups that used the knowledge of group members to facilitate the knowledge building of other group members.

Engagement. Martin (2010) defined engagement as students' persistence, organization and follow through during a cycle of learning.

Motivation. Martin (2003) defined motivation as students' energy and will put forth to acquire knowledge and achieve.

Problem-based learning. Hung et al. (2008) defined PBL as an instructional method that promoted learning through problem-solving. PBL was problem focused, student-centered, and directed by the student.

Socioeconomic status. For this study, SES was defined by school lunch status per the guidelines set forth by the United Stated Department of Agrictulture (2015). Students were identified as participating in the free or reduced school lunch program or not participating.

21st-century skills. Bellanca and Brandt (2010) defined 21st-century skills as a move away from learning that focused on knowledge gathering and instead focused on life and career skills (collaboration, critical thinking, communicating, creative thinking), literacy skills (technology literacy, information literacy, media literacy), and life skills (flexibility, initiative, social skills, productivity, leadership).

Significance

Research Gaps

The implementation of technology in the junior high literacy classroom grows daily. Throughout the 1990s, however, research on technology use in the classroom was limited by the restricted access that students had to technology. The late 1990s and early 2000s saw an emphasis on the access to technology that prompted opportunities for the study of this subject (Bebell & Kay, 2010). Early studies regarding technology and its effect on learning lacked rigor compared to recent research. Specifically, there was little research on the impacts of 1:1 computing's effects on students (Lei & Zhao, 2008). Between 2008 and 2012, research focused on how best to combine technology and learning.

Research on effective instructional strategies has been frequent and ongoing since the introduction of No Child Left Behind at the dawn of the 21st century. What was not thoroughly investigated was the effect of 1:1 computing on the student motivation, engagement, and achievement when combined with high-yield instructional strategies. This study examined the impacts of 1:1 computing combined with high-yield instructional strategies.

Possible Implications for Practice

Technology implementation is a topic that every K-12 school district must continuously discuss. Critical questions that require an articulate response if the technology is to be used effectively within the school system include the following. What type of technology should schools support? How should different types of technology be supported? The trend of 1:1 technology programs is increasing. The research conducted within this study provided decision-makers with data regarding the effects of a 1:1 technology program on different students' factors, as well as key practices within the research. This research also highlighted the effects of a 21-C grant program that helps to maximize the effectiveness of 1:1 technology deployment.

Process to Accomplish

Design

A quantitative, non-experimental strategy was used to examine Hypothesis 1 and Hypothesis 2; a 2 x 2 factorial between-groups design was used for statistical analysis. The independent variables for Hypothesis 1 and Hypothesis 2 were SES defined by school lunch status (participating versus not participating) and exposure to 1:1 technology instruction in literacy classrooms (participation versus no participation). The dependent variable for Hypothesis 1 was positive student motivation as measured by the MES. The dependent variable for Hypothesis 2 was positive student engagement as measured by the MES.

A quantitative, regression strategy was used to examine Hypothesis 3. The predictor variables for Hypothesis 3 were student efficacy, 1:1 technology in literacy classrooms (participation versus no participation), SES (participating versus not participating), and gender. The dependent or criterion variable for Hypothesis 3 was literacy achievement as measured by the MAP assessment.

Sample

Students chosen to participate in this study were 2015–2016 eighth graders from three junior highs in Northwest Arkansas. The sample was chosen from the two accessible populations, those participating in 1:1 technology in a literacy classroom and those not participating in 1:1 technology in a literacy classroom. The sample consisted of 1200 students, mostly Caucasian, from an urbanized area with a combined SES rate of 27%.

Instrumentation

Two of the main dependent variables of this study were motivation and engagement. The collection of data on these components was through a self-reported survey that evaluated the students' motivation and engagement in learning. Hattie (2009) stated that student motivation was critical to student achievement. If a student was not motivated to engage in learning within the classroom, no lesson plan or instruction had a chance to succeed. If students were to learn, it was imperative that they be cognitively present in the classroom. Students involved in this study completed a self-reported study that evaluated whether or not their classroom environment was engaging. Prior literature that examined technology as a teaching tool failed to consider the factor of student engagement, a variable crucial to raising student achievement.

In the spring of 2016, students were given the MES-Junior High survey instrument created by Martin (2015) from the University of Sydney and published by the Lifelong Achievement Group. Fredricks et al. (2011) stated the MES had an internal consistency of .78 (Cronbach's Alpha) and a test-retest correlation of .61-.81. The instrument was a student self-report questionnaire and developed for students ages 9-13. Measurement from 11 subscales combined to create four categories of motivational and engagement strengths and weaknesses. The instrument was administered in classrooms by school staff. The motivation and engagement categories served as the dependent variables for Hypotheses 1 and 2, and as two of the predictor variables for Hypothesis 3.

The criterion variable used in the evaluation of the 21-C program was literacy achievement. Formative assessment data were collected on the students participating in the survey. Literacy achievement data were collected in the form of scale scores from an assessment that students took three times per year. The spring assessment, the final assessment of the year, was examined for this study.

In the Fall 2015 and the Spring 2016 terms, the students were assessed using the MAP assessment, created by the Northwest Evaluation Association (2013). The literature of the Northwest Evaluation Association asserted that the MAP assessment contained norm-referenced test items. The literacy achievement scale scores were used in the analysis for this study. During Spring 2016, permission to use scores was obtained from school principals. The overall literacy scale scores were used as a predictor variable for Hypothesis 3. Identifiable information was removed, and data were entered into IBM Statistical Packages for the Social Sciences Version 21 software.

Data Analysis

Hypothesis 1 was analyzed using a 2 x 2 factorial between-groups ANOVA with 1:1 technology in a literacy classroom and SES as the independent variables and positive student motivation as the dependent variable. Hypothesis 2 was analyzed by a 2 x 2 factorial between-groups ANOVA using 1:1 technology in a literacy classroom and SES as the independent variables and positive student engagement as the dependent variable. Hypothesis 3 was analyzed using multiple regression. The independent or predictor variables for Hypothesis 3 were student efficacy, 1:1 technology in literacy classrooms (participation versus no participation), school lunch status (participating versus not participating), and gender. The dependent variable for Hypothesis 3 was literacy achievement as measured by the MAP assessment. The analysis of Hypothesis 3 examined the significance of the model as a whole and then examined each predictor variable within the model to determine how much it contributed to the overall formula. The null hypotheses were tested using a two-tailed test with a .05 level of significance.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

This literature review provided an examination of the related literature and was broken into five parts. First, an overview of the development of the use of technology in the classroom was presented. Second, an overview of the research was conducted on the use of technology in the classroom. Third, an examination of collaborative strategies and their effects on student motivation and student engagement was discussed. Fourth, an examination was made of the research of how socioeconomic status impacted student learning and the effect that technology may have on that learning. Finally, an overview was offered of the 1:1 computing program that was the focus of this study.

History of Technology in the Classroom

The term *technology* often correlates with a computer or tablet. However, these devices represent only the latest forms of technology that educators have considered using to enhance student learning. The creation of the motion picture in 1922 represented the origin of the idea that technology could dramatically change education and improve student learning (Hew & Brush, 2006). The invention of the computer in the mid-1970s further prompted educators and those that concerned themselves with reforming education, to explore whether or not technology increased student learning. The increase of technology in schools began in the 1990s, a time when the infrastructure of the Internet in schools was quite limited. Access to technology in schools was one of the highest priorities for education in the country (North Central Regional Educational Laboratory, 2005). In 1994, only 3% of public school classrooms had access to the Internet compared to 93% in 2003 (North Central Regional Educational Laboratory, 2005). The national emphasis on access to technology and the Internet provided a starting point for some research on the relationship between technology and student learning.

Although limited, the research in the 10 years between 1994 and 2003 showed the prioritization of access to technology. The decreasing ratio of students to a computer provided an opportunity for researchers, both proponents and opponents, to measure the effects of educational technology, effects that were difficult to measure previously (Bebell & Kay, 2010). However, studies in the field of educational technology largely lacked an examination of how the technology was used, specifically in the area of 1:1 computing (Lei & Zhao, 2008). Furthermore, the studies conducted suffered methodological problems and were often of a feeble quality (Penuel et al., 2001). Unique to the subject of 1:1 computing, the research that was available was not on a large scale regarding scope and did not focus on student achievement (Penuel, 2006). The lack of research on a large scale presented a learning curve that existed in identifying best practices for the use of technology in the classroom to enhance student learning, leading to inconclusive research regarding best practices and the impact of technology.

Despite the uncertain nature of the research, school leaders continued to look for ways to implement technology with instruction during the mid-to-late 1990s and into the early 2000s. Goe (2007) stated that the identification of practices that enhanced student learning, with or without the use of technology, was a difficult task. More specific research, such as the work of Dean et al., (2012), provided more thorough and conclusive investigations on factors that led to increased student achievement. Goe (2007) found that the factors measured—such as qualifications and experience, classroom culture, student motivation, and high expectations—did not produce any clear consensus on their impacts related to student achievement. Another concern of the researchers was that studies did not articulate how technology functioned in the classrooms of students they were studying. Kuyatt et al. (2015) stated that, until recently, “few studies have been conducted to determine if teachers are using technology as a learning tool as opposed to a teaching tool” (p. 64). The reduction of the students to computer ratio and the requirements of the No Child Left Behind Act (NLCB), which became law in 2002, created the need for research-based strategies to close achievement gaps.

An Increase in the Use of Computers Leads to a Rise in Research

Increase in the Home

An attribute examined when investigating the effects of more technology in the classroom was the growing exposure to the same technology at home. The early 2000s saw an increase in technology in every aspect of a student's life. Educators and educational reformers were not alone in their belief that a correlation existed between technology and learning; parents also saw the existence of a possible link between technology and student achievement. Laumann (2000) stated, “Not only is the number of computers in education growing exponentially, but also the number of computers in the home is growing at a rapid rate” (p. 196). Although students were more likely to use computers at home for entertainment purposes, the fact that students were using computers at home provided additional opportunities for students to learn how to use information on a computer screen, a process that may have aided cognitive development

(Delen & Bulut, 2011). For example, the increased use of computers may have contributed to increased cognitive processing and visual attention (Delen & Bulut, 2011). A rise in the use of technology at home accompanied a rise in the use of technology at school.

Increase at School

Technology existed in schools before the early 2000s, but research indicated that it was not until this time that educators began incorporating information and communication technologies in the classroom. Kozma (2003) stated, “Teachers in many countries are beginning to use information and communication technologies to help change classroom teaching and learning, and are integrating technology into curriculum” (p. 13). State and national initiatives primarily funded the increase in technology in response to NCLB legislation. Hew and Brush (2006) found that school districts reported spending $7.87 billion on technology equipment during the 2003–2004 school year. During this same school year, the “student-per-instructional computer ratio” fell to 3.8:1 (Miller, 2015, p. 46). Additionally, the price of computers fell to a level that made them accessible to students at school and at home, increasing the amount of time that students spent on devices.

Increase in Research

Research related to the use of technology and student learning became more precise as the student to computer ratio decreased around the country. Lee, Berscia, and Kissinger (2009) found that students who used a computer for 1 hour per day had better mathematics scores. Dumais (2009) also found that students who used computers for fun had higher mathematics scores. Similarly, when teachers used computers in the classroom, it positively affected students' science achievement (Delen & Bulut, 2011). In sum, the research indicated a positive correlation between the use of technology and increased student achievement. However, not all studies concluded that technology affected student learning in a positive manner. Delen and Bulut (2011), in their study on the frequency of information and communication technologies use and student achievement, found that technology was not a good predictor of student learning outcomes, that neither little nor frequent use of information and communication technologies improved student performance. Furthermore, Kuyatt et al. (2015) examined the effect of technology usage in Texas schools, and when state assessment scores were examined, they found that students exposed to more technology in the classroom had lower scores statistically compared to their peers who had access to less technology. These studies indicated that the relationship between exposure to information and communication technologies and student learning outcomes was inconclusive.

1:1 Computing

An increase in information and communication technologies research led to the formation of several opinions regarding the use of technology with teaching and learning. Lei and Zhao (2008) wrote that the increase in the number of 1:1 computing initiatives led many to question whether the high cost of the initiatives was a wise investment. During the 2000s, many parents and educators resisted the implementation of 1:1 computing initiatives because they felt strongly that technology in the classroom was not useful for all students. Penuel (2006) stated that these opinions were often formed because a limited amount of research existed on the topic. Bebell and Kay (2010) reported the decrease in the ratio of students to a computer that led to an increase in 1:1

computing research. In 1983, the ratio was 125:1. In 2002, that ratio had decreased to 4:1. The increase in computers saw several positive results from early 1:1 initiatives. Dunleavy and Heinecke (2007) compared students who participated in classrooms with 1:1 technology to their peers who did not have access to the technology. Their findings indicated an overall increase in science scores, with boys showing a greater difference compared to girls. Similar studies in other states showed that 1:1 programs in middle schools resulted in higher achievement in English and mathematics (Shapely, 2008; Silvernail, 2008). The success of these initial studies created a foundation for further research into 1:1 computing. Although some of the initial studies focused on student achievement, that was not always the case. Lei and Zhao (2008) reported that many of the early studies focused on the implementation and management of 1:1 technology programs without substantial examination of how students were using their devices. Penuel (2006) also stated that, although 1:1 computing research was trending, there was a lack of research on how teaching and learning with 1:1 computing impacted student achievement.

Holistically, the continued research into 1:1 computing trended positively. In their analysis of 1:1 computing initiatives, Bebell and Kay (2010) stated:

> Within months of the initial student implementation, teacher and student use of technology increased dramatically across the curriculum in nearly all of the participating classrooms. On average, teachers reported widespread adoption of new and novel approaches across their traditional curriculum, which were then subsequently reported by teachers and administration to increase student

motivation and engagement, and to a somewhat lesser extent, academic performance. (p. 16)

Kuyatt et al. (2015) supported this finding and stated that students often preferred the use of technology when completing assignments and that student choice in assignment completion increased student engagement. Student achievement was accompanied by student engagement and student motivation in the continued study of the effects of 1:1 computing.

Student Motivation and Engagement

Research moved beyond the issue of limited access to technology and focused on the use of technology and its influence on student achievement, as well as the use of instructional strategies that promoted high student engagement. During this time, students began requiring a different way of learning because they did not understand the world that did not revolve around technology. Lent (2012) stated that students needed to be highly engaged in the learning, honing skills from actual tasks, and solving problems rather than learning from textbooks or lecturing teachers. In *The New Brain,* Restak (2003) found that the brain responded and adjusted due to the technology. Restak stated, “Our brain literally changes its organization and functioning to accommodate the abundance of stimulation forced on it by the modern world” (p. 38). Increased student engagement resulted in a shift of philosophies, including the role of the teacher.

Role of the Teacher

It is often necessary for teachers to adjust what they do to guarantee the success of students. Johnson (2012) stated,

> The role of the teachers has rapidly changed from one of desert guide (helping learners locate scarce sources) to one of jungle guide (helping learners evaluate, select and use resources of value). This change has been so rapid that many teachers have not had time to learn the skills for their new roles. (p. 104)

This transition requires teachers to give up some of the control for learning in the classroom to the students. Flavin (2012) stated that instruction through a lecture was not compatible with technology in the classroom and that enhanced learning meant less lecture and more collaboration. Cochrane (2012) also stated that one of the factors needed for success in the 1:1 computing was shared ownership of the learning environment. The shared ownership of the learning environment had positive implications for students. Barber, King, and Buchanan (2015) found that building a collaborative culture in the classroom facilitated the development of self-directed learners who could solve complex problems. Guidance from a teacher, rather than direct instruction facilitated, increased student engagement.

Impact on Students

Learning is difficult without high student engagement. Conner (2011) acknowledged that student engagement became one of the most prominent topics in education over the past two decades. Teachers taught the material, and students were compliant. If a lesson was of high student engagement, it was a benefit and not necessity. Those who followed instructions and completed the work passed the course (Lent, 2012). Johnson (2012) stated that, after two decades of technology in schools, little evidence existed that showed substantial gains in student achievement. Johnson elaborated, "Programmed learning, drill and practice software, and computer simulations, although mainstays in many labs, have not resulted in gains in student test scores and rarely even attempt to engage students in more than low-level thinking skills" (p. 105). Throughout the early adoption of technology by schools, the use of technology was at times considered an instructional strategy. Pitler, Hubbell, and Kuhn (2012) found that using technology just to use technology was not a good use of instructional time, nor was it likely to raise student achievement. In other words, incorporating technology without an instructional strategy provided little to facilitate student learning.

The way students learned began to change, necessitating a transformation of instructional practices. Lent (2012) noted that students preferred learning methods other than pencil and paper and that social media created a world driven by visual images. Regardless of student preferences, quality instruction began with identifying learning objectives, identifying appropriate instructional strategies to teach content and skills, and then determining how students would present their learning (Pitler et al., 2012). Similarly, Lent (2012) found that students needed to be learning actively, synthesizing information into meaningful tasks, and solving problems. These tasks, facilitated by technology, had the ability to produce rich and significant opportunities for learning.

Problem-Based Learning

PBL is an instructional strategy that focuses on engaging students with real-world problems to facilitate learning. Johnson (2012) found that PBL allowed students to link instruction to impacting the community and apply learning to self-improvement. The origin of PBL may be traced from several traditions, the most prominent being the medical field. Barber et al. (2015) noted that the McMaster Medical School was one of the first users of PBL in an educational setting. Bellanca and Brandt (2010) stated that the

21st century required the use of all skills that helped develop humans as builders, maintainers of societies, and creators of ways of living. Walser (2008) found that these included “critical thinking, problem-solving, collaboration, creativity, self-direction, leadership, adaptability, responsibility [and] global awareness” (p. 2). The increased complexity of the 21st century required educators to prepare students for those complex problems. The incorporation of technology with PBL as an instructional strategy provided students with real-world technologies to solve real-world problems. Bellanca and Brandt (2010) found that PBL moved students beyond lower-level questioning and thinking. In addition, PBL also allowed for the restructuring of curriculum into a series of complex scenarios that embraced the themes that needed to be comprehended and mastered by students. Students engaged in properly structured PBL units found suitable solutions by examining relevant issues, asking complex questions, and using critical thinking skills. Johnson (2012) also noted that PBL was an instructional strategy that allowed for application of classroom skills in problem-solving and answering questions. PBL thus allowed teachers to develop meaningful instruction that linked concepts to the real-world experiences of students.

PBL is based on solving problems that relate to students. As the world continues to change, a change of instructional strategies becomes necessary. Savin-Baden (2007) stated that significant characteristics of PBL existed. These characteristics included real situations with no single right answer, collaboration among students to identify and solve problems, teachers as facilitators of the learning, and development of students' problem-solving skills. Barrell (2007) developed a framework that organized student questions within a unit of instruction. Variations of problem-based instruction were used, but the prominent and structured approach to PBL was the KWHLAQ framework of inquiry developed by Barrell. The framework was aligned as follows:

- K—What do we think we already *know*? Explore prior knowledge.
- W—What do we *want* and need to find out?
- H—*How* will we proceed to investigate our questions? *How* will we organize time, access to resources and reporting? *How* will we self-assess our progress (such as with a scoring rubric)?
- L—What are we *learning* (daily)? And what have we *learned* at the end of our investigations?
- A—How and where can we *apply* the results of our investigations—to this and other subjects/to our daily lives?
- Q—What new *questions* do we have now? How might we pursue them in our next units? (p. 85)

Bellanca and Brandt (2010) found that a highly engaging scenario had two important attributes that led to high levels of engagement and learning from the problem-based unit. The first was a situation portraying an elaborate problem that held the concepts that were the focus of learning. Second, authentic assessment guidelines were in place that explained what students needed to retain the information. Clear guidelines for assessment, combined with a framework of inquiry that guided students through the learning sequence within a complex scenario, provided an environment for learning that allowed students to develop critical thinking and collaboration skills among peers.

PBL did not necessitate the use of computers. However, with the move away from textbooks as a resource, educators found that PBL went hand in hand with 1:1 computing environments. Johnson (2012) stated that using computers with access to databases and other sources of information was most useful in teaching information literacy skills. Furthermore, computers also supported PBL. Bellanca and Brandt (2010) found that, although the amount of research supporting PBL was significant, some studies conducted between 2005 and 2009 called for more research in the area of PBL before it was considered a best practice for educators. After the publication of Bellanca and Brandt's article, a greater increase in the access of 1:1 technology and the Internet provided the opportunities to show that PBL was a high-yield, highly engaging strategy.

Cooperative Learning

Pressure to increase student achievement led to an assumption that direct instruction (the teacher taking control) was necessary for students to be successful. Likewise, with an increased focus on tying student achievement to teacher ratings, the intuition of many teachers was that they needed to control the classroom to be in control of their professional ratings (Danielson, 2011). Johnson, Johnson, and Holubec (2008) defined *cooperative learning* as small groups of students working together and in concert with instruction to maximize their independent and collaborative learning. As Kagan and Kagan (2009) stated, "The numbers have been crunched, and the results are in: Cooperative learning is the single most effective educational innovation to simultaneously address the many challenges and crises we face in our schools and in our society" (p. 31). Roseth, Johnson, and Johnson (2008) found that cooperative learning improved student motivation because the increased relationships that students experienced led to greater vestment, student achievement, and motivation. The effectiveness of cooperative learning may have been one of the few things upon which a super majority of researchers agreed (Hattie, 2009; Johnson, 2012; Kagan & Kagan, 2009)

Research on cooperative learning as an instructional strategy indicated that, with correct implementation, student achievement increased with use. Dean et al. (2012), in *Classroom Instruction that Works*, analyzed the results of meta-analyses on the effects of cooperative learning. The growth of student achievement after the implementation of cooperative learning had an effect size of 0.78, which is an average of a 28th percentile gain. Johnson and Johnson (2008) found that, in multiple experimental studies, minority students learned more than Caucasian students in cooperative learning classrooms than compared to traditional classrooms. Caucasian students learned more in cooperative classrooms as well, but the achievement gap between minority and Caucasian students decreased. Kagan and Kagan (2009) also found results that showed closure of the achievement gap. An elementary school using cooperative learning strategies decreased the achievement gap from 53% to 10%. Similarly, these results were not at the expense of majority students. Hattie (2009) identified four groups of meta-analyses regarding cooperative learning:

1. those that compare cooperative learning versus heterogeneous classes (d = 0.41);
2. those that compare cooperative versus individualistic learning (d = 0.59);
3. those that compare cooperative versus competitive learning (d = 0.54);
4. those that compare competitive versus individualistic learning (d = 0.24). (p. 212)

Student achievement increased with the use of cooperative learning strategies, as did other aspects of student development.

However, cooperative learning did more than increase student achievement. Bellanca and Brandt (2010) found the following benefits beyond student achievement:

- Students worked harder (greater productivity, greater use of higher-level thinking, greater motivation, higher frequencies of on-task behavior, greater transfer of knowledge from one unit of learning to another);
- Relationships among peers were of a higher quality (higher levels of working with peers and support of one another); and
- Emotional health increased (higher self-esteem, higher social aptitudes, a broader perception of situations, and a greater ability to deal with difficult situations).

Johnson (2012) also found that increased motivation could result from cooperative learning and that it also led to a sense of responsibility for peers of the group. Dean et al. (2012) stated,

> We can no longer expect students to learn in isolation any more than we can expect to learn in isolation. By giving students opportunities to learn and lead in cooperative groups, we are helping them develop those essential skills for higher education and the workplace. (p. 46)

Cooperative learning improved both the intellectual and emotional qualities of the student.

The complexity of educating students in the 21st century calls for instructional strategies that offered high flexibility and long, sustainable student growth. Dean et al.

(2012) found that students needed not only intellectual skills but also skills that required them to work with peers to accomplish tasks. Bellanca and Brandt (2010) noted that it was essential for students to understand how to work effectively in cooperation with their peers to resolve conflicts constructively. Dean et al. (2012) also found that, although numerous variations of cooperative learning existed, the consistent theme through each variation was the inclusion of two critical components: positive interdependence and individual accountability. Positive interdependence was critical because it emphasized the importance of the highly-functioning individual within the team. Positive interdependence also taught that the success (or lack thereof) of the individual did not hinder the success of the peer(s). Teachers needed to ensure that the workload of the team was balanced to promote this critical component. The second critical component of cooperative learning was individual accountability. Slavin (2014) noted that, when individual accountability was absent from cooperative learning, many of the potential benefits were lost, as well. Dean et al. (2012) continued that teachers needed to use various assessments to determine the student's individual contribution to the team's work. Feedback needed to be timely and clearly communicated. Cooperative learning, based on the premise that learning through teamwork provided greater learning than individual learning, sought accountability of the individual.

The key to cooperative learning is effective implementation of the strategy. Pitler et al. (2012) gave three recommendations: (a) positive interdependence and individual accountability, (b) small group sizes, and (c) consistent and systematic use of the strategy. Dean et al. (2012) noted that students who were not accustomed to their roles within the cooperative group needed ample opportunity to practice those roles. Slavin

(2014) found that the strategy was not effective when used for just a brief activity. Rather, the frequency of the strategies used had to be frequent enough that students felt they could depend on one another. Dean et al. (2012) continued that cooperative learning was to be used minimally, once per week, but that the strategy could frequently be used as long as the lesson included the key concepts of the strategy. Johnson and Johnson (2008) found that cooperative learning groups should be changed up to keep students highly engaged. The researchers also noted three variations of the groups: informal, formal, and base. Informal groups were those most frequently used for quick, formative assessments (e.g., shoulder partners, think-pair-share). Formal groups were used to make sure students worked collaboratively to complete a more complex unit of instruction; these groups may have lasted multiple class periods. Base groups were those that were in place perhaps for an entire year. These groups were used to complete daily tasks and to increase the social climate of the classroom rather than to increase explicit academic purposes.

The use of computers with cooperative learning strategies seemed to complement one another. Dean et al. (2012) stated that every model of cooperative learning involved two basic concepts that were foundational in the preparation of students: collaborating and creating. The concepts of collaboration and creation are themes that make the most successful digital learning environments. Johnson (2012) espoused his belief that digital environments had the ability to teach the 21st-century skills of collaboration and creation. He argued that, to develop the problem-solving abilities of students, teachers had to teach what he referred to as information literacy skills, which included the ability to:

1. Articulate the problem and identify the information needed to answer it,
2. Know information sources and locate relevant information,
3. Select and evaluate the information in those sources,
4. Organize, synthesize, and draw supported conclusions from the information,
5. Communicate findings and conclusions to others, and
6. Evaluate the final product and how effective and efficient the process of completing the project was. (p. 106)

Many teachers chose to develop a subset of each of these skills in their classroom on a daily basis. These skills equipped students to collaborate in a structured and productive manner that facilitated a deep understanding of skills and knowledge.

Socioeconomic Status

A great deal of literature exists describing the risk factors of poverty. Saudino (2005) stated that many psychologists and those specializing in child development research believed behavior was a combination of heredity and environment. Most of the literature espoused that 30-50% of behavior was a predisposition of one's DNA and that an estimated 50–70% of behavior was explained by environment. The 30–50% of behavior attributed to DNA is often formed during pregnancy. Jensen (2009) wrote that factors such as stress levels during pregnancy, the exposure to toxins, and the quality of care during pregnancy were all factors that influenced the developing child. In addition, the environment plays a pivotal role in the development of young children. Rutter, Moffitt, and Caspi (2006) found that the development of genes in the DNA sequence could be engaged or disengaged by environmental triggers such as quality of diet and levels of stress. The engagement or disengagement of these genes affected the immune system, learning, aggression, and memory. The success or failure of children's learning ability could greatly be determined before they stepped foot inside a classroom, children focused on survival rather than learning.

Emotional Challenges

Students from poverty were more likely to think about the basic needs of their families rather than the lessons taught in school. Beegle (2003) reported that, when asked about the value of education within their families, 98% of respondents reported that education had little to no meaning in their lives. Further, 92% of respondents reported that education was just something that was a part of their daily lives. The emotional stress created by not having basic needs met was overwhelming. Jensen (2009) stated that children needed four basic things to develop into emotionally healthy adults: unconditional love and direction from a primary caregiver, consistent and safe environments, 10–20 hours of reciprocal interactions per week, and exposure to personal activities that grew in complexity. Children in affluent environments were much more likely to have these basic needs met compared to their peers raised in poverty. Beegle (2003) reported that 98% of respondents believed that money was directly associated with stability, defined by the attributes of security, choice, and safety.

Caregivers in poverty held the same perspectives as children in poverty, and many of these emotions were carried from one generation to the next. Ahnert, Pinquart, and Lamb (2006) stated that parents in poverty often failed to develop consistent and meaningful relationships with their children. Parents were often overworked, concerned with the basic needs of the family, and used authoritarian discipline strategies. Jensen (2009) found that parents of students in poverty were often not emotionally engaged with their children. These parents frequently did not know where their children were, did not know the names of their children's teachers, and did not know the names of their children's friends. Children from these households were often left unattended or in charge of their younger siblings while their parents worked. These parents often had diminished self-esteem and felt powerless. Poverty often passed from one generation to the next through the transfer of these emotions.

Families in poverty struggle with some of the most basic needs. Beegle (2003) stated that food was a barrier to 99% of families in poverty. These individuals felt like second-class citizens when their school lunches were inferior to their peers, or when they had to purchase food with government vouchers or food stamps. Further, many individuals described situations where they became weak and distracted by hunger due to not being able to afford food. Payne (2012) stated that the mental duress of a lack of basic needs led to an increased rate of medical treatment for mental health disorders such as anxiety and poverty. The increase was not limited to out-patient services but also an increase in hospital admissions. Payne continued, "However, poor mental health may, in turn, arise out of the effects of being poor—the stress of managing on a low income, for example, or of living in poor quality housing, or trying to provide for children" (p. 2). Beegle (2003) found that most of those in poverty had access to no medical care or a limited amount of medical care. Even when they were able to seek medical attention, they lacked the financial means to pay for prescriptions. Jensen (2009) stated that the acute and chronic stressors associated with poverty were detrimental to children. Almeida, Neupert, Bank, and Serido (2005) found that the chronic stress in students from poverty was much higher than the stress levels in their affluent peers and that this stress may have been due to low income and poor living conditions. Jensen (2009) stated, “This kind of stress exerts a devastating, insidious influence on children’s physical, psychological, emotional, and cognitive functioning, areas that affect brain development, academic success, and social competence” (Chapter 2, Section 6, para. 1). The exposure to chronic stress may have limited the development of ways to cope with difficult situations and may have led to an increase in behavior and learning issues. Beegle (2003) stated that the lack of basic necessities led to feelings of hopelessness and loss of control. When basic needs were not met, it was difficult for students to focus on learning and the development of social skills.

Continuous chronic stressors and a preoccupation with the basic needs left the student with these things as primary thoughts. Rather than being engaged in learning, students focused on their hunger or worried about living conditions. Beegle (2003) stated that many of those living in poverty lived within a culture that did not value education, and it was something they did because they had to. Beegle continued by stating that the low priority of education left students unmotivated when they were at school and that infrequent conversations about the future led to a mentality that students were biding their time.

Miller (2015) stated that deficits in language and literacy skills were likely if a child grew up in poverty. He stated that the individual, intensive instruction that could be provided in a 1:1 setting through the computer was an essential part of closing deficits in language skills. However, Miller found that limited access to technology within the home left students challenged or intimidated by the use of technology at school when compared to their affluent peers. Smerdon et al. (2000) stated that technology could significantly aid in the learning of problem-solving, comprehension, and composition skills that were frequently not mastered by students from poverty. Technology was only part of the equation to closing deficits in learning. Beegle (2003) stated, “Participants reported that they believed their lives would have turned around sooner had they experienced teachers who believed in them and treated them like they were ‘somebody’” (p. 15). Technology in and of itself was not the answer, but when partnered with teachers who cared, it was a combination that enhanced the learning of students from poverty.

1:1 Computing in the Local Schools

The program of interest in this study began 5 years ago in a public school district in Northwest Arkansas. The vision of this program was to put devices in the hands of students so that they could learn and develop 21st-century skills at the same time. The grant was funded by an organization consisting of retired teachers from the district. Recipients of the grant were individual teachers who submitted winning applications.

Selection of Grant Recipients

Grant recipients were chosen from the submission of an application that was blindly scored by the district's technology committee. Applicants were required to answer questions in a narrative that was less than two pages in length. The questions asked about the applicant’s vision for 1:1 computing in his classroom, how 1:1 computing would improve the learning experience of students, and the attributes that the applicant held that made them the best choice for the program. A district administrator and member of the selection committee, noted that the trend over the life of the application was to scale back the questions of the application (Administrator, personal communication, October 19, 2015). Originally five, the questions became both fewer and broader for the purpose of understanding the applicant rather than rating how well the applicant could research and write a textbook answer to a specific question. Applications were scored on the merits of forward thinking, vision for collaboration, and instructional skills. Award announcements were made in the spring semester before the required summer technology summit.

Instruction with Technology

A critical attribute of this 1:1 computing program was the training that teachers received in implementing strategies focused on student collaboration. Grant recipients spent 5 days of the summer in professional development learning how to use collaborative strategies with 1:1 computing environments. Management of the computers was also a substantial portion of the training. Bellanca and Brandt (2010) reported that the success of 1:1 computing environments was often predicated on how well the devices were managed; in other words, whether the management of devices interrupted the learning process. Throughout the first school year as grant recipients, teachers received ongoing professional development focused on recipients learning from one another. They shared their experiences, both challenges and celebrations, and collaborated with other grant recipients to improve the effectiveness of their 1:1 computing environments.

CHAPTER III

METHODOLOGY

The review of literature presented evidence that problem-based learning and 1:1 computing initiatives had a positive impact on student achievement, student motivation, and student engagement. The research indicated that, when students were able to work on skill mastery in a process that used technology, collaborative strategies, and solved real-world problems, students were much more likely to be motivated to complete the work and engaged at higher levels. There were three purposes of this study. First, the purpose of this study was to determine by SES the effects of students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 instruction on positive student motivation as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas. Second, the purpose of this study was to determine by SES the effects of students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 instruction on positive student engagement as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas. Third, the purpose of this study was to determine the predictive effects of student efficacy, participation in 1:1 technology instruction in literacy classrooms, SES, and gender on literacy achievement as measured by the MAP assessment for eighth-grade students in three junior highs in Northwest Arkansas. From these statements, the researcher generated the following hypothesis:

1. No significant difference will exist by SES between students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 instruction on positive student motivation as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas.
2. No significant difference will exist by SES between students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 instruction on positive student engagement as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas.
3. The combination of efficacy, participation in 1:1 technology instruction in literacy classrooms, SES, and gender do not significantly predict the literacy achievement of eighth-grade students in three junior highs in Northwest Arkansas as measured by the MAP assessment.

The objectives of this chapter are to explain the research design, identify the sample population and how it was obtained, identify the instrumentation, explain the process of data collection, examine the process of statistical analysis, and discuss any limitations in the study.

Research Design

A quantitative, non-experimental, causal-comparative design was used in this study. The participants included eighth-grade students in three junior highs in Northwest Arkansas who may have been a part of a 1:1 computing environment in a literacy classroom. Because the 1:1 computing environments were determined prior to the beginning of this study, manipulation of the independent variable was not possible. A causal-comparative strategy was determined to be appropriate (Johnson & Christensen, 2008). A 2 x 2 between-groups factorial design strategy was used to analyze the interaction effect and main effects of SES and participation in 1:1 technology instruction in literacy classrooms on two separate dependent variables. This study used two 2 x 2 factorial ANOVAs. The independent variables for Hypothesis 1 and Hypothesis 2 were SES defined by school lunch status (participating versus not participating) and exposure to 1:1 technology instruction in literacy classrooms (participation versus no participation). The dependent variable for Hypothesis 1 was positive student motivation as measured by the MES. In addition, the dependent variable for Hypothesis 2 was positive student engagement as measured by the MES.

A quantitative, non-experimental, hierarchical regression strategy was used to analyze Hypothesis 3. Morgan, Leech, Gloeckner, and Barrett (2012) stated, "Multiple regression attempts to predict a normal (i.e., scale) dependent variable from a combination of several normally distributed and/or dichotomous independent/predictor variables." (p. 163). Using this regression strategy, all predictor variables are entered into the analysis simultaneously. This method allows the researcher to identify if any variable, or set of variables, significantly contributes to the regression model. The predictor variables for Hypothesis 3 were positive student engagement, positive student motivation, exposure to 1:1 technology in literacy classrooms (participation versus no participation, SES defined by school lunch status (participation versus no participation), and gender. The criterion variable for hypothesis 3 was literacy achievement measured by the eighth-grade MAP assessment.

Sample

Students chosen to participate in this study were 2015–2016 eighth grade students from three junior high schools in Northwest Arkansas. The sample was chosen from the two accessible populations, those participating in 1:1 technology in a literacy classroom and those not participating in 1:1 technology in a literacy classroom. The sample consisted of 350 students, mostly Caucasian, from an urbanized area with a combined SES rate of 27%. Each school principal and the district superintendent gave approval for the collection of data. All students were classified according to gender, SES, and exposure to 1:1 technology in a literacy classroom. Study participants were placed in a spreadsheet, and the sample was selected using the randomization formula in Excel.

Instrumentation

Motivation and Engagement Scale

The MES, a self-reported survey administered to participants, was used to provide the data for the dependent variables in Hypothesis 1 and Hypothesis 2. The data gathered from the MES were used for two of the predictor variables for Hypothesis 3. Fredricks et al. (2011) reported that the MES had a Cronbach's Alpha of .70-.87 and a test–retest correlation of .61-.81. After the survey was administered, positive student motivation and positive student engagement were calculated. Positive student motivation consisted of three subcategories: self-belief, learning focus, and valuing. Survey results from each of the three sub categories were combined in order to calculate a value for positive student motivation. Positive student engagement consisted of three subcategories: persistence, task management, and planning. Survey results from each of the three sub categories were combined in order to calculate a value for positive student engagement. Positive student motivation was used as the dependent variable in Hypothesis 1, and positive student engagement was used as the dependent variable in Hypothesis 2. The MES took approximately 20 minutes for students to complete. It consisted of 42 questions on a 7-point Likert-type scale. The cost for permission to use the instrument was approximately $100. The instrument was created by Martin (2015) of Lifelong Achievement Group. Of the 42 items on the instrument, 12 are related specifically to positive student motivation. Each item is assigned a value ranging from 1–7 by the study participant. In order to calculate a score for positive student motivation, the sum of the 12 related items is multiplied by 3.575 in order to create a score on a scale ranging from 43-100. Of the 42 items of the instrument, 12 are related specifically to positive student engagement. Each item is assigned a value ranging from 1–7 by the study participant. In order to calculate a score for positive student engagement, the sum of the 12 related items is multiplied by 3.575 in order to create a score on a scale ranging from 43–100.

Measures of Academic Progress

The MAP reading assessment, a norm reference test, was used to assess the literacy achievement of the eighth-grade students. The Northwest Education Association of Portland, Oregon published the assessment. The publisher recommends that the MAP assessment be administered 3 to 4 times per year, once each season. The district used in this study administered the assessment 3 times per year. The Director of Assessment determined each assessment window. The MAP assessment is administered on a computer; and it is not timed, although most students complete the assessment within 60 minutes. The questions on the assessment are presented in a multiple-choice format. There are not a set number of questions; rather, the assessment asks questions in an increasingly difficult format until the appropriate level of the student is determined. It measures reading comprehension and language usage. The MAP reading assessment is aligned with the literacy standards of the studied district, the Common Core State Standards. The result of the assessment is a score on a Rausch Unit scale. According to the Northwest Evaluation Association (2016), the Rausch Unit scale is a scale that uses the difficulty of an individual item to assess student achievement of the curriculum. The Rausch Unit scale can relate the scale number directly to the difficulty of an item on the assessment. Further, the Rausch Unit scale has equal intervals, meaning that the distance between each score within the scale is of equal distance, regardless of if the score is at the top or bottom and has the same meaning regardless of the grade level of the student. The Northwest Evaluation Association (2011) stated that the Pearson Product–Moment Correlation of the MAP reading assessment is .79-.88. The MAP assessment does not consist of a set number of questions. As students answer the multiple choice questions on the assessment, the instrument becomes more or less difficult depending on how students respond to questions until the assessment is able to calculate a Rausch Unit score within a range of 140–300. This MAP assessment only measures literacy achievement. Tables published by Northwest Evaluation Association provide normative data for grade levels.

Data Collection Procedures

After Institutional Review Board approval, the researcher obtained the existing data from the central office of the three schools within this study. This data included whether each student was exposed to 1:1 technology in the literacy classroom, SES, gender, and literacy achievement as measured by the MAP assessment. During the Spring 2015 semester, the MES survey was administered to the eighth-grade students at three junior high schools in Northwest Arkansas. The survey was administered in the literacy classrooms. Students responded to each of the questions by paper on a Likert-scale with seven possibilities. A number was used to identify students to link their survey results with demographic data and MAP assessment results in a manner that maintained confidentiality. The results of surveys administered to students were physically collected from each of the three schools within the study. Demographic data for study participants was obtained from the school district database. The school district ID number was used to identify each student in order to link survey results with demographic data and MAP assessment results in a manner that maintained anonymity. The student data were reviewed to verify that surveys were complete. The survey data found not to be complete were not used in the statistical analysis. Survey results were manually typed in an Excel spreadsheet. The survey results were matched with student demographic information, and a positive motivation score and positive engagement score were computed for each research participant. Paper copies of the survey were shredded, and student confidentiality was maintained because students used school-based id numbers unique to them. Student names were not placed on the surveys.

Analytical Methods

Data from this study were analyzed statistically using SPSS version 24. To test the three hypotheses, a two-tailed test with a .05 level of significance was used for statistical analysis. Two of the hypotheses were analyzed with a 2 x 2 factorial between-groups design and one hypothesis was analyzed using a regression design.

ANOVA

Data collection for Hypothesis 1 and Hypothesis 2 were coded according to participation in 1:1 technology in a literacy classroom and SES. The positive motivation score was used as the dependent variable for Hypothesis 1. The positive engagement score was used as the dependent variable for Hypothesis 2. The data were examined before statistical analysis for SES, gender, and participation in 1:1 technology in a literacy classroom to ensure the sample collected appropriately represented the population. Further analysis was used to check for outliers, and homogeneity of variances was checked using the Levene's statistic.

Hypothesis 1 was statistically analyzed with a 2 x 2 factorial between-groups ANOVA using exposure to 1:1 technology in a literacy classroom (participation versus no participation) by SES (participation versus no participation) as the independent variables, and positive student motivation as measured by the MES was used as the dependent variable. Hypothesis 2 was statistically analyzed with a 2 x 2 factorial beween-groups ANOVA using exposure to 1:1 technology in a literacy classroom (participation versus no participation) by SES (participation versus no participation) as the independent variables, and positive student engagement as measured by the MES. To test the two null hypotheses, a two-tailed test with a .05 level of significance was used as the dependent variable.

Multiple Regression

The sample was classified according to positive student motivation score, positive student engagement score, participation in 1:1 technology in literacy classrooms, SES, and gender. The sample was analyzed with the descriptive techniques of central tendency, skewness, kurtosis, and variance appropriate to the level of measurement for each variable. Before a regression analysis was conducted, the data were analyzed to determine if the assumptions of multiple regression were met. A scatter plot was used to determine if the variables had a linear relationship. Residual plots were computed to determine linearity, normality, and homoscedasticity. The results of the data analysis and discussion are reported in Chapter IV. At the conclusion of the statistical analysis, student data were removed from all computers.

Limitations

Limitations are noted in most research studies to assist in helping the reader determine how to interpret the results of studies. The following were limits identified with this study. First, it is not possible to determine how often students in the no participation category of the exposure to 1:1 technology in a literacy classroom group did receive instruction with technology. The opposite is also true. It is not possible to determine whether 21-C teachers always taught with 1:1 technology, or with collaborative methods that are a part of the 21-C program. Second, two-thirds of this study used a nonexperimental, causal-comparative strategy. The researcher was unable to randomly assign participants to groups because, in this strategy, the sample for the groups is chosen from two or more populations. Using this strategy also eliminated the ability to manipulate one or more of the independent variables (Rovai, Baker, & Ponton, 2013). Third, there were a limited number of participants within the study. These students were from three separate schools within the same district. It should be noted that a lack of diversity also existed within the population of the study. Fourth, the positive motivation score and positive engagement score were self-reported by the research participants. The researcher cannot, with certainty, state that all participants filled out the survey with fidelity. Finally, the researcher of this study was an administrator at one of the schools selected for the study. Procedures were put in place to avoid undue bias. Once student ID numbers were placed on the surveys, the surveys were proctored by teachers. Once a case ID number was assigned to participants, no school or teacher identification data were stored. Study participants were only identified by whether they participated in 1:1 technology within a literacy classroom. Limitations exist within every study. However, the variables chosen were done so with the utmost concern for consistency. This study provides the reader with information that should allow for an informed decision regarding the effects of collaborative instructional strategies when paired with 1:1 technology within some categories derived from demographics.

CHAPTER IV

RESULTS

The study was a quantitative, nonexperimental analysis of three hypotheses. Hypothesis 1 and Hypothesis 2 were 2 x 2 between-group designs, and the two independent variables for both hypotheses were exposure to 1:1 technology in a literacy classroom (participation versus no participation) and SES defined by school lunch status (participating versus not participating). The dependent variable for Hypothesis 1 was positive student motivation, and the dependent variable for Hypothesis 2 was positive student engagement. Hypothesis 3 examined the predictive effects of student efficacy (positive student engagement and positive student motivation, 1:1 technology in literacy classrooms (participation versus no participation, SES defined by school lunch status (participation versus no participation), and gender. The dependent or criterion variable for Hypothesis 3 was literacy achievement measured by the eighth-grade MAP assessment.

Analytical Methods

The three hypotheses were analyzed using *IBM Statistical Packages for the Social Sciences Version 24* (IBM Corporation, 2016). Data for the hypotheses were collected and coded for SES, exposure to 1:1 technology in a literacy classroom, and gender. Hypothesis 1 and Hypothesis 2 were analyzed using two 2 x 2 factorial ANOVAs. Two-tailed tests with a .05 significance level were used to test the null hypotheses. The researcher assessed assumptions of normality and homogeneity of variances prior to statistical analysis of Hypothesis 1 and Hypothesis 2. Hypothesis 3 was analyzed with a regression strategy. Data were examined in order to determine that assumptions were met. Normality was assumed due to the sample size of 350.

Demographics

Student demographics, scores, and surveys were obtained from three schools in a district in Northwest Arkansas; the schools chosen represented the eighth-grade population, which constituted two populations: those participating in the 1:1 program and those not participating. A stratified sample of 350 students was chosen from the population of approximately 1,200 students. The stratification of the sample mirrored the proportion of the population participating in 1:1 technology (37%) in a literacy classroom and those participating in the free/reduced lunch program (26%). Although not stratified, gender of the sample was checked and found to be within 1% of the population.

Hypothesis 1

Hypothesis 1 stated that no significant difference will exist by SES between students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 instruction on positive student motivation as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas. The population from which the sample was not normally distributed. Skewness was less than 1, and kurtosis was slightly more than 1. Table 1 displays the group means and standard deviations.

Table 1

Descriptive Statistics for SES by Exposure to 1:1 Technology in a Literacy Classroom on Positive Student Motivation

SES	Program Participation	*M*	*SD*	*N*
Yes	1:1 Program	72.67	16.43	34
	No 1:1 Program	80.70	11.48	50
	Total	77.44	27.19	84
No	1:1 Program	80.37	11.71	99
	No 1:1 Program	77.57	13.66	167
	Total	78.61	13.02	266
Total	1:1 Program	78.40	13.44	133
	No 1:1 Program	78.30	13.23	217
	Total	78.33	13.29	350

Screening for extreme outliers was conducted and no cases were removed. Four cases were reported as outliers, but they were not significantly extreme enough to be removed. The Kolmogorov-Smirnov test was used to test for normality with $p < .05$ for each group, indicating that the data were not normally distributed across all groups. However, factorial ANOVA is able to tolerate this violation (Morgan et al., 2012). Levene’s test of equality of variances was conducted within ANOVA and indicated that homogeneity of variances existed across groups, $F(3, 346) = 0.13$, $p > .05$, indicating that the assumption was met. However, the robust nature of ANOVA still allows the use of this test for statistical analysis (Morgan et al., 2012). A line plot indicated an interaction between SES and exposure to 1:1 technology in a literacy classroom. A 2 x 2 factorial

ANOVA was used to test the hypothesis to evaluate the effects of SES (participating versus not participation) by exposure to 1:1 technology in a literacy classroom (participation versus no participation) on positive student motivation. The results of the ANOVA are displayed in Table 2.

Table 2

Factorial ANOVA Results from Positive Student Motivation

Source	*SS*	*df*	*MS*	*F*	*p*	*ES*
SES	321.30	1	321.30	1.86	.174	0.01
1:1 Program	419.87	1	419.87	2.43	.120	0.01
SES*1:1 Program	1794.56	1	1794.56	10.39	.001	0.03
Error	59767.82	346	172.74			
Total	61651.30	349				

There was evidence to reject the null hypothesis of the interaction. The interaction between SES and exposure to 1:1 technology in a literacy classroom on positive student motivation was significant, $F(1, 346) = 10.39$, $p = .001$, $ES = 0.03$. According to Cohen (1988), this is a small effect size. Due to this interaction, a simple effects analysis was conducted. Figure 1 shows the means for positive student motivation as a function of SES and 1:1 technology.

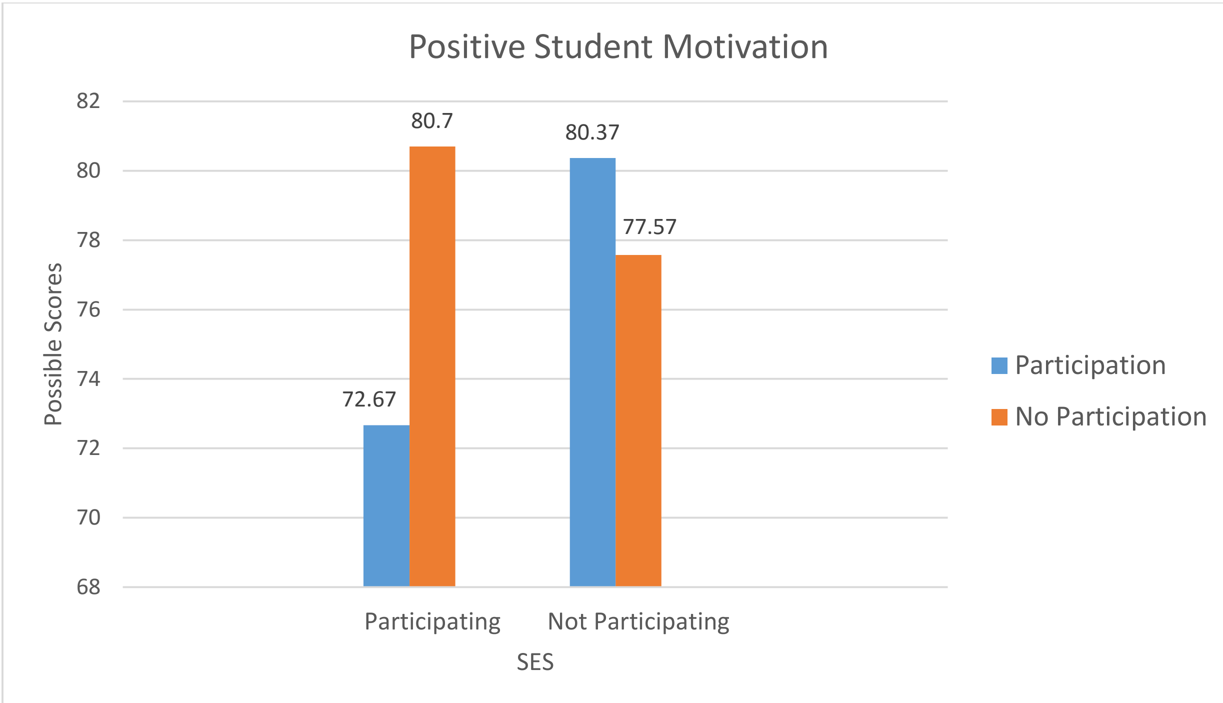

Figure 1. Means for positive student motivation as a function of SES by 1:1 technology.

Of the four groups created by the two independent variables in the first hypothesis (Yes SES/Yes 1:1 Program participation; Yes SES/No 1:1 Program participation; No SES/Yes 1:1 Program participation; and No SES/No 1:1 Program participation), the results of the simple effects analysis indicated a significant difference between two of the six group comparisons. The results of the simple effects analysis are displayed in Table 3.

Table 3

Simple Effects Analysis Results

Source	*SS*	*df*	*MS*	*F*	*p*	*ES*
Corrected Model	1883.47	3	627.83	3.64	.013	0.03
Intercept	1479489.50	1	1479489.50	8564.87	.000	0.97
Cellcode	1883.47	3	627.83	3.64	.013	0.03
Error	59767.82	346	172.74			
Total	2209291.44	350				

The No SES/Yes 1:1 Program participation sample mean (*M* = 80.37, *SD* = 11.71) was significantly higher compared to the Yes SES/Yes 1:1 Program participation sample mean (*M* = 72.67, *SD* = 16.43), *p* = .018. In other words, in the two groups participating in the 1:1 Program, the students not participating in the free and reduced lunch program, in general, demonstrated a statistically higher positive student motivation compared with the students participating in the free and reduced lunch program. In addition, the Yes SES/No 1:1 Program participation sample mean (*M* = 80.70, *SD* = 11.48) was also significantly higher compared to the Yes SES/Yes 1:1 Program participation sample mean, *p* = .013. In other words, in the two groups participating in the free and reduced lunch program, the students not participating in the 1:1 Program, in general, demonstrated a statistically higher positive student motivation compared with the students participating in the 1:1 Program.

The main effect for SES was not significant, *F*(3, 346) = 3.64, *p* = .174, *ES* = 0.01. When analyzing the main effect for SES on positive student motivation, even though the mean of the not participating group (*M* = 78.61, *SD* = 13.02) was slightly higher, it was not significantly different compared to the participating group's mean (*M* = 77.44, *SD* = 27.19). Similarly, the main effect for exposure to 1:1 technology in a literacy classroom was also not significant, $F(1, 346) = 2.43$, $p = .120$, *ES* = 0.01. When analyzing the main effect for program exposure on positive student motivation, the means of the participating group (*M* = 78.40, *SD* = 13.44) and the not participating group (*M* = 78.30, *SD* = 13.23) were similar. Therefore, there was not enough evidence to reject the null hypothesis for the main effects.

Hypothesis 2

Hypothesis 2 stated that no significant difference will exist by SES between students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 instruction on positive student engagement as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas. The population from which the sample was normally distributed. Skewness and kurtosis were both less than 1. Table 4 displays the group means and standard deviations.

Table 4

Descriptive Statistics for SES by Exposure to 1:1 Technology in a Literacy Classroom on Positive Student Engagement

SES	Program Participation	*M*	*SD*	*N*
Yes	1:1 Program	61.06	18.04	34
	No 1:1 Program	68.43	14.91	50
	Total	65.44	16.55	84
No	1:1 Program	66.26	15.09	99
	No 1:1 Program	66.17	16.51	167
	Total	66.20	15.97	266
Total	1:1 Program	64.93	15.99	133
	No 1:1 Program	66.69	16.15	217
	Total	66.02	16.09	350

Screening for extreme outliers was conducted and no cases were removed. No outliers were found. The Kolmogorov-Smirnov test was used to test for normality with $p < .05$ for each group, indicating that the data were not normally distributed across all groups. However, factorial ANOVA is able to tolerate this violation (Morgan et al., 2012). Levene's test of equality of variances was conducted within ANOVA and indicated that homogeneity of variances existed across groups, $F(3, 346) = 0.74$, $p > .05$, indicating that the assumption was met. A line plot did not indicate interaction between SES and exposure to 1:1 technology in a literacy classroom. A 2 x 2 factorial ANOVA was used to test the hypothesis to evaluate the effects of SES (participating versus not participation) by exposure to 1:1 technology in a literacy classroom (participation versus no participation) on positive student motivation. The results of the ANOVA are displayed in Table 5.

Table 5

Factorial ANOVA Results from Positive Student Engagement

Source	*SS*	*df*	*MS*	*F*	*p*	*ES*
SES	133.10	1	133.10	0.52	.473	0.00
1:1 Program	808.20	1	808.20	3.14	.078	0.01
SES*1:1 Program	850.63	1	850.63	3.30	.070	0.01
Error	89205.29	346	257.82			
Total	1615946.69	349				

The interaction of the variables was not significant, $F(1, 346) = 3.30$, $p = .070$, $ES = 0.01$. Program participation and SES did not combine to affect positive student engagement. Therefore, the null hypothesis could not be rejected. Because no significant interaction was found between SES and exposure to 1:1 technology, the main effect of each variable was examined independently. The main effect for SES on positive student engagement was not significant, $F(1, 346) = 0.52$, $p = .473$, $ES = 0.00$. Similarly, the main effect for exposure to 1:1 technology was not significant, $F(1, 346) = 3.14$, $p = .078$, $ES = 0.01$. Figure 2 shows the means for positive student engagement as a function of SES and 1:1 technology.

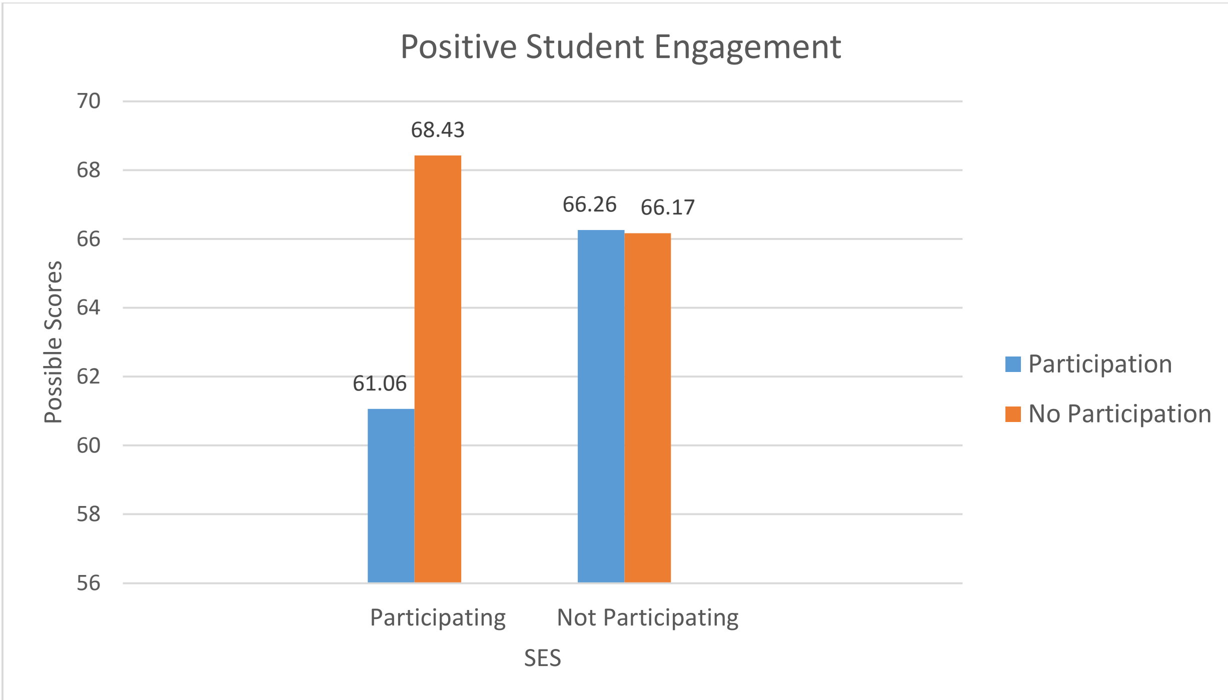

Figure 2. Means for positive student engagement as a function of SES by 1:1 technology.

When analyzing the main effect for SES on positive student engagement, even though the mean of the not participating group (*M* = 66.20, *SD* = 15.97) was slightly higher, it was not significantly different compared to the participating group's mean (*M* = 65.44, *SD* = 16.55). Similarly, when analyzing the main effect for program participation on positive student engagement, even though the mean of the not participating group (*M* = 66.69, *SD* = 16.15) was slightly higher, it was not significantly different compared to the participating group's mean (*M* = 64.93, *SD* = 15.99). Therefore, not enough evidence existed to reject the null hypotheses for the main effects.

Hypothesis 3

Hypothesis 3 stated that the combination of student efficacy, participation in 1:1 technology instruction in literacy classrooms, SES, and gender do not significantly predict the literacy achievement of eighth-grade students in three junior highs in Northwest Arkansas as measured by the MAP assessment. A multiple regression strategy was used to determine the extent to which a model of student efficacy, 1:1 technology participation, SES and gender would predict the literacy MAP scores of eighth-grade students in three junior highs in Northwest Arkansas. A residual plot indicated that linearity, normality, and homoscedasticity were not markedly violated. Scatterplots and correlation coefficients were also examined to determine that none of the predictor variables had a substantial nonlinear relationship with MAP scores, these findings are presented in Table 6. Positive student motivation and positive student engagement were each predictor variables at the beginning of this statistical analysis. However, concerns of high multicollinearity compelled the research to create an operational variable, student efficacy. The calculation used for student efficacy was the sum of positive student motivation and positive student engagement divided by two.

Table 6

Correlation Results for Hypothesis 3 on MAP Scores

Pearson Correlation	MAP	Gender	SES	1:1 Tech	Efficacy
MAP	1.000	-.089	-.209	-.004	-.065
Gender	-.089	1.000	.085	-.002	-.204
SES	-.209	.085	1.000	.029	-.031
1:1 Tech	-.004	-.002	.029	1.000	-.030
Efficacy	-.065	-.204	-.031	-.030	1.000

Note. MAP = Measures of Academic Progress; Gender = Male or Female; SES = Participating or Not Participating; 1:1 Technology = Participation or No Participation; Efficacy = Positive Student Motivation + Positive Student Engagement/2.

No high multicollinearity was observed between any of the variables. Tolerance and VIF indicators for all variables were within acceptable limits. A summary of the regression model is presented in Table 7.

Table 7

Model Predicting MAP Scores

Model	*SS*	*df*	*MS*	*F*	*p*
Regression	2653.71	4	663.44	5.15	.000
Residual	44409.56	345	128.72		
Total	47063.27	349			

Results of the regression analysis indicated that the overall model significantly predicted literacy MAP scores, $F(4, 345) = 5.15$, $p < .001$. The model accounted for only 4.5% of variance of literacy MAP scores ($R2 = .056$, $R2adj = .045$). According to Cohen (1988), this is a medium effect size. A summary of the regression coefficients is presented in Table 8.

Table 8

Regression Results for Predictors of Literacy MAP Scores

Model	*B*	*SE*	*β*	*t*	*p*	Collinearity Statistics	
1(Constant)	233.45	3.62		64.58	.000	Tolerance	VIF
Gender	-2.09	1.24	-.090	-1.68	.094	.952	1.050
SES	-5.54	1.43	-.204	-3.88	.000	.992	1.008
1:1 Tech	-0.01	1.25	-.001	-0.01	.991	.998	1.002
Efficacy	-0.08	0.05	-.090	-1.68	.095	.957	1.045

Note. SES = Socioeconomic Status; 1:1 Tech = Exposure to 1:1 Technology; Efficacy = Combined Positive Student Motivation and Positive Student Engagement/2.

Regression results for predictors of literacy MAP scores indicated that only one predictor significantly contributes to the model. From the model including student efficacy, participation in 1:1 technology instruction in literacy classrooms, SES, and gender, only SES contributed to the model in a statistically significant manner.

Summary

This study contained three hypotheses. Hypothesis 1 and Hypothesis 2 were both 2 x 2 factorial between-groups designs, and Hypothesis 3 was a multiple regression analysis. The dependent variable for Hypothesis 1 was positive student motivation; the dependent variable for Hypothesis 2 was positive student engagement; and the dependent or criterion variable for Hypothesis 3 was literacy MAP scores. The same sample was used in the three hypotheses. A summary of the findings of each of the hypotheses is presented in Table 9.

Table 9

Summary of Statistically Significant Results for Hypotheses 1-3

Hypothesis	Significant Result	*p*	*ES*
1	Interaction of SES*1:1 Technology	.031	.009
2	None	----	----
3	SES predicts MAP scores	.000	.056

Hypothesis 1 had a significant interaction with a small effect size between SES and 1:1 technology participation. There was no significant finding in Hypothesis 2. Hypothesis 3 indicated that SES was a significant predictor of literacy MAP scores although the predictors only accounted for 4.5% of the regression model.

CHAPTER V

DISCUSSION

The computer has dramatically changed the learning process since its invention in the 1970s. Many educators embraced the computer from its inception. Although some viewed it as a novelty, many believed that it would revolutionize how students learned (Hew & Brush, 2006). The recent examination of how students use computers in the classroom furthered the conclusions that could be found in the use of computers and learning. These findings contribute to that discussion.

Conclusions

The following statistical analyses were used to address the three hypotheses. Hypothesis 1 was analyzed with a 2 x 2 factorial ANOVA with SES (participating versus not participating) and participation in 1:1 technology instruction in a literacy classroom (participation versus no participation) as the between subjects' independent variables with positive student motivation as the dependent variable. Hypothesis 2 was analyzed with a 2 x 2 factorial ANOVA with SES (participating versus not participating) and participation in 1:1 technology instruction in a literacy classroom (participation versus no participation) as the between subjects' independent variables with positive student engagement as the dependent variable. Hypothesis 3 was analyzed with a regression strategy. The predictor variables were student efficacy, participation in 1:1 technology instruction in literacy classrooms (participation versus no participation), SES (participating versus not participating), and gender. The dependent variable was literacy achievement of eighth-grade students as measured by the MAP assessment.

Hypothesis 1

Hypothesis 1 stated that no significant difference will exist by SES between students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 technology instruction on positive student motivation as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas. Both main effects for SES and participation in 1:1 technology in a literacy classroom were not significant; therefore, the main effect hypotheses were not rejected. However, the interaction between SES and exposure to 1:1 technology in a literacy classroom was significant; therefore, the interaction null hypothesis was rejected. A simple effects analysis was conducted to further examine the significance. Of the four groups created by the two independent variables in the first hypothesis (Yes SES/Yes 1:1 Program participation; Yes SES/No 1:1 Program participation; No SES/Yes 1:1 Program participation; and No SES/No 1:1 Program participation), the results of the simple effects analysis indicated a significant difference between two of the six group comparisons. The No SES/Yes 1:1 Program participation sample mean was significantly higher compared to the Yes SES/Yes 1:1 Program participation sample mean. In other words, in the two groups participating in the 1:1 Program, the students not participating in the free and reduced lunch program, in general, demonstrated a statistically higher positive student motivation compared with the students participating in the free and reduced lunch program. In addition, the Yes SES/No 1:1 Program participation sample mean was also significantly higher compared to the Yes SES/Yes 1:1 Program participation sample mean. In other words, in the two groups participating in the free and reduced lunch program, the students not participating in the 1:1 Program, in general, demonstrated a statistically higher positive student motivation compared with the students participating in the 1:1 Program.

Hypothesis 2

Hypothesis 2 stated that no significant difference will exist by SES between students participating in 1:1 technology instruction in literacy classrooms versus students not participating in 1:1 technology instruction on positive student engagement as measured by the MES for eighth-grade students in three junior highs in Northwest Arkansas. There was no significant interaction between the variables, not allowing for the rejection of the null hypothesis. The main effect of each independent variable was examined. The main effect for SES was not significant. The main effect for exposure to 1:1 technology was not significant. In the analysis of means, the mean of the positive student engagement scores for the 1:1 technology participation group were not significantly different compared to the means of the 1:1 technology no participation group. The mean of the positive student engagement scores for the SES participating group was not significantly different than the SES not participating group. No significant difference existed with the main effect for SES or exposure to 1:1 technology in a literacy classroom.

Hypothesis 3

Hypothesis 3 stated that the combination of student efficacy, participation in 1:1 technology instruction in literacy classrooms, SES, and gender do not significantly predict the literacy achievement of eighth-grade students in three junior highs in

Northwest Arkansas as measured by the MAP assessment. The hypothesis was analyzed using a multiple regression strategy, and the results indicated that the overall model significantly predicted literacy MAP scores and accounted for 4.5% of variance of literacy MAP scores. The only significantly contributing predictor variable to the model was SES. Although it was determined that the model was useful, the low variance of percentage of this model provided a limited explanation. However, the significance of the overall model allowed for the rejection of the null hypothesis. It is possible that a combination of other predictors may provide a greater understanding of what might predict literacy MAP scores.

Implications

The results of this study were mixed. The interaction effect of 1:1 Program participation and SES was found to be statistically significant on positive student motivation in Hypothesis 1. However, neither the interaction effect of 1:1 Program participation and SES nor either main effect was found to be statistically significant on positive student engagement in Hypothesis 2. Additionally, SES was the only significant predictor variable in the regression analysis on literacy achievement in Hypothesis 3. This study was dependent upon a unique set of variables within a population of eighth-grade students in a single school district. An examination of the study results must be placed within the breadth of literature on 1:1 technology and collaborative instructional strategies. The statistical calculations of this study provided insight into the variables that explained positive student motivation, positive student engagement, and literacy achievement.

Hypothesis 1

Students from a background of poverty were less motivated in a 1:1 computer environment when compared to other students from poverty in a regular classroom setting (no 1:1 Program participation). Two factors for consideration in this finding are collaboration with peers and the technology within the classroom. Cooperative learning and PBL are statistically significant learning strategies that were identified as instructional strategies that maximized learning (Hattie, 2009; Johnson et al., 2008; Kagan & Kagan, 2009). Within the context of these instructional strategies is a focus on peer-to-peer collaboration. However, students from poverty are often focused on their basic needs instead of the learning that takes place in the classroom, which may lead to a detachment from the learning environment. Roseth et al. (2008) found that collaborative strategies increased student motivation, but an examination of the results of this study indicate that students from poverty may not have been fully vested in the learning environment. Further, those students in classrooms not participating in the 1:1 technology initiative may have felt motivated due to the highly effective learning cycles taking place in their classrooms. This study did not measure which learning strategies were used in the technology no participation groups. If one assumes that high-yield strategies were used in 1:1 classrooms, as well as traditional classrooms, further discussion of how students from poverty interacted with the technology is necessary.

A second significant comparison in the present study was that the Yes SES/No 1:1 Program participation sample mean was also significantly higher compared to the Yes SES/Yes 1:1 Program participation sample mean. One consideration is the assumption that all students are familiar with computers and computing devices. Miller (2015) stated that there was a high likelihood that students from poverty had limited access to technology. Further, Beegle (2003) reported that many families from poverty did not value education. Based on Beegle’s findings, this researcher proposes that, even if students from poverty had access to technology in the home, a high likelihood exists that their proficiency on those devices may not be in the areas that would facilitate academic activities. Students may use the devices to play games and surf the internet, rather than use collaborative applications, learn to type, or gain proficiency in word processing. Pairing Beegle’s research with the fact that students from poverty may struggle with basic needs provides evidence that assumptions about student proficiency with technology need to be reexamined (see also Jensen, 2009). This research indicates the following: (a) a critical conversation when using technology in the classroom should be that no presumptions should be made about student proficiency on computers and (b) computer literacy is a foundational skill needed prior to learning cycles involving 1:1 computing.

Hypothesis 2

Hypothesis 2 indicated no significance with the variables of SES or exposure to 1:1 technology in a literacy classroom on student engagement. One consideration for this result is that a measurement that involves student response is only one way to evaluate engagement in the classroom. Observations and teacher surveys may yield different results. A second consideration is that students from all settings may have felt engaged at a high level because of effective teacher instruction. A result with no statistical significance may mean that all environments are engaging students at high levels. As the role of the teacher continues to evolve from instructor to facilitator (Johnson, 2012), further development of teaching pedagogy may inform professional practice, including 1:1 computing environments.

An informed perspective on the results of Hypothesis 2 are not complete without further examination of the link between poverty and engagement. Jensen (2009) stated that frequent or chronic stress because of an impoverished home environment could directly impede social competence and academic success in schools. The impediment of social competence, combined with a heightened awareness of social structures, could prevent students from fully engaging in collaborative environments. Jensen’s finding is applicable to classrooms with 1:1 computing capabilities, as well as the traditional classrooms. Students who struggle with their basic needs are not going to be interested in improving their critical thinking skills or collaborating with their peers. A final consideration is the limited studies available on how student use technology as opposed to how teachers use technology. Researchers acknowledged that the limited amount of studies on how students use computers in 1:1 environments limited conclusions (Bebell & Kay, 2010; Penuel, 2006).

The regression analysis offered a statistically significant result; yet, the findings were minimal due to the limited effect size and the small percent of prediction. From the multiple regression model, SES was the only significant predictor of literacy achievement. Almeida et al. (2005) found that students of poverty’s academic achievement was affected from an early age, specifically by the amount of stressors faced in early childhood. Rutter et al. (2006) discussed the development of DNA sequences and found that stress caused by environmental triggers could slow the development of those sequences. Further, Saudino (2005) wrote that significant amounts of stress during early childhood, often an attribute of poverty, predisposed children to emotional deficiencies that could hinder learning and self-control. SES is a factor that educators are unable to control but should acknowledge when making decisions for learners.

One last discussion is to determine whether or not a 1:1 computing program that emphasizes collaborative learning is worth the investment. Educational leaders spend much of their budgets attempting to increase the motivation and engagement of students in an attempt to increase student achievement. Computers are expensive and must be replaced on a regular basis in order to remain relevant. In talking with the leadership of the grant program that is the subject of this study, they offered an analogy.

> Educators do not sit around and discuss the value of a pencil; yet, we use the pencil in every classroom, every period of the day. We don't put a value on the pencil and discuss whether or not we can afford it, because in our minds, it is essential, in essence a prerequisite, necessary for learning to take place. The pencil of the 21st century is the computer. Whether or not the computer increases academic achievement is not the most important question to ask. The most important question is what are we doing to teach students computer literacy, which will be needed prior to entering the work force in nearly every field (personal communication, October 19, 2015).

When considering an investment in technology, decision makers must balance the essential skills that students will need and the effect on motivation, engagement, and academic achievement when 1:1 computing environments are in place.

Recommendations

Potential for Practice/Policy

This study examined the motivation, engagement, and achievement effects of 1:1 computing, combined with collaborative strategies, in a literacy classroom. The study was conducted with a sample from three junior highs in Northwest Arkansas, each of which had students that did and did not participate in the 1:1 computing environment. The findings of this study could provide conclusions for schools that have similar student populations in similar grade levels in Northwest Arkansas and in other suburban areas. Regardless of the size or demographics of the district, all educational leaders must decide how to spend their technology dollars and evaluate whether the expense of technology provides results that satisfy the investment when compared to other investments in curriculum and instruction.

First, districts should consider more than just the motivation, engagement, and achievement that may or may not come with an investment in instructional technology. A district must understand that students will be expected to be able to use technology when they enter the workforce. Basic computing skills are considered a prerequisite for many sectors of industry. It is not possible to assign value to a computer just as it is not possible to assign value to a pencil. Technology is a fundamental requirement that is necessary to prepare today's students for tomorrow's jobs. The mission and vision statements of most school districts will use some phrasing that states part of why they exist is to prepare students to be successful beyond graduation. As schools focus on how to spend their instruction and technology dollars, this reason of existence should be considered with equal weight as the various metrics of achievement.

Second, districts should strive to present learning in a manner that builds on the social skills and critical thinking skills of students. The results of this study did not demonstrate that the use of technology in a classroom increased academic achievement, although studies in the literature reviewed were able to show an increase in academic achievement (Dunleavy & Heinecke, 2007; Shapely, 2008; Silvernail, 2008). As the role of the teacher continues to move further toward that of the facilitator of learning (Savin-Baden, 2007), the ability of students to use tools of learning, including technology, continues to be important. Educational leaders strive to make choices that support students. Providing the tools that today's students are able to use best falls into the definition of supporting students.

Third, districts should focus on what students do with technology rather than what teachers do with technology. For many years, research focused on teachers, and a substantial amount of research failed to determine which uses of technology were most effective in the classroom (Kuyatt et al., 2015). District populations are unique, and the correct use of technology could vary from community to community. However, what remains true of all districts is that the focus should remain on implementing technology and other tools of learning that best support each school population.

Fourth, legislatures should be cautious in their attempts to force the use of technology in the classroom. Act 187 of the 90th General Assembly of the state of Arkansas requires computer science as a mandated part of school curriculum:

> A.C.A. § 6-16-146 Computer science—Required course offering. (a) Beginning in the 2015-2016 school year, a public high school or public charter high school shall offer at least one (1) computer science course at the high school level. (b) A

computer science course offered by a public high school or public charter high school shall: (1) Be of high quality; (2) Meet or exceed the curriculum standards and requirements established by the State Board of Education; and (3) Be made available in a traditional classroom setting, blended learning environment, online-based, or other technology-based format that is tailored to meet the needs of each participating student.

No study observed by the researcher indicated that policy is an effective manner in which to create learning environments that develop technology literacy of students or increase academic achievement. What is effective is gathering pertinent data in order to complete a needs assessment that shows what unique attributes of a school's population should become the areas of focus.

Future Research Considerations

Some of the findings in this research support the use of technology as a tool that enhances learning for students. Further investigation into the students' use of technology to increase learning positively is needed. In order to more fully comprehend the effects of 1:1 computing with collaborative strategies, the researcher recommends further examination of the following:

1. An examination of the relationship of 1:1 computing in a literacy classroom with a student population that has a higher representation of students from poverty
2. An examination of the relationship between 1:1 computing in a literacy classroom and the difference in motivation, engagement, and academic achievement between genders

3. An examination of the relationship of 1:1 computing in academic areas other than literacy including mathematics and science
4. A study of best practices for the use of 1:1 technology in literacy classrooms at various grade levels and how best practices affect motivation, engagement, and academic achievement
5. A multi-year, longitudinal study of a learning cohort that examines the effects of 1:1 technology and collaborative strategies over a span of 5 or more years
6. Further exploration of student engagement and its relationship to 1:1 technology beyond the parameters of a student survey to include classroom observations and evaluations of engagement administered by education professionals
7. A study that examines the motivation, engagement, and academic achievement in a more ethnically diverse student population
8. Further exploration of how learners in traditional classrooms are presented learning opportunities while studying how students in the same population are presented learning opportunities in 1:1 computing environments

Each learning community has a specific set of needs in order to maximize learning. The effects of this study are limited to this specific demographic of students.

Educational leaders and decision makers should be cognizant of the ever-changing landscape that is the world of technology. Trends in technology come and go, but what remains is the need for students to be able to speak the language of computers. Research, including this study, indicated that classrooms have the capability to produce high levels of student engagement and student motivation, regardless of whether technology is used. However, to remain relevant in an ever-changing world, educators must continuously evaluate what are the best strategies and the best tools to maximize motivation, engagement, and achievement.

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Appendix A

HARDING
UNIVERSITY
INSTITUTIONAL REVIEW BOARD

Status of Request for Exemption from IRB Review

(For Board Use Only)

Date: 4/25/16

Proposal Number: 2016-061

Title of Project: Effects of 1:1 Computing by SES on Student Motivation, Engagement and Literacy Achievement

Principal Investigator(s) and Co-Investigator(s): Bryan Appleton bappleton@harding.edu

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■ Research exempted from IRB review.

☐ Research requires IRB review.

☐ More information is needed before a determination can be made. (See attachment.)

I have reviewed the proposal referenced above and have rendered the decision noted above. This study has been found to fall under the following exemption(s):

■ ☐2 ☐3 ☐4 ☐5 ☐6

In the event that, after this exemption is granted, this research proposal is changed, it may require a review by the full IRB. In such case, a ***Request for Amendment to Approved Research*** form must be completed and submitted.

This exemption is granted for one year from the date of this letter. Renewals will need to be reviewed and granted before expiration.

The IRB reserves the right to observe, review and evaluate this study and its procedures during the course of the study.

Rebecca O. Weaver

Chair
Harding University Institutional Review Board