THE EFFECT OF ONE-TO-ONE DEVICE INITIATIVES ON MATH AND ENGLISH LANGUAGE ARTS ACADEMIC ACHIEVEMENT IN SECONDARY SCHOOLS

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THE EFFECT OF ONE-TO-ONE DEVICE INITIATIVES ON MATH AND ENGLISH LANGUAGE ARTS ACADEMIC ACHIEVEMENT IN SECONDARY SCHOOLS

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ABSTRACT

The purpose of this non-experimental, quantitative study was to determine the effectiveness of one-to-one device initiatives in a secondary school setting. Not only was this study focused on the academic achievement of all students, but also the impact of such initiatives on the academic achievement in the free and reduced lunch population. The study was conducted utilizing standardized test scores from 30 schools in the state of Missouri. Test scores from three years pre-implementation and three years post implementation were compiled and analyzed using a paired samples t-test. The results demonstrated that one-to-one device initiatives were ineffective at improving academic achievement in the areas of math and English language arts. As one-to-one devices become more commonly utilized by school districts, this study serves as an opportunity to determine their effectiveness and consider the amount of money being used for their implementation.

APPROVAL PAGE

The faculty listed below, appointed by the Dean of the School of Education, Social Work, and Psychological Services have examined a research study titled "The Effect of One-to-One Device Initiatives on Math and English Language Arts Academic Achievement in Secondary Schools," presented by Mark Rorvig candidate for the Doctor of Education degree, and certify that in their opinion it is worthy of acceptance.

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CHAPTER 1

INTRODUCTION

In 2002, President George W. Bush signed the No Child Left Behind Act (No Child Left Behind [NCLB], 2002) into law, which fundamentally altered how schools were held accountable for the academic achievement of all students. The law was developed with the purpose of closing what was labelled at that time as achievement gaps and providing an equitable education for all students regardless of identifying factors (Husband & Hunt, 2015). The 2019 National Assessment of Educational Progress (NAEP), often referred to as our Nation's Report Card, announced poor 12th grade students scored, on average, 24 points less in mathematics than middle income students and 23 points less in reading. Likewise, findings of fourth graders reflected 24 points less in math and reading for poor students when assessing results of their peers from higher income families. Specifically, chronically low-performing schools were being held to the same achievement standards as schools that traditionally performed well.

Many of these low-performing schools shared similar characteristics and were frequently found in areas of high poverty such as the urban core or rural areas, which often include a disproportionate population of students that struggle with standardized testing, such as special education students, students of color, and English Language learners [ELL] (Garcia, 2020; Mintrop & Sunderman, 2009; Schwartz et al., 2021; VanGronigen & Meyers, 2019). Despite its intent, several researchers and theorists contend most reform policies, such as NCLB, have enticed educators to close these disparities with an emphasis on "achievement gap" talk rather than investigating opportunity gaps (Hung et al., 2020; Irvine, 2010; Ladson-Billings, 2006; Milner IV, 2012). Gutierrez (2008) has pointed out that the

"gap gazing" fetish is inappropriate because it stimulates deficit thinking and encourages negative narratives about marginalized students and working-class students. This can be attributed to what Ladson-Billings' (2006) described as an educational debt, due to opportunity gaps grounded in historical, economic, sociopolitical, and moral decisions and policies. Hung et al. (2020) imply, "the education system actually presents an opportunity gap that leads to unequal outcomes, such as achievement gaps" (p. 177). Despite these realities and the relative lack of support and guidance the legislation provided in addressing them (Cuban, 2004; Darling-Hammond, 2004; Earley, 2004), NCLB began the nationwide focus on accountability for schools improving the academic achievement of all students.

In order to measure the academic achievement of students and the progress being made by schools, school districts were required to administer high-stakes, standardized tests to all students. The initial goal of NCLB was to have all students performing at proficient levels on the standardized exams administered in the subjects of reading and mathematics by 2014 (NCLB, 2002). While the legislation failed at reaching this goal, the spirit of the bill and its method of measuring academic achievement continues to live on in current legislation (Mathis & Trujilo, 2016). In 2015, President Obama signed Every Student Succeeds Act [ESSA] (2015) into law. While NCLB expanded the federal government's role in education, ESSA looked to pare it back and give more power to states. Despite the transfer of power back to states, the high-stakes, test-based accountability system continues to be a focus of the law. In addition, this legislation supports schools teaching all students with the goal of college and career preparation in mind (ESSA, 2015). The overall increase in accountability measures and emphasis on standardized testing have left school districts looking for ways to improve instruction, while ignoring opportunity gaps. This typically involves lengthy lists of

teaching practices, which become the emphasis of instruction, as opposed to innovations that can help meet the learning needs of special education students, students of color, and English Language learners (ELL) (Darling-Hammond et al., 2017; Hattie, 2009; Howard & Milner, 2021; Picower, 2021). Given the increased emphasis on academic achievement rates from local and federal agencies, schools are looking for ways to help all students succeed at higher levels academically, which potentially includes some of these educational innovations.

The current approach used by schools to meet these accountability standards has fallen short. The collective efforts of school districts to close opportunity gaps have had no impact, with gaps widening instead of narrowing (Easterbrook & Hadden, 2021; Michelmore & Dynarski, 2017; Reardon, 2013). Schools have become faced with the reality that they must change their approach or continue to unsuccessfully meet the accountability standards enforced by federal and state institutions (Aguilar, 2020; Darling-Hammond et al., 2017; Howard & Milner, 2021). Fortunately, with more research-based knowledge than ever before, schools can make informed decisions to provide a stronger academic experience for all students.

One research-based approach to improving academic achievement is making coursework more relevant to students. Relevance of coursework is tied directly to student engagement and motivation in the classroom (Martin & Dowson, 2009; Neppl, 2019; Papworth, 2016; Suárez et al., 2019; Wang & Degol, 2014). Academic relevance is also seen as a gateway to other important attributes in education, such as critical thinking and problem solving. Gilman and Anderman (2006) noted that academic relevance is key to fostering an environment of creativity, which leads to critical thinking and problem solving amongst students. These skills not only have a role in improving academic achievement, but also in

preparing students for the ever-changing world they face now and in the future. Creativity, critical thinking, and problem solving are noted as just a few of the many skills that will be essential for students to be successful in the 21st century work and learning environment (Varier et al., 2017). Given the close connection between relevance, 21st century skills, and academic achievement, educators know they must make learning more relevant for students. In an effort to achieve a more relevant learning experience that allows students to build valuable skills for the future, educational institutions have turned to technology. Given the prevalent use of technology in society, providing opportunities for technology usage in learning makes lessons more relevant while also allowing students to build necessary 21st century skills.

Schools are not only looking at technology integration as a means for relevance in learning, but also to provide more equitable learning environments for all students (Hatakka et al., 2013; Tate & Warschauer, 2022; Warschauer et al., 2014; Zheng et al., 2013). While many educators feel it is valuable to increase the use of computers in schools, specific barriers have kept it from being a reality. One such barrier is the widespread availability of technology for all students inside and outside of school, regardless of socioeconomic background (Chandra et al., 2020; Tate & Warschauer, 2022; Vigdor et al., 2014; Warschauer, 2016). To combat this, schools have developed ubiquitous computing programs, which take place when teachers and students have access to technology (computing devices, the Internet, and services) whenever and wherever they need it (Van't Hooft & Swan, 2007). In the world of education, these are more commonly known as one-to-one device or one-to-one laptop programs, due to the one computer to one student ratio they create (Sauers & McLeod, 2012). A key goal of these initiatives is to increase educational and social equity by

decreasing the digital divide among different socioeconomic classes throughout a student population (Zheng et al., 2013). By providing all students, regardless of identifying characteristics, with the same technological device and opportunity to use said device, schools are hoping to provide more opportunities for relevance and creativity in the classroom. These initiatives take a privilege that was once reserved for students from a financially stable background, and make it available to all (Hatakka et al., 2013). In theory, this provides new educational opportunities for all students, especially students of poverty and historically underserved students.

While one-to-one device initiatives provide valuable technological resources to all students, they come at a significant financial cost to school districts. The market for classroom devices is led by two companies, Apple and Google. Apple (2019) currently markets their MacBook Air models for as low as $850 for educational institutions. Google's (2019) Chromebook models can sell for as low as $200 per machine. Regardless of the price disparity, providing either device to an entire school building of children will cost a substantial amount of money. In fact, the amount of money that schools are spending on technology for the classroom continues to grow. In the results of a 2020 survey, it was determined that K-12 institutions in the United States spent $35.8 billion on technology for the classroom, with $16.6 billion attributed solely to the purchase of hardware (Cauthen, 2021). The amount of money spent on hardware alone was an increase of $4.5 billion from the previous year (Cauthen, 2021). As schools continue to spend significant amounts of money on providing devices for students, it begs the question of whether or not these purchases are making a difference in student learning.

Statement of the Problem

Federal legislative actions, such as NCLB and ESSA, have placed significant pressure on schools to increase the academic achievement of all students. Unfortunately, many schools are not experiencing the level of achievement expected of the legislation (Howard & Milner, 2021; Hung, et al., 2020; Kastberg et al., 2016; Lomas 2020; Milner, 2012; Reardon, 2013). Multiple standardized test results have provided evidence of deficiencies in American schools, specifically in the areas of mathematics and English language arts. The recent scores of NAEP paint a concerning picture. The last time secondary students were assessed in the area of writing, 73% of students scored below the proficient level on the exam (National Center for Education Statistics [NCES], 2012). Results also showed reading as an area of concern, with 65% of students scoring below the proficient level on the exam and scores decreasing in 31 different states when compared to the previous test (NCES, 2019). When looking at math performance on the NAEP test, the results were equally concerning, with 75% of secondary students scoring below proficient on the exam. The concerns in mathematics achievement are highlighted even more when American schools are compared with their global counterparts (Kelly et al., 2013). According to Kastberg et al. (2016), "the Program for International Student Assessment (PISA) is a system of international assessments that allows countries to compare outcomes of learning as students near the end of compulsory schooling" (p. 1). On this exam, American students performed below the average score on the mathematics portion of the test, and their trend in mean performance has not improved in either reading or mathematics since the PISA tests given in the early 2000's. Given these results, it is apparent that the American education system is falling short in educating students in the areas of mathematics and English language arts.

While the overall levels of academic achievement in these two content areas raise concern, the disparities seen within different segments of the population in the United States point to an alarming imbalance in the education system. Results from the PISA tests show that there is a significant difference in the scores between students that are from high poverty backgrounds and students that are not. In the most recent PISA exam, students from socio-economically advantaged backgrounds scored, on average, 99 points better on the reading portion of the test than socio-economically disadvantaged students (Organization for Economic Co-Operation and Development [OECD], 2019). The same was found in the mathematics portion of the test, where socio-economic background was a strong predictor for performance, and explained 16% of the variation in mathematics performance, which is higher than the global average (OECD, 2019). Keeping this information in mind, schools in the US must work to balance the disparities facing students from low-income backgrounds and provide a more equitable education that allows for academic success.

One possible reason for the low level of academic achievement seen in American students is the lack of relevance and engagement in their coursework (Hur & Oh, 2012). Students have become disengaged and uninterested with traditional instructional practices that vary from their experiences in technology-rich environments (Rosen & Beck-Hill, 2012). While the availability of technology has generally increased throughout society, there are still many that are not able to utilize it due to the cost or issues with access. The disparity that has developed in technology access amongst different segments of the population has come to be known as the digital divide (Warschauer et al., 2014). Rideout and Katz (2016) found that 69% of families living in poverty have some type of computer in their household, leaving 31% without one. For families from poverty, access to high-speed internet was also an

obstacle, as 52% did not have a high-speed Internet connection available at their household. The numbers are much different for individuals not living in poverty as 87% were found to own a computer and 78% had high-speed internet access (Rideout & Katz, 2016).

This disparity in access to technology and high-speed internet only became more obvious as schools and communities adjusted to the impacts of COVID-19. Lai and Widmar (2021) noted that the digital divide was especially obvious in rural areas during COVID-19 shutdowns, due to a lack of high-speed internet infrastructure. Schools in high-poverty areas were also heavily impacted. In the results of the 2020 American Instructional Resources Survey (AIRS), 30% of teachers in schools with the highest category of school poverty responded that "all" or "nearly all" of their students had access to the internet (Stelitano et al., 2020). When compared to the schools in the lowest category of poverty, there was a significant difference in access, with 83% of teachers reporting that "all" or "nearly all" of their students had internet access (Steliano et al., 2020).

While these numbers display an obvious gap in access between different segments of the population, it has narrowed in recent years thanks to the efforts of many schools. In the year 2000, the National Center for Education Statistics reported that the ratio of students to computers in the classroom at the secondary level was 5.2 to 1. In their most recent survey of schools, it was found that the ratio of computers had lowered to 2.9 computers per one student (NCES, 2017). In addition, many schools have moved to a true one-to-one device environment during that time with 48% of schools now showing a ratio of one computer to each student (Maylahn, 2018). Schools' response to COVID-19 restrictions also led to an increase in access to technological resources. In the 2020 AIRS survey, 78% of teacher respondents noted that their school provided students with access to a device, and 45%

provided students with internet hot spots. While these figures represent a step in the direction of increased access, it is unclear whether or not these one-to-one device environments are helping all students academically achieve at higher levels.

Previous empirical studies conducted over the academic impact of one-to-one device initiatives have yielded inconsistent results. While some research has shown that one-to-one programs result in positive academic achievement gains, others have shown no gain or a decline in learning (Bleyer, 2017; Gatens, 2017; Silvernail & Gritter, 2008). In addition, much of the research available focuses on elementary and middle grades, often disregarding the secondary level. This has led to inconsistent conclusions as to the effectiveness of these programs in a high school setting. Considering the sizable costs that go in to initiating and maintaining a one-to-one device program, it is imperative to determine whether or not these programs are, in fact, improving academic achievement amongst students.

In two separate empirical studies conducted at pre-secondary levels, one-to-one device initiatives were shown to have positive impacts on academic achievement. Zheng et al. (2013) studied two elementary schools that planned to implement one-to-one laptop programs after displaying low achievement in the area of English language arts. The researchers utilized a pre- and post-test design, comparing the growth between pre-tests and post-tests for a total of three years. Students showed significantly higher levels of growth on the writing test after the implementation of a one-to-one laptop program, which led the researchers to conclude that such programs have a positive effect on English language arts achievement among students (Zheng et al., 2013). Clariana (2009) found similar results in the area of mathematics. This study examined a school district with eight elementary school buildings, seven of which were used as a control group. The treatment building initiated a

one-to-one laptop program which resulted in a device ratio of 1:1 while the control buildings had a classroom set of computers that created a device ratio closer to 5:1 (Clariana, 2009). The students in both groups were given common quarterly benchmark assessments, with the treatment group significantly outscoring the control group, thus resulting in a conclusion that one-to-one device programs improve math achievement (Clariana, 2009). While neither study was conducted in a secondary setting, they point to evidence of increased math and English language arts achievement in a one-to-one device environment.

Just as research has shown that one-to-one initiatives can have a positive impact on student learning, researchers have come to the opposite conclusion as well. Cristia et al. (2012) focused on the One Laptop per Child program used by several countries to provide affordable laptops to all students. The researchers specifically focused on students between the age of 6-12 in Peru and their achievement in area of math. Data analysis from the first 15 months of the program, revealed that introduction of the laptops had little or no effect on the academic achievement on the students (Cristia et al., 2012). Grimes and Warschauer (2008) had similar findings in the area of English language arts through their study of three California junior high and elementary schools. In the first year of the laptop program, the researchers found that students in the treatment group experienced significantly lower achievement in English language arts than students in the control group. In the second year of the program, scores bounced back, but only enough to bring the students receiving a laptop back to the same level as students that had not received a laptop (Grimes & Warschauer, 2008). This information led the researchers to conclude that the effectiveness of the laptop program on the students was minimal (Grimes & Warschauer, 2008). With both studies

showing little and no effect on academic achievement, they are evidence of the varied results that have come from one-to-one device initiative research.

The ambiguity of past research regarding one-to-one device initiatives does not undermine school improvement efforts related to technology usage, it only intensifies the need to determine the effectiveness of these programs. Schools are spending significant resources on hardware, infrastructure, and human capital to initiate one-to-one device programs in high schools that will theoretically improve academic achievement. However, there is limited research showing the benefits of one-to-one initiatives supporting student learning in a high school environment (Brown, 2018; Zheng et al., 2016). Much of the research, including the cited empirical studies, focused on elementary and middle grades, which makes it difficult to determine the value of one-to-one device programs. If one-to-one device initiatives are found to be ineffective, then financial and instructional resources could be allocated to research-based strategies that have proven to positively impact student learning. This study attempts to address this problem by exploring one-to-one device initiatives at the high school level and their effectiveness on improving academic achievement.

Statement of Purpose

The purpose of this study is to determine the effectiveness of one-to-one device initiatives in improving academic achievement in the areas of math and English language arts at the high school level. With ongoing pressure stemming from federal legislative efforts, schools must find a way to improve the academic achievement of all students. Schools are increasingly turning to ubiquitous technology integration as a means to experience the progress expected of them. However, there is a lack of solid empirical evidence supporting

the outcome of these initiatives at the high school level. This study will help provide evidence of the impact one-to-one device initiatives have on the academic achievement in high school students and examine whether or not the constant availability of technological resources impacts achievement in students from a low-income background. By determining the impact of these programs, schools can make more informed decisions in regard to technology availability for students, and the resources required for their inception and continued use.

Research Questions

The research questions examined in this study are aligned to the statement of purpose and were vital in guiding the methodology of the study. The central theme being researched is whether or not one-to-one device initiatives make an impact on student achievement. The specific questions examined in this study are:

1.) Do Missouri high schools demonstrate higher levels of academic achievement in the area of math after implementing a one-to-one device initiative? Are the levels of academic achievement different in the Free and Reduced Lunch population?

2.) Do Missouri high schools demonstrate higher levels of academic achievement in the area of English language arts after implementing a one-to-one device initiative? Are the levels of academic achievement different in the Free and Reduced Lunch population?

In this study, the one-to-one device initiative is the independent variable and the level of academic achievement as measured by the Missouri End of Course Exam (EOC) is the dependent variable. Given that the one-to-one device initiative is the variable being introduced, the scores of the EOC will be considered the dependent variable. Given the questions guiding the proposed studies with significant variables tested, the theoretical

framework points to the background knowledge for interpreting the findings of the study, summarized here and expanded in the Chapter Two, the literature review.

Theoretical Framework

Schools continue to struggle with meeting the demanding requirements of federal legislation tied to academic achievement. This is especially true in the areas of math and English language arts, where students from the United States struggle to meet both the level of achievement found in foreign countries and the country's own expectations of proficiency (Howard & Milner, 2021; Hung, et al., 2020; Kastberg et al., 2016; Kelly et al., 2013; NCES, 2012, 2019; OECD, 2019). While these concerns are not unique to one group of students, the results are exacerbated among students from families of low socioeconomic backgrounds (Barshay, 2013). In an effort to improve achievement and meet the accountability standards set by federal legislation, schools have turned to technology as a possible answer, with the implementation of one-to-one device initiatives. In theory, the increased technology usage and integration that comes with one-to-one device initiatives will allow students a more relevant and engaging learning environment by utilizing resources commonly used outside of school (Rosen & Beck-Hill, 2012). While many share this belief, there is conflicting empirical evidence regarding the value of one-to-one device initiatives at the high school level. To better understand this problem and possible reasons behind inconsistent past research, it is valuable to consider the theoretical components and historical context of the subject.

The theoretical framework of this study is grounded in the belief that schools are struggling to make learning relevant and engaging for their students. Rose (2016) theorized that the lack of relevance and engagement in a school setting is due to the structure of our

educational system and the limited individualization. Classrooms are designed for the "average" student at a specific age, but in reality, the abilities of students are more jagged and complex. By failing to consider the individual interests, capabilities, strengths, and weaknesses of students, schools are catering to no specific student and creating an educational environment that leaves few engaged and many bored (Rose, 2016). To avoid students experiencing this lack of relevance and engagement, schools are considering more self-directed learning opportunities. Technology has allowed this concept to be more prevalent as students can now access learning tools and resources anytime and anywhere (Jaleel & Anuroofa, 2017). Despite the student taking a more active role in a self-directed learning environment, effective pedagogical practices are still essential to ensure the technology is being utilized effectively (Kop & Fournier, 2011). While educators often use technology on a daily basis, their skills with integrating it into a self-directed learning environment are limited (Buabeng-Andoh, 2012; Ertmer & Ottenbreit-Leftwich, 2010). To help teachers through this process, a strong instructional leader is essential. An instructional leader not only provides an overall vision for technology integration, but also supports the instructor and offers guidance (Shepherd & Taylor, 2019). Given the self-directed nature of one-to-one device initiatives, and the role of instructional leader in these programs, there will be several theoretical considerations given to the data encountered in this study.

One-to-one device initiatives are deeply rooted in the belief that academic change focused on both student-directed and independent learning will benefit students. This focus on student driven learning, along with many of the other characteristics found in the constructivist learning environment are supported by a one-to-one device initiative. Merriam and Caffarella (1999) described constructivism as an individual's ability to interpret the

experiences around them and create meaning from those experiences. This approach differs from the traditional view on education, which focuses more on fact acquisition. Ertmer and Newby (1993) noted that the greatest influence on learning in the constructivist approach is environmental factors. The interaction between the student and the environment around them dictates what knowledge is gained and the learning that takes place. This typically means that a constructivist learning environment focuses on classroom activities and lessons that are designed around relevant and real experiences (Ertmer & Newby, 1993). Cuban (2009) noted that utilizing laptops in a way that promotes this type of learning is more important for students now than ever before, due to the rapidly changing work climate of our society. While discussing the use of laptops in the classroom, he stated, "They can revolutionize classroom practice and prepare the next generation for an emerging workplace whose texture and boundaries few can predict with confidence" (Cuban, p. 15). By focusing on providing students the tools and skills to create their own learning experience, as opposed to the acquisition of outdated facts, students are being prepared to change along with the world around them.

As students switch from observer to active participant and teachers move from instructor to facilitator, both engagement and motivation levels are likely to increase in students. Woolfolk and Margetts (2007) believe that motivation and engagement are both pre-requisites for deeper levels of understanding for students. However, in order for students to become more deeply engaged with a lesson or coursework, they must first be motivated (Saeed & Zyngier, 2012). One way to effectively motivate students is by creating relevant coursework that is applicable to future use in their lives (Papworth, 2016). By facilitating lessons that are relevant and contain knowledge that can be transferred to future use, the

constructivist learning environment motivates students. Students that are motivated are more likely to be engaged, thus improving the chances for improved academic outcomes (Barkley, 2020; Ben-Eliyahu et al., 2018; Ryan & Deci, 2009). The student-centered learning environment created by implementing the constructivist learning theory is well supported through a one-to-one device initiative. Not only does the combination of one-to-one devices and constructivism provide opportunities for the genuine and relevant learning experiences craved by students, but it also creates a learning environment where students are both highly engaged and motivated by their coursework.

In a 2010 study, Nie and Lau observed the impact of constructivist learning strategies on student motivation and achievement in English classes. The researchers used a sample of 3000 ninth grade students from 39 secondary schools in Singapore. The focus of the study was to determine whether or not constructivist instructional methods were more effective than traditional, or didactic, instructional strategies. Each class was split into two separate groups, one that identified and rated instructional strategies, and one that provided feedback on achievement and motivational outcomes. Students were administered an independently designed English test at the end of the course to determine their level of proficiency in the subject. The researchers found that constructivist instructional practices were strong predictors for success on the assessment, with didactic instructional practices being a negative predictor for achievement (Nie & Lau, 2010). Additionally, the researchers found that students in classrooms where constructivist instructional practices were heavily utilized showed higher levels of motivation and feelings of self-efficacy (Nie & Lau, 2010). This study not only helps illustrate the type of impact constructivist teaching strategies can have on academic achievement, but also on students' feelings towards their schoolwork.

The aim of this study is to focus on the introduction of a computing device to all students in a learning environment and determine the impact of that introduction on student achievement. In a one-to-one device initiative, the increased amount of technology created by the introduction of the device creates a unique environment that is suitable for constructivist learning principles (Howland et al., 2012; Stanley, 2015). Students involved in a one-to-one device initiative are no longer bound solely by lessons and instruction provided by teachers but are also learning through their interactions with the technology and resources available through Internet connection. Lev Vygotsky and Jean Piaget, who are both well known for their contributions to advances in the theoretical foundations of constructivism, described this process of learning through interaction with our surrounding environment as construction of knowledge (Smith, 1997). Construction of knowledge is a core tenet of the constructivist learning approach and this belief helps inform a theoretical basis of how constructivist learning is manifested among students in a one-to-one environment, even without teacher direction. As students assimilate to a one-to-one device environment, the device itself becomes a significant part of the learning environment.

Seimans (2022) maintains more recently constructivism has been viewed as outdated along with other broad learning theories of behaviorism and cognitivism used in developing instructional environments when “learning was not impacted by technology” (para. 2). Further, within a knowledge economy, where information and data change within a month, connectivism is a way to integrated multiple principles characterized by “chaos, network, and complexity and self-organization theories” (Connectivism, para 1) and learning is no longer under the control of individuals and can occur outside oneself, focusing individuals to make connections that enable one to learn more. Vaill emphasizes that "learning must be a way of

being - an ongoing set of attitudes and actions by individuals and groups that they employ to try to keep abreast of the surprising, novel, messy, obtrusive, recurring events..." (1996, p.42).

In addition to the constructivist theory of learning with shifts toward connectivism, learning occurring inside and outside us, the theoretical framework of this study consists of the three other topics also discussed later in the literature review. The first of these is student poverty and its impact on student achievement. This will be a significant focus of this study as poverty impacts a large segment of the student population, with 41% of children under the age of 18 in the United States coming from low-income families (Koball & Jiang, 2018). In addition to the relationship between poverty and academic achievement, the overall effectiveness of one-to-one device initiatives on academic achievement will be examined. This study is based on varying results in past research, and those inconsistencies will be examined in the literature review. Lastly, due to the nature of one-to-one device initiatives and the profound changes it creates in an academic environment, instructional leadership has the potential to play a role in the eventual success or failure of the program implementation. The role of the instructional leader and their impact on academic achievement will be more closely discussed in the literature review.

The strands of this theoretical framework combine to provide a complete view of the subject being investigated in this study. Schools continue to struggle with making learning relevant and engaging for their students, which has led to poor performance on high stakes testing. In an effort to increase student achievement, school leaders are considering more ways to drive self-directed learning opportunities for their students. Recently, this has been done through providing more access to technological resources for all students in the form of

one-to-one device initiatives. The relative new nature of these initiatives has led to inconsistent results in past studies, especially when considering their impact on high school students and students from poverty. These concepts helped frame this research and guide the methodology utilized in the study.

Design and Methods

This quantitative study has a non-experimental design focusing on ex post facto analysis of archival data. Given the nature and amount of data being used for this study, quantitative research methods will be utilized. Swanson and Holton III (2005) state that "quantitative techniques are particularly strong at studying large groups of people and making generalizations from the sample being studied to broader groups beyond that sample" (p. 30). Additionally, quantitative research will have a numeric or statistical component within its design (Williams, 2007). This study will include both of these components, as there is a numeric component and this type of research allows for generalizations to be made about the population beyond only those used in the sample, which is valuable in this study. Nearly all of the data used in this study are public records and from previous school years, which allows the study to be classified as both ex post facto and focused on archival data (Kerlinger, 1964).

The same statistical analysis will be used to assess all four research questions. In this study, I utilized the schools as my unit of analysis. School achievement data from three years pre-implementation and three years post-implementation were analyzed. A paired samples t-test was utilized as the statistical analysis to test the hypotheses. Additionally, a post hoc test was used to determine the effect size of the independent variable.

This research is aimed at providing information about students participating in one-to-one device initiatives. The information gained from this research will better inform the educational community about high school students and their ability to be successful within the structure of a one-to-one device program. In this particular study, the data collected will come from school districts found within the state of Missouri. The sample of schools used will be representative of the many different types of schools found throughout the state, including urban, suburban, and rural schools. The number of schools sampled in the study should make the conclusions applicable to high schools, regardless of their specific geographic location.

Schools used in this study will be chosen at random. A list of all the schools that service high school aged students in Missouri will be compiled. Schools will then be broken into their Missouri Department of Elementary and Secondary Education (DESE) supervisory areas. All schools will be given a number based on alphabetical order and their supervisory area. A random number generator will be developed and used to select school districts at random. As schools are selected in the number generator, an internet search will be conducted to determine whether or the school has implemented a one-to-one-device initiative. If no information can be found regarding one-to-one device implementation on the internet, a phone call will be made to the technology director of the school district to determine the use of one-to-one devices.

Schools will be considered for this study if they meet specific criteria. For purposes of this study, a one-to-one device initiative is considered a situation in which a student has been provided constant access to an individual technological device and Internet access while at school (Penuel, 2006). Duration of the one-to-one device program is important as data will

be utilized from three years post implementation. This is necessary in order to determine whether or not there has been a significant difference in academic achievement experienced by schools. With this in mind, schools involved in this study will have initiated a one-to-one device program at the high school level no later than the beginning of the 2017-18 school year. Additionally, schools selected for this study will have initiated a one-to-one device program no earlier than the 2010-11 school year. To consistently measure pre- and post-implementation effect of the treatment, all districts involved in the study will have data available from three years both before and after the implementation of the program.

To measure academic achievement amongst students and across school districts, I will utilize Missouri End of Course (EOC) exams. In the subject of math, scores from the Algebra I EOC will be used, while data from the English II EOC will be used to measure academic achievement in the subject area of language arts. All EOC data will be accessed through a search conducted on the Missouri Department of Elementary and Secondary Education (DESE) web portal. This web portal contains information from state tests that were conducted between the 2008-09 and 2018-19 school years. Students that attempt EOC exams are provided both a scaled score and an achievement level to help illustrate how they performed on the assessment (DESE, 2018). Both of these data points could be used to determine the level of academic performance by students within a school district.

Academic achievement will be measured by the achievement level on the Missouri Algebra I and English II EOC exams. DESE currently has four achievement levels on EOC exams: advanced, proficient, basic, and below basic. Earning achievement levels of advanced and proficient are considered acceptable, as evidenced by their inclusion in DESE's Annual Performance Report that is provided each year to Missouri school districts. With this in mind,

the percentage of students scoring advanced or proficient levels on the Algebra I and English II EOC exams will be a strong measure of academic achievement in schools.

The EOC exams and the data that are provided as a result are reliable to use in this situation. The results provide a consistent measure of academic achievement across all school districts in the state of Missouri. This makes the comparison of district-to-district academic performance more consistent and simplistic. Additionally, the validity of the exams used for comparisons have been examined and are considered to be reliable. Egan (2012) investigated the convergent and divergent validity of the Missouri EOC exams to ensure that students are being assessed using appropriate testing mechanisms. The research concluded that the exams accurately assessed students on the proper content material while also being consistently constructed (Egan, 2012).

Limitations

This study focused on the schools as the unit of analysis as opposed to the students. Given that different students take the EOC test each year, there is a possibility that any differences in test scores could be due to the change in students as opposed to the impact of the one-to-one device initiative. The same could be said for other factors, such as a change in teachers, teaching strategies, or educational materials.

There are two school years in which EOC results will not be available. In the 2017-18 school year, DESE did not release results of EOC scores. This leaves a one-year gap in all possible results for that school year. Additionally, EOC exams were not proctored during the 2019-20 school year due to concerns surrounding COVID in Missouri schools. This could potentially skew results by omitting particularly good or bad results.

List of Terms

Many key terms related to the research will be utilized throughout the study. The following terms have been defined as used:

Academic Achievement – Student performance as measured by the percentage of students scoring either proficient or advanced on the Missouri End of Course Exam.

Digital Divide – An unequal access to computing and digital resources due to certain differences, for example in income, leading to larger inequalities in the distribution of income and wealth within and across societies (Tetard & Patokorpi, 2008).

Low Income Student – Students that qualify for federal free and reduced lunch status, which requires an income at or below 185% of the poverty level (United States Department of Agriculture, 2020).

One-to-One Device Initiative - A situation in which a student has been provided constant access to an individual technological device and Internet access while at school (Penuel, 2006).

Ubiquitous Computing Program - When teachers and students have access to technology (computing devices, the Internet, and services) whenever and wherever they need it (Bixler (2019; van't Hooft & Swan, 2007; Vigdor et al., 2014).

Significance of the Study

The current study focuses on one-to-one device initiatives and the levels of academic achievement experienced by schools implementing the program. Given the relatively new nature of one-to-one device initiatives, the limited research on the subject does not provide a clear consensus on their effectiveness. While there are several pieces of research available on the topic, this specific study fills gaps in what is currently available. For instance, there is

very little information available on the impact of one-to-one device programs in a high school setting. Many of the statewide or large-scale one-to-one initiatives have been implemented at the middle school or elementary level (Bixler, 2019; Dunleavey & Heinecke, 2007; Grimes & Warschauer, 2008; Gulek & Demirtas, 2005; Silvernail & Gritter, 2008; The Abell Foundation, 2008; Zheng et al., 2016). By providing results on the impact of the program at the high school level, school leaders will have information available to determine whether or not a one-to-one device initiative is a worthy investment for high school aged students.

Schools in the United States are achieving at low rates in the content areas of math and English language arts (Kelly et al., 2013; NCES, 2012, 2019). This study aims to determine whether or not a one-to-one device initiative has an impact on academic achievement in these particular content areas. Some researchers theorize that specific tasks on the computer might translate to these content areas, making them a valuable tool in the classroom (Bleyer, 2017; Kposowa & Valdez, 2013; Zheng, et al., 2016). The findings of this study will inform educators on the value of a one-to-one program in math and English language arts classrooms. Using this information will allow them to determine whether or not one-to-one capabilities can result in an achievement increase in these content areas leading to closing opportunity gaps.

Poverty and socioeconomic status are often cited as a reason for schools moving to a one-to-one device initiative. Schools are struggling to get students from poverty and low-income backgrounds to achieve at high levels (Lacour & Tissington, 2011; Lomas 2020; Reardon, 2011) as well as students of color (Aguilar, 2020; Howard & Milner, 2021; Irvine, 2010); special needs students (Blanchett, 2014; National Center for Learning Disabilities,

2020; Wilson & Hunt, 2022); and English Language Learners (ELL) (Cervantes-Soon & Carrillo, 2016; Lee & Oxelson, 2006; Soland & Sandilos, 2021; Uro & Lai, (2019). In short, there is a concern among educators regarding the digital divide and its role in student performance. There is a significant difference in the access to technological resources between low-income and higher-income students (Rideout & Katz, 2016). Research suggests that if students from a low socioeconomic background receive appropriate technological access, then positive learning gains can take place (Darling-Hammond et al., 2014). The findings of this study will help determine the value of increased technological access for high school students from low-income backgrounds. As discussed in the introduction, this will allow educators the opportunity to determine whether or not one-to-one device initiatives are a financially and academically viable way to improve achievement among the lowest achieving segments of the student population.

CHAPTER 2

REVIEW OF THE LITERATURE

One-to-one device initiatives are a relatively new solution to an old problem. Educators and stakeholders alike have been searching for a seemingly endless amount of time for the best ways to provide effective and meaningful strategies to help all students learn to their capabilities. Given all of the recent advances in technology, and the increasing affordability and availability of said technology, one-to-one device initiatives have the ability to change the way students are educated. While promising, there is concern about the willingness of schools to make wholesale changes to traditional educational structures and instructional practices. In order for educators to openly consider change, it is helpful to provide relevant and meaningful data to different stakeholders (Schildkamp, 2019). To develop a truly informed and effective study that can offer such data, it is necessary to consider past works on the topic as well as capture current empirical studies and relevant theories and concepts. This literature review was developed to help inform the reader regarding how the study and its findings will guide the research and help to make meaning of findings. The pragmatic goal of the study is to fill a gap in available data related to the use of one-to-one devices.

A literature review was conducted using online databases, such as Google Scholar, EBSCOhost, ERIC, ProQuest, and Academic Search Complete. Many of the searches were related to the four main topics of the literature review, which included terms such as: *constructivism, constructivist learning, constructivist teaching, project-based learning, instructional leadership, school culture, academic achievement, one-to-one device initiative, ubiquitous computing program, high school, secondary school, English language arts, math,*

poverty, low socioeconomic status, marginalized students, and digital divide. When completing searches through the JSTOR database, the term one-to-one device initiative yielded 3,994 responses. Narrowing down the search to the terms "one-to-one device initiative", "high school", and "poverty" in combination yielded the most helpful results for this literature review. Different combinations of terms also displayed a gap in the literature. A search for the combination of terms *one-to-one device initiative* and *high school* generated 545 results. When the term *high school* was changed to *middle school*, it nearly tripled the results by returning 1,631 articles. A similar change was noticed when *high school* was changed to *elementary school*, with 1,602 results returned. Significant to the study's participants are high school age students, who were notably under-represented in the results.

Through this process, many valuable resources were found that either were used as cited references or led to other literature that informed on the subject. Both quantitative and qualitative empirical studies were utilized in this review to provide a more holistic view of the topics. It will be imperative to address dissenting or opposing viewpoints to avoid the appearance of bias and present a complete representation of the topics. Significant to the study's participants are high school age students, who are notably under-represented in research related to the effectiveness of one-to-one device initiatives when compared to other age groups. Many of the statewide initiatives and seminal literature have been centered on the middle school or elementary level (Bebell & Kay, 2010; Silvernail & Gritter, 2008; The Abell Foundation, 2008; Zheng, et al., 2016). It is the aim of this study to help fill this gap in literature and inform potential stakeholders of outcomes at the high school level of the student population.

To better inform the reader of the larger context of this study, this literature review is focused on four topics intricately connected to one-to-one device initiatives. First, the review will explore the constructivist approach to teaching and learning, including the current focus on connectivism. Given its potential for future use as a practical application in one-to-one device initiatives, constructivism and connectivism will help provide a philosophical foundation for this study. The next topic covered in this review is poverty and its impact on students. This will include an examination of the impact of poverty on student achievement as well as past research that might give insight into how a one-to-one device environment can affect students from low socioeconomic backgrounds. Next, the literature will include a look at the relationship between one-to-one device initiatives and academic achievement including the history of one-to-one device initiatives and their effectiveness in a variety of settings, one-to-one device initiatives and overall achievement with a focus on achievement in math and English language arts. By looking at the past, a better idea of what to expect in the present and the future are important to the implementation of these learning tools. Lastly, when such a large shift in instructional practice is considered, leadership and guidance will also play a role in implementation. This reality contributes to the significance of the inclusion of instructional leadership as an integral part of the literature review. A discussion of constructivist learning as a key theory follows.

Constructivist Learning

There are many different reasons why schools transition to one-to-one device programs, but one of the most commonly stated is the possibility devices bring for instructional innovation (Bixler, 2019; Er & Er, 2013; Petko, 2012; Weston & Bain, 2010). Penuel (2006) pointed out that widespread computer and internet access among students can

open up new pedagogical doors for classroom teachers. The computers and internet access utilized in a device initiative provide opportunities for teachers to evolve from the traditional classroom environment that is based on teacher-led fact acquisition. Cuban (2013) noted that this is imperative, because changes in student achievement often take place due to new and innovative teaching methods that promote individual problem-based learning, not solely because of a structural change such as a new device program. Teachers play an important role in student success and their approach to the dissemination of content will influence both student achievement levels and the success or failure of any technology initiative (Gilakjani et al., 2013). By providing students and teachers constant access to technological resources, school leaders are hopeful that teachers can adjust their instructional strategies and create an environment that allows for deeper levels of learning.

In general, there are two types of instructional approaches utilized in the classroom: didactic and constructivist. In a didactic learning environment, the course curriculum is decided by the school or teacher, as is the pace of the course, which is usually controlled by how the information is transmitted to students (Thomas et al., 2013). Students in this classroom will often work on structured problems with pre-determined answers, while teachers provide feedback through the correcting of responses and grading of assignments. Lecture-based lessons are common in this type of classroom, because of the opportunity it provides the teacher to control the content and pace of the course (Thomas et al., 2013). This is a more traditional instructional approach and is still being utilized by the majority of classrooms in the United States (Hannafin & Vermillion, 2008; Wise & O'Neill, 2009). The constructivist approach to learning is in direct contrast to didactic learning. Constructivism is the belief that any reality or truth is mentally constructed by those who have discovered and

then investigated it (Bellefeuille, 2006; Saunders, 1992; Wivell & Day, 2015). The process that leads to truth is often self-directed and teacher-facilitated as opposed to fully teacher-led (Gilakjani et al., 2013; Koehler et al., 2013; Scheer et al., 2012). In a constructivist learning environment, there is also an emphasis placed on social interaction and cooperative learning, so there is a significant amount of group work involved (Vygotsky, 1997). These factors lead to a de-centralized instructional approach, where the student plays a central role in their own learning process, and the teacher becomes a resource as opposed to the central classroom figure.

As society and industry become more dominated by technology, the skills desired by businesses have shifted. Schools have taken notice and realize that it is no longer enough to simply provide students with basic literacy skills (Anagun, 2018). When students begin their vocation of choice, they are expected to have a skillset that is better equipped for today's digital rich world. This skillset is commonly referred to as 21st century skills (Anagun, 2018; Partnership for 21st Century Skills, 2019; Varier et al., 2017). This includes the ability to critically think, solve problems, cultivate creativity, collaborate, self-direct, and innovate (Larson & Miller, 2011; Partnership for 21st Century Skills, 2019; Varier et al., 2017). As the desire for these skills has increased, so too has the importance of promoting them in the school setting (Anagun, 2018). There is a natural connection between these 21st century skills and the constructivist approach to learning, and ubiquitous technology can be viewed as the bridge between the two. As schools strive to create an environment where students can build the skills and knowledge necessary to be successful in the digital age, it is clear that there is value in reviewing past literature regarding constructivist learning and how it connects with one-to-one device initiatives.

Theoretical Foundations of Constructivist Learning

The roots of constructivist learning were planted long before the practice became a widely accepted approach. The philosophical foundation of constructivist learning goes all the way back to ancient Greece and the time of Socrates (Murphy, 1997). While not seen as a constructivist, nor the developer of explicit constructivist theories, much of his approach to teaching and learning are found in constructivist classrooms (Ernest, 1995; Kuhlich, 1970). The Socratic Method, which requires extensive questioning, was and still is intended to promote deep, critical thinking in its subjects (Murphy, 1997). Constructivists believe that knowledge is constructed while individuals attempt to make sense of the world around them, and that it is the teacher's role to guide this process. When Socrates helped facilitate questioning in his Socratic Method, he played this role, just as a constructivist teacher would (Ernest, 1995; Kuhlich, 1970; Murphy, 1997). His approach to questioning was one of the first documented instances of a "teacher" advocating for learners to be active in the learning process rather than through the passive transmission of knowledge (Murphy, 1997). Through the years, many other individuals would build on these ideas, which largely came to be known as constructivist philosophies of learning. The journey of constructivism as an approach to learning and teaching is well told through these individuals and their contributions to the development of this line of thinking.

John Dewey is one of the most well-known constructivists and helped develop and provide direction for many constructivist viewpoints. Dewey (1884, 1959) is widely known for his views on progressive education and developmental psychology. Through his work in developmental psychology, Dewey (1961, 1998) established strong beliefs regarding education and how it could be used to aid in an individual's development. He did not feel that

the top-down enforcing of curricular goals was the best way to promote individual development (Dewey, 1998). Instead, Dewey (1961) felt that classrooms should provide opportunities for self-direction and active participation, because they better allow for a student's personal experience and worldview to aid in problem solving. He felt that traditional instructional approaches isolated students and were more likely to prepare them for the present as opposed to the future and any changes that may take place in the world (Dewey, 1998). This focus on self-directed learning that utilizes active participation in students is one of the hallmarks of the constructivist learning theory.

Around the same time as Dewey, Maria Montessori emerged as another leading voice in the philosophical foundations of constructivist learning. Montessori was a medical doctor by trade and created a learning program while working with children suffering from various health conditions and intellectual delays (Marshall, 2017). She developed an interactive curriculum that emphasized opportunities for movement and interaction with others. As opposed to being assigned work that needed to be completed by a specific timeframe, students in a Montessori learning environment select their subject of choice as well as the timeframe for completing the work (Marshall, 2017). The classroom environment is organized by subjects, and students are free to move about the room experiencing different subjects as they see fit. By organizing the classroom in this manner, the teacher shifts into the role of learning facilitator, allowing students to be more engaged and critical of their own education (Montessori, 1912). This also theoretically allows students to not only learn traditional content, but develop socially, emotionally, and physically (Hedeen, 2005; Marshall, 2017). This approach to education helped promote the decentralization of teachers

and encourage student choice in learning, both key concepts for a constructivist learning environment.

Jean Piaget was also well known for his constructivist views and his role in advancing constructivist learning. Piaget's research was heavily focused on children and how children construct knowledge (Ultanir, 2012). Piaget (1937) posited that there were four main development states that help shape an individual's mind: 1) Sensorimotor Stage (ages zero to two), 2) Pre-operational Stage (ages two to seven), 3) Concrete Operational Stage (ages seven to eleven), and 4) Formal Operational Stage (ages eleven to adulthood). Each of these stages bring different abilities in regard to reasoning, cognitive construction, and the ability to resolve conflict (Piaget, 1937). He also developed the concept of adaptation, and explained how it plays a significant role in the cognitive development of children. His theory of adaption stated that children go through a process of assimilation and accommodation in order to construct knowledge (Piaget, 1953). They assimilate when new information is added to their personal schema and accommodate when they acquire new knowledge that challenges and changes their viewpoint (Piaget, 1953). A child's ability to adapt to changes at each of the different stages of development, and the pace at which they able to do so is unique to each student. These differences in each child bring forth the need for individual pacing in learning opportunities (Powell & Kalina, 2009). Piaget's ideas regarding the construction of knowledge in children and the individual pacing of learning became significant to the advancement of constructivist learning theory.

Lev Vygotsky also added a different perspective that helped further the theory of constructivist learning. Vygotsky (1978, 1986) promoted social constructivism, which focused on the external factors that influence cognitive development, as opposed to the

internal processes. Vygotsky (1978) believed that thought and knowledge were developed from society, which means that cultural, historical, and social factors were significant in cognitive development. He also felt that language and communication were the most essential tools for constructing reality, so any forms of learning needed to incorporate opportunities for dialogue (Leeds-Hurwitz, 2009). Vygotsky's (1978) other significant contribution to constructivist learning theory was his concept of scaffolding. Scaffolding is the process of guiding a student from their current level of knowledge to a point of discovery (Murphy, 1997). Vygotsky (1978) categorized students' problem-solving skills into three possible groups: 1) skills which the student cannot perform, 2) skills which the student may be able to perform, and 3) skills that the student can perform with help. By using scaffolding, students can perform tasks with the guidance of their teacher that otherwise would be beyond their ability (Murphy, 1997). The usage of scaffolding and social interaction that Vygotsky promoted are important characteristics of constructivist learning.

Challenges and Benefits of Constructivism in Education

Challenges

As with any strategy or idea that challenges the standard quo in education, the concept of utilizing constructivist teaching methods in the classroom is wrought with potential challenges. The concerns regarding constructivist teaching techniques are often multi-faceted but tend to center on the teacher and their role in the process of implementation. Specifically, there is an overall concern in education with teachers' willingness to embrace change from teaching methods they find more comfortable (Fullan, 2016; Le Fevre, 2014; Tallvid, 2014). This is especially prevalent among veteran teachers, as past researchers have noted several reasons for their resistance to pedagogical change,

including fatigue, fear of failure, and nostalgia (Le Fevre, 2014; Orlando, 2014; Snyder, 2017). These concerns are no different in constructivist learning environments, especially where technology is involved, as veteran teachers tend to fundamentally struggle with implementing both approaches in classrooms. Koh et al. (2014) found that teachers with the most experience have the lowest perceived constructivist-oriented technological pedagogical content knowledge, placing them at a deficit when trying to adopt constructivist methods. Other research has suggested that teachers might be de-motivated to take on constructivist practices due to previous bad experiences with project-related methods. They are simply more difficult to assess, due to the objective nature of the work, placing more strain on the teacher (Scheer et al., 2012). These concerns are barriers that make it not only more difficult for experienced teachers to utilize constructivist strategies in the classroom, but also to apply them in tandem with student technology usage.

Concerns with constructivism in the classroom do not just lie with veteran teachers that are resistant to change instructional practices, but also with those willing to embrace new and different methods of teaching. Savasci and Berlin (2012) found that teachers who are open to adopting constructivist teaching methods still have struggles putting these strategies into practice. Bixler (2019) directed a study on teachers' use of one-to-one iPad devices in a middle school environment and their perceived implementation of constructivist strategies with the devices. Part of the research focused on the use of one-to-one iPad technology in the classroom and how it was used to support constructivist teaching strategies in the classroom. Teachers involved in the study were asked to self-assess their use of constructivist teaching strategies, as students were then asked to assess teachers over the same. Teachers surveyed reported mostly high levels of constructivist teaching methods in the areas of classroom

management, teaching activities, and assessment. In a survey of the students, some discrepancies were found as only 13 of the 62 students questioned reported that their teachers used a constructivist approach for assessments (Bixler, 2019). While in this instance, the teachers were willing to try new methods, the difference in teacher and student perceptions displays the concerns surrounding the implementation of constructivist strategies with fidelity.

While many of these challenges revolve around teachers' implementation of constructivist strategies, there are also concerns about the relative effectiveness of certain aspects commonly found in a constructivist learning environment. For instance, given the nature of the constructivist learning approach, there is a concern about student performance on standardized testing, and how it might be impacted by an approach that is not focused on test results (Grady et al., 2012; Shah, 2019). There are also concerns related to the impact on classrooms that are heterogeneous either culturally or in student ability. Teachers leading a constructivist classroom are in a position where they must balance between a structured learning environment and providing student autonomy. An inability to structure the class in a way that student differences are given explicit consideration could potentially exclude some students from active participation (Bermejo et al., 2021; Bricker et al., 2022; Fixen & Wald, 2021 Gupta, 2011). Having the necessary resources available to effectively implement constructivist learning strategies has also been a concern for some researchers, as they have found that a lack of proper time, tools, and funding can potentially cause these learning strategies to be less effective (du Plessis, 2020; Chiphiko & Shawa, 2014). Each one of these issues has the potential to impact the learning of students and need to be considered before adopting constructivist teaching strategies in the classroom.

Benefits

Just as the integration of constructivist practices bring challenges to learners, they can also provide potential benefits. One of the common benefits cited by proponents of constructivist learning is the opportunity it provides for flexibility and individualization in learning (Akpan & Beard, 2016; Davies et al., 2013; Isik, 2018). When taught using constructivist principles, the pace of the course is determined by the student instead of the teacher (Schell & Janicki, 2012). Tullis and Benjamin (2011) found this concept of flexible and self-paced learning to be valuable for learners. In their study, students were divided into two groups with each provided a list of words to recognize. One group was allowed to study the words at their own time and pace, while the other group was given a structured time to study. The researchers found the group of self-paced learners scored significantly higher at recognizing the words than the group that was provided structured learning guidelines (Tullis & Benjamin, 2011). This type of flexibility in the learning process, as well as curriculum flexibility better allow for individual learning strengths and preferences to manifest, especially in a blended classroom environment (Jonker et al., 2020). Self-pacing and curriculum flexibility have also been found to have learning benefits for students with special and diverse learning needs (Akpan & Beard, 2016; Hadjipanayi & Michael-Grigoriou, 2020). When constructivists work to create a learning environment that is flexible in both pace and curriculum, it allows for the individualized learning opportunities that benefit students.

Constructivists often use social interaction as an effective way to acquire relevant knowledge and allow individuals to develop socially, which can have long-lasting benefits for learners. Vygotsky (1978, 1986), as a proponent of social constructivism, viewed social interaction at the forefront of learning. By focusing on social interaction and its role in

promoting communication and collaboration as a means to gain knowledge, constructivist teachers better and more meaningful interactions. Generating these opportunities for students makes it more likely that deeper and more significant learning can occur (Dixson, 2015; Poonam, 2017). Additionally, learning is more applicable and relevant to real world situations, which makes the content easier to apply outside of the classroom (Aholi et al., 2018; Poonam, 2017) Since these learning strategies make the content more applicable to real life situations, students have also been found to enjoy the learning process more (Poonam, 2017). By focusing on creating learning opportunities that incorporate social interaction, constructivist teachers make learning activities more relatable and enjoyable for students.

Another benefit of social interactions that result from constructivism is the role they play in helping students build and shape their identity (Vygotsky, 1978). This can be especially beneficial to students of color as this approach to learning directly aligns with culturally responsive teaching (Robinson, 2020; Wachira & Mburu, 2017). Culturally responsive teaching focuses on the infusion of culture into school curriculum in a way that allows students of color to make more valuable cultural connections (Vavrus, 2008). Gay (2012) discussed the use of culturally relevant teaching as a way to respond to the cultural needs of marginalized students and to bridge the "discontinuities between the school culture and the home and community cultures of low-income students and students of color" (p. 12). When African American students come to school and nothing there speaks to their life outside of school, it can be discouraging. Khalifa et al. (2016) suggest several different strategies to create a culturally responsive school, which includes the introduction of culturally responsive curriculum, developing an inclusive environment, and focusing on leader self-awareness. Schools that have been able to utilize a culturally responsive approach

have seen benefits such as increased test scores (Bui & Fage, 2013; Hubert, 2013), increased student engagement (Christianakis, 2011; Dimick, 2012), and improved student-teacher relationships (Coughran, 2012). By providing students the opportunity to explore their identity and shape their self, they are able to develop a greater connection to the material and thus, experience positive outcomes academically and personally.

Milner (2010) reported on the benefits of a culturally responsive curriculum implemented by a White male science teacher who developed cultural knowledge and competence to teach African American students in a high poverty urban middle school comprising a population of predominantly 354 African American students. Milner incorporated observations, documents, and semi-structured interviews over 19 months that focused on the teacher' classroom experiences including teaching and learning, management, parent involvement, curriculum, and approaches to teaching decisions for increasing student learning. Findings showed the teacher's dispositions and high expectations for students supported cultural competences in daily practices for effective teaching which involved establishing authentic relationships with his students, understanding their identities, addressing issues of race, and creating a classroom environment of collaboration with students and staff (Milner, 2010). Constructivist teaching, as viewed by the teacher, valued the experiences students brought to the classroom. Applebee (1993) asserts that

> [r]ather than treating the subject of English as subject matter to be memorized, a constructivist approach treats it as a body of knowledge, skills, and strategies that must be constructed by the learner out of experiences and interactions within the social context of the classroom. In such a tradition, understanding a work of literature does not mean memorizing someone else's interpretations, but constructing and elaborating upon one's own within the constraints of the text and the conventions of the classroom discourse community. (p. 200).

Such teaching conventions point to the possibilities of constructivist teaching practices to prepare students for twentieth-first skills and critical thinking (Ah-Nam & Osman, 2017; Anagun, 2018; Göksün & Kurt, 2017; Mellis et al., 2013; Scheer et al., 2012; Yoders, 2014).

One of the main motivators for the implementation of both a one-to-one device program and constructivist teaching practices is the possibility both provide for 21st century skill development in students (Anagun, 2018; Cogan-Drew, 2010; Rosefsky & Opfer, 2012; Wrigley & Straker, 2017). Twenty-first century skills include the ability to critically think, solve problems, cultivate creativity, collaborate, self-direct, and innovate (Larson & Miller, 2011; Partnership for 21st Century Skills, 2019; Varier et al., 2017). Many scholars and researchers believe that constructivist learning strategies foster opportunities for students to develop this skillset. Jonassen (2009) noted that current educational constructs teach us that truth lies in the textbook, which makes it more difficult for students to critically evaluate and construct knowledge. Utilizing the problem solving and critical thinking that is necessary in constructivist learning allows individuals to apply their own experiences and interactions from outside of the textbook to construct reality. This ability to construct knowledge and critically think not only helps students in academic environments but ensures learning can continue when educators do not have control over all of the instructional variables (Schwartz et al., 2009). Outside of the academic environment, individuals will be expected to utilize their surroundings and resources to acquire knowledge, which makes collaboration a focus of the 21st century skillset as well as constructivist educators. Providing students the opportunity to learn collaboratively not only offers students the opportunity to learn from each other, but also the chance to hone collaborative skills that can be used throughout life (Gresalfi & Lester, 2009). Developing these life-long learning skills, which are becoming

more necessary in the 21st century, are a benefit to students learning through a constructivist approach.

Constructivism and Academic Achievement

A key component of constructivist learning is the shift from teacher-directed instruction to a more hands-on, student directed learning environment (Dewey, 1961; Vygotsky, 1978). To achieve this interactive student-centered approach, project-based learning (PBL) has gained traction in constructivist classrooms. PBL strategies intend to engage students by placing them at the center of the learning process and allowing them to investigate and solve real world problems with teacher guidance (Cervantes et al., 2015; Koparan & Guven, 2015). Summers and Dickinson (2012) researched the effectiveness of this approach by comparing the social studies performance of students from two separate high schools in the same rural school district. The student population of the district was diverse, as over 70% of the student population was made up of African American and Latinx students, as well as a 70% free and reduced lunch population. Over the course of the study, students in the PBL-focused classrooms achieved at a higher rate than traditional classrooms. The researchers also noted that achievement in the PBL-focused classroom was not impacted by identifying factors such as race or socioeconomic status (Summers & Dickinson, 2012). These results provide credibility to the constructivist belief that an interactive student-centered learning environment improves student performance.

In other research, the benefits of PBL strategies have not been limited to just academic achievement or social studies classrooms. PBL strategies have been found to improve student performance in almost every core subject area for high school aged students (Fogleman et al., 2011; Halvorsen et al., 2012; Koparan & Guven, 2015; Parker et al., 2013;).

Students in classrooms utilizing PBL also experienced improvement in problem-solving ability, standardized test scores, and technological aptitude (Finkelstein et al., 2011; Mioduser, & Betzer, 2007; Summers & Dickinson, 2012;). This approach may also benefit special education students, as research has found that classrooms using PBL strategies are more inclusive and less restrictive (Hernández-Ramos & De La Paz, 2009; Saunders-Stewart et al., 2015). The effectiveness of this instructional approach in improving the academic achievement of diverse student populations, as well as in the development of 21st century skills, provides more support to the benefits of an interactive student-centered learning environment.

Despite such a large number of studies supporting the effectiveness of a student-centered classroom utilizing PBL, some research has uncovered concerns with the approach. In a 2016 study involving 4,000 seventh grade students from 24 different schools, researchers found that PBL did not have an impact on either student literacy or engagement (Menzies et al., 2016). Fogleman et al. (2011) researched the effectiveness of PBL strategies and found mixed results. While overall, students experienced an improvement in test scores, the results were inconsistent from teacher to teacher. Certain classrooms experienced significantly higher gains than others, leading to concerns about the fidelity of teachers implementing the strategies (Fogleman et al., 2011). There is also concern that PBL strategies are more difficult to implement in certain subject areas, specifically math, than others (Huberman et al., 2014). This dissenting research displays some of the potential pitfalls and concerns that can manifest in a hands-on, student-centered learning environment.

While ensuring an interactive and student-centered learning environment is in place is an essential component for a constructivist learning environment, other classrooms and

schools have incorporated a more holistic constructivist approach to education. Studies that have focused on classrooms that fully incorporate multiple constructivist learning strategies into their classrooms have found mostly positive results. Toraman and Demir (2016) conducted a meta-analysis focused on student attitudes towards constructivist learning methods. The researchers found that students in constructivist learning environments displayed more positive attitudes towards lessons than students in traditional learning environments. They also found specific differences within subject areas, as these teaching methods led to more positive feelings in science and technology related lessons (Toraman & Demir, 2016). Akanwa and Ovute (2014) reported similar findings about constructivist learning and physics, as students in their study not only experienced an increased interest in the subject, but also higher levels of achievement. English language arts is another content area that has been found to work well with constructivist learning, as constructivist methods have been found to increase both writing skills and overall student achievement in the subject area (Nie & Lau, 2010; Zulela & Rachmadtullah, 2019). These studies continue to show that there are several potential benefits to utilizing constructive learning methods in the classroom.

Rosen and Beck-Hill's (2012) research specifically focused on a constructivist one-to-one device initiative and the impact it had on students. The study involved 476 fourth and fifth grade students and teachers from a one-to-one device initiative in Texas. The researchers compared the experimental group, which received the constructivist instruction as well as the computers, to a control group that received more traditional instruction. Academically, students in the one-to-one environment scored significantly higher on state standardized test in both math and reading than students in a traditional environment. In

addition to the academic effect, researchers also considered how the approach would impact attendance and student behavior. They found that student attendance in the experimental schools improved significantly, seeing unexcused absences decrease by 29.2% from the beginning of the school year. Additionally, student disciplinary issues decreased by 62.5% during the study. It was also noted that the change in instructional strategies created more one-on-one teacher-student interactions. Teachers utilizing the constructivist teaching approach had over twice as many one-to-one interactions with students as teachers in the control group (Rosen & Beck-Hill, 2012). This study not only provides helpful data for the constructivist learning approach, but also how it can impact students when paired with a one-to-one device initiative.

While much of the research surrounding constructivist teaching methods is encouraging for its proponents, not all previous studies have shown that it has a positive impact on students. Grady et al. (2012) determined whether or not constructivist teaching had an impact on mathematics achievement in rural schools by following three groups of students from three separate rural Illinois school districts from kindergarten all the way to their sixth-grade year. One group of students was taught using a curriculum focused on constructivist teaching methods, another group received a mixture of traditional and supplemental online instruction, while the last group just received traditional classroom instruction. When the researchers compared scores on state standardized testing, students receiving math instruction through the constructivist-focused curriculum scored the lowest of the three groups. (Grady et al., 2012). While the results showed lower scores in classrooms using constructivist teaching methods, the researchers noted that the difference could be due to teacher bias. Typically, teachers are prepped and trained to utilize traditional instructional

methods in teacher prep programs, and in this study, no measures were taken to ensure the program was implemented with fidelity (Grady et al., 2012). In addition to this study, others found constructivist teaching approaches to have no significant impact on student learning. Chen and Bennett (2012) examined the effectiveness of constructivist approaches at the postsecondary level on students from China and found it to be detrimental to their learning and psychological well-being. Kirschner et al (2006) also found constructivist approaches to be ineffective unless sufficient prior knowledge of a topic is already in place. These potential negative outcomes of constructivist learning must be weighed when determining whether it is the best instructional strategy to employ in a given situation.

Connectivism

As introduced in the theoretical framework of Chapter One, information and data change rapidly in a knowledge economy. The theoretical views and beliefs related to constructivism have advanced and taken shape in response to the ever-changing world around us. Technological tools and resources have become so integrated into everyday life, that they have become significant to the learning process and have caused some to reconsider what constructivism looks like in the digital age. George Siemens (2005) and Stephen Downes (2008) are credited with developing a learning theory that considered how technology and the connections made from technology are used to drive learning, which has come to be known as connectivism. Connectivism "is the thesis that knowledge is distributed across a network of connections, into its nodes, and therefore, learning consists of the ability to construct and traverse those nodes connected into networks" (Downes, 2012, p. 9). Central to the theoretical foundation of connectivism are networks, and their role in connecting knowledge to individuals. As stated by Duke et al. (2013, p. 6), "stated simply, connectivism

is social learning that is networked." The connectedness that comes from ubiquitous access to technology opens up learning networks that were previously closed or more difficult to foster, leading to new opportunities for education. Where constructivism encourages teachers to value the schemas and self-knowledge of students, connectivism has evolved to increase learning and encourage students to make connections to the outside world.

Corbett and Spinello (2020) outlined four foundations that are key to learning in connectivism: 1) autonomy, 2) connectedness, 3) diversity, and 4) openness. In a connectivist learning environment, learning is de-centralized, and the focus is placed on the interactions of the student with networks, as opposed to the dissemination of lessons or knowledge from an instructor (Alam, 2023; Garcia et al., 2014; Smidt et al., 2017). Students will have the autonomy to form their own networks and determine which resources contain relevant information without being guided by the traditional learning process (Alam, 2023; Corbett & Spinello, 2020). In addition to the self-directed autonomy that a connectivist learning environment creates, the connectedness that comes from networking is essential to this form of learning. Being connected with a network not only allows for the dissemination and reception of knowledge, but allows for different ideas, viewpoints, and opinions to be shared and looked at through a critical lens (Corbett & Spinello, 2020; Utecht & Keller, 2019). Downes (2012) noted that this diversity in networks is important to help students fully see the unique perspectives and creativity of all those involved. Students must also be willing to have an openness to the process for true knowledge to be attained. If students hold on to preconceived biases or have an unwillingness to participate with fidelity in the process, then no authentic learning can take place (Corbett & Spinello, 2020; Utecht & Keller, 2019). The

four foundations of autonomy, connectedness, diversity, and openness help create a framework for what authentic learning looks like in a connectivist learning environment.

Literature related to connectivism has shown some of the positive aspects the approach can bring to student learning. Dron and Anderson (2014) focused on the process of learning in networks, which touched upon some of the positive outcomes that result from connectivist learning. They found that connectivism is effective in promoting collaborative learning, as well as developing social and networking skills. Additionally, the ability to partake in such vast and diverse networks of connections for learning increases the likelihood for students to engage in deep and meaningful learning experiences (Dron & Anderson, 2014). Kim and Bonk (2017) conducted a survey of 160 students that took part in a connectivist focused course to determine the motivations and achievements of participants. The researchers found the motivation behind most respondents was to learn a new skill or acquire new knowledge that could help benefit them, making them more motivated learners. They also found that students participating in the course had an enhanced sense of identity and self-worth (Kim & Bronk, 2017). Connectivist learning approaches have also been found successful in taking lower-order cognitive skills and turning them into skills that require higher order thinking (Al-Maawali, 2022; Wongwatkit et al., 2023). One of the most common outcomes in connectivist learning is more autonomy and self-directedness in the learning process (Mackness et al., 2013; Tschofen & Mackness, 2012; Whewell et al., 2022). Given the promise of research findings regarding connectivist learning practices, there is potential that this learning approach can lead to effective outcomes in student achievement.

In 2023, Kilag et al used a pre-test and post-test design which included a control group and an experimental group of 200 eleven and twelfth grade Philippine students. The

groups were provided two different forms of instruction to investigate the impact of integrating connectivism-based instruction on student learning. The experimental group received instruction that was based on connectivism theory, while the control group received traditional instruction including lectures, worksheets, and textbooks. The two different assessments were focused on critical thinking and problem-solving skills. Students in the experimental group showed a significant growth on the critical thinking and problem-solving tests, while the students in the control group showed no significant growth. (Kilag et al., 2023). Additionally, a Likert-scale style survey was given to students to determine their perceptions of connectivism based instruction. The researchers ran a regression analysis and determined that students' perceptions of their learning experiences using online resources had a significant positive impact on their learning and views on their learning (Kilag et al, 2023). Given the positive outcome of the study, an instructional approach focused on connectivism can bring about effective opportunities for our students to learn material through the use of technological resources.

Much as studies related to connectivism have yielded positive results, the opposite has been found as well. Kop (2011) conducted research on a Massive Open Online Course (MOOC), with 1,610 participants. In the study, Kop found that some students struggled with autonomously directing their own learning and thus were unable to master critical concepts needed to be successful in the course. Specifically, a minority of the participants were unable to create content that would be viewed or used by others in the learning process (Kop, 2011). This study highlights a common problem found in literature related to connectivist learning, which is commonly referred to as "lurkers". Honeychurch et al (2017) discussed the many characteristics of a lurker, which can be described an individual that is a passive participant

in an online communication network. Researchers found lurkers to be a significant problem in connectivist learning environments due to their unwillingness to actively engage in dialogue that could further the learning of all students in the learning network (Honeychurch et al., 2017; Milligan et al., 2013; Wang et al., 2018). Milligan et al (2013) conducted survey research to specifically determine the participation level of students and identify what percentage of students are identified as lurkers. Of the 29 participants surveyed, 13 were identified as lurkers, which was the largest percentage of any category. Twelve of the participants were considered active participants in the class, which means more students were passive about their involvement than active (Milligan et al., 2013). In this same vein, Mackness and Bell (2015) reported that many students involved in a MOOC reported feeling disconnected, demotivated, and disturbed while completing the course. Given the hope that connectivist learning will open up new networks of communication and learning, there is concern to see research showing such high numbers of passive learning amongst participants and such few opening up to the opportunities provided by increased connectedness.

Constructivism, in its various forms and iterations, brings about the potential for significant changes to education. Learning through exploration and discovery of the surrounding environment is a central theme in constructivist learning. Ubiquitous technology in the hands of students creates the opportunity to completely alter a student's environment, and thus change learning as we know it. However, if not facilitated properly, it can also cause issues that have the opposite impact most schools are looking for when introducing a one-to-one device initiative.

The purpose of this literature review strand was to highlight the link between constructivist learning strategies and one-to-one device initiatives. Research provided

throughout the strand displayed the relative strengths and weaknesses of constructivism observed in past studies. Several studies showed that constructivist teaching strategies yield positive results on student achievement and attitudes towards learning (Akanwa & Ovute, 2014; Nie & Lau, 2010; Rosen & Beck-Hill, 2012; Toraman & Demir, 2016; Zulela & Rachmadtullah, 2019). Some studies reflected the opposite, with the constructivist approach of learning having no positive impact on student achievement or attitude toward learning (Chen & Bennett, 2012; Grady et al., 2012; Kirschner et al., 2006). As this study also considers the impact one-to-one device initiatives have on students from a low socioeconomic background, this literature review strand helps display an indirect link between constructivist teaching strategies and poverty. In past research, the socioeconomic status of a student has been found to impact student attendance and behavior (Anderson & Ritter, 2017; Bartanen, 2020; Loveless, 2017; Morrissey et al., 2014). Keeping students engaged is a hallmark of constructivist teaching methods, and increased student engagement has been proven to decrease classroom discipline issues (Neppl, 2019; Palasigue, 2009). Given the hallmark traits of constructivist classroom on student engagement in a constructivist classroom, it stands to reason that constructivist teaching methods could have a positive impact on both student attendance and discipline among students from low socioeconomic backgrounds as well.

Poverty and Academic Achievement

At its most basic form, poverty is a condition where an individual or family does not have a great enough income to provide basic needs such as clothing, shelter, or food for themselves or their family (Brooks-Gunn & Duncan, 1997). Poverty is considered a social construct, and as with any construct, it is much more complex than a simple definition. In

this case, poverty is a significant societal issue that has a far-reaching effect on a variety of people in an assortment of ways, especially school-aged children. The impact of poverty is not only felt by individuals directly, but it can also manifest itself through significant societal and economic implications (Reardon, 2013). Given its cyclical nature, poverty creates deeply ingrained inequalities among the student population (Noguera, 2011). While there is no "one size fits all" approach to fully counterbalance the effect of poverty on student achievement, there are multiple methods deployed by schools to mitigate its impact (Noguera, 2011).

One area of inequity being addressed more frequently by schools is student access to technology. Technological resources have become more widely used and readily available to many segments of the population, which has led to educational institutions looking for more ways to implement them into the academic environment. In the year 2000, just over 50 % of households in the United States had a laptop or desktop computer (Ryan & Lewis, 2015). By the year 2015, this number increased to 78% of households (Ryan & Lewis, 2015). The same can be said for smartphones and the Internet, as access to both have increased significantly over the last fifteen years (Taylor & Silver, 2019). Additionally, the ratio of computers available to students within school buildings has improved. In the year 2000, there was an average 5.2 students to each school computer in the United States, whereas more recently, that ratio has lowered to 2.9 students per computer (NCES, 2017). All of these statistics show an increasing amount of reliance both inside and outside of schools on technological tools and resources.

Given all these figures, the number of students with ubiquitous access to technology is relatively high. However, that access is not equally distributed amongst all segments of the population. Individuals from poverty and poorly educated backgrounds are significantly less

likely to have access to a computer, smartphone, or high-speed Internet (Rideout & Katz, 2016; Taylor & Silver, 2019; Vigdor et al., 2014). With fewer individuals from low-income households having access to these resources, it creates a "digital divide" in our schools between students from economic privilege and those that are not (Vigdor et al., 2014). Those with the financial means to access educational tools and resources through the Internet, computer, or smartphone while away from school are able to extend or enrich their learning outside of the school day while those without suitable financial resources are left devoid of those opportunities. The divide in digital learning opportunities created between the economically advantaged and disadvantaged leads to an imbalance in the educational environment that can adversely impact the poor (Bach et al., 2018; Kwakye et al., 2021; Vigdor et al., 2014; Warschauer & Ames, 2010). With such a high level of importance being placed on 21st century skills in both education and industry, and having less opportunity to hone those skills, the potential gap it creates between student populations could have far reaching effects. To have a greater understanding of those implications, it is necessary to understand poverty and the impact it has on the student population.

Who Lives in Poverty?

Poverty and low-income living situations are a common concern for individuals in the United States and impact a large percentage of the student population. In 2018, the United States Census Bureau set the federal poverty line for a family of four at $25,465 (Semega et al., 2019). To illustrate the difference between poverty and a more typical household in the U.S., the median household income at this time was $63,179. There were 38.1 million people in the U.S. that fell under the poverty threshold, which made up 11.8% of the population (Semega et al., 2019). While these numbers encompass the poorest individuals in the

country, they also neglect others who struggle to meet basic financial demands. DeNavas-Walt et al. (2013) recognize individuals that earn between 0% and 199% of the federal poverty line as "working poor" or low-income individuals. When factoring in this segment of the population, the numbers impacted grow significantly. In 2018, there were 323.8 million individuals in the U.S. that fell under the working poor threshold, 73.2 million of which were children under the age of 18 (Semega et al., 2019). Combined, all of these figures illustrate that a substantial number of the population experiences financial struggles.

Poverty is a concern that impacts individuals from all different backgrounds and geographic regions, but some are more likely to be affected than others. According to the United States Census Bureau, individuals of certain racial backgrounds are more likely to experience poverty than others. In 2018, African Americans and Latinx were around two times more likely to be poverty stricken than White or Asian-Americans (Semega et al., 2019). Education attainment was also found to be a factor in higher poverty rates, as individuals that did not complete their high school education had a poverty rate of 25.9%. This was over two times higher than those that completed their high school education, as 12.7% of people who earn their high school diploma, but do not complete any college live in poverty. The disparity grows even more when considering the difference between individuals that have not graduated high school and college graduates, as the rate of college graduates experiencing poverty was 4.4% (Semega et al., 2019). Family structure has also been shown to play a role in poverty rates as single parent households experience much higher levels of poverty than two parent households. This was especially true in family units where there was a single mother and children involved as 36.5% of families with children and a single female householder were considered to be living in poverty (Semega et al., 2019). While no

identifying factor or living situation guarantees a life of poverty for anyone, this information shows that some populations are more at risk of living in a low-income situation than others.

Just like all states, Missouri provides its own unique population complexities which influence its poverty statistics. In 2018, the state of Missouri had a total population of 5,943,658 (Missouri Community Action Network, 2020). Of that population, 786,330 were living in poverty, while 1,087,383 were considered as working poor. Together, this makes up 31.5% of the state of Missouri's population. It was found that poverty strikes some groups and geographic areas harder than others in the state. The African American community is hit the hardest by poverty in the state of Missouri, with 25.7% of the population living in these conditions (Missouri Community Action Network, 2020). This number is higher than the Latinx (19.6%), White (11%), and Asian-American (9%) communities. Geographic location also plays a role in poverty levels, as rural and metropolitan areas experience higher levels of poverty than suburban areas (Missouri Community Action Network, 2020). Given that the state of Missouri contains two large metropolitan areas and many rural areas, it provides a strong explanation for why such a significant segment of the population can be classified as either living poor or poverty stricken. While no two situations are alike, these figures do point to some consistent trends with poverty and certain segments of the population and areas where it may be more prevalent than others.

When considering the impact of poverty on schools, it is necessary to understand its frequency throughout the population of school-aged children. In 2018, there were 11.9 million children under the age of 18 that fell below the federal poverty threshold, which made up 16.2% of the population in that age group (Semega et al., 2019). When considering individuals classified as working poor, those numbers grow to 73.2 million individuals,

which make up 37.6% of the population for that age group (Semega et al., 2019). One figure that provides valuable data for schools when evaluating the number of students living in a low-income situation is the quantity of students eligible for the national free and reduced lunch program. To be eligible for free school lunches, a student must come from a household with an income below 130% of the poverty level, and to be eligible for reduced price lunches, students must come from a household with an income between 130% and 185% of the poverty level (National School Lunch Program, 2020). In the 2016-17 school year, 26.1 million students in the U.S. public school system were eligible for the free and reduced lunch program in schools (NCES, 2018). This equals 52.3 % of the student population, which is a number that has risen by 14% in the last fifteen years. In Missouri, the percentage of students eligible for the free and reduced lunch program is slightly higher than the national percentage, as 52.7% of the student population is eligible for the free and reduced lunch program (NCES, 2018). Between the number of students living in poverty and those signed up for the free and reduced lunch program, these figures provide a picture of the number of students living in a household that struggles to meet basic financial obligations. Coupled with these disparities is the impact of poverty and race on student achievement, not fully understood until the landmark Coleman Report.

The Moynihan and Coleman Reports

While systematic inequalities driven by socioeconomic status and race have been ingrained in the United States educational system forever, they were not widely recognized until the 1960's. Two influential pieces of literature regarding socioeconomic status and its impacts were released at this time. The Moynihan Report, titled *The Negro Family: The Case for National Action* was first leaked to the public in 1965, and met with much criticism

(Gans, 2011; Greenbaum, 2015; Rainwater & Yancey, 1967). This report blamed poverty on a "tangle of pathology", which Moynihan (1967) credited to broken families, and more specifically, the lack of male authority in broken families. He believed the lack of traditional family structure was the root cause of poverty and pushed the narrative that low wages, a lack of jobs, and poor schools in low-income areas (especially in predominately Black neighborhoods) was due to this reality instead of structural inequities.

The Coleman Report was the other influential piece of literature surrounding poverty released around this time. The report was commissioned by the U.S. Office of Education in response to the Civil Rights Act of 1964 and its stated purpose was to determine and highlight any significant differences between the schools attended by African Americans and those attended by southern Whites (Coleman et al., 1966). The findings of the report showed that most discrepancies in academic achievement were not a result of schools, but rather family environments, which were heavily influenced by socioeconomic status. This was summarized by Coleman et al. (1966) as follows:

> One implication stands out above all: That schools bring little influence to bear on a child's achievement that is independent of his background and general social context; and that this very lack of independent effect means that the inequalities imposed on children by their home, neighborhood, and peer environment are carried along to become inequalities with which they confront adult life at the end of school. (p. 325)

The overall conclusion of the report was that school-based interventions were ineffective in the light of familial poverty, leading to grim academic outcomes for low-income students (Coleman et al., 1966). This research has since been supported by other studies, which have found that poverty plays a role in struggling student performance due to low parent education, poor student health, high mobility rates, higher tendency for disruptive classroom behaviors, and social disincentives related to high academic achievement (Rothstein, 2008; Tileston & Darling, 2008; Wood et al., 1993). Rothstein (2008) posited that these factors are

so influential on students that relocating students from low-income living situations to a high-income area school would have no impact on improving their academic outcomes. Since the release of both the Moynihan and Coleman Reports, other research has been conducted on the relationship between poverty and academic achievement, which has brought their assertions and findings into question. Both reports reflect deficit thinking about the families of poor students and historically oppressed groups as responsible for challenges and inequities they face (Bruton & Robles-Piña, 2009; McKay & Devlin, 2016; Valencia, 1997, 2010).

While this research helped shed light on the cyclical and systematic nature of poverty and the difficulty schools face in effectively neutralizing its impact, subsequent research has both criticized the Coleman Report and contradicted its findings. Among the most common criticisms of the Coleman Report is the lack of attention paid to the role of teachers and their ability to impact student achievement on students from low-income living situations (Edmonds, 1982; Rivkin, 2016). There is also a belief that not enough consideration was given in the Coleman Report to the cognitive deficit many students in poverty face when beginning school and the gains made throughout the school year by these students. Downey and Condron (2016) found schools are able to slow the socioeconomic gap in cognitive skills when school is in session. This gap increases over the summer months, due to external factors that are out of the school's control. However, when the gap widens each summer, the amount of work needed to make progress is often greater than the amount needed in schools with a lower student population living in poverty (Alexander, 1997; Downey & Condron, 2016). In addition to this consideration, other qualitative variables such as peer support and collective efficacy, which might have an impact on academic outcomes, were not properly

addressed in the Coleman Report (Aguilar, 2020; Hattie, 2009; Marzano, 2007; Rivkin, 2016). There is also empirical evidence that specific school-based interventions or asset-based pedagogies can lead to higher academic achievement in high-poverty areas (Edmonds, 1982; Egalite et al., 2015; Hanushek, 2011). Asset-based pedagogies consist of theories and pedagogies centered on classroom practices that affirm student identities (Aguilar, 2020; Cervantes-Soon & Carrillo, 2016; Ladson-Billings, 2009; Love, 2019; Milner IV, 2012).

These findings help provide evidence that schools can influence the academic achievement of students from high poverty backgrounds, and that these students are not automatically relegated to a future defined by the outcomes of cyclical poverty and the deficit thinking it breeds. Kennedy and Soutullo (2018) interviewed 29 teachers, counselors, and administrators about placement decisions of students in alternative school settings of an Arizona suburban-rural district with over 28,000 students, the majority low income and students of color. Researchers found deficit thinking was used to explain students' challenges and placements in alternative education settings. They attributed students' individual characteristics as primary reasons for school problems and failure was beyond their control and not considered within the scope of their positions (Kennedy & Soutullo, 2018).

Poverty and Academic Achievement

The Coleman Report was able to clearly display an opportunity gap based on socioeconomic status, and when looking at more recent data, there has not been significant improvement. Recent NAEP test scores highlight an academic gap between students from poverty and those that are not (NCES, 2019). The 2019 NAEP test was administered to twelfth grade students in the area of reading and mathematics. Results from the test were disseminated using several different identifying variables, one of which was student

eligibility in the nation's free and reduced lunch program. Students that were eligible for this program scored, on average, 24 points less than students that were not eligible on the mathematics portion of the test. The results for the reading test were similar, as students eligible for free and reduced lunch program scored, on average 23 points less than students not eligible for the program (NCES, 2019.). These results were not only seen at the high school level, but also at lower grades as well, with results from the fourth-grade test showing similar results. Students in this grade level who were eligible for the free and reduced lunch program scored, on average, 24 points less on the math exam and 24 points less on the reading exam, than their classmates that were not eligible for the program (NCES, 2019). Just as there were concerns raised about the academic prowess of students from low-income situations in the 1960's, it is a continued concern to this day. Achievement gap talk has been criticized as not going far enough to examine the reasons for poor learning outcomes described earlier as an educational debt (Ladson-Billings, 2006). Anyon (2014) maintains that "an unjust economy and the policies through which it is maintained create barriers to educational success that no teacher or principal practice, no standardized test, no 'zero tolerance' policy can surmount for long" (p. 4).

Income level has been proven as a factor in academic success in past research. Higher income level can have a significant impact on the academic success of low-income families, even if it is a just a small increase in income. Dahl and Lochner (2012) examined the impact of the Earned Income Tax Credit on the achievement level of children. The researchers utilized panel data of 4,412 children with an average age of 11 from the National Longitudinal Survey of Youth (NLSY), which contained information related to income, demographics, and cognitive tests on each of the children administered the Peabody

Individual Achievement Tests in math and reading on a biennial basis. The researchers utilized data from 1988 to 2000, which reflected the median payment provided for the Earned Income Tax Credit increase for participants. It was found that over this time frame, when family income and the amount of Earned Income Tax Credit increased, so did academic achievement. On average, the researchers found that a $1,000 increase in family income led to an increase in children's reading and math scores by six percent of a standard deviation (Dahl & Lochner, 2012). This study is tangible evidence that family income level influences student achievement.

One concern for the achievement level of some low-income students is the lack of access and opportunity for enriching and challenging educational opportunities. Bromberg and Theokas (2014) examined the trajectory of high-achieving high school students from a low-income background. Using the data from the Educational Longitudinal Study of 2002, the researchers found that overall, low-income students were less likely to achieve in the top quartile when compared to students from a more economically advantaged family. High-achieving, low-income students were also less likely to take advantage of more rigorous opportunities that could advance their education. Their enrollment in Advanced Placement (AP) or International Baccalaureate (IB) programs is lower than more economically advantaged students. Nationally, 48% of students enroll in AP courses at some point in their education, while 28% of students eligible for the free and reduced lunch program take advantage of these courses. Additionally, there is a disparity between low-income and high-income students in the participation of college aptitude tests, as low-income students are less likely to take the Scholastic Aptitude Test (SAT) or the American College Testing (ACT) tests. This is detrimental to a student from a low-income background because it prevents the

opportunity to apply for more selective post-secondary institutions (Bromberg & Theokas, 2014). The researchers theorize that at least some of the reasons for low-income students not taking advantage of these opportunities include the lack of knowledge regarding their importance, poor advisement from adults, and low expectations from educators (Bromberg & Theokas, 2014). This study highlights not only the disparities in low-income students taking advantage of rigorous and challenging academic opportunities, but also reasons why this might be the case.

Not all research shows that low-income students are destined for a path of educational struggle. Existing empirical literature indicates with proper resources and eradication of opportunity gaps low achievement can be narrowed (Milner IV, 2012; Olszewski-Kubilius et al., 2017; Picower, 2021). Hung et al. (2020) suggests, "the education system actually presents an opportunity gap that leads to unequal outcomes, such as achievement gaps" (p. 177). Milner (2012) cautions educators to avoid achievement gap language which promotes deficit perceptions instead of assets of students and their families; a constant comparison of White students with historically underrepresented students that fails to address the reasons for the gaps; middle-class White students become the norm for assessment of all other student groups; and focuses on individual students instead of school structures, policies, and practices that promote inequalities. The digital-divide gap, the focus of this research is just one of gaps that Irvine (2010) insists must be explored:

> …the teacher-quality gap, the teacher-training gap, the challenging curriculum gap, the school-funding gap, the digital-divide gap, the affordable-housing gap, the health care gap, the employment-opportunity gap, the school-integration gap, and the quality child-care gap. (p. xii)

When educators give attention to asset-based practices, opportunity gaps are reduced, as was shown in the Olszewski-Kubilius's et al. (2017) study. Olszewski-Kubilius et al. (2017)

conducted a 14-year longitudinal study on the outcomes of a program called, Project Excite initiated in the Evanston, IL school district, that provided extensive supplemental programming in STEM subject areas to historically underserved and low-income students. The creators of the program hoped that it would help improve the participants' high school and college readiness, leading to a narrowing of the racial and income opportunity gaps (Olszewski-Kubilius et al., 2017). The researchers examined data such as standardized test scores, high school math course placements, and college placements to determine if an increase in targeted resources would have an impact on achievement. The results showed that students in the Project Excite reduced the math and science scores between low-income and high-income students, while also improving their participation in advanced high school courses. Students in the program also showed an overall positive growth in their standardized test scores, as they regularly exceeded the scores of their peers in the subjects of math and reading (Olszewski-Kubilius et al., 2017). The results of this study help support the claims that proper access to resources and educational support can help close the income opportunity gap.

While determining how poverty impacts academic achievement is helpful, it is also important to understand why it manifests itself in academic results. Learning deficits among low-income population have been tied to several common concerns. Many researchers have pointed to the poor health and nutrition of students from poverty as a factor for their low academic performance (Basch, 2011; Engle & Black, 2008; Irvine, 2010; Jensen, 2013; Schoen et al., 2015). A lack of proper environmental stimulation and parental nurturance are more commonly found in low-income households and can lead to underdeveloped linguistic and executive functioning abilities (Hair et al., 2015). Growing up in a low-income

household also exposes children to food with lower nutritional value, which impacts brain development (Antonow-Schlorke et al., 2011). Children growing up in a low-income household have lower rates of insurance coverage, which makes them less likely to receive routine medical checkups that could identify health concerns (Schoen et al., 2015). A combination of infrequent medical attention and nutritional deficits can lead to chronic illness and fatigue, which impacts school attendance and performance (Gabarino, 1991). Given all this information, the health risk factors associated with poverty can have both a direct and indirect impact on a student's level of academic success.

Unstable living conditions that lead to a high mobility rate are a concern for the low-income student population. Student mobility can happen for many reasons, both positive and negative, but within the poverty population it is often not a choice. Schafft (2006) sought to determine reasons behind student mobility in one New York school district and found 78% of the respondents that changed school districts were forced to move due to reasons outside of their parents' control. The most common reasons cited for moving were housing-related, employment or social/interpersonal reasons (Schafft, 2006). High mobility rates often have a negative impact on all involved, especially schools and students. Schools with high rates of mobility often score lower on standardized test scores, generally have lower academic rigor, and allocate more of their financial and human resources on support staff and programs (Rumberger, 2015; Thompson et al., 2011). The impact of student mobility reaches students of all ages and can be more damaging with more frequency. Burkam et al. (2009) noted that four percent of kindergarten students who remain in the same school for the whole year are not promoted to first grade, whereas 12% of kindergartners who change schools are not promoted to first grade. Another study showed that just one non-promotional school move

increased dropout rates among high school students, with a pronounced effect on students that moved three or more times (Rumberger, 2015). Given the high rates of mobility in low-income student populations, it is a significant factor to consider when looking at the impact poverty has on student achievement.

In addition to student health and mobility rates, the behavior of students from poverty has been found to influence their academic achievement. Poverty has been linked to multiple behaviors that lead to a student either being removed from the classroom setting or suspended from the school building. Low socioeconomic status is often accompanied with the stress that comes with financial hardship, and the behaviors exhibited due to that stress can look similar to depression (Butterworth et al., 2012). This may cause students from poverty to come across as unmotivated and irritable in the classroom, which impacts how teachers interact with these students (Jensen, 2013). When a student spends less time in the classroom, it leads to a more difficult time understanding the content. This can often manifest as disruptive behavior, and eventually lead to the student accepting the role of classroom disruptor (Glenn, 2010). These behaviors are not only detrimental to an individual's education, but also the classroom environment and the teacher's ability to effectively provide instruction.

Impact of One-to-One Device Initiatives on Students from Poverty

Given the connection between poverty and academic achievement, as well as the concern to improve achievement in this segment of the student population, many believe that technology and the capabilities it brings can help bridge the social and educational gaps that plague economically under-served students (Darling-Hammond et al., 2014; Vigdor et al., 2014; Warschauer, 2016). However, with technology rapidly improving and high-speed

internet becoming a necessity as opposed to a luxury, inaction could cause the opportunity gap between low-income and high-income students to continue to widen (Vigdor et al., 2014). To better understand the direct impact between one-to-one device initiatives and low-income students, past research can provide some answers.

In a 2014 study, Warschauer et al. investigated three different school districts that implemented one-to-one laptop programs. One school district the researchers focused on was Birmingham, Alabama, comprised of 95% African American and 80% free or reduced lunch status students. Laptops were provided district wide to 15,000 students in first through fifth grade. Before the program began, only 63% of the student population reported having access to a computer at home. Through interviews, surveys, and observations, the researchers worked to determine the impact of the devices on student learning. While the school was able to provide the laptops successfully, they did not make the necessary upgrades to technical or social infrastructure to support the devices. There was little funding available for repair of broken or damaged devices and wireless access was only available at specific common spots, leading to less opportunity for usage inside the classroom. While availability of the device did not always lead to increased usage in the classroom, it did provide increased access and use of technology outside of school hours. Students involved in the program noted a significant increase in total computer usage as well as the feeling that they were more proficient with technology (Warschauer et al., 2014). Even though the study did not show a significant improvement in academic achievement, the increase in access provided benefits for students.

Whereas the Birmingham School District did not experience success with a one-to-one program among their low-income population, research depicting opposite results have

been observed as well. Mouza (2008) implemented a quasi-experimental study in an elementary school with a student population consisting of 94% Latinx students that qualified for free and reduced lunch. The researcher compared three classrooms of students that were given laptops to use in the classroom and the classrooms that were not provided laptops. Over the course of the study, the author found that the laptop classrooms experienced higher levels of motivation, improved communication with their teacher and peers, as well as academic gains in writing and mathematics (Mouza, 2008). The teachers believed the computers were especially helpful in this area due to the increased access of spreadsheet and word processing software (Mouza, 2008). These findings provide credibility to the belief that increased access to technology will improve academic achievement among low-income students.

One-to-one device initiatives have also been shown to have an impact on specific subject areas in high poverty schools. Zheng et al. (2016), highlighted a study completed in the Littleton, CO school district, which focused on academic achievement in English language arts. The school district provided laptops for all fifth through tenth grade students. While the makeup of the school district was predominately middle-class and White, one of the schools closely observed contained an English language learner (ELL) population of 70%. Over the course of the study, the school district did not see a significant improvement in the overall achievement of students. However, there were significant gains observed among Latinx and low-income students (Zheng et al., 2013). Interviews with participants revealed that the laptops provided more opportunities for students from low-income households to participate in writing through online activities. The results were not unique, as

other past research regarding English language arts achievement and low-income learners had similar outcomes (Weber, 2012; Weers, 2012).

Brown (2018) through a quasi-experimental study with 236 students from the state of Georgia, using a pre-test/posttest design, focused on the impact of technology interventions on math achievement scores of low-income students. Of the 236 students, 42% were considered poor. Students were divided into three different groups with two experimental groups receiving a Google Chromebook, one with daily use and one with weekly use, and a control group that did not receive school issued technology to use. Overall, the study found no difference between the control group and the experimental groups. However, when the researcher focused on students from high poverty backgrounds, the results were different. The students from a low-income family and in the daily laptop intervention group experienced a gain of 65% on learning goals, which was significantly higher than both the control group and the weekly laptop intervention group (Brown, 2018). Previous research revealed similar results regarding low-income student technology usage and achievement in math (Broussard et al., 2014; Darling-Hammond et al., 2014). These results provide support to the belief that increased technology availability and usage can result in increased achievement of high poverty students, disputing such findings as the Coleman report from the Moynihan era and the war on poverty.

Schools are expected to provide a high-level education for all students, despite the differences that exist from diverse upbringings. While completely out of a student's control, family income level is one of the major home life factors that influences the effectiveness of their education. Given its complexity, yet relative common nature, there has been no simple answer to suppress the negative impacts of poverty in education. As schools have become

more aware of the issue, they have continued to work on solutions. One path taken by many schools to help narrow the opportunity gap between low-income and high-income students is to bridge the digital divide that exists between the two groups through one-to-one device initiatives. If a clear-cut connection between one-to-one device initiatives and academic achievement in low-income student populations can be made, it will provide a means to narrow opportunity gaps that some schools are desperately seeking to address.

One to One Device Initiatives and Academic Achievement

As stated previously, one-to-one device initiatives are still a relatively new approach in education. With the technology and infrastructure now more readily available to allow what was once a pipedream to become a widespread reality, more and more school districts are attempting to implement device initiatives of their own. Despite the newness of the programs, there have been numerous studies conducted that are either directly or indirectly related to the subject. The majority of this research has been conducted to determine the relationship between academic achievement and one-to-one devices. The results of these studies are varied, and often point to a general lack of consensus on the subject (Bebell & Kay, 2010; Bleyer, 2017; Gatens, 2017; Silvernail et al, 2011; Warschauer et al, 2014). Despite the lack of agreement among scholars, examining the different components of one-to-one device initiatives provides a more complete picture of the possible drawbacks and benefits of implementing such a program.

Hence, the purpose of this literature review strand is to explore the relationship of one-to-one device initiatives and academic achievement. To provide a comprehensive and organized review over previous literature regarding this subject, the information in this strand has been divided into four sub-topics. The first sub-topic will be focused on the history of

one-to-one device initiatives, which includes its origins and growth to the widely used method it is today. The second is centered on the overall relationship between one-to-one device initiatives and academic achievement. The review will conclude with an in-depth look at one-to-one device initiatives and their impact on the third and fourth subtopics related to the content areas of math and English language arts. Each of the sub-topics within this literature review strand provide important knowledge that helps increase understanding of one-to-one devices and their impact on students.

History of One-to-One Device Initiatives

The idea of ubiquitous computing in an educational setting has been floating around since the 1980's. Seymour Papert (1980), a professor at Massachusetts Institute of Technology, was the first to develop and communicate the idea of one-to-one computer availability for students. He viewed the omnipresence of computers in schools as imperative as other school resources such as pencils, paper, and books. In his view, schools would never provide one pencil for 30 students, so the same ratio for computers to students would be equally as unacceptable (Papert, 1980). While many found Papert's idea intriguing, the cost of the hardware was just too much of a burden for many schools or students to bear at that time (Johnstone, 2003).

While the idea of one-to-one computing had been conceived, it was years later that it was actually put into practice. In 1985, Apple, Inc. initiated the very first one-to-one computing program. Apple provided one classroom in Blue Earth, Minnesota and in Eugene, Oregon with computers for each student and teacher in the class (Dwyer, 1995). This was before laptops were readily available, so Apple provided each student and teacher with a desktop computer at school and at home (Dwyer, 1995). Through this program, students and

teachers were able to have constant access to computer technology, one of the trademark characteristics of any one-to-one computing program.

The first instance of one-to-one laptop computer availability took place outside of the United States, in Melbourne, Australia. In 1990, at a private school named Methodist Ladies' College, the students in fifth grade classes were required to purchase a laptop computer that was to be used at school (Johnstone, 2003). This initiative, led by Microsoft, stimulated the increased use of one-to-one laptop computers in Australia's schools, which caused supporters of such programs in the United States to take notice (Johnstone, 2003). In 1996, Microsoft and Toshiba began their Anytime Anywhere Learning Program (Walker et al., 2000). In this program, 29 pilot schools in different areas of the United States were selected and given Toshiba laptop computers loaded with Microsoft Office software to be used in the classroom (Walker, et al., 2000). This marked the first notable one-to-one laptop initiative in the United States.

In 2001, the first large-scale, district-wide one-to-one laptop initiative in the United States took place with Henrico County Public Schools in Virginia. The initiative provided Apple iBook laptops to 31,000 students, teachers, and staff members (The Abell Foundation, 2008). This covered all students in the district from grade 6 through 12, which included 22 secondary schools and 48 elementary schools. Shortly after this program was initiated, Maine became the first state to institute a statewide one-to-one device program (Fleischer, 2011). Maine Governor Angus King, inspired by a conversation with Seymour Papert, initiated a program to provide a laptop to all Maine students in the seventh and eighth grades (Fleischer, 2011). Maine was soon followed by programs in Texas and Michigan, which aimed to provide laptop computers to large numbers of students statewide (The Abell Foundation,

2008). With an increase in statewide programs as well as individual school districts across the country, the use of one-to-one laptop programs have grown exponentially in the United States.

The increased implementation of one-to-one device initiatives can be attributed to many factors, but one key consideration is the decrease in costs to implement such a program. In 2012, Apple was the most dominant company in the school device market, making up 52% of all sales, with Microsoft coming in second with 43% of the school laptop market (Taylor, 2015). At that time, Google had just introduced its Chromebook product, with a price point from $199 to $249 per device. In the three subsequent years, Chromebooks became the most popular device purchased by school districts, as it made up 53% of the devices purchased by school districts in 2015 (Taylor, 2015). With lower cost of devices, schools can now allocate more money towards technology and receive a greater amount of goods. School districts across the country are increasing their spending in technology, specifically on hardware (Bushweller, 2017; Schaffhauser, 2016). Schaffhauser (2016) noted that 87% of districts were planning on purchasing tablets, mostly for elementary students, while 86% were expecting to purchase laptops for their students, which would predominately be used in secondary classrooms. While not every one of these purchases points to use in a one-to-one device program, it does show a trend of schools lowering the ratio of devices to students.

One-to-One Device Initiatives and Achievement

At its most basic level, a one-to-one device initiative is the introduction of ubiquitous computing capabilities to teachers and students in an educational setting. A one-to-one device initiative does not suggest that the computer changes instruction, only that the

computers are provided to all involved. Cuban (2006) theorized that the introduction of computers without a fundamental change to instructional strategies would be ineffective for both students and teachers. Past research focused on the introduction of computers in the classroom and its impact on student achievement align with Cuban's assertion that instructional practices must adjust with the devices (Bebell & Kay, 2010; Dunleavy, et al., 2007; Zucker & Light, 2009). A study conducted at West Point in 2016 specifically set out to determine whether or not the introduction of a devices, without a change in instruction, would lead to improved academic outcomes. Researchers separated a classroom into three categories of technology usage to determine what type of impact devices would have on student grades (Carter et al., 2016). One group was not allowed to use technology at all, the second group was allowed to use laptops and tablets freely, and the third group was allowed to use a tablet as long as the screen was visible to the instructor. Students in the groups that were allowed to use technology scored, on average, 1.7 percentage points lower than students that were not allowed to use technology (Carter et al., 2016). By simply providing students constant access to technology without altering instruction, computer usage was seen as a hindrance to the students as opposed to an advantage.

In past research, one of the barriers to successful technology integration in the classroom has been student distraction with devices. In a 2013 Canadian university study, researchers set out to determine the impact of students multi-tasking on devices during instruction. Students were divided in to two different groups with one group completing non-educational tasks or "multi-tasking" activities on the computer during instruction, while the other was allowed to use their laptops for educational purposes only. At the completion of the course, students were given a comprehension test over the material covered. Test scores were

analyzed and students that used a computer or were in view of a computer scored, on average, 17% lower than students who used their computers for educational purposes only (Sana et al., 2013). In another study, Risko et al. (2013) investigated whether or not "mind wandering" due to computer usage had a negative impact on academic achievement. The researchers had 64 students take part in the same lecture activity, with half of the students completing tasks on the computer that promote mind wandering and the other half attempting to fully engage in the lesson. After the lecture, the students completed a post-test over the material to determine their comprehension of the coursework. The students that were not engaging in mind wandering activities scored, on average, 13 points higher than students given mind wandering tasks. (Risko et al., 2013). These studies show that common detracting behaviors that take place with technology present, such as "mind wandering" and "multi-tasking" impede students' abilities to learn.

While there are specific behaviors shown to negatively impact student achievement when technology is available at a universal level, the opposite has also been observed. In a summary of one-to-one laptop initiatives from seven different states, Argueta et al. (2011) noted several studies where positive school behaviors were witnessed in a one-to-one environment. This included decreased student discipline, increased student motivation, and an improvement in student attendance. (Argueta et al., 2011). In a study of the Berkshire Wireless Learning Initiative, which took place across five different middle schools in Massachusetts, researchers also noted multiple positive behaviors amongst students (Bebell & Kay, 2010). In this study, students were divided into three groups: 1) high achievers, 2) traditional students, and 3) at-risk/low achieving students. Teachers involved in the program were surveyed at different times throughout the study and were asked to report levels of

student engagement and motivation. At the time of the final survey, teachers felt all three groups experienced increased levels of student engagement. This included 71% of teachers feeling like engagement improved among high achieving students, 83% in traditional students, and 84% among struggling students. Similar results were reported when teachers were asked about student motivation as 59% of teachers noted an improvement for high achieving students, 73% traditional students, and 76% struggling students (Bebell & Kay, 2010). These behavioral effects are ultimately encouraging for future one-to-one device initiatives and the potential impact they might have on student achievement.

In addition to student behavior, it is necessary to consider the academic ramifications of one-to-one device initiatives to understand their full impact. One common measure used to determine student learning is grade point average (GPA). There have been multiple studies that have studied the relationship between one-to-one devices and student GPA. Gulek and Demirtas (2005) followed 259 students at Harvest Park Middle School in California, which represented 24% of the student population, in a one-to-one device initiative over the course of three years. The GPA's of participants in the program were compared to those not participating in the program. Over the life of the study, the students participating in the program displayed significantly higher GPA's than students not participating. In addition to this study, there were others that noted a positive relationship between student GPA and the involvement in a one-to-one device initiative (Hansen, 2012; Zucker & Hug, 2007). Still, there was some inconsistency in the literature as not all studies point to a positive relationship between GPA and a one-to-one device initiative, with others showing either no relationship or a negative relationship between the two (Delgado-Hachey et al., 2005;

Gatens, 2017). Given the overall inconclusiveness of past research, this topic bears the need for future studies.

Multiple studies have examined not only at the relationship between student GPA and a one-to-one program, but also the amount of time spent on the device and its effect on student GPA. Lei and Zhao (2007) showed the more time a student spent on their device each day, the better the GPA. However, they also found that there was a critical "no-gain point" of three hours. Student GPAs improved with up to three hours of computer use but started to decrease the more students used their device over the three hours a day threshold. While the study showed more computer usage benefits student GPA, the researchers also hypothesized that the quality of device use is more important than the quantity (Lei & Zhao, 2007). Drain et al. (2012) confirmed similar findings. They compared the amount of time the student spent on the device for educational purposes and student GPA. There was a positive relationship between the two, helping the researchers conclude that one-to-laptop usage for school purposes benefits academic performance.

While student GPA is commonly used as an internal tool for schools to measure academic achievement, others point to statewide standardized tests as a more helpful tool when determining levels of student learning. Standardized tests are purported to be absent of bias and subjectivity, making them fair for all students and a good tool for academic achievement measurement (Gawthorp, 2014). Even though standardized tests are purported to be objective, there is still a concern regarding students experiencing cultural bias on these assessments (Au, 2009; Beliner, 2013; Hartman, 2007; Knoester & Au, 2017). Despite cultural bias, many researchers have used standardized test scores to determine the effectiveness of one-to-one device initiatives.

Bebell and Kay (2010) conducted a three-year pre/posttest comparative study to track student achievement at seven different schools across western Massachusetts; five of which implemented one-to-one programs and two that did not implement programs. Of the schools that received laptops, three were public schools, while the other two were private, parochial schools. The two schools involved that did not implement the one-to-one program were public schools. Schools were selected for the study due to their similar demographic makeup. Schools participating in the study had on average, a non-white student population of 17.6% and a free/reduced eligibility percentage of 42%. The researchers used the Massachusetts Comprehensive Assessment System (MCAS), the Massachusetts standardized test, as the tool for measuring student achievement. Students received their device in the sixth grade and were tracked for the purposes of the study through eighth grade. Test results showed that students in the program for multiple years improved passing rates. In addition, test results showed the students in the one-to-one laptop program scored significantly higher than students that were not a part of the one-to-one laptop program.

In 2012, Greaves et al. examined the one-to-one laptop program at Mooresville Graded School District in Mooresville, NC. Instead of focusing on one school or a targeted grade level, the school district provided laptops for every single student, kindergarten through high school, in a district of 5,409 students (Greaves et al., 2012). Of the 5,409 students in the district, 40% were eligible for free or reduced lunches, and 27% were non-white. The progress of the district's initiative was measured by evaluating the percentage of students that scored proficient or higher on the North Carolina statewide standardized test, which assessed the areas of reading, math, and science. The district's laptop program started at the beginning of the 2008 school year. The data from the assessments were compiled over

the course of three school years, which ended in the 2010-11 school year. In 2007-08, the year before the one-to-one program began, 73% of students scored proficient or higher on their assessment. In the first year (2008-09) of the laptop initiative, the school raised their scores to 82% of students scoring proficient or above. In the second year (2009-10), the percentage increased to 86% of students scoring proficient or higher. In the last year (2010-11) of provided data, 88% of students scored proficient or higher on the statewide test, placing the school district with the third highest number of such students in the state of North Carolina (Greaves et al., 2012). This data shows a steady, overall improvement in standardized test scores over the course of the study.

Not all studies suggest one-to-one device initiatives lead to improved standardized test scores. Silvernail and Gritter (2008) noted that in one of the largest-scale one-to-one laptop initiatives, no significant changes were observed in students' standardized test scores. The Maine statewide one-to-one laptop initiative provided laptops to roughly 100,000 middle school students from 2002 to 2008. In 2006-07 school year, towards the end of the study, 36.4% of the student population in the state of Maine was eligible to receive free and reduced lunches (Silvernail & Gravelle, 2008). During this time, researchers studied whether or not the devices provided to students had an effect on their academic achievement. In this case, student achievement was measured by evaluating results of the statewide Maine Education Assessment (MEA). The scores on the MEA showed no considerable improvement from the implementation of the program to 2008 (Silvernail & Gritter, 2008). The data did not display significantly improved standardized test scores but showed improvement in other areas. In a 2011 study of the Maine laptop initiative, it was found that students' writing skills, as measured by the MEA improved significantly over the course of the laptop initiative

(Silvernail, et. al., 2011). While the initiative may not improve overall achievement scores, it still did have a positive impact on the students involved.

Academic Achievement in Math

Academic achievement in the area of math, while integrating one-to-one technology, has been well documented in previous studies. Much of the previous literature points to academic achievement in math lagging while taking part in a one-to-one device program (Bleyer, 2017; Dunleavy & Heinecke, 2007; Gatens, 2017; Silvernail et al., 2011). Dunleavy and Heinecke (2007) observed a one-to-one laptop program in an urban middle school over the course of three years with a total enrollment of 972 students, 87% non-White, and a poverty rate of 60%. The researchers provided only100 students per grade level with laptops. All students were given a pre and post-test in the areas of science and math, and the results of the assessment were compared. The researchers found a significant effect on test scores observed for students in the laptop group in science, but not in the area of math.

Similar results were discovered by Gatens (2017) in his research of a New Jersey high school one-to-one laptop program. Gatens compared two demographically and geographically similar school districts, with one utilizing a one-to-one device initiative, and the other one not. The percentage of students classified as "economically disadvantaged" involved in the study from the district not participating in the one-to-one initiative was four percent, while the percentage of students involved in the study from the school that implemented the one-to-one program was six percent. The school not participating in the one-to-one initiative was represented in the study by a sample of students, which included 61% White students, 28% Asian students, and 11% Latinx students. The school participating in the one-to-one initiative was represented in the study by a sample of students, which

included 80% White students, 13% Asian students, 6% Latinx students, and 1% Multiracial students (Gatens, 2017). To determine the impact of the program on student achievement, the standardized test scores of students involved in the one-to-one laptop program were compared to the scores of students that were not involved in the program. Students involved in the one-to-one laptop program scored, on average, eight points less on the math portion of the New Jersey standardized test than students not involved in the one-to-one laptop program. The researcher noted that the limited demographic scope of the study could make it difficult to generalize these results (Gatens, 2017). The study included a low percentage of students from low-socioeconomic background. Since other studies have found that one-to-one device initiatives can have a positive impact on academic achievement for students from low-socioeconomic background (Brown, 2018; Mouza, 2008; Warschauer et al., 2014), it is possible that the lack of improvement can be attributed to the setting and sample of students used in the study.

In contrast to Dunleavy and Heinecke's (2007) and Gatens' (2017) studies, Bleyer (2017) was interested in examining one-to-one device initiatives based on school size. Students were categorized based on the size of their school, with a "small school" (enrollment of less than 1,200 students) or a "large school" (enrollment of more than 1,200 students) designation. The Partnership for the Assessment of Readiness for College and Careers exam, the Illinois state standardized test, was used to measure academic achievement. When comparing test results, students taking part in a one-to-one device program from large schools scored significantly lower on the exam than students not taking part in a device program. For small schools, it showed the opposite. Students from a small school scored significantly higher when involved in a one-to-one device program (Bleyer,

2017). Given the relative lack of infrastructure to support high speed internet and device usage in rural settings (Lai & Widmar, 2021), it stands to reason that the introduction of devices would have more of an impact in these settings than those where devices are more readily available and integrated outside of school.

Early research into the Maine statewide one-to-one initiative program, the Maine Laptop Initiative pointed to low academic achievement in the area of math (Silvernail & Gritter, 2008). Data showed that math teachers were using laptops less frequently than teachers in other content areas. In a 2011 study on the initiative, a more focused approach towards math instruction was noted (Silvernail et al., 2011). Fifty-six schools in the state were selected as either a participant of the experimental or control group. The experimental group would receive professional development intended to improve their effectiveness of teaching math with devices. The control group would not receive any additional support than what was already being provided by their school district. The two groups were followed over the course of the next two school years. The experimental group scored significantly higher on a math achievement test than the control group (Silvernail et al., 2011). This points to the importance of teacher support and professional development inclusion in the development of a laptop initiative.

Other studies have noted specific areas within the mathematics discipline that translate well to daily computer usage. Freiman et al. (2010) suggested that access to a computer aids students as they develop problem solving skills, specifically in the area of math. It was also noted that computer access allowed students to create and use more graphic organizers, which helped with their math lessons (Freiman, et al., 2010). Manuel and Freiman (2017) reported that a virtual learning environment for math benefits gifted students.

Technology allows students to enrich a project or problem in a way that is not possible for more traditional schoolwork, leading to a deeper learning experience (Manuel & Freiman, 2017). Varier et al. (2017) found that device programs were being used in math for students to play content-related computer games to improve student engagement and motivation. Clariana (2009) deduced that students in a one-to-one laptop program held an advantage on a math standardized test that was computerized due to the students receiving practice and instruction with the medium.

Some information suggests that students will see academic progress in the area of math as long as they are given sufficient time on their device. Bebell and Kay (2010) found that students were more successful, specifically in the area of math in a one-to-one environment, when more frequent use of the device occurred. Warschauer (2011) supported this finding and noted the use of technology can be more effective and efficient when students have regular, daily use of the technology. In another study, Tang and Patrick (2018) researched the impact of technology and social media usage on 8th and 10th graders in the United States. The researchers found that students who spent the most time using their computers for schoolwork also saw the greatest benefit to their grades. In the study, a one standard deviation increase in school related computer usage led to 16% higher odds of better grades (Tang & Patrick, 2018). The belief that more, regular device usage can lead to higher achievement has also been supported by other studies as well (Dumais, 2008; House, 2010; Lei & Zhao, 2007). These studies help lend credibility to the belief that one-to-one device initiatives can be impactful in the area of math, especially if students are allowed sufficient time on the devices.

Academic Achievement in English Language Arts

Several pieces of research have posited that the skills used, and content taught in an English language arts class lend itself to a one-to-one laptop environment. As noted by Zheng et al. (2016) in their meta-analysis of one-to-one laptop programs, "together with gathering information online, writing and editing was found to be among the most common uses of technology in the laptop classroom. Students were found to write more in classrooms where all students are provided with individual computers" (p. 1067). Grimes and Warschauer (2008) found that the most common use for students with devices in a one-to-one environment was writing papers. One-to-one device availability also creates more opportunity for reading, which is another key component in the English language arts subject area. Even basic computer tasks, such as browsing the Internet can help build and develop reading skills (Kposowa & Valdez, 2013). By doing nothing more than simply substituting pencil and paper for computers, the opportunities students have to improve skills in the English language arts content area increase.

In Silvernail and Gritter's (2008) examination of the Maine Laptop Initiative Program, the program's effect on writing achievement was closely observed. Scores from 8th graders on the writing portion of the state standardized test from 2000 (two years before the program implementation) were compared to the scores from 2005 (three years after the program implementation). The average writing score improved 3.44%. Additionally, the number of students meeting the state writing proficiency standard increased from 29.1% in 2000 to 41.4% in 2005. In addition to the testing data provided, Silvernail and Gritter (2008) also conducted surveys to determine how laptops were being used for writing in the classroom. Two notable findings of the survey data were shared. First, teachers were having

students utilize the computers effectively. Of the 15,881 students that were surveyed, 11,593 (or 73%) responded that teachers had them use computers to develop rough drafts and final copies, while 642 students (or 4%) responded that their teachers did not have them use the computers for writing at all. Second, for those students that stated teachers required them to complete rough drafts and final copies of writing assignments, standardized test writing scores were significantly higher than for those whose teachers did not require computer usage. Forty-three percent of students who were put in a position to use the computer more met the proficiency standard, while only 21% of the students that did not use their laptops for writing met the proficiency standard (Silvernail & Gritter, 2008). Given the breadth of the initiative covered in this study, the results display that widespread technology usage has substantial potential to positively impact English language arts achievement.

While much of the research supports the positive impact of one-to-one device initiatives in English language arts classrooms, not all of the research agrees with this point of view. Bleyer (2017) saw no significant difference in English language arts achievement between the students involved in a one-to-one laptop program and those that were not involved in the program. Gatens (2017) did not observe a significant difference between the English standardized test scores of students involved in a one-to-one program and students that were not. While these studies did not result in a significant difference in test scores, they did not show a complete lack of effectiveness. Multiple researchers noted that despite the lack in score improvement, students were still using devices in an increased manner that would allow them to improve their writing skills outside of the traditional school day (Bleyer, 2017; Zheng, et al., 2016). Despite some of the negative findings of these studies,

there was still some student benefits observed for use of devices in the area of English language arts.

Given the overall cost and scale of a one-to-one device initiative, there is significant value in looking at the results of past programs to determine their relative failures and successes. In review of past research, the effectiveness of one-to-one device initiatives and their ability to impact academic achievement are inconclusive and contain a mix of both positive and negative outcomes (Bebell & Kay, 2010; Bleyer, 2017; Gatens, 2017; Silvernail et al, 2011; Warschauer et al, 2014). The research has led to no consensus on the subject, often with gaps in the literature. With more and more schools taking this approach as a means to improve student achievement, there are hopes that school districts will learn from others' past failures and adjust their own programs to fit the needs of students. As schools consider this path, the necessity to fill gaps in research and add more clarity to the current research remains. By doing so, educators can use the available information and determine whether or not one-to-one device initiatives are a viable program for their students, their school, and their community. The efforts of districts must also include issues related to traditional and non-traditional forms of teaching in the world of technology.

While the challenge remains in schools to address constructivist forms of instruction, the shifting nature of a knowledge driven world calls for connectivism as ways to address inner and outside forms of learning. As Seimans (2022) notes, "new information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognize when new information alters the landscape based on decisions made yesterday is also critical" (Connectivism, para 3). The

discussion of traditional and contemporary forms of knowledge begins with the significance of schema embedded constructivism.

Instructional Leadership

As schools make the transition to one-to-one device environments, they must consider the responsibility of the school leader during the implementation and duration of the program. Principals fill many roles throughout the course of a school year, which include management, political, organizational, strategic, and academic components (Kafka, 2009). However, one of the most important roles a principal fill may be that of the instructional leader (Day et al, 2016). Robinson (2011) found that "instructional leaders" that focus on professional growth and learning have a significant impact on student achievement. In this capacity, the leader will help shape the culture of the school, facilitate growth and learning opportunities, and supervise the staff to ensure student success (DiPaola & Hoy, 2014). All of these components are essential in the implementation of any new learning initiative that requires a change in instructional materials or practice.

With this in mind, the instructional leader role is especially significant as schools implement and execute a one-to-one device initiative. Throughout a one-to-one device initiative, the guidance of a strong instructional leader is necessary to help navigate the changes taking place in the classroom environment, and essential to the program's success (Danielson, 2009; Jones, 2013, Parr & Ward, 2011). Without a solid instructional leader to develop a plan and support teachers' growth with the device initiative, the program is less likely to be successful. Given the relationship between educational change and the role of an instructional leader, the inclusion of instructional leadership as a foundational area of this research is significant to the effective use of one-to-one devices. To fully investigate this

topic and its connection to the study, this strand will include information about the history of instructional leadership, the roles of an instructional leader, and the impact of instructional leadership on the outcome of one-to-one device initiatives.

History of Instructional Leadership

The focus on the principal's role as the instructional leader in the building began to gain traction during the Effective Schools Movement of the 70's and 80's (Hallinger & Murphy, 1986). As individuals began to look at school reform and what made schools successful, the role of the school leader became more scrutinized. In 1971, George Weber conducted a study on four inner-city schools that were successful despite facing the same challenges as similar schools. This research began to show that students could be successful as a result of the school, regardless of family background or socioeconomic situation. Weber (1971) identified several common characteristics of effective schools, one of which was strong leadership. As the Effective Schools Movement evolved and more research was conducted, the understanding and meaning of strong leadership in schools evolved as well. One of the main researchers behind the Effective Schools Movement, Ronald Edmonds (1982) noted that two characteristics of effective schools are "(1) the principal's leadership and attention to the quality of instruction and (2) a pervasive and broadly understood instructional focus" (p. 4). What had typically been seen as a management position was beginning to morph into a position of instructional leadership.

As research continued, a clearer picture of the role instructional leadership plays in a school took shape. There was increasing importance for the principal to assume the role of instructional leader in the building, but in a different capacity:

> The role of the principal will be changed to that of "a leader of leaders," rather than a leader of followers. Specifically, the principal will have to develop his/her skills as

> coach, partner and cheerleader. The broader concept of leadership recognizes that leadership is always delegated from the followership in any organization. It also recognizes what teachers have known for a long time and what good schools have capitalized on since the beginning of time: namely, expertise is generally distributed among many, not concentrated in a single person. (Lezotte, 1991, p. 4)

While principals would still be responsible for the academic vision for the school, they would utilize the strengths of others to help carry out that vision. This process naturally evolved with Professional Learning Communities (PLC's) that were made common with the research of Robert Marzano (Archer, 2012). Many schools that identify as a PLC have a "school leadership team" in place, which is a formal team that functions similar to the decentralized leadership approach suggested by Lezotte (1991). According to the National Institute for Urban School Improvement (2005), a building leadership team is defined as "a school-based group of individuals who work to provide strong organizational process for school renewal and improvements" (p. 2). Through the building leadership team, the principal was no longer the sole voice, but the guiding voice of instructional leadership in a school.

While a distributed leadership model can be an effective form of leadership, ultimately the onus of student success still falls on the shoulders of the building leader. Federal legislation, such as the No Child Left Behind Act (NCLB) and Every Student Succeeds Act (ESSA) have altered the amount of focus on school leaders and how their time is spent, with more time being spent on ensuring academic achievement. Research continues to show a relationship between effective instructional leadership and academic achievement, further reflecting the importance of the principal's role as instructional leader (Horng et al., 2009; Robinson, 2011). Horng et al. (2010) observed 65 principals from elementary, middle, and high school backgrounds to determine how much time was spent on instructional tasks. They shadowed each of the principals for a full day, recording how they spent their time on school-related tasks each day. The researchers found that principals spent on average, six

percent of their time on instructional tasks. Lavigne et al. (2016) surveyed the weekly amount of time principals spent on instruction. Surveys questioned how much time was spent on different job-related tasks each day. The authors received 5,950 responses and discovered that an average secondary school principal spends roughly 59 total hours on the job each week. Of those 59 hours, 27% of that time is spent on instructional-related tasks. While these are two different studies looking at two different populations using two different methods, the difference in the numbers illustrates the change in expectations for an instructional leader and how those expectations are continuing to evolve.

Roles of the Instructional Leader

As the expectations of school administrators have progressed over time, so too has the role of instructional leader. Before the onset of the Effective Schools Movement, the building principal was seen as the manager of the building whose primary responsibility was to supervise the professionals in the school (Beck & Murphy, 1993). During this time, principals were still responsible for the instructional program provided in their school, although it was not always emphasized as much as other duties (Beck & Murphy, 1993). As research began to show the importance of strong instructional leadership, the emphasis on this role of the principal increased. The instructional leader was now focused on improving teaching and ensuring learning was taking place (Leithwood et al., 2008). With this renewed focus on teaching and learning, the duties of an instructional leader became more defined. Professional development, supervision, and developing a culture of learning have been identified as the core responsibilities of an instructional leader (DiPaola & Hoy, 2014). Through the evolving expectations of the instructional leadership role, principals have become more attentive to the quality of instruction provided to aid in student learning.

Professional Development

Professional development is considered all of the learning experiences that a teacher encounters, formally or informally, throughout their entire teaching career (Fullan, 2016). Professional development can take place in many different settings and forms, such as teacher-administrator conferences, inner-staff work sessions, collaboration opportunities, book studies, and outside seminars and conferences (DiPaola & Hoy, 2014). Regardless of the setting or activity, the goal of professional development is to increase student learning and ensure the goals of the school and the district are met (Whalan, 2012). While there is not a singular, specific professional development approach that past literature points to as most effective, there are generally two broad categories of professional development that have shown to alter teacher practice and improve instruction. Content-specific professional development that is focused on teachers gaining subject matter knowledge has been found as an effective approach for teachers to gain more comfort over content and to improve student achievement (Darling-Hammond et al, 2017; Desimone, 2011; Martin et al, 2018; Roth et al, 2019). Pedagogy-focused professional development, which is centered on improvement of teaching methods, has also led to positive outcomes for both teachers and students (Danielson, 2014; Gore & Rosser, 2022). By understanding the various types of effective professional development and fostering opportunities for teachers to engage in learning these methods, instructional leaders can positively impact student learning.

While it is important for an instructional leader to consider the content of professional development, they must also find meaningful ways to structure professional development in order to maximize its effectiveness. In order for the professional development to be effective, it must contain several common characteristics. Professional learning opportunities that have

drawn on Knowles's (1984) ideas of adult learning theory have traditionally been successful. Knowles (1984) provided four principles of adult learning: 1) Adults need to be involved in the planning and the evaluation of their instruction, 2) Adults want immediate relevancy in their learning, 3) Adult learning is centered on problems rather than content, and 4) Experience provides for effective learning opportunities. In addition to the ideas of adult learning theory, other researchers have noted effective components of professional learning. Zepeda (2013) found that effective professional development must be relevant and goal oriented. The professional development opportunity must be ongoing, and the organizer must avoid making it a one-time experience for the learner (Guskey, 2009). Additionally, effective professional development must be collaborative in nature (Gore & Rosser, 2022). Considering the findings in this field of research, the role of the instructional leader and how they develop professional learning opportunities is crucial to the growth of educators.

In a study conducted by Gore et al (2017), a professional development approach that highlighted the characteristics of adult learning theory and effective professional learning research was shown to have a positive impact on teacher learning. The approach was referred to as Quality Teacher Rounds (QTR) and focused on pedagogy through an ongoing process that allowed regular collaboration between different groups of teachers. The QTR process called for "rounds", which would all be completed in sequential order by a collaborative group in one day. The rounds included the following activities: 1) reading discussion, 2) classroom observation of a group member, and 3) coding and discussion (Gore et al, 2017). The researchers had eight teachers in 24 different schools participate in this process for a 12-month period. Through the study, the researchers found this approach to have a significant impact on teaching quality, which was observed at both the 6-month and 12-month periods of

the study (Gore et al, 2017). This research helps show that by incorporating characteristics of adult learning theory and effective professional learning research, an instructional leader has the ability to develop a professional development program that helps foster teacher growth.

Akiba and Liang (2016) obtain similar outcomes in their investigation of the impact of research-based and teacher-centered collaborative learning activities on student achievement. The researchers tracked three years of survey data from 467 middle school mathematics teachers in 91 Missouri schools to determine type and frequency of professional development activities. This information was compared to student achievement scores, as measured by the Missouri Assessment Program (MAP) in the area of mathematics. The researchers concluded that teachers participating in research-based and teacher-centered collaborative learning activities were more likely to see an increase in student achievement (Akiba & Liang, 2016). This study, once again, illustrates the positive impact professional development can have if structured and implemented correctly.

Supervision

The role of instructional leader has an impact on students in a primarily indirect fashion. The leader is typically not responsible for the development or implementation of daily lesson plans. However, the instructional leader does work to ensure that teacher performance is maximized and that schools provide a high-quality education (Gawlik, 2015; Goldring et al., 2018). Since an instructional leader is not in the classroom implementing sound educational strategies on a micro level, they must instead ensure quality teaching through the use of effective supervision strategies.

In order to determine which professional development activities would be most valuable to teachers, school leaders must be aware of their staff's strengths and weaknesses.

One effective way to observe areas in need of improvement is by spending time in classrooms as a supervisor. Marshall (2009) noted that the most valuable time an administrator can spend is in the classroom observing teachers and students. The supervision process does not consist solely of visiting classrooms, but also providing feedback and collaboratively working with teachers to improve instruction. DiPaola and Hoy (2014) stated, "instructional supervision is an informal process during which principals and teachers interact in a collegial, professional manner with the expressed goal of improving the quality of classroom instruction and student learning" (p. 81). Marzano et al. (2011) also pointed out that the goal of supervision is to help teachers improve their teaching skills, which in turn helps increase student achievement. The supervisor role is intended to focus on growth and improvement, but often gets confused with the evaluation duties of a school leader. Evaluation is a formal process where the principal makes authoritative decisions that impact working conditions, such as job status, which require little to no collaboration (Saphier, 1993). By utilizing the supervision process, principals proactively avoid addressing instructional issues through the evaluation process (DiPaola & Hoy, 2014). If implemented correctly, proper supervision can help teachers identify problems with instruction and develop a plan of action to address those issues, leading to improved student performance.

While instructional supervision is viewed as an informal process, there are still consistent structural characteristics evident in effective practice. The relationship and communication between instructional leader and teacher are significant factors to the success of the supervision process. During this process, a collaborative relationship develops that places the principal in a support role, which in turn, creates a relationship that is less hierarchical and more horizontal in nature (Gall & Atcheson, 2011). Through this

relationship, the principal and teacher develop a shared vision of what teaching and learning looks like (Glickman et al., 2013). They identify areas of concern, discuss strategies to address the concerns, and develop and implement a plan that ultimately improves the areas of concern (Aseltine et al., 2006). If the teacher feels like the instructional leader is acting in an authoritative manner instead of as a supporter, it can lead to distrust and eventually disrupt the process of teacher improvement (DiPaola & Hoy, 2014). The ability of an instructional leader to develop and maintain a strong relationship and communication practices with their teachers will ultimately determine the success of their supervisory practices.

Supervision that draws from effective instructional leadership characteristics has been found to make a significant impact on student achievement. Hoppey and McLeskey (2013) incorporated a case study approach of a Florida elementary principal through phenomenological interviews, participant observations, and dialogical or informal conversational interviews to determine his perspective of effectiveness in "today's era of high-stakes accountability." (p. 247). The school had a population of 460 students with a 54% free and reduced lunch rate and 18% of the students were identified as having a disability (learning, speech, behavior, or health). However, the school scored significantly higher than similar schools in the state and the district in reading and math proficiency with a similar demographic makeup. Three characteristics of his leadership style described how he facilitated the development of a supportive and caring school community. The researchers noted his attention and focus on teacher growth, the personal relationships he developed with staff members, and the level of trust between himself and the teachers as factors for the high level of student success (Hoppey & McLeskey, 2013). This study helps demonstrate that

effective instructional leadership practices can lead to increased student achievement and an effective school culture.

Culture

While professional development and supervision are both important aspects of instructional leadership, neither can be effective without the culture to support their presence. Bozkurt et al (2021) summarized school culture as a mixture of the norms, values, beliefs, rituals, ceremonies, and stories that inform and dictate the behaviors of the collective members of a school building. All of these factors that influence school culture also define the morality and normalcy of the school (Gruenert & Whitaker, 2015). Given the influence of culture on the day-to-day operations of a school, natural barriers often stand in the way of schools accepting or embracing growth. The instructional leader is in one of the most natural positions to mold and shape the culture of a school. Their approach will help determine whether or not change and growth is accepted or challenged by the members of the school community (Gruenert & Whitaker, 2015). Choosing which aspects of a school culture to challenge or change can be one of the most difficult and demanding tasks for a school leader (Barth, 2013). It cannot be changed by one teacher or individual at a time; instead, the whole staff must be open and willing to invite a new organizational direction (Fullan, 2016). Given the embedded nature of school culture, a staff that does not value growth and improvement can make it more difficult for an instructional leader to inspire change.

To help aid in the school improvement process, the instructional leader must work on developing a culture of growth and learning. School culture is seen as an important factor to student success. Lunenburg (2010) noted that the most critical role an instructional leader plays is shifting a school's culture to focus on learning rather than teaching. He stated, "the

focus on results; the focus on student achievement; the focus on students learning at high levels, can only happen if teaching and learning become the central focus of the school and the central focus of the principal" (Lunenburg, 2010, p. 1). DiPaola and Hoy (2014) maintain by creating an autonomous environment where risk and innovation are recognized, the staff becomes more open to professional development opportunities that are focused on self-reflection and growth, encouraged by an instructional leader that values an environment conducive to growth and learning to improve achievement. Further, DiPaola and Hoy (2014) suggested this culture shift can take place with the proper approach by the instructional leader. They must value trust, openness, and embrace innovation through mistakes.

Past studies have shown that school culture, and the actions of the instructional leader that impact culture, can influence student achievement. Bozkurt et al (2021) researched the relationship between school culture and academic achievement through the lens of collective efficacy among teachers. This specific study involved 194 teachers and 948 students across 30 schools in Turkey. The researchers measured teacher efficacy using the Collective Teacher Efficacy Scale (CTS). Additionally, the researchers measured the culture of the school using the Organizational Culture Scale (OCS) and instructional leadership using the Instructional Leadership Scale (ILS). The study found that teachers' perception of collective efficacy was related to academic achievement among students. Additionally, they found that teachers' perceptions of the instructional leader and the organizational culture had a significant impact on the collective efficacy of the teachers (Bozkurt et al., 2021). These findings not only link instructional leadership and school culture together, but also their relationship to student achievement.

MacNeil et al (2009) also studied the relationship between school culture and academic achievement. The researchers examined at the standardized test results of 29 Texas schools from the Texas Assessment of Academic Skills (TAAS). The results of this assessment were compared to the results of the Organizational Health Instrument (OHI) to see if there was a relationship between the culture of the organization and the academic performance. Schools in the study were placed into one of three categories based on the results of the TAAS: Exemplary, Recognized, or Acceptable. Schools categorized as Exemplary performed the best on the TAAS, with those that performed Recognized below Exemplary, and Acceptable schools had the lowest performance of the three. When test scores were compared to the school's OHI results, it was determined that schools performing in the Exemplary category also had the highest results on the OHI (MacNeil et al., 2009). This research helps further the claim that instructional leaders can either enhance or diminish student learning through the cultivation of school culture.

To assure the academic success of all students, an instructional leader is also responsible for cultivating a building culture that is culturally responsive and can meet the varied needs of all students. Given the role that building leaders play in promoting and nurturing practices within a school, their ability to understand and provide awareness of the diverse needs of learners will directly impact the ability of the staff to effectively incorporate culturally responsive strategies (Khalifa, 2018; Brown et al, 2019). Esteban-Guitart and Moll (2014) described the concept of culturally responsive learning through the idea of funds of knowledge. Funds of knowledge is the understanding that families and students have deeply rooted life and cultural experiences that influence their worldview, social norms, and knowledge base. Students are informed of the world through their funds of knowledge, and

they help dictate how a student functions in the school setting (Esteban-Guitart & Moll, 2014). Szech (2021) highlighted how an inadequate understanding of funds of knowledge can impact a teachers' view of family involvement. Szech questioned nine elementary teachers with varying levels of experience about family involvement with the school. In the initial questioning, the researcher found that many of their views towards family involvement reinforced middle-class norms. After completing a course on family literacy, which focused on funds of knowledge, not only did the teachers' perceptions of family involvement evolve, but they were also able to incorporate more opportunities for culturally sustaining practices (Szech, 2021). This research shows that a change in culturally responsive practices is possible, especially when given the opportunity and knowledge to do so by an instructional leader. With direct and indirect influence over the culture of the building, the instructional leader will make decisions that help ensure the success of all students, regardless of any identifying factors. As such, providing leadership relative to one-to-one device initiatives aids the integration of technology within the culture of schools and classroom.

Instructional Leadership and One-to-One Device Initiatives

When implementing a one-to-one laptop initiative, the availability of quality professional development to teachers and administrators has proven to be one of the most significant factors to success (The Abell Foundation, 2008; Parr & Ward, 2011; Zheng et al., 2016). Research has shown that exposure to technology-related professional development is directly linked to a teacher's effective use of technology in the classroom (Kim et al., 2017; Bowman et al., 2022). By avoiding this step, instructional leaders are increasing the likelihood that a one-to-one device initiative will be unsuccessful in improving student achievement or helping students improve technology-related skills. Simply providing laptops

to students has not been enough to improve student learning as previous studies have showed that providing a laptop to students with no support can either have minimal or no positive impact on student achievement (Bryan, 2011; Fairlie & Robinson, 2013; Escueta et al., 2020). Given the importance of professional development to a teacher's effective implementation of technology in the classroom, as well as its importance to the students' ultimate use of technology in the classroom, the instructional leader plays a vital role in the one-to-one device initiative.

Teachers' perceptions of a one-to-one laptop initiative play a significant role in the success of the program. Studies have shown that many teachers have initial concerns about a one-to-one laptop environment, which come from a variance of their own pedagogical beliefs (Er & Kim, 2017; Teo et al., 2018; Vongulluksn et al., 2018), a lack of professional development and support (Bowman et al., 2020; Francom et al., 2021; Samatova, 2019), and concern for the amount of time and effort it will take to fully integrate technology in the classroom (Cheng et al., 2020). In order for these concerns to be addressed, it is crucial for district and school leadership to train teachers on the most effective ways to incorporate technology in their classrooms (Thannimalai & Raman, 2018). Additionally, it is the instructional leader's role to ensure the professional development is ongoing and that it becomes an essential part of day-to-day communication for teachers (Boardman, 2012; Jones, 2013; Plummer, 2012). When leaders are unable to provide ongoing or effective professional development, the one-to-one initiative can have a negative effect on student learning (Corn et al., 2012; Shapley et al., 2011). As instructional leaders are ultimately responsible for the overall culture and professional development direction of the building,

this research highlights the importance of addressing both effectively in a one-to-one device initiative.

In 2011, Shapley, et al. implemented an in-depth study of Texas' Technology Immersion model with "high need" middle school students and their teachers provided one-to-one laptop technology to be used in the classroom. The program, funded by the state, provided laptops to 7,718 students in 21 school districts. As each school was evaluated, the researchers looked at the level of "technology immersion", or how seamlessly both teachers and students were using the laptops in the classroom. Some schools were able to transform their classrooms with the use of the technology, while others simply dissolved and quit utilizing the laptops. For the schools that became fully immersed in the program, professional development was a major factor. Teachers that made the greatest progress in the program participated in high-quality sustained professional development through the life of the initiative, while schools that did not provide ongoing professional development saw no improvement in student learning (Shapley et al., 2011). This study provides evidence of the importance a strong professional development plan plays in the eventual success or failure of a one-to-one device initiative.

While reviewing past research over the subject, it becomes apparent that instructional leadership is a key component to the outcome of one-to-one device initiatives (Danielson, 2009; Jones, 2013, Parr & Ward, 2011; Shapley et al., 2011). DiPaola and Hoy (2014) noted that three of the core responsibilities of an instructional leader are development of a professional development program, supervision of teachers, and promoting a culture of learning. Developing and maintaining a plan that allows teachers the opportunity to better learn how to effectively integrate and use technology in the classroom is a key piece to the

success of a one-to-one device initiative (Abell Foundation, 2008; Parr & Ward, 2011; Shapley et al, 2011; Zheng et al., 2016). The instructional leader can also help promote the success of a one-to-one device initiative by cultivating a positive culture that encourages technology usage, which has been found to help past initiatives (Botha & Herselman, 2015; Rehmat & Bailey, 2014). Additionally, supervising teachers and responding to their individual development needs helps to provide the ongoing and effective professional development that is so crucial to a one-to-one device initiative (Boardman, 2012; Jones, 2013; Plummer, 2012). As a result of past research regarding one-to-one device initiatives and factors that are influenced by instructional leadership roles, it stands to reason that effective instructional leadership can potentially play a significant role in the achievement of students in a one-to-one device initiative.

This literature review is intended to inform readers of the larger context surrounding the issue of one-to-one device initiatives and their impact on student achievement. There are many components of one-to-one device initiatives which ultimately influence how they are implemented. Whether it be past successes or failures, pedagogical influences, one-to-one initiatives they can have powerful impact in the lives of students from all backgrounds. The role of leaders in the process and information from previous research can help inform future practices. Understanding the full context of a one-to-one device program can ultimately ensure their success or lead to their failure. It is important for school leaders to consider all of the necessary factors before implementing a one-to-one device initiative in any educational environment.

The purpose of this study is to explore the effectiveness of one-to-one device initiatives for improving academic achievement in the areas of math and English language

arts at the high school level. Given the limited empirical evidence supporting the outcome of these initiatives at the high school level, this proposed study will help provide evidence of the impact one-to-one device initiatives may have on academic achievement among high school students with attention to the availability of technological resources for students from low-income backgrounds and the effects on their learning. The next section delineates the methodology to address this issue for Missouri districts and schools. The findings can have implications for the decision making of high school administrators and teachers as they pursue the implementation of one-to-one devices.

CHAPTER 3

METHODOLOGY

With achievement levels at current rates, many researchers and experts agree that change is necessary in schools throughout the United States (Best & Dunlap, 2014; Istance & Paniagua, 2019; Maier et al., 2017). The implementation of federal accountability measures for schools has not only highlighted the need for more equitable access to high quality education, but also access to resources that are beneficial to academic success. While there is debate about which resources would be most beneficial to improve academic achievement, an increase in technology-related spending in K-12 institutions has signaled that schools view technology as a potential solution. Despite the increase in spending, there is no conclusive evidence that an increase in devices at the high school level will improve academic achievement (Zheng et al., 2016). With the goal of adding to the literature over this topic and providing more conclusive evidence on the issue, this study aimed to determine whether one-to-one device initiatives increase achievement at the high school level in the subject areas of math and English language arts and whether they have an impact on students from low-income families.

This quantitative study examined whether one-to-one device initiatives have an impact on student achievement in a high school environment in the subject areas of math and English language arts by providing answers to the following research questions:

1.) Do Missouri high schools demonstrate higher levels of academic achievement in the area of math after implementing a one-to-one device initiative? Are the levels of academic achievement different in the Free and Reduced Lunch population?

2.) Do Missouri high schools demonstrate higher levels of academic achievement in the area of English language arts after implementing a one-to-one device initiative? Are the levels of academic achievement different in the Free and Reduced Lunch population?

This chapter will include an explanation of the methodology for this research study. This includes an overview of the participants and the selection process of these individuals. It will then focus on the design of the study by sharing the tools and procedures used to collect and analyze data, and the process for carrying out the study. In this chapter, I will also address the validity of the study and steps that have been taken to insure the credibility of the research. Lastly, I will address steps taken to ensure that the study was designed in a way that is ethical to all involved.

Research Design

This quantitative study had a non-experimental design focusing on ex post facto analysis of archival data. There was no random assignment of treatments, which makes this study non-experimental. The study is designated as ex post facto due to the data's origin from previous school years.

This study is classified as a quantitative study given the focus on change in achievement rates after introduction of a one-to-one device initiative. Involvement in a one-to-one device initiative was the independent variable in this study. The independent variable is the factor being introduced to all of the participants. Prior to the years included in this study, none of the schools participated in a one-to-one device initiative. The dependent variable in this study was achievement rates in the areas of math and English language arts as measured on the Missouri EOC exams.

Participants

All schools utilized in this study are located in the state of Missouri. Missouri was selected due to its proximity to the researcher, as well as the widespread availability of state-wide assessment results. In order to be considered for this study, schools will have initiated a one-to-one device program at the high school level no later than the beginning of the 2017-18 school year. For purposes of this study, a one-to-one device initiative is considered a situation in which a student has been provided constant access to an individual technological device and Internet access while at school (Penuel, 2006). Additionally, schools selected for this study will have implemented a one-to-one device program no earlier than the 2010-11 school year. This time frame ensured that data was available from three years pre- and post-implementation of the one-to-one device initiative. It is determined that through this process, a total of 30 schools were selected for the study.

A stratified random sampling was utilized in this study in order to ensure that a geographical mix within the state is represented. Stratified random sampling is a sampling approach that allows a researcher to separate a target population into smaller, segmented populations, which a random sampling is then selected from (Iliyasu & Etikan, 2021). In this particular research design, the target population was originally identified as all school buildings within the state of Missouri that house students between ninth grade and twelfth grade. From this target population, all schools that implemented a one-to-one device initiative no earlier than the 2010-11 school year and no later than the 2017-18 school year were segmented from the larger population. Schools from this segmented list were then chosen through a random selection process based on geographic location.

To ensure that there would be geographical representation in the study of the whole state, Missouri Department of Elementary and Secondary Education (DESE) supervisory regions were utilized when developing a sample. A list of all schools that house students from ninth to twelfth grade was downloaded from the DESE website. On this list, each school in the state of Missouri was also identified by their supervisory region. The names of all schools and their supervisory region were then placed in a spreadsheet and assigned a number between 1 and 499. A randomized number generator was then developed using a Microsoft Excel function. As the number generator provided a number, it was cross referenced with the corresponding row on the spreadsheet. Each selection of a school resulted in a follow up search of the school's website for information regarding a one-to-one device initiative. If no evidence existed of a one-to-one device initiative on the school website, a phone call was made to determine the current device to student ratio. This was followed up with questions about the year of implementation and type of device used. This process was repeated until 30 different school buildings met the criteria. Table 3.1 displays the breakdown of schools involved in this study by geographical region and implementation year. Regions B, C, D, and G are represented by four schools, Regions A and H are represented by three schools, and Regions E, F, and I are all represented by two schools. The majority of schools in the study implemented their device initiative during the 2016-17 school year, as eight schools fell into that category. Seven schools implemented their initiative in 2012-13 as well as 2015-16. Five began implementation in 2013-14, two began in 2017-18, and one implemented their initiative in the 2014-15 school year.

Table 3.1

One-to-One Device Implementation by Year and DESE Region

Year of Implementation	DESE Supervisory Region									Total Number of Schools
	A	B	C	D	E	F	G	H	I	
2010-11	0	0	0	0	0	0	0	0	0	0
2011-12	0	0	0	0	0	0	0	0	0	0
2012-13	0	1	2	0	0	1	0	1	1	7
2013-14	0	0	0	0	2	0	2	1	0	5
2014-15	0	1	0	0	0	0	0	0	0	1
2015-16	2	1	1	1	0	0	1	1	0	7
2016-17	1	1	1	2	0	1	1	0	0	8
2017-18	0	0	0	1	0	0	0	0	1	2
Total Schools	3	4	4	4	2	2	4	3	2	30

Measures

To measure academic achievement amongst students and across school districts, the results from Missouri End of Course (EOC) exams were utilized. In the subject of math, scores from the Algebra I EOC were used, while data from the English II EOC were used to measure academic achievement in the subject area of English language arts. All EOC data was accessed through a search conducted on the Missouri Department of Elementary and Secondary Education (DESE) web portal. This web portal contains information from state tests that were conducted between the 2008-09 and 2018-19 school years. Students that attempt EOC exams are provided both a scaled score and an achievement level to help illustrate how they performed on the assessment (DESE, 2018). Both of these data points could be used to determine the level of academic performance by students within a school district.

DESE (2018) has identified four achievement levels on EOC exams: advanced, proficient, basic, and below basic. Earning achievement levels of advanced and proficient are

considered acceptable, as evidenced by their inclusion in DESE's Annual Performance Report that is provided each year to Missouri school districts. With this in mind, the percentage of students scoring advanced or proficient levels on the Algebra I and English II EOC exams will be a strong measure of academic achievement in schools.

The DESE web portal also contains information regarding student achievement within different subgroups. The percentage of students that scored advanced or proficient, which also qualify for the free and reduced lunch program is provided on the web portal. This information was used as a measure for academic achievement amongst students that qualify for the free and reduced lunch program.

Reliability and Validity of Measures

Each year, DESE is required to ensure that all of its testing instruments are both reliable and valid as a measure of student performance (DESE, 2021). The reliability of a testing instrument refers to its ability to repeat the same results while reducing the possibility of random error. The reliability of both the English II EOC and Algebra I EOC were reported with a Cronbach's alpha value. The reliability score of the English II EOC in the Spring of 2021 was 0.87 and the reliability score of the Algebra I EOC in the Spring of 2021 was 0.88. A Cronbach's alpha value higher than .80 provides solid evidence of reliability, which means both of these testing instruments would be considered highly reliable (Cortina, 1993).

In addition to consistency, any form of measurement must also be valid. Validity can be measured in many different ways, with two common forms as convergent and divergent validity. According to DESE (2021), "convergent validity examines the extent to which theoretically related constructs are empirically related, whereas divergent validity examines the extent to which theoretically unrelated constructs are empirically unrelated" (p. 83). In a

technical report presented to Missouri DESE (2021), it was noted that the validity of the EOC exams was tested in a variety of ways. This included the validity of tests across content areas, as well as the cut scores used to determine different achievement levels for students. All of the exams were found to be sufficiently valid in all areas (DESE, 2021).

Analysis

The study was seeking to determine the impact of a one-to-one device initiative on the academic achievement of high school students in the areas of English language arts and math. In order to determine the effectiveness of the treatment, previous Algebra I and English II EOC data from the state of Missouri was examined. A paired samples t-test was used to analyze the impact of the one-to-one device initiative on student achievement in the selected schools.

Paired Samples t-Test

To determine the impact of a one-to-one device initiative on the school, a paired samples t-test was utilized for statistical analysis in this study. A paired samples t-test is commonly used when data values are paired measurements (Peck et al., 2020). A t-test specifically compares two means to determine whether or not there is a statistically significant difference between the two. This is an especially helpful statistical analysis for certain circumstances, such as a before and comparison. In this specific study, I looked at the impact of the device initiative on the school's standardized test results before and after the implementation of the treatment.

With this particular study and in this analysis, the schools were used as the unit of analysis. Using the school as the unit of analysis allowed me to consider the impact of the independent variable over time on the school, as opposed to its impact on individual students.

Given the random sampling of schools and the use of the school as the unit of analysis, the results could be generalized to all school populations.

Before running a paired samples t-test, data from the 30 schools needed to be aggregated for the pre-implementation and post-implementation means to be compared. All the achievement data were organized, then placed into SPSS. The software calculated the percentage of students that scored proficient or advanced on the EOC exams each year as well as a mean for pre-implementation and post-implementation. Additionally, the standard deviation and standard error mean of the sample were calculated. This process prepared the data for a paired samples t-test to be conducted.

Hypotheses

Research Question 1

Do Missouri high schools demonstrate higher levels of academic achievement in the area of math after implementing a one-to-one device initiative? Are the levels of academic achievement different in the Free and Reduced Lunch population?

Hypothesis 1. There will be no significant difference in math achievement scores, as measured by the Algebra I EOC exam, in schools after implementation of a one-to-one device initiative.

Rationale. While there is a gap in current research regarding the effectiveness of one-to-one device initiatives in a high school setting, inferences can be made when considering related studies. Silvernail and Gritter (2008) conducted a study on the most ubiquitous one-to-one device initiative conducted to this point. In this study, math was found as the area of lowest academic achievement among all subjects. Grady et al. (2012) reported that the constructivist learning approach was not an effective approach to improving math achievement. Some

research suggests that one-to-one device initiatives and a constructivist learning approach have been successful in improving achievement in students from a low-income background (Brown, 2018; Olszewski-Kubilius et al., 2017), but it is posited that some growth in these situations is more related to the instructional strategies used, as opposed to the access to technology (Jones, 2013, Parr & Ward, 2011; Shapley et al., 2011). Given the relative lack of positive track record in previous research, it does not seem likely that students will benefit in the area of math from exposure in a one-to-one device environment.

Research Question 2

Do Missouri high schools demonstrate higher levels of academic achievement in the area of English language arts after implementing a one-to-one device initiative? Are the levels of academic achievement different in the Free and Reduced Lunch population?

Hypothesis 2. There will be a significant difference in English language arts achievement scores, as measured by the English II EOC exam, in schools after implementation of a one-to-one device initiative.

Rationale. Just as with math, past research and a careful consideration of skills assessed can inform the hypothesis to this research question. On the English II EOC exam, the state of Missouri is focused on assessing knowledge and proficiency in the following areas: (a) Reading literary texts; (b) Reading informational Texts; (c) Writing. Research in the areas of constructivist learning and past one-to-one device initiatives show that growth is evident in these areas when one or both approaches are utilized. Rosen & Beck-Hill (2012) reported that students receiving constructivist-based instruction while taking part in a one-to-one device initiative saw significantly more improvement in reading scores than peers in a traditional classroom setting. Zulela & Rachmadtullah (2019) noted similar improvements in

the area of writing. Several other studies conducted on one-to-one devices initiatives have shown that students have either resulted in improved academic achievement as measured by a standardized test (Bebell & Kay, 2010; Greaves et al., 2012; Silvernail & Gritter, 2008) or in an assessment of skill (Kposowa & Valdez, 2013; Zheng et al., 2013). Given the transfer of skill between general computer use and the English language arts learning standards, as well as the consideration of past research results, it is plausible that a one-to-one device initiative will lead to an increase in academic achievement in this subject area.

Limitations

In the 2016-17 school year, DESE administered statewide assessments in both English language arts and math, but the results contained statewide irregularities. Due to the concerns in reliability, scores were not reported as a part of school districts' APR scores (Wilson, 2017). By not having these scores publicly available, there is one year of missing data from multiple schools included in the study. In these situations, the study will only include two years of post-treatment data, as opposed to three years.

The data utilized in this study all originated from pre-COVID learning environments. All participants included in the study were required to have three years of implementation before the 2019-20 school year. Data became significantly more challenging to gather in the wake of COVID-19 related school shutdowns. There was no 2019-20 statewide testing, and only recently have APR scores started to be tabulated for the most recent Missouri School Improvement (MSIP) cycle. This created challenges and limitations, due to number of schools eligible to be included in the study. In research, many schools have moved to a one-to-one device environment since the onset of the pandemic, but there is simply not enough available data yet to include them in the study. Additionally, those data are potentially

skewed by the mode of instruction utilized, as several school districts either offered or required fully online and hybrid learning options for students in the immediate aftermath of schools shutting down due to the pandemic.

Ethical Considerations

This study does not classify as human subjects research and is also non-experimental. No individual identities were utilized in the study, so no information needed to be de-identified. Since most of the data being used are archival in nature, there will be minimal opportunity to handle information in an unethical manner. Additionally, the names of schools being utilized are being withheld. They will all be identified by their DESE supervisory area and a corresponding number.

CHAPTER 4

RESULTS

The purpose of this study was to determine whether the implementation of a one-to-one device initiative at the high school level had a significant impact on academic achievement in the areas of math and English language arts. Additionally, a focus of this study was to determine whether there was a significant impact on academic achievement in students that are identified as free and reduced lunch status. End of Course (EOC) exam results in Algebra I and English II from three years pre-implementation and three years post-implementation were analyzed to determine whether any significant difference was present. Given the increasing amounts of money being spent by schools on ubiquitous technology, it is important to understand whether these initiatives are improving the academic outcomes for students.

As discussed in Chapter 3, two hypotheses were tested in this study. Each of the research questions and hypotheses was chosen to determine whether significant changes in academic achievement were present after the treatment was introduced. In this specific circumstance, the treatment was the implementation of a one-to-one device initiative. With each hypothesis test, academic achievement was measured by performance on a state-wide standardized test. The hypotheses are as follows:

- *Hypothesis 1*. There will be no significant difference in math achievement scores, as measured by the Algebra I EOC exam, in schools after implementation of a one-to-one device initiative.

- *Hypothesis 2*. There will be a significant difference in English language arts achievement scores, as measured by the English II EOC exam, in schools after implementation of a one-to-one device initiative.

In Chapter 3, the statistical analysis used to test the hypotheses is described. The results of the statistical analysis and a summary of those results will be presented in the following sections.

Description of the Sample

As discussed in Chapter 3, 30 schools were randomly identified to be included in this study. All schools included in the study were required to implement a one-to-one device program prior to the 2010-11 school year, and no later than the 2017-18 school year. This study is identified as quasi-experimental due to the data being publicly available and historic in nature. Results from the corresponding years in Algebra I and English II EOC exams were compiled and used to provide a descriptive analysis between academic achievement and the implementation of a one-to-one device initiative. In addition to the scores of all students, the scores of students identified as free and reduced lunch status were also collected and analyzed. The results of students scoring proficient or advanced on each exam can be found in Appendices A through D.

To test the hypotheses, paired samples t-test were utilized. A paired samples t-test helps determine whether statistically significant differences is present between two means. To initiate this analysis, data had to be organized into eight different groups: 1) The scores of all students that completed the Algebra I EOC pre-implementation, 2) The scores of all students that completed the Algebra I EOC post-implementation, 3) The scores of students identified as free and reduced lunch status on the Algebra I EOC pre-implementation, 4) The

scores of students identified as free and reduced lunch status on the Algebra I EOC post-implementation, 5) The scores of all students that completed the English II EOC pre-implementation, 6) The scores of all students that completed the English II EOC post-implementation, 7) The scores of students identified as free and reduced lunch status on the English II EOC pre-implementation, and 8) The scores of students identified as free and reduced lunch status on the English II EOC post-implementation. After the data were compiled and sorted by year, student population, and test type, the information necessary to test the hypotheses was ready.

Research Question One

Research Question One is focused on academic achievement in math after the implementation of a one-to-one device initiative. To begin this process, the data from pre-implementation and post-implementation were aggregated, so that a paired sample t-test could be run later. This included determining what percentage of students scored 'proficient' or 'advanced' on the Algebra I EOC. After this information was identified, I was able to calculate the aggregated mean, standard deviation, and standard error mean of each sample.

Once aggregated, the mean of students scoring proficient or advanced on the Algebra I EOC pre-implementation was .4809 or 48.09%. The standard deviation in this sample was .16267 and the standard error mean was .03021. The mean of students identified as free and reduced lunch status and scoring proficient or advanced on the Algebra I EOC was .4012 or 40.12%. The standard deviation of this sample was .15139 and the standard error mean was .02913. The data shown in Table 4.1 represents the percentage of students that scored proficient or advanced on the Algebra 1 EOC.

Table 4.1

Aggregated Data on Algebra I EOC Exams Pre-Implementation

Group	Mean	Std. Deviation	Std. Error Mean
All Students	.4809	.16267	.03021
Free and Reduced Lunch Status	.4012	.15139	.02913

The mean of students scoring proficient or advanced post one-to-one device implementation was .4236 or 42.36%. The standard deviation of this sample was .14839 and the standard error mean was .02756. The mean of students represented in the sample that were identified as free and reduced lunch status, and scored proficient or advanced was .3593 or 35.93%. The standard deviation of this sample was .12903 and the standard error mean was .02483. Table 4.2 represents Algebra I EOC performance post-implementation of a one-to-one device initiative.

Table 4.2

Aggregated Data on Algebra I EOC Exams Post-Implementation

Group	Mean	Std. Deviation	Std. Error Mean
All Students	.4236	.14839	.02756
Free and Reduced Lunch Status	.3593	.12903	.02483

Hypothesis Testing

In hypothesis 1, the aggregated data from all students taking the Algebra I EOC and students that are specifically identified as free and reduced lunch status taking the Algebra I EOC were analyzed to determine whether a significant difference was observed post-implementation of a one-to-one device program. The hypothesis is as follows:

Hypothesis 1. There will be no significant difference in math achievement scores, as measured by the Algebra I EOC exam, in schools after implementation of a one-to-one device initiative.

Schools participating in a one-to-one device initiative exhibited a decrease in the mean number of students scoring proficient or advanced on the Algebra I EOC. Pre-implementation, 48.09% of students scored proficient or advanced, while the number decreased to 42.36% post-implementation for an average decrease of 5.73%. The two-sided p-value of .070 suggests that the mean differences observed in this study are not statistically significant at the alpha level of .05. Further, Cohen's d was calculated using a Hedges' correction factor. When there is a relatively small sample size, a correction factor can be used to help adjust for bias (Hedges, 1981). In this instance, Hedges' g indicates a small to medium effect size of the independent variable (one-to-one device initiative) on the dependent variable (Algebra I EOC score). These data are shown in Table 4.3.

Table 4.3

Paired Samples t-Test Results for All Students Taking the Algebra I EOC

All Students Paired Samples Test (n = 29)				
Paired Differences				
Mean	Std. Dev.	SE	t	p
.0573	.1636	.0304	1.884	.070
Hedges' g: .340				

Similar results were found in students that were identified as free and reduced lunch status. Schools participating in one-to-one device initiatives experienced an average 4.19% decrease in scores post-implementation in the free and reduced lunch student population. The two-sided p-value of .170 suggests that mean differences observed in this study are not statistically significant at the alpha level of .05. A Hedges' g of .264 indicates a small to medium effect size of the independent variable on the dependent variable. Table 4.4 displays

the results of the paired samples t-test for students that are identified as free and reduced lunch on the Algebra I EOC.

Table 4.4

Paired Samples t-Test Results for Free and Reduced Lunch Status Students Taking the Algebra I EOC

Free and Reduced Lunch Status Paired Samples Test (n = 27)				
Paired Differences				
Mean	Std. Dev.	SE	t	p
.0419	.1540	.0296	1.413	.170
Hedges' g: .264				

Hypothesis 1 stated that there would be no significant difference in academic achievement in the area math after a one-to-one device initiative is implemented. Based on the results of both paired samples t-tests, there were no significant differences in performance after the implementation of the one-to-one device initiative. As a result, the hypothesis was supported.

Research Question Two

Research Question Two is focused on academic achievement in English language arts after the implementation of a one-to-one device initiative. Like the results in math, the statistical analysis began with aggregating data related to performance on the English II EOC exam, which would allow for a paired samples t-test to be run. This specifically began with determining the percentage of students that scored either 'proficient' or 'advanced' on the English II EOC. After this information was calculated, I was able to determine the aggregated mean, standard deviation, and standard error mean of each sample.

The mean of students scoring proficient or advanced on the English II EOC was .7371 or 73.71% of students. The standard deviation in this sample was .09041 and the

standard error mean was .01651. The mean of students identified as free and reduced lunch status and scoring proficient or advanced on the English II EOC was .6390 or 63.90%. The standard deviation of this sample was .10312 and the standard error mean was .01915. Table 4.5 represents these data.

Table 4.5

Aggregated Data on English II EOC Exams Pre-Implementation

Group	Mean	Std. Deviation	Std. Error Mean
All Students	.7371	.09041	.01651
Free and Reduced Lunch Status	.6390	.10312	.01915

The mean of students scoring proficient or advanced on the English II EOC was .6629 or 66.29% of students. The standard deviation of this sample was .10581 and the standard error mean was .01932. The mean of students identified as free and reduced lunch status and scoring proficient or advanced on the English II EOC after implementation of the one-to-one device initiative was .5478 or 54.78%. The standard deviation of this sample was .12179 and the standard error mean was .02262. Table 4.6 represents English II EOC performance post-implementation of a one-to-one device initiative.

Table 4.6

Aggregated Data on English II EOC Exams Post-Implementation

Group	Mean	Std. Deviation	Std. Error Mean
All Students	.6629	.10581	.01932
Free and Reduced Lunch Status	.5478	.12179	.02262

Hypothesis Testing

In hypothesis 2, the aggregated data from all students taking the English II EOC and students that are specifically identified as free and reduced lunch status taking the English II

EOC were analyzed to determine whether a significant difference was observed post-implementation of a one-to-one device program. The hypothesis is as follows:

Hypothesis 2. There will be a significant difference in English language arts achievement scores, as measured by the English II EOC exam, in schools after implementation of a one-to-one device initiative.

Schools participating in a one-to-one device initiative exhibited a decrease in the mean number of students scoring proficient or advanced on the English II EOC. Before implementation of a one-to-one device initiative, 73.71% of students scored proficient or advanced on the exam. This number decreased post-implementation by an average of 7.42%, with a total average of 66.29% of students scoring proficient or advanced on the English II EOC. The two-sided p-value of <.001 suggests that the mean differences observed in this study are statistically significant at the alpha level of .05. Cohen's d was calculated using a Hedges' correction factor. In this instance, Hedges' g indicates a medium to large effect size of the independent variable (one-to-one device initiative) on the dependent variable (English II EOC score). These data are represented in Table 4.7.

Table 4.7

Paired Samples t-Test Results for All Students Taking the English II EOC

All Students Paired Samples Test (n = 30)

Paired Differences				
Mean	Std. Dev.	SE	t	p
.07419	.09841	.01797	4.129	*<.001

Hedges' g: .734

Students that were identified as free and reduced lunch status experienced a similar outcome. Schools participating in one-to-one device initiatives experienced an average

9.12% decrease in scores post-implementation in the free and reduced lunch student population. The two-sided p-value of .001 suggests that mean differences observed in this study are statistically significant at the alpha level of .05. A Hedges' g of .664 indicates a medium to large effect size of the independent variable on the dependent variable. Table 4.8 displays the results of the paired samples t-test for students that are identified as free and reduced lunch on the English II EOC.

Table 4.8

Paired Samples t-Test Results for Free and Reduced Lunch Status Students Taking the English II EOC

Free and Reduced Lunch Status Paired Samples Test (n = 29)				
Paired Differences				
Mean	Std. Dev.	SE	t	p
.09124	.13378	.02484	3.673	*.001
Hedges' g: .664				

Hypothesis 2 stated that there would be a significant difference in academic achievement in the area English language arts after a one-to-one device initiative is implemented. Based on the results of both paired sample t-Tests, there were significant differences in performance after the implementation of the one-to-one device initiative. As a result, the hypothesis cannot be rejected.

Conclusions and Summary

The purpose of this study was to determine whether one-to-one device initiatives are effective at improving academic achievement in the areas of math and English language arts. Given noted disparities in access to devices (Lai & Widmar, 2020; Rideout & Katz, 2016; Stelitano et al., 2020) and equitable academic achievement outcomes (Easterbrook & Hadden, 2021; Michelmore & Dynarski, 2017; Reardon, 2013), the achievement level of

students that are identified as free and reduced lunch status was also examined in this study. Chapter 2 provided information on past research regarding one-to-one device initiatives and provided context for the theoretical background of learning in an independent, technology rich environment. Given the nature of increased access to technology and the opportunities it brings to expand learning inside and outside of the classroom, one could assume that increased student achievement is possible. However, the results of this study showed the opposite is likely.

The results of the statistical analyses demonstrated different outcomes for each content area. The statistical analyses showed that one-to-one device initiatives led to an average decrease in the percentage of students scoring proficient or advanced on the Algebra I EOC exam in schools implementing a one-to-one device initiative. While there was an average decrease in the number of students showing proficiency or better on these exams, the disparity was not great enough to be considered statistically significant. Similar results were found in the free and reduced lunch population, as they experienced an average decrease in scores as well, but not great enough to be considered statistically significant. The disparity in scores pre- and post-implementation on the English II EOC was statistically significant enough to determine that one-to-one device initiatives had a negative impact on academic achievement in both the full student population, as well as the free and reduced lunch student population.

In Chapter 5, I will discuss the findings of these results and the implications they hold for high schools. Additionally, this chapter will include limitations for this specific study and recommendations on future research regarding the topic to address potential gaps in the study.

CHAPTER 5

DISCUSSION

Over the past several years, there has been a significant increase in the number of resources allocated in high schools towards the implementation of one-to-one device initiatives. Not only have these programs been initiated with the goal of providing more relevance to learning (Rosen & Beck-Hill, 2012), it is also the hope that equity in access to technological resources will lead to increased achievement (Darling-Hammond et al., 2014). This purpose of this specific study was to determine whether the implementation of a one-to-one device initiative at the high school level achieves the goal of increasing student achievement. Given the widespread concerns about the lack of progress made in the content areas of math and English language arts (NCES, 2019; OCED, 2019), they were the content areas of focus in this study.

There are many reasons to believe that ubiquitous technology access could be an effective solution to improving academic achievement in high school students. First, students at the high school level have grown up in a technology rich world and will continue to matriculate into work environments that require frequent use of technology after they complete their high school education. By creating opportunities for high school students to integrate technology into their learning activities, there is also a greater opportunity for relevance based on potential application both currently and in the future. Next, given the amount of experience on devices students are bringing into schools, it speaks to the potential for constructivist related learning activities to be successful in a one-to-one device environment. Self-directed and project-based learning can be easily facilitated and encouraged through the use of technology, thus promoting higher levels of engagement

traditionally found in constructivist learning environments. Lastly, past research regarding one-to-one device initiatives at the elementary and middle school levels have led to positive achievement outcomes (Clariana, 2009; Dunleavey & Heinecke, 2007; Grimes & Warschauer, 2008; Zheng et al., 2013). The past success of these initiatives at lower grade levels points to the possibility that success could be realized at higher grade levels as well. Despite these considerations, as well as others, the results of this study did not support the belief that one-to-one device initiatives have a positive impact on student achievement.

While the goal of this study was not necessarily to focus on the reasons behind the relative successes or failures of one-to-one device initiatives, the results do provide an opportunity to reflect. Given the statistical significance of the analysis in English language arts and the lack of statistical significance in math, it became clear that past one-to-one device initiatives in and of themselves have not been successful at improving academic achievement as measured by standardized tests. The findings suggest that the devices themselves are not an answer to increasing test scores, and a discussion around the integration of technology and instructional strategies is necessary.

Puentedura (2006) developed one of the most common frameworks for technology integration, known as the Substitution, Augmentation, Modification, and Redefinition (SAMR) Model. This model suggests a framework that might help understand why one-to-one devices were ineffective during this study at improving academic achievement. Many teachers begin at the Substitution level, which simply means that the computer becomes a "substitute" for traditional learning tools, such as pencil, paper, and textbooks. The second tier, or the Augmentation level, is where teachers facilitate use of technology to enhance a task or complete a task at a swifter rate. The Modification level requires the teacher to

change their instruction so that students could accomplish learning outcomes that were not possible without technology. Lastly, the Redefinition tier allows for technology to be used in a way to create tasks that were previously inconceivable and impossible without technology (Puentedura, 2006). If teachers never move past the Augmentation level, then there is no real change to instruction. The computer essentially becomes a replacement for less efficient tools, which only helps make certain tasks quicker and easier. While this could allow for teachers to cover more content or students to complete assignments and projects faster, it does not necessarily help develop the critical thinking and problem-solving skills that are becoming increasingly more important for students to acquire. It would stand to reason that no discernable change in instructional strategies would also lead to no growth in achievement.

Given that equity in access is cited as a reason for the implementation of one-to-one device programs, the results of students identified as free and reduced lunch status deserves discussion. The results of this study found that academic achievement did not improve in either math or English language arts for free and reduced lunch status students. In fact, in the case of English language arts achievement, it created a greater discrepancy in achievement. Free and reduced lunch status student scores decreased, on average, 1.7 percentage points more when compared to the overall student population. Even though this is not a statistically significant result, it is worth mentioning. While access to more resources should likely be seen as a positive, it did not result in improved achievement. Consideration needs to be given to what is done with access and how to utilize resources in a way that redefines learning opportunities for all students.

The findings in this study also indicate the importance of strong instructional leadership to guide a new educational initiative. Ultimately, the instructional leader is responsible for the instructional direction of a school building. They must create a culture where teachers are comfortable taking risks and ensure access to the professional development and resources necessary to be successful (DiPaola & Hoy, 2014). Creating and maintaining an instructional plan that allows teachers the opportunity to better learn how to effectively integrate and use technology in the classroom is a key piece to eventual success or failure of a one-to-one device initiative (Abell Foundation, 2008; Parr & Ward, 2011; Shapley et al, 2011; Zheng et al., 2016). Without these pieces in place, teachers will likely default back to more traditional and comfortable teaching strategies. This means most teachers will not move past the Augmentation tier of the SAMR model, which in turn, does not promote growth in academic achievement through the use of technological resources.

As this chapter progresses, the discussion will shift towards different topics. First, the implications of this study and how it adds to the existing body of knowledge will be discussed. Next, the limitations of the study will be highlighted to inform the reader of potential areas of concern in the research. This will then transition to recommendations for future research on this topic to either fill missing gaps from this study or extend the topic for further investigation. Lastly, the conclusion will provide final thoughts on this study as well as personal reflections over the topic.

Implications

Technology is a source of increased spending for schools across the world. As we have seen, both pre- and post-pandemic, schools have ramped up the amount of money being spent on devices as a means to improve student learning. In 2021, a survey showed that

spending on educational technology had increased by $4.5 billion from the previous year, and trends show that it will not likely slow down (Cauthen, 2021). Given the focus on spending related to educational technology, it is imperative to have a better understanding of its impact on student achievement. This study sought out to determine whether one-to-one device initiatives have an impact on student achievement. The results suggest one-to-one device initiatives do not have a positive impact on academic achievement, which requires reflection on the money being spent on devices, as well as how they are being utilized by both teachers and students.

As noted previously, Puentedura's (2006) SAMR model is frequently referenced when looking at technology integration for a school setting. While it is not necessary for every school to view technology usage through this specific framework, the consideration of how technological tools are being used to enhance learning does need to be on the forefront of educators' minds. If teachers are only going to use computers as a tool to replace pencil and paper, the latter is significantly less expensive. Investing the money into upgrading and improving technological hardware only provides part of the solution. Schools must also consider how they will invest in their human resources to ensure the hardware is being utilized to its greatest capabilities.

School leaders must be cognizant that technology integration is not intuitive for all educators. While some educators can be described as digital natives or early adopters, which will likely make technology integration seamless, others will need significant training and coaching to adopt new methods of instruction. As training and coaching strategies are developed, sustainability needs to be considered. Professional development programs are simply more effective if they continue over time and if they contain opportunities for

constant and quick application (Cordingley et al., 2015; Dunst et al., 2015; Walter, 2012). An inability to create these opportunities can undermine the effectiveness of individual teachers, as well as the entire initiative.

These results are also a call for school leaders to place more consideration on technology integration within the human resource and hiring process. As building leaders hire new staff, knowledge and comfort with technology become more important in prospective employees. Prospective teachers must show a willingness to utilize technology in the classroom and the desire to adapt with its ever changing abilities. Instructional coaches need to be adept at using technology and willing to learn strategies that can be shared with teachers. Building leaders need to embrace the importance of integrating technology into the classroom and understand how to effectively develop teachers to build skills in this area. From top to bottom, the ability for staff to effectively use and integrate technology in instruction becomes significantly more important.

The results of this study suggest that scores not only failed to improve, but in the case of English language arts the laptop initiatives caused scores to drop. These results refute the belief that certain skills tested on standardized tests, such as writing and reading, would be naturally enhanced using devices in a classroom. The addition of technology changes the very fiber of a classroom and makes it difficult for traditional or didactic instruction to take place. A concern discussed regarding ubiquitous technology usage in past research is digital distraction (Carrier et al., 2015; Mendoza et al., 2018; Ravizza et al., 2017). The mere presence of an Internet-connected device opens the possibility for distracting activities to take place. If students are not engaged in relevant learning activities, the likelihood that they will engage in distracting behavior increases. Without providing skill-focused learning

activities, it is unlikely that students will be able to show growth in some of the basic skills necessary to be successful in multiple content areas.

There is also a concern that no significant improvement in students identified as free and reduced lunch status were present in the results. While it is clear that one-to-one device initiatives provide more equity in access to devices inside the school building, these results raise questions regarding equity elsewhere. To truly break down barriers and guarantee equity in access, students must be assured of access to a high-speed Internet connection outside of school. The discrepancy in access to high-speed Internet between students from schools in the highest category of poverty when compared to students from schools in the lowest category of poverty is significant (Stelitano et al., 2020). This deprives students from a low-income background valuable opportunities to extend learning outside of the school walls. Consideration needs to be given to this discrepancy and schools must determine how they can play a part in narrowing the gap of access if technology is going to continue to be used as a significant learning resource.

Limitations

There were multiple limitations that presented throughout the study due to the design of the study, as well as the timing of the data utilized for the analyses. The first limitation with the study is missing data. In the 2016-17 school year, DESE did not release EOC scores in either Algebra I or English II due to concerns regarding the reliability of the results (Wilson, 2017). These missing scores potentially led to one year of results not being included in the post-implementation data. Without knowing how students performed on these tests, it is unknown whether it could have a significant impact on the results of the analyses.

In addition to the missing data from 2016-17, there were several results that included incomplete information. In any publicly available data sets available through DESE, they omit results that are lower than a count of five. While this did not typically impact the larger schools included in the study, it was encountered in some of the data sets for smaller schools. Additionally, it can be seen more frequently in the free and reduced lunch status results. This potentially could skew some of the data for smaller schools in the study or schools with a small percentage of free and reduced lunch status students, as one or two missing data points could impact the percentage of students identified as proficient or advanced. In the end, the inclusion of all eligible schools to provide a representative sample was more important than the missing data points.

The length of this study could also impact the outcome. Research on school reform suggests that implementation of reform strategies can take up to five years for noticeable differences in academic achievement to be evident (Aladjem et al., 2010). Considering this information, it is plausible that a study extended up to five years could yield different results. If building leaders, teachers, and students have more time to become familiar with devices and are more comfortable with their integration into a classroom setting, the results could improve as time moves on, potentially leading to a different result.

Another limitation observed was the use of schools as the unit of analysis as opposed to an individual group of students. By using the school as the unit of analysis, the scores used in these statistical analyses were from a different group of students each year. That can cause some potential for variance from year to year. The same can be stated for teachers. This study covered a duration of six years in each school, which could mean multiple teacher turnovers were represented in the data sets. Despite these possibilities for variance, the purpose of this

study was to determine whether the introduction of a one-to-one device initiative had an impact on schools' level of achievement. While there is potential value in selecting an experimental and control group, it does not always allow for the considerations of how the treatment might impact the whole school system (Debnam et al., 2015). In this specific study, determining the impact of the treatment on the school was paramount to the individual student or group outcome.

The last limitation to consider is the difference in devices utilized for initiatives across different school districts. Schools have the choice to purchase one of many different available devices to create a one-to-one learning environment. As noted previously, Google Chromebooks have become the most popular, but there are many other offerings such as an Apple Macbook, Apple iPad, and any number of Windows-based PC's. While some of these devices do have different functionalities, it did not seem imperative to make a distinction between the different devices for the purposes of this study. The goal was not to determine which device, or which features on the device were the most or least effective, but whether the overall initiative was effective. This topic could be the basis for future research in the field of instructional technology.

Recommendations for Further Research

There are opportunities for future researchers to either expand on this work or further explore areas that were not the focus of this study. Given the methods utilized, as well as the results of the study, there are multiple areas where future researchers might allow us to better understand one-to-one device initiatives and what causes them to either succeed or fail.

First, a closer look should be taken at the different types of teacher support and training that is provided during one-to-one device initiatives. While the overall results of this

study do not fully explain the reasons behind the relative lack of success of device initiatives, one can make a reasonable assumption that teacher effectiveness plays a role in the success or failure of any academic initiative. There is not currently one agreed upon approach for technology integration into the school setting and it is possible that all 30 schools included in this study utilized different methods to train and support teachers throughout the initiative. There would be a benefit in looking at the different approaches used and comparing the relative success and failure of each one. This would help inform schools of different options for effective technology integration and instruction.

Next, to better understand which instructional strategies being utilized are effective or ineffective, it would be valuable to conduct research focused on teacher practices in a one-to-one device initiative. Teachers play an important role in student success and their approach to the dissemination of content will influence both student achievement levels and the success or failure of any technology initiative (Gilakjani et al., 2013). By conducting research that is solely focused on the effectiveness of different teacher strategies, school leaders in charge of future technology initiatives could be better informed. This could potentially help in the development of teacher training and determining what types of supports would be necessary for a specific staff.

Additionally, focused research on low-income student population could also be valuable for school leaders. Specifically, there would be an interest in determining whether increased access to high-speed Internet outside of the traditional school hours has an impact on academic achievement. While a one-to-one device initiative does provide a more readily accessible learning tool to all students, it does not necessarily lead to equity. As long as some students are able to use a device to extend learning opportunities once the school day is over

and others are not, there is not equity in opportunity. Future research could allow us to determine whether furthering this type of initiative can narrow the opportunity gaps that hinder some of the most underserved student populations.

Lastly, by design, the timeframe of this study did not include data post-pandemic. To get a clear picture of one-to-one device initiatives and how successful they were in a classroom setting, it felt necessary to narrow the scope of this study to schools that could provide data points that were not compiled during or after the pandemic. There were simply too many variables to consider when looking at COVID-era data that would be best studied in separate and focused research. Among these include: 1) online instruction, 2) hybrid instruction, 3) training and support related to these types of instruction, 4) onboarding procedures for students in these learning environments, 5) mental well-being and impact on academic achievement, and 6) family dynamics and impact on learning. While this is not an exhaustive list, it does include some of the significant topics that would be worth a closer look to gain a better understanding of one-to-one device initiatives and their connection to educating students during a pandemic.

Conclusions

The amount of money being spent on technology-related hardware for educational institutions has recently grown and continues to grow (Cauthen, 2021). Despite the amount of money being spent on equipping teachers with more instructional tools and students more learning tools, results of this study indicate that no significant increase in learning is taking place. While the results of this study do not mean that one-to-one device initiatives are inherently ineffective or doomed to fail, it does require pause and reflection on current practices.

The implementation of a one-to-one device initiative should require significant planning and distribution of resources within a building. Specifically, school leaders need to consider the physical, human, and financial resources necessary to implement and sustain such changes to the infrastructure of school. It is so much more than the purchase of new devices. Before a one-to-one device initiative can go forward, Internet access and support must be available. The proper amount of bandwidth and Wi-Fi access points are necessary for students and teachers to have wireless Internet connections throughout a building. Additionally, a designated individual needs to be able to address issues with hardware and the network. From an instructional standpoint, teachers must have the support necessary to make changes to their methods and practices. This includes the assurance that both teachers and students have access to the software and programs needed to help redefine learning. Also, they need to have the human support through building leadership or instructional coaching that allows them to take risks and try innovative learning strategies with students. These suggestions should be a bare minimum when considering a switch to a one-to-one device learning environment.

The most under-resourced population of our schools also need specific consideration when implementing a one-to-one device program. It would stand to reason that increased access to learning tools would be beneficial to one of our most under-resourced populations. The results of this study did not support that assertion, however that should not be an indication to stay put and continue down the same course. It is imperative to look at the reasons behind the results and consider true equity in access. While the end result could be expensive, schools must determine a solution to filling the opportunity gap that exists

between device usage at home and device usage at school between our high to middle-income population and low-income population.

The researcher is hopeful that this study will add to research regarding one-to-one device initiatives and inform school leaders as they attempt to make decisions regarding future implementation of such programs. I am hopeful that this study will also begin a broader conversation and more research regarding the topic. If current practices are ineffective, the cause behind those practices need to be discovered. It is not likely that schools or society will scale back technology as a learning and teaching tool in the future. Given this reality, educators must find a better way to incorporate devices into the learning environment and use them as tools to improve achievement and create more equitable opportunities for all.

APPENDIX A

PERCENTAGE OF STUDENTS SCORING PROFICIENT OR ADVANCED ON ALGEBRA I EOC

Table A1

Percentage of Students Scoring Proficient or Advanced on Algebra I EOC

	Pre-Implementation				Post-Implementation			
School	Year 1	Year 2	Year 3	Average	Year 1	Year 2	Year 3	Average
A1	.3902	.3667	.4045	.3871	.4945	****	.4211	.4578
A2	.1832	.3852	****	.2842	****	.1941	.1771	.1856
A3	.5326	.3854	.5116	.4765	.6840	****	.4788	.5814
B1	.7207	.7613	.5981	.6934	.3348	.2961	.5318	.3876
B2	.4679	.2105	.3509	.3431	****	.1486	.2661	.2074
B3	.3413	.4235	.3333	.3661	.2138	.4667	****	.3402
B4	.7112	.6755	.7072	.6979	.7205	****	.5086	.6146
C1	.5556	.5345	.7500	.6133	****	.3019	.3393	.3206
C2	.4061	.3904	.2657	.3541	.3791	.2699	.4152	.3547
C3	****	****	.3308	.3308	.3727	.3743	.4965	.4145
C4	.7853	.8102	.8628	.8194	****	.6855	.6839	.6847
C5	.3300	.4025	.3663	.3663	.4043	****	.1822	.2932
D1	.4458	.5837	****	.5148	.2199	.2538	****	.2369
D2	****	.2435	.2534	.2485	.6376	****	.4152	.5264
D3	****	.4038	.5962	.5000	****	****	.4043	.4043
D4	.6422	.5714	****	.6068	****	.3145	.3048	.3096
E1	.3360	.2803	.4189	.3451	.2600	.4159	.4878	.3879
E2	****	.5778	.4565	.5171	.6429	.6667	.6296	.6464
E3	.4545	.5455	.3194	.4398	.4670	.4817	.6490	.5326
F1	.7391	.8333	.7246	.7657	.6406	.4340	.2909	.4552
F2	.6552	.5619	.6782	.6317	****	.4184	.3537	.3860
G1	.2321	.5526	.4462	.4103	****	.1905	.3231	.2568
G2	.7923	.7719	.7262	.7635	.7879	.7179	.7541	.7533
G3	****	.4634	.5693	.5164	.5526	.6610	.7295	.6477
G4	.4703	.4762	.4607	.4691	.4765	****	.2478	.3621
H1	.5039	.4457	.6023	.5173	.2097	****	.4403	.3250
H2	.2092	****	.1752	.1922	.3947	.3373	.3979	.3767
H3	.3459	.3887	.3768	.3705	.5070	.4610	.5466	.5049
I1	.5185	.2970	.3421	.3859	*****	****	.3304	.3304
I2	****	****	****	****	.4300	****	****	.4300

APPENDIX B

PERCENTAGE OF FREE AND REDUCED LUNCH STATUS STUDENTS SCORING PROFICIENT OR ADVANCED ON ALGEBRA I EOC

Table B1

Percentage of Free and Reduced Lunch Status Students Scoring Proficient or Advanced on Algebra I EOC

	Pre-Implementation				Post-Implementation			
School	Year 1	Year 2	Year 3	Average	Year 1	Year 2	Year 3	Average
A1	****	.3529	.4045	.3787	.4945	****	.4211	.4578
A2	****	.3750	****	.3750	****	.1941	.1775	.1858
A3	.4059	.2410	.4250	.3573	.5424	****	.2295	.3859
B1	.6042	.7213	.5906	.6387	.3445	.3402	.4590	.3813
B2	****	****	****	****	****	.1860	.2456	.2158
B3	.4026	.4026	.2353	.3468	.2295	.4333	****	.3314
B4	****	.4528	.5349	.4939	.5806	****	.3871	.4839
C1	****	.3333	****	.3333	****	.2308	.1818	.2063
C2	.3615	.3677	.2151	.3148	.3000	.2300	.3424	.2908
C3	****	.3433	****	.3433	****	****	.5000	.5000
C4	.6838	.7788	.7706	.7444	****	.5581	.5161	.5371
C5	****	.3353	.2742	.3048	.3906	****	.1370	.2638
D1	.3307	.4455	****	.3881	.1338	.1567	****	.1452
D2	.3009	****	.2027	.2518	.4444	****	.2273	.3359
D3	****	.4038	.5962	.5000	****	.2813	.4043	.3428
D4	.5500	.4286	****	.4595	****	.2857	****	.2857
E1	****	.1834	.3136	.2485	.2105	.3778	.4457	.3447
E2	****	****	****	****	****	****	.7037	.7037
E3	.3851	.4386	.2167	.3468	.3675	.4603	.6142	.4807
F1	.6316	.8571	.5556	.6814	.5000	****	.1923	.3462
F2	.5814	.4615	****	.5215	****	.3636	****	.3636
G1	.2059	.4615	.3611	.3428	****	.1957	.1818	.1887
G2	.7176	.7222	.6543	.6981	.7000	.6806	.6907	.6904
G3	.3077	.3134	.4935	.3715	.5231	****	.6500	.5865
G4	.3377	.3443	.3491	.3437	.4068	****	.2545	.3307
H1	.3636	.3243	.5143	.4007	.1765	****	.2264	.2014
H2	.1959	****	.1957	.1958	.3587	.3276	.3609	.3491
H3	****	.2887	****	.2887	.3662	.3568	.4211	.3814
I1	****	****	.1321	.1321	****	****	.3043	.3043
I2	****	****	****	****	****	****	****	****

APPENDIX C

PERCENTAGE OF STUDENTS SCORING PROFICIENT OR ADVANCED ON ENGLISH II EOC

Table C1

Percentage of Students Scoring Proficient or Advanced on English II EOC

	Pre-Implementation				Post-Implementation			
School	Year 1	Year 2	Year 3	Average	Year 1	Year 2	Year 3	Average
A1	.6667	.7308	.7755	.7243	.7097	****	.5376	.6237
A2	.5986	.5660	.6209	.5952	****	.4638	.4430	.4534
A3	.7505	.8221	.8175	.7967	.8756	****	.7603	.8180
B1	.8007	.7809	.8047	.7954	.7492	.7938	.7396	.7608
B2	.8427	.8421	.8792	.8547	****	.7078	.7331	.7205
B3	.7591	.7082	.7427	.7367	.7171	.8048	****	.7609
B4	.8868	.8868	.9109	.8949	.9453	****	.6954	.8204
C1	.7636	.7963	.8475	.8025	****	.4821	.6047	.5434
C2	.7218	6685	.6090	.6664	.6402	.6277	.5675	.6118
C3	.6434	.7030	.6783	.6749	.6927	.6867	.6047	.6614
C4	.8774	.8600	.9480	.8951	****	.7511	.7426	.7469
C5	.5526	.6322	.6766	.6205	.7236	****	.5333	.6285
D1	.6571	.8053	****	.7312	.6037	.5655	****	.5846
D2	.5697	.7310	.6866	.6624	.7244	****	.4026	.5635
D3	.6286	.7179	****	.6733	****	.6190	.5000	.5595
D4	.7483	.8309	.7639	.7810	****	.5793	.5786	.5790
E1	.5876	.5592	.6996	.6155	.7118	.6483	.7387	.6996
E2	****	.7347	.7347	.7347	.5208	.7344	.5345	.5966
E3	.6306	.6920	.5882	.6369	.5917	.6444	.7273	.6544
F1	.8833	.9143	.8929	.8968	.8734	.8475	****	.8604
F2	.7129	.7982	.8660	.7924	****	.5301	.5854	.5577
G1	.7727	.6102	.7949	.7259	****	.3286	.6094	.4690
G2	.7923	.7719	.7262	.7635	.7879	.7179	.7541	.7533
G3	.7063	.6471	.7717	.7083	.7672	.7283	.7459	.7471
G4	.7507	.8348	.7620	.7825	.7918	****	.6541	.7229
H1	.6233	.7078	.7413	.6908	.7899	****	.5238	.6568
H2	.5272	.5423	.6579	.5758	.6457	.6798	.6150	.6468
H3	.7377	.8108	.7265	.7584	.7667	.7652	.7822	.7714
I1	.6905	.6583	.6364	.6617	.5568	.6979	.6625	.6391
I2	.8105	.9195	****	.8650	.7927	.6829	****	.7378

APPENDIX D

PERCENTAGE OF FREE AND REDUCED LUNCH STATUS STUDENTS SCORING PROFICIENT OR ADVANCED ON ENGLISH II EOC

Table D1

Percentage of Free and Reduced Lunch Status Students Scoring Proficient or Advanced on English II EOC

	Pre-Implementation				Post-Implementation			
School	Year 1	Year 2	Year 3	Average	Year 1	Year 2	Year 3	Average
A1	.6721	.7200	.7755	.7225	.7096	****	.5376	.6237
A2	.5515	.5316	.5682	.5504	****	.4638	.4459	.4549
A3	.5983	.6815	.7093	.6630	.7229	****	.5424	.6326
B1	.7391	.6985	.7143	.7186	.7143	.7299	.6942	.7128
B2	.8000	****	.8393	.8196	****	.5811	.6892	.6351
B3	.5890	.6111	.6211	.6071	.5758	.7059	****	.6408
B4	.6429	.7091	.7609	.7043	.7714	****	.4615	.6165
C1	.5000	****	.7407	.6204	****	.2609	.5417	.4013
C2	.6406	.5569	.4416	.5464	.4903	.5083	.4400	.4795
C3	.4590	.5692	.5974	.5419	.5455	.5405	.4651	.5170
C4	.8099	.7717	.8909	.8242	****	.6136	.5688	.5912
C5	.4615	.5694	.6710	.5673	.6733	****	.4179	.5456
D1	.4296	.6167	****	.5231	.3200	.3099	****	.3149
D2	.3976	.5696	.5000	.4891	.6324	****	.2885	.4604
D3	.5217	.7179	****	.6198	****	.6190	.5000	.5595
D4	.6667	.7600	.6230	.6832	****	.4853	.5469	.5161
E1	.4333	.3831	.5672	.4612	.5948	.4775	.6220	.5647
E2	.3793	.7273	****	.5533	.3714	.7179	.4333	.5076
E3	.4895	.5970	.4088	.4984	.4286	.5159	.6538	.5328
F1	.7647	.8333	.8387	.8122	.7692	.7391	.7647	.7577
F2	.5938	.7353	.7500	.6930	****	.4063	.5357	.4710
G1	.6667	****	****	.6667	****	.3077	.5278	.4177
G2	.7176	.7222	.6543	.6981	.7000	.6806	.6907	.6904
G3	.5867	.5738	****	.5802	.6557	.7045	.6349	.6651
G4	.6146	.7294	.6706	.6715	.7381	****	.5694	.6538
H1	.5625	.6190	.6250	.6022	.7037	****	.3542	.5289
H2	.4558	.4832	.5965	.5118	.6032	.6535	.5431	.5999
H3	.6154	.7222	.5772	.6383	.6089	.6378	.6727	.6398
I1	.6481	.4528	.4490	.5167	.3226	.5532	.6000	.4919
I2	****	****	****	****	****	****	****	****

REFERENCES

Aaronson, D., Barrow, L., & Sander, W. (2007). Teachers and student achievement in the Chicago Public High Schools. *Journal of Labor Economics, 25*, 95-135.

Aguilar, E. (2020). *Coaching for equity: Conversations that change practice*. Jossey-Bass.

Ah-Nam, L., & Osman, K. (2017). Developing 21st century skills through a constructivist-constructionist learning environment. *K-12 Stem Education, 3*(2), 205-216.

Aholi, S.S., Konyango, J.J., & Kibett, J.K. (2018). Influence of instructional resources in learning agriculture in secondary school on employment creation in Vihiga County, Kenya. *International Journal of Educational Administration and Policy Studies, 10*(1), 1-9.

Akiba, M., & Liang, G. (2016). Effects of teacher professional learning activities on student achievement growth. *The Journal of Educational Research, 109*(1), 99-110.

Akpan, J.P. & Beard, L.A. (2016). Using constructivist teaching strategies to enhance academic outcomes of students with special needs. *Universal Journal of Educational Research, 4*(2), 392-398.

Al-Maawali, W. (2022). Experiential writing through connectivism learning theory: a case study of English language students in Oman higher education. *Reflective Practice, 23*(3), 305–318.

Aladjem, D.K., Birman, B.F., Orland, M., Harr-Robins, J., Heredia, A., Parrish, T.B., & Ruffini, S.J. (2010). *Achieving dramatic school improvement: An exploratory study. A cross-site analysis from the evaluation of comprehensive school reform program implementation and outcomes study.* Office of Planning, Evaluation and Policy Development, U.S. Department of Education. Retrieved from https://eric.ed.gov/?id=ED526783

Alam, M.A. (2023). From teacher-centered to student-centered learning: The role of construcvism and connectivism in pedagogical transformation. *Conflux Journal of Education, 11*(2).

Alexander, K.L. (1997). Public schools and the public good. *Social Forces, 76*(1), 1-30.

Allen, J.P., Pianta, R.C., Gregory, A., Mikami, A.Y., & Lun, J. (2011). An interaction-based approach to enhancing secondary school instruction and student achievement. *Science, 333*(6045), 1034-1037.

Ally, M. (2004). Foundations of educational theory for online learning. *Theory and Practice of Online Learning, 2*, 15–44.

Amineh, R.J. & Asl, H.D. (2015). Review of constructivism and social constructivism. *Journal of Social Sciences, Literature and Languages. 1*(1), 9-16.

Anagun, S.S. (2018). Teachers' perceptions about the relationship between 21st century skills and managing constructivist learning environments. *International Journal of Instruction, 11*(4), 825-840.

Anderson, K.P., & Ritter, G.W. (2017). Disparate use of exclusionary discipline: Evidence of inequities in school discipline from a U.S. state. *Educational Policy Analysis Archives, 25*(49), 1-36.

Apple (2019). *Education – MacBook Air*. Retrieved from https://www.apple.com/us-hed/shop/buy-mac/macbook-air

Archee, R. (2012). Reflections on personal learning environments: Theory and practice. *Procedia – Social and Behavioral Sciences, 55*, 419-428.

Archer, K.R. (2012). *The historical context and development of professional learning communities* (Doctoral dissertation, University of Kansas). Retrieved from ProQuest Dissertations and Theses database. (ProQuest Number 3524335)

Argueta, R., Huff, J., Tingen, J., & Corn, J.O. (2011). 1:1 laptop initiatives: A summary of research findings across seven states. *Raleigh, NC: Friday Institute for Educational Innovation, North Carolina State University*, 1-20.

Aseltine, J.M, Faryniarz, J.O., & Rigazio-DiGilio, A.J. (2006). *Supervision for learning*. ASCD.

Au, W. (2009). *Unequal by design: High-stakes testing and the standardization of inequality*. Routledge.

Bach, A.J., Wolfson, T., & Crowell, J.K. (2018). Poverty, literacy, and social transformation: An interdisciplinary exploration of the digital divide. *Journal of Media Literacy Education, 10*(1), 22-41.

Barkley, E. F., & Major, C. H. (2020). *Student engagement techniques: A handbook for college faculty*. John Wiley & Sons.

Barshay, J. (2013). Top US students fare poorly in international PISA test scores, Shanghai tops the world, Finland slips. *The Hechinger Report*, 12-14.

Bartanen, B. (2020). Principal quality and student attendance. *Educational Researcher, 49*(2), 101-113.

Barth, R.S. (2013). Culture in question. In M. Grogan (Ed.). *The Jossey-Bass reader on educational leadership* (p. 441-449). Jossey-Bass.

Basch, C. E. (2011). Breakfast and the achievement gap among urban minority youth. *Journal of School Health, 81*(10), 635–640.

Basham, M.D. (2012). *Do ubiquitous laptop initiatives decrease the high school dropout rate?* (Doctoral dissertation, Wingate University). Retrieved from ProQuest Dissertations and Theses database. (ProQuest Number 3523182)

Bebell, D. & Kay, R. (2010). One to one computing: A summary of the quantitative results from the Berkshire wireless learning initiative. *Journal of Technology, Learning, and Assessment. 9*(2), 1-60.

Beck, L. & Murphy, J. (1993). *Understanding the principalship: Metaphorical themes, 1920s-1990s.* New York: Teachers College Press.

Becker, H. J. (2000). Findings from the teaching, learning, and computing survey: Is Larry Cuban Right? *Education Policy Analysis Archives, 8*(51), 51.

Belland, B. R., Glazewski, K. D., & Ertmer, P. A. (2009). Inclusion and problem-based learning: Roles of students in a mixed-ability group. *Research in Middle Level Education, 32*(9), 1-19.

Bellefeuille, G. L. (2006). Rethinking reflective practice education in social work education: A blended constructivist and objectivist instructional design strategy for a web-based child welfare practice course. *Journal of Social Work Education,* 42(1), 85–103.

Ben-Eliyahu, A., Moore, D., Dorph, R., & Schunn, C. D. (2018). Investigating the multidimensionality of engagement: Affective, behavioral, and cognitive engagement across science activities and contexts. *Contemporary Educational Psychology*, *53*, 87-105. https://doi.org/10.1016/j.cedpsych.2017.12.006

Berliner, D.C. (2013). Effects of inequality and poverty vs. teachers and schooling in America's youth. *Teachers College Record, 115*(12), 1-26.

Bermejo, V., Ester, P., & Morales, I. (2021). A constructivist intervention program for the improvement of mathematical performance based on empiric developmental results. *Frontiers in Psychology, 11*, 1-12.

Best, J., & Dunlap, A. (2014). Continuous improvement in schools and districts: Policy considerations. *McRel International.* Retrieved from http://eric.ed.gov/?id=ED557599

Biancarosa, G., Bryk, A.S., & Dexter, E.R. (2010). Assessing the value-added effects of literacy collaborative professional development on student learning. *The Elementary School Journal, 111*(1), 7-34.

Bixler, S.G. (2019). One-to-one iPad technology in the middle school mathematics and science classrooms. *International Journal of Technology in Education and Science, 3*(1), 1-18.

Blanchett, W. J. (2014). African American students and other students of color in special education. In R. Milner R. & K. Lomotey (Eds.), *Handbook of Urban education* (pp. 271-284). Routledge.

Bleyer, C.T. (2017). *One-to-one laptop programs: Do students in identified Illinois high schools have an advantage when state assessments are computer based?* (Doctoral dissertation, McKendree University). Retrieved from ProQuest Dissertations and Theses database. (ProQuest Number 10288083)

Boardman, D.C. (2012). *Educator responses to technology influences in a 1:1 laptop middle school* (Doctoral dissertation, University of Maine). Retrieved from ProQuest Dissertations and Theses database. (ProQuest Number 3528200)

Botha, A. & Herselman, M. (2015). A teacher tablet toolkit to meet the challenges posed by 21st century rural teaching and learning environments. *South African Journal of Education, 35(*4), 1-19.

Bowman, M. A., Vongkulluksn, V. W., Jiang, Z., & Xie, K. (2020). Teachers' exposure to professional development and the quality of their instructional technology use: The mediating role of teachers' value and ability beliefs. *Journal of Research on Technology in Education, 54*(2), 188-204.

Bozkurt, S., Coban, Ö., Özdemir, M., & Özdemir, N. (2021). How leadership, school culture, collective efficacy, academic self-efficacy, and socioeconomic status affect student achievement. *Education and Science, 46*(207), 465-482.

Bricker, D.D., Felimban, H.S., Lin, F.Y., Stegenga, S.M., & Storie, S.O. (2022). A proposed framework for enhancing collaboration in early intervention/early childhood special education. *Topics in Early Childhood Special Education, 41*(4), 240-252.

Bromberg, M., & Theokas, C. (2014). *Falling out of the lead: Following high achievers through high school and beyond*. The Education Trust.

Brooks-Gunn, J., & Duncan, G.J. (1997). The effects of poverty on children. *The Future of Children, 7*(2), 55-71.

Broussard, J., Hebert, D., Welch, B., & VanMetre, S. (2014). Teaching today for tomorrow: A case study of one high school's 1:1 computer adoption. *Delta Kappa Gamma Bulletin, 80*(4), 37-45.

Brown, R. (2018). Using laptop technology to improve mathematical achievement rates: A quasi-experimental study. *Journal of Computers in Mathematics and Science Teaching, 37*(3), 217-238.

Brown, M., McNamara, G., O'Hara, J., Hood, S., Burns, D., & Kurum, G. (2019). Evaluating the impact of distributed culturally responsive leadership in a disadvantaged rural primary school in Ireland. *Education Management Administration and Leadership, 47*, 457–474.

Brush, T., & Saye, J.W. (2009). Strategies for preparing preservice social studies teachers to integrate technology effectively: Models and practices. *Contemporary Issues in Technology and Teacher Education, 9*(1), 46-59.

Bryan, A. (2011). *Elementary reading fluency and comprehension: Do laptops make a difference?* (Doctoral dissertation, University of Virginia). Retrieved from ProQuest Dissertations and Theses database. (ProQuest Number 3475631)

Buabeng-Andoh, C. (2012). Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the literature. *International Journal of Education and Development Using Information and Communication Technology, 8,* 136-155.

Bui, Y. N., & Fagan, Y. M. (2013). The effects of an integrated reading comprehension strategy: A culturally responsive teaching approach for fifth-grade students' reading comprehension. *Preventing School Failure, 57,* 59–69.

Burchinal, M.R., Roberts, J.E., Zeisel, S.A., & Rowley, S.J. (2008). Social risk and protective factors for African American children's academic achievement and adjustment during the transition to middle school. *Developmental Psychology, 44*(1), 286.

Bruton, A., & Robles-Piña, R. A. (2009). Deficit thinking and Hispanic student achievement: Scientific information resources. *Problems of Education in the 21st Century, 15*, 41–48.

Bushweller, K.C. (2017). Classroom technology: Where schools stand. Technology counts. *Education Week, 36*(35), 1-40.

Butterworth, P., Olesen, S. C., & Leach, L. S. (2012). The role of hardship in the association between socio-economic position and depression. *Australia and New Zealand Journal of Psychiatry, 46*, 364–373.

Caffarella, R.S., & Merriam, S.B. (1999). Perspectives on adult learning: framing our research. In *40th Annual Adult Education Research Conference Proceedings*. Northern Illinois University

Carnoy, M., & Garcia, E. (2017). *Five key trends in US student performance*. Washington, DC: Economic Policy Institute.

Carrier, L.M., Rosen, L.D., Cheever, N.A., & Lim, A.F. (2015). Causes, effects, and practicalities of everyday multitasking. *Developmental Review, 35*, 64-78.

Carter, S.P., Greenburg, K., & Walker, M. (2016). *The impact of computer usage on academic performance: Evidence from a randomized trial at the United States military academy* (Working Paper #2016-02). Retrieved from Massachusetts Institute of Technology, School Effectiveness and Inequality Inmitiative website: https://seii.mit.edu/wp-content/uploads/2016/05/SEII-Discussion-Paper-2016.02-Payne-Carter-Greenberg-and-Walker-2.pdf

Cauthen, L. (2021). *The 2020 digital transition survey results are in: Just how large is the k12 ed-tech market?* Retrieved from the Learning Counsel website: https://thelearningcounsel.com/article/2020-digital-transition-survey-results-are-just-how-large-k12-ed-tech-market

Cauthen, N.K., & Fass, S. (2008). *Measuring income and poverty in the United States*. New York, NY: National Center for Children in Poverty, Columbia University Mailman School of Public Health.

Cervantes, B., Hemmer, L., & Kouzekanani, K. (2015). The impact of project-based learning on minority student achievement: Implications for school redesign. *NCPEA Education Leadership Review of Doctoral Research, 2,* 50-66.

Cervantes-Soon, C. G., & Carrillo, J. F. (2016). Toward a pedagogy of border thinking: Building on Latin@ students' subaltern knowledge. *The High School Journal, 99*(4), 282-301.

Chandra, S., Chang, A., Day, L., Fazlullah, A., Liu, J., McBride, L., Mudalige, T., & Weiss, D. (2020). *Closing the K–12 digital divide in the age of distance learning.* Common Sense Media. Boston Consulting Group. Retrieved from https://www.bbcmag.com /pub /doc/BBC_Nov20_DigDivide.pdf

Chen, R., & Bennett, S. (2012). When Chinese learners meet constructivist pedagogy online. *Higher Education, 64*, 677-691.

Cheng, S.L., Chen, S., & Chang, J. (2020). Examining the multiplicative relationships between teachers' competence, value and pedagogical beliefs about technology integration. *British Journal of Educational Technology, 52*(2), 734-750.

Chiphiko, E., & Shawa, L.B. (2014). Implementing learner-centered approaches to instruction in primary schools in Malawi. *Mediterranean Journal of Social Sciences, 5*(23), 967-975.

Christianakis, M. (2011). Hybrid texts fifth graders, rap music, and writing. *Urban Education, 46*, 1131–1168.

Clariana, R. (2009). Ubiquitous wireless laptops in upper elementary mathematics. *Journal of Computers in Mathematics and Science Teaching, 28*, 5–21.

Cogan-Drew, D. (2010). 21st century skills: Making student achievement public in the digital age. *eLearn, 2010 2*(6), 6-8.

Coleman, J.S., Campbell, E.Q., Hobson, C.J., McPartland, J., Mood, A.M., Weinfeld, F.D., et al. (1966). *Equality of Educational Opportunity*. Washington, DC: Government Printing Office, 325.

Cook-Harvey, C. M., Darling-Hammond, L., Lam, L., Mercer, C., & Roc, M. (2016). *Equity and ESSA: Leveraging educational opportunity through the Every Student Succeeds Act*. Learning Policy Institute.

Cordingley, P., Higgins, S., Greany, T., Buckler, N., Coles-Jordan, D., Crisp, B., & Coe, R. (2015). *Developing great teaching.* London, UK: Teacher Development Trust.

Corn, J., Argueta, R., & Tagsold, J.T. (2012). Students with special needs and 1:1 computing: A teacher's perspective. *Journal of Research in Special Educational Needs, 12*(4), 217-223.

Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology*, *78*(1), 98.

Coughran, M. J. (2012). *Enacting culturally relevant pedagogy: Going beyond heroes and holidays curriculum* (Masters' thesis, Mills College). Available from Proquest Dissertations and Theses Database. (UMI No. 1510828)

Cristia, J., Ibarraran, P., Cueto, S., Santiago, A., & Severin, E. (2012). *Technology and child development: Evidence from the One Laptop per Child program* (Working Paper No. IDB-WP-304). Washington, DC: Inter-American Development Bank.

Cuban, L. (2004, March 17). The contentious "no child" law I: Who will fix it? And how? *Education Week*. Retrieved from www.edwk.org/ew/articles/2004/03/17/27cuban.h23.html

Cuban, L. (2006, October 18). The laptop revolution has no clothes. *Education Week*. Retrieved from https://www.edweek.org/ew/articles/2006/10/18/08cuban.h26.html

Cuban, L. (2009). *Oversold and underused: Computers in the classroom*: Harvard University Press.

Cuban, L. (2013). Why so many structural changes in schools and so little reform in teaching practice? *Journal of Educational Administration, 51*(2), 109-125.

Daggett, W. R. (2010). Preparing students for their technological future. International Center for Leadership in Education. Retrieved from http://www.leadered.com/pdf/preparing%20Students%20for%20Tech%20Future%20white%20paper.pdf

Dahl, G.B., & Lochner, L. (2012). The impact of family income on child achievement: Evidence from the Earned Income Tax Credit. *American Economic Review, 102*(5), 1927-1956.

Danielson, C. (2014). *The framework for teaching evaluation instrument* (2014 ed.).: The Danielson Group.

Danielsen, J. (2009). *A case study of one-to-one laptop initiatives in midwest public high schools* (Doctoral dissertation, University of South Dakota). Retrieved from ProQuest Dissertations and Theses database. (ProQuest Number 3382615)

Darling-Hammond, L. (2004). From "separate but equal" to "no child left behind": The collision of new standards and old inequalities. In D. Meier & G. Wood (Eds.), *Many children left behind: How the No Child Left Behind Act is damaging our children and our schools* (pp. 3-32). Beacon

Darling-Hammond, L., Zielezinski, M.B., & Goldman, S. (2014). *Using technology to support at-risk students' learning*. Alliance for Excellent Education. Washington, D.C. Retrieved from https://edpolicy.stanford.edu/sites/default/files/scope-pub-using-technology-report.pdf

Darling-Hammond, L., Hyler, M. E., Gardner, M. (2017). *Effective teacher professional development.* Learning Policy Institute.

Davies, R.S., Dean, D.L., & Ball, N. (2013). Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course. *Education Technology Research Development, 61*(4), 563-580.

Day, C., Gu, Q., & Sammons, P. (2016). The impact of leadership on student outcomes: How successful school leaders use transformational and instructional strategies to make a difference. *Educational Administration Quarterly*, *52*(2), 221-258.

Debnam, K.J., Bradshaw, C.P., Pas, E.T., & Lindstrom Johnson, S. (2015). School as a unit of assignment and analysis in group-randomized controlled trials. In K. Bosworth (Ed.). *Prevention Science in School Settings: Complex Relationships and Processes*, 247-269. Springer.

Delgado-Hachey, M., Evans, J. H., Hunley, S. A., Krise, J., Rich, T., & Schell, C. (2005). Adolescent computer use and academic achievement. *Adolescence, 40(158),* 307-318.

DeNavas-Walt, C., Proctor, B.D., & Smith, J.C. (2013). *Income, poverty, and health insurance coverage in the United States: 2012*. Washington, DC: United States Census Bureau.

Desimone, L.M. (2011). A primer on effective professional development. *Phi Delta Kappan, 92*(6), 68-71.

Dewey, J. (1884). The new psychology. *Andover Review, 2*, 278-289.

Dewey, J. (1959). My pedagogic creed. In J. Dewey, *Dewey on education* (pp. 19-32). Teachers College, Columbia University.

Dewey, J. (1961). *John Dewey on education (selected writings)*. Macmillan Publishers.

Dewey, J. (1998). *Experience and education*. The 60th. Anniversary Edition., Lecture Part. Kappa Delta Pi, International Honor Society in Education.

Dimick, A. S. (2012). Students' empowerment in an environmental science classroom: Toward a framework for social justice science education. *Science Education, 96*, 990–1012.

DiPaola, M.F., & Hoy, W.K. (2014). *Improving instruction through supervision, evaluation, and professional development.* Information Age Publishing, Inc.: Charlotte, NC.

Dixson, M.D. (2015). Measuring student engagement in the online course: The online student engagement scale (OSE). *Online Learning, 19*(4), 51-65.

Downes, S. (2008). Places to go: Connectivism & connective knowledge. *Innovative: Journal of Online Education, 5*(1), 1-6.

Downes, S. (2012). *Connectivism and connective knowledge: Essays on meaning and learning networks.* Retrieved from http://www.downes.ca/files/books/Connective_Knowledge-19May2012.pdf

Downey, D.B., & Condron, D.J. (2016). Fifty years since the Coleman Report: Rethinking the relationship between schools and inequality. *Sociology of Education, 89*(3), 207-220.

Drain, T. S., Grier, L. E., & Sun, W. (2012). Is the growing use of electronic devices beneficial to academic performance? Results from archival data and a survey. *Issues in Information Systems*, *13*(1), 225-231.

Dron, J., & Anderson, T. (2014). *Teaching crowds: Learning and social media*. Athabasca University Presss.

du Plessis, E. (2020). Student teachers' perceptions, experiences, and challenges regarding learner-centered teaching. *South African Journal of Education, 40*(1), 1-10.

Duke, B., Harper, G., & Johnston, M. (2013). Connectivism as a digital age learning theory. *The International HETL Review, Special Issue, 2013*, 4-13.

Dunleavy, M., & Heinecke, W.F. (2007). The impact of 1:1 laptop use on middle school math and science standardized test scores. *Computers in the Schools, 24*(3/4), 7-22.

Dunst, C.J., Bruder, M.B., & Hamby, D.W. (2015). Metasynthesis of in-service professional development research: Features associated with positive educator and student outcomes. *Educational Research and Reviews, 10*(12), 1731-1744.

Dwyer, D.C. (1995). *Changing the conversation about teaching learning and technology: A report on 10 years of ACOT research*. Retrieved from https://saidnazulfiqar.files.word press.com/2014/10/changing-the-conversation-about-ict-in-learning-10-years-of-acot.pdf

Earley, P. (2004). Searching for the common good in federal policy: The missing essence in NCLB and HEA: Title II. In N. Michelli & D. Keiser (Eds.), *Teacher education for diversity and social justice* (pp. 57-76). New York: Routledge/Taylor & Francis.

Easterbrook, M.J., & Hadden, I.R. (2021). Tackling educational inequalities with social psychology: Identities, contexts, and interventions. *Social Issues Policy Review, 15*, 180-236.

Edmonds, R. (1982). Programs of school improvement: An overview. *Educational Leadership, 40*, 4-11.

Education Superhighway. (2017). 2*016 state of the states: Education Superhighway's second annual report on the state of broadband connectivity in America's public schools*. San Francisco, CA. Retrieved from https://s3-us-west-1.amazonaws.com/esh-sots pdfs/2016_national_ report_K12_broadband.pdf.

Egalite, A. J., Kisida, B., & Winters, M. A. (2015). Representation in the classroom: The effect of own-race teachers on student achievement. *Economics of Education Review, 45*, 44- 52.

Egan, K.L. (2012). EOC examination of convergent and divergent validity on the Missouri end-of-course assessments. Retrieved from https://dese.mo.gov/sites/default/files/asmt-eoc-examination-convergent-divergent-validity-2012.pdf

Engle, P.L., & Black, M.M. (2008). The effects of poverty on child development and educational outcomes. *Annals of the New York Academy of Science, 1136*, 243-256.

Er, E., & Kim, C. (2017). Episode-centered guidelines for teacher belief change toward technology integration. *Educational Technology Research and Development, 65*(4), 1041–1065.

Er, M., & Er, N.F. (2013). Instructional technology as a tool in creating constructivist classrooms. *Procedia – Social and Behavioral Sciences, 93*, 1441-1445.

Ernest, P. (1995). The one and the many. In L. Steffe & J. Gale (Eds.). *Constructivism in education* (pp. 459-486). New Jersey: Lawrence Erlbaum Associates, Inc.

Ertmer, P. A., & Newby, T. J. (1993). Behaviorism, cognitivism, constructivism: comparing critical features from an instructional design perspective. *Performance Improvement Quarterly, 6*(4), 50-72.

Ertmer, P.A., & Ottenbreit-Leftwich, A.T. (2010). Teacher technology change: How knowledge, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*, 255-284.

Escueta, M., Nickow, A.J., Oreopoulos, P., & Quan, V. (2020). Upgrading education with technology: Insights from experimental research. *Journal of Economic Literature, 58*(4), 897-996.

Esteban-Guitart, M. & Moll, L. (2014). Funds of identity: A new concept based on funds of knowledge approach. *Culture & Psychology, 20*, 31-48.

Every Student Succeeds Act of 2015, Pub. L. No. 114-95 § 114 Stat. 1177 (2015).

Fairlie, R.W., & Robinson, J. (2013). Experimental evidence on the effects of home computers on academic achievement among schoolchildren. *American Economic Journal: Applied Economics, 5*(3), 211-240.

Finkelstein, N., Hanson, T., Huang, C. W., Hirschman, B., & Huang, M. (2011). Effects of problem based economics on high school economics instruction. Final Report. NCEE 2010-4002. *National Center for Education Evaluation and Regional Assistance*.

Fixen, M., & Wald, N. (2021). Obstacles overcome: A universal guide to active learning. J*ournal of Higher Education Theory and Practice, 21*(4), 106–110.

Fleischer, H. (2011). What is our current understanding of one-to-one computer projects: A systemic narrative research review. *Educational Research Review, 7*(2), 107-122.

Fogleman, J., McNeill, K.L., & Krajcik, J. (2011). Examining the effect of teachers' adaptations of a middle school science inquiry-oriented curriculum unit on student learning. *Journal of Research in Science Teaching, 48*(2), 149-169.

Forsyth, A. (2012). Defining suburbs. *Journal of Planning Literature, 27*(3), 270-281.

Francom, G. M. (2020). Barriers to technology integration: A time-series survey study. *Journal of Research on Technology in Education, 52*(1), 1-16.

Freiman, V., Beauchamp, J., Blain, S., Lirette-Pitre, N., & Fournier, H. (2010). Does one-to-one access to laptops improve learning: Lessons from New Brunswick's individual laptop school initiative. *Procedia – Social and Behavioral Sciences, 2*(2), 5685-5692.

Fullan, M. (2016). *The new meaning of educational change* (5th ed.). New York, NY: Teacher's College Press.

Gabarino, J. (1991). *The human ecology of early risk*. New York, NY: Cambridge University Press.

Gall, M.D., & Acheson, K.A. (2011). *Clinical supervision and teacher development: Preservice and inservice applications (6th ed.)*. Hoboken, NJ: John Wiley & Sons.

Gans, H.J. (2011). The Moynihan report and its aftermaths: A critical analysis. *Du Bois Review: Social Science Research on Race, 8*(2), 315-327

Garcia, E. (2020). *Schools are still segregated, and black children are paying a price*. Economic Policy Institute. Retrieved from https://www.epi.org/publication/schools-are-still-segregated-and-black-children-are-paying-a-price/

Garcia, E., Elbeltagi, I., Brown, M., & Dungay, K. (2015). The implications of a connectivist learning blog model and the changing role of teaching and learning. *British Journal of Educational Technology, 46*(4), 877-894.

Gatens, B.P. (2017). *The relationship between student participation in a 1:1 laptop initiative and academic achievement in a 9-12 upper middle class suburban New Jersey public school district* (Doctoral dissertation, Seton Hall University). Retrieved from Seton Hall University Dissertations and Theses website: https://scholarship.shu.edu/dissertations/2476

Gawlik, M. A. (2015). Shared sense-making: How charter school leaders ascribe meaning to accountability. *Journal of Educational Administration, 53*, 393–415.

Gawthorp, J. (2014). *Measuring student achievement: A study of standardized testing & its effect on student learning*. Retrieved from http://my.jessup.edu/publicpolicy/wp-content/uploads/sites/39/2014/04/Gawthrop_Jeremiah_Final.pdf

Gay, G. (2012). *Culturally responsive teaching theory, research, and practice (3rd ed.)*. Teachers College Record.

Gilakjani, A.P., Leong, L.M., & Ismail, H.N. (2013). Teachers' use of technology and constructivism. *International Journal of Modern Education and Computer Science, 5*(4), 49-63.

Gilman, R., & Anderman, E. (2006). Motivation and its relevance to school psychology: An introduction to the special issue. *Journal of School Psychology, 44*, 325–329.

Glenn, D. (2010). How students can improve by studying themselves. *The Chronicle of Higher Education, 2*(2), 1.

Glickman, C.D., Gordon, S.P., & Ross-Gordon, J.M. (2013). *The basic guide to supervision and instructional leadership* (3rd ed.). Pearson.

Göksün, O. D., & Kurt, A. A. (2017). The relationship between pre-service teachers' use of 21st century learner skills and 21st century teacher skills. *Education and Science, 42*(190), 107-130.

Goldring, E., Grissom, J., Rubin, M., Rogers, L., Neel, M. & Clark, M. (2018), *A New Role Emerges for Principal Supervisors: Evidence from Six Districts in the Principal Supervisor Initiative*. The Wallace Foundation

Google (2019). *Google for education*. https://edu.google.com/k-12-solutions/

Gore, J. & Rosser, B. (2022). Beyond content-focused professional development: Powerful professional learning through genuine learning communities across grades and subjects. *Professional Development in Education, 48*(2), 218-232.

Grady, M., Watkins, S., & Montalvo, G. (2012). The effect of constructivist mathematics on achievement in rural schools. *The Rural Educator, 33*(3), 38-46.

Greaves, T.W., Hayes, J., Wilson, L., Gielniak, M., & Peterson, E.L. (2012). *Revolutionizing education through technology: The project red roadmap for transformation*. International Society for Technology in Education.

Greenbaum, S. (2015). *Blaming the poor*. Rutgers University Press.

Gresalfi, M.S. & Lester, F. (2009). What's worth knowing in mathematics? In Tobias, S. & Duffy, T. (Eds.), *Constructivist theory applied to instruction: Success or failure?* Taylor and Francis.

Grimes, D. & Warschauer, M. (2008). Learning with laptops: A multi-method case study. *Journal of Educational Computing Research, 38*(3), 305-332.

Gruenert, S., & Whitaker, T. (2015). *School culture rewired: How to define, assess, and transform it.* Association for Supervision and Curriculum Development (ASCD).

Gulek, J., & Demirtas, H. (2005). Learning with technology: The impact of laptop use on student achievement. *Journal of Technology, Learning, and Assessment, 3*(2), 3-38.

Gunner, J. P. (2007) *One-to-one laptop initiatives: Powerful hubs of a distributed student learning network?* (Doctoral dissertation, Bowling Green State University). Retrieved from https://etd.ohiolink.edu/!etd.send_file?accession=bgsu1178899152 &disposition=inline

Gupta, S. (2011). Constructivism as a paradigm for teaching and learning. *International Journal of Physical and Social Sciences, 1*(1), 23-47.

Guskey, T.R., & Yoon, K.S. (2009). What works in professional development? *Phi Delta Kappan, 90*(7), 495-500.

Gutierrez, R. (2008). A "gap-gazing" fetish in mathematics education? Problematizing research on the achievement gap. *Journal for Research in Mathematics Education, 39*(4), 357-364.

Hadjipanayi, C., & Michael-Grigoriou, D. (2020). Conceptual knowledge and sensitization on Asperger's syndrome based on the constructivist approach through virtual reality. *Heliyon, 6*(6), 1-10.

Hair, N.L., Hanson, J.L., Wolfe, B.L., & Pollak, S.D. (2015). Association of child poverty, brain development, and academic achievement. *Journal of the American Medical Association Pediatrics, 169*(9), 822-829.

Hallinger, P., & Murphy, J. (1986). *Instructional leadership in effective schools*. Retrieved from https://files.eric.ed.gov/fulltext/ED309535.pdf

Halvorsen, A., Duke, N.K., Brugar, K.A., Block, M.K., Strachan, S.L., Berka, M.B., & Brown, J.M. (2012). Narrowing the achievement gap in second-grade social studies and content area literacy: The promise of a project-based approach. *Theory and Research in Social Education, 40*, 198-229.

Hannafin, R.D., Vermillion, J.R. (2008). Technology in the classroom. In T.L. Good (Ed.), *21st century education: A reference handbook* (pp. 209-218). Sage.

Hansen, R.C. (2012). *Exploring the effects of 1:1 laptop implementation on quantifiable students outcomes in junior high school science classes between demographic subpopulations of students* (Doctoral dissertation, Utah State University). Retrieved from https://digitalcommons.usu.edu/etd/1355

Hanushek, E. (2011). Valuing teachers: How much is a good teacher worth? *Education Next, 11*(3), 40-45.

Harris, A. (2002). *School improvement: What's in it for schools?* Routledge Falmer.

Hartman, A. (2007). The social production of American identity: Standardized testing reform in the United States. *Socialism and Democracy, 17*(2), 131-164.

Hatakka, M., Andersson, A., & Grönlund, Å. (2013). Students' use of one to one laptops: A capability approach analysis. *Information Technology & People, 26*, 94–112.

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses related to student achievement.* Routledge.

Hedges, L.V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *Journal of Educational Statistics, 6*, 107-128.

Heeden, T. (2005). Dialogue and democracy, community and capacity: Lessons for conflict resolution education from Montessori, Dewey, and Frieire. *Conflict Resolution Quarterly, 23*(2), 185-202.

Hernández-Ramos, P., & De La Paz, S. (2009). Learning history in middle school by designing multimedia in a project-based learning experience. *Journal of Research on Technology in Education, 42*(2), 151-173.

Honeychurch, S., Bozkurt, A., Singh, L., & Koutropoulos, A. (2017). Learners on the periphery: Lurkers as invisible learners. *European Journal of Open, Distance and E-Learning, 20*(1), 192–212.

Hoover, W.A. (1996). The practice implications of constructivism. *SEDL Letter, 9*(3), 1-2.

Hoppey, D., McLeskey, J. (2013). A case study of principal leadership in an effective inclusive school. *Journal of Special Education, 46*, 245–256.

Horng, E.L., Klasik, D., & Loeb, S. (2010). Principal's time use and Huberman, M., Bitter, C., Anthony, J., & O'Day, J. (2014). *The shape of deeper learning: Strategies, structures, and cultures in deeper learning network high schools.* American Institutes for Research.

Howard, T. C., & Milner, H. R. (2021). Teacher preparation for urban schools. In H.R. Milner & K. Lomotey (Eds.), *Handbook of urban education* (pp. 195-211). Routledge.

Howland, J. L., Jonassen, D. H., & Marra, R. M. (2012). *Meaningful learning with technology*. Pearson.

Hubert, T. L. (2013). Learners of mathematics: High school students' perspectives of culturally relevant mathematics pedagogy. *Journal of African American Studies, 18*, 324–336

Hung, M., Smith, W.A., Voss, M.W., Franklin, J.D., Gu, Y., & Bounsanga, J. (2020). Exploring student achievement gaps in school districts across the United States. *Education and Urban Society, 52*(2), 175-193.

Hur, J.W., & Oh, J. (2012). Learning, engagement, and technology: Middle school students' three-year experience in pervasive technology environments in South Korea. *Journal of Educational Computing Research, 46*(3), 295-312.

Husband, T., & Hunt, C. (2015). A review of the empirical literature on No Child Left Behind from 2001 to 2010. *Planning and Changing, 46*(1), 212-254.

Iliyasu, R., and Etikan, I. (2021). Comparison of quota sampling and stratified random sampling. *Biometrics and Biostatistics International Journal, 10*(1), 24–27.

Irvine, J.J. (2010). Forward. In H.R. Milner, *Culture, curriculum, and identity in education* (pp. xi-xv). Palgrave Macmillan.

Isik, A.D. (2018). Use of technology in constructivist approach. *Educational Research and Reviews, 13*(21), 704-711.

Istance, D., & Paniagua, A. (2019). *Learning to leapfrog: Innovative pedagogies to transform education.* Center for Universal Education at Brookings Institute.

Jaleel, S., & Anuroofa, O.M. (2017). A study on the relationship between self-directed learning and achievement in information technology of students at secondary level. *Universal Journal of Educational Research, 5*(10), 1849-1852.

Jensen, E. (2013). How poverty affects classroom engagement. *Educational Leadership, 70*(8), 24-30.

Johnstone, B. (2003). *Never mind the laptops: Kids, computers, and the transformation of learning*. iUniverse, Inc.

Jonassen, D. (2009). Reconciling a human cognitive architecture. In Tobias, S. & Duffy, T. (Eds.), *Constructivist theory applied to instruction: Success or failure?* Taylor and Francis.

Jones, M.B. (2013). *Technology integration in a one-to-one laptop initiative: A multiple case study analysis* (Doctoral dissertation, University of Houston-Clear Lake). Retrieved from ProQuest Dissertations and Theses (ProQuest Number 3578720)

Jonker, H., Marz, V., & Voogt, J. (2020). Curriculum flexibility in a blended curriculum. *Australasian Journal of Educational Technology, 36*(1), 68-84.

Kelly, D., Nord, C., Jenkins, F., Chan, J., Kastberg, D., Westat, I., & National Center for Education Statistics (2013). *Performance of U.S. 15-year-old students in mathematics, science, and reading literacy in an international context. First look at PISA 2012* (NCES 2014-024). National Center for Education Statistics.

Kennedy, B.L., & Soutullo, O. (2018). "We can't fix that": Deficit thinking and the exoneration of educator responsibility for teaching students placed at a disciplinary alternative school. *Journal of At-Risk Issues, 21*(1), 11–23.

Kerlinger, F.N. (1964). *Foundations of behavioral research*. Holt, Rinehart, & Winstron.

Khalifa, M.A. (2018). *Culturally responsive school leadership*. Harvard Education Press

Khalifa, M.A., Gooden, M.A., & Davis, J.E. (2016). Culturally responsive school leadership: A synthesis of the literature. *Review of Educational Research, 86*(4), 1272-1311.

Kilag, O.K., Abalo, S.J., Retes, G.P., & Dalogdog, L.G. (2023). Enhancing student learning through the integration of connectivism theory in blended learning environments. *European Journal of Innovation in Nonformal Education, 3*(6), 1-10.

Kim, M.K., Xie, K., & Cheng, S. L. (2017). Building teacher competency for digital content evaluation. *Teaching and Teacher Education, 66*, 309–324

Kirschner, P.A., Sweller, J., & Clark, R.E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*(2), 75-86.

Knoester, M., & Au, W. (2017). Standardized testing and school segregation: Like tinder for fire? *Race Ethnicity and Education, 20*(1), 1-14.

Knowles, M. (1984). *Andragogy in action*. Jossey-Bass.

Koball, H., & Jiang, Y. (2018). *Basic facts about low-income children: Children under 18 years, 2016*. National Center for Children in Poverty, Columbia University Mailman School of Public Health.

Koehler, M.J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education, 193*(3), 13-19.

Koh, J.H.L., Chai, C.S., & Tsai, C.C. (2014). Demographic factors, TPACK constructs, and teachers' perceptions of constructivist-oriented TPACK. *Educational Technology & Society, 17*(1), 185-196.

Kop, R. (2011). The challenges to connectivist learning on open online networks: Learning experiences during a massive open online course. *The International Review of Research in Open and Distributed Learning, 12*(3), 19-38.

Kop, R., & Fournier, H. (2011). New dimensions to self-directed learning in an open networked learning environment. *International Journal of Self-Directed Learning, 7*(2), 2-20.

Koparan, T., & Guven, B. (2014). The effect of project-based learning on statistical literacy levels of 8th grade students. *European Journal of Educational Research, 3*(3), 145-157.

Kornrich, F., & Fustenberg, F. (2013). Investing in children: Changes in parental spending on children 1972-2007. *Demography, 50*, 1-23.

Kposowa, A.J., & Valdez, A.D. (2013). Student laptop use and scores on standardized tests. *Journal of Educational Computing Research 48*(3), 345-379.

Kuhlich, J. (1970). *An historical overview of the adult self-learner*. Paper presented at the Northwest Institute Conference on Independent Study: The adult as self-learner. University of British Columbia, Vancouver.

Kwakye, I., Kibort-Crocker, E., Lundgren, M., & Pasion, S. (2021). *The digital divide: Examining high-speed internet and computer access for Washington students.* Washington Student Achievement Council. Retrieved from https://files.eric.ed.gov/fulltext/ED613330.pdf

Lacour, M., & Tissington, L. D. (2011). The effects of poverty on academic achievement. *Educational Research and Reviews, 6*, 522–527.

Ladson-Billings, G. (2006). From the achievement gap to the education debt: Understanding achievement in US schools. Educational researcher, 35(7), 3-12.

Ladson-Billings, G. (2009). *The dreamkeepers: Successful teachers of African American children* (2nd ed.). John Wiley & Sons.

Lai, J., & Widmar, N.O. (2020). Revisiting the digital divide in the COVID-19 era. *Applied Economic Perspectives and Policy, 43*(1), 458-464.

Larson, L.C., & Miller, T. N. (2011). 21st century skills: Prepare students for the future. *Kappa Delta Pi Record, 47*(3), 121-123.

Lee, J. S., & Oxelson, E. (2006). “It's not my job”: K–12 teacher attitudes toward students' heritage language maintenance. *Bilingual Research Journal, 30*(2), 453-477.

Le Fevre, D.M. (2014). Barriers to implementing pedagogical change: The role of teachers' perceptions of risk. *Teaching and Teacher Education, 38*, 56-64.

Leeds-Hurwitz, W. (2009). Social construction of reality. *Encyclopedia of communication theory*, 892-895.

Lei, J., & Zhao, Y. (2008). One-to-one computing: What does it bring to schools? *Journal of Educational Computing Research*. *39*(2), 97-122.

Leithwood, K., Harris, A., & Hopkins, D. (2008). Seven strong claims about successful school leadership. *School Leadership & Management, 28*(1), 27-42.

Leithwood, K., Louis, K.S., Anderson, S., & Wahlstrom, K. (2004). *How leadership influences student learning*. Wallace Foundation. Retrieved from http://www.wallacefoundation.org/knowledge-center/school-leadership/key-research/Pages/How-Leadership-Influences-Student-Learning.aspx

Lezotte, L.W. (1991). *Correlates of effective school: The first and second generation*. Effective Schools Products, Ltd.

Lomas, D. (2020). How might data-informed design help reduce the poverty achievement gap? C. Stevens, E. Pakulak, M. Segretin, and S. Lipina, (Eds.). *Neuroscientific Explorations of Poverty* (pp. 267-309). Erice.

Love, B. (2019). Dear white teachers: You can't love your black students if you don't know them. *Education Week, 38*(26), 512-523.

Loveless, T. (2017). *The 2017 Brown Center report on American education: How well are American students learning?* Brookings Institution.

Lunenburg, F.C. (2010). The principal as instructional leader. *National Forum of Educational and Supervision Journal, 27*(4), 1-7.

Lutrick, E., & Szabo, S. (2012). Instructional leaders' beliefs about effective professional development. *Delta Kappa Gamma Bulletin, 78*(3), 6-12.

Mackness, J., & Bell, F. (2015). Rhizo14: A rhizomatic learning cMOOC in sunlight and in shade. *Open Praxis, 7*(1), 25-38

Mackness, J., Waite, M., Roberts, G., & Lovegrove, E. (2013). Learning in a small, task–oriented, connectivist MOOC: Pedagogical issues and implications for higher education. *International Review of Research in Open and Distributed Learning, 14*(4), 140–159.

MacNeil, A.J., Prater, D.L., & Busch, S. (2009). The effects of school culture and climate on student achievement. *International Journal of Leadership in Education, 12*(1), 73-84.

Maninger, R.M., & Holden, M.E. (2009). Put the textbooks away: Preparation and support for a middle school one-to-one laptop initiative. *American Secondary Education, 38*(1), 5-33.

Manuel, D., & Freiman, V. (2017). Differentiating instruction using a virtual environment: A study of mathematical problem posing among gifted and talented learners. *Global Education Review, 4*(1), 78-98.

Marshall, C. (2017). Montessori education: A review of the evidence base. *Science of Learning, 2*(11), 1-19.

Marshall, K. (2009). *Rethinking teacher supervision and evaluation*. John Wiley and Sons.

Martin, A.J., & Dowson, M. (2009). Interpersonal relationships, motivation, engagement, and achievement: Yields for theory, current issues, and educational practice. *Review of Educational Research. 79*(1), 327-365.

Martin, C., Polly, D., Mraz, M., & Algozzine, R. (2018). Teacher perspectives on literacy and mathematics professional development. *Issues in Teacher Education, 27*(1), 94-105.

Marzano, R. (2007). *The art and science of teaching: A comprehensive framework for effective instruction*. Association for Supervision and Curriculum Development.

Marzano, R.J., Frontier, T., & Livingston, D. (2011). *Effective supervision: Supporting the art and science of teaching*. Association for Supervision and Curriculum Development.

Mathis, W.J., & Trujillo, T.M. (2016). *Lessons from NCLB for the Every Student Succeeds Act.* National Education Policy Center. Retrieved from http://nepc.colorado.edu/ publication/lessons-from-NCLB

Maylahn, P. (2018). *CoSN's 2018 annual infrastructure survey report*. Consortium for School Networking. Retrieved from https://www.cosn.org/sites/default/files/CoSNs%202018% 202019 %20Annual%20Infrastructure%20Survey%20Report%20final_0.pdf

McKay, J., & Devlin, M. (2016). "Low income doesn't mean stupid and destined for failure": Challenging the deficit discourse around students from low SES backgrounds in higher education. *International Journal of Inclusive Education, 20*(4), 347–363.

Mellis, S., Carvalho, L., & Thompson, K. (2013). *Applying 21st century constructivist learning theory to stage 4 design projects*. Australian Association for Research in Education.

Mendoza, J.S., Pody, B.S., Lee, S., Kim, M., & McDonough, I.M. (2018). The effect of cellphones on attention and learning: The influences of time, distraction, and nomophobia. *Computers in Human Behavior, 86*, 52-60.

Menzies, V., Hewitt, C., Kokotsaki, D., Collyer, C. & Wiggins, A. (2016). *Project based learning: Evaluation report and executive summary*. School of Education. London, Education Endowment Foundation.

Michelmore, K., & Dynarski, S. (2017). The gap within the gap: Using longitudinal data to understand income differences in achievement. *AERA Open 2017, 3*(1), 1-18.

Milligan, C., Littlejohn, A., & Margaryan, A. (2013). Patterns of engagement in connectivist MOOCs. *MERLOT Journal of Online Learning and Teaching, 9*(2), 149–159.

Milner IV, H.R. (2012). Beyond a test score. *Journal of Black Studies, 43*(6), 693-718.

Mintrop, H., & Sunderman, G.L. (2009). Predictable failure of federal sanctions-driven accountability for school improvement and why we retain it anyway. *Educational Researcher, 38*(5), 353-364.

Mioduser, D., & Betzer, N. (2008). The contribution of project-based-learning to high-achievers' acquisition of technological knowledge and skills. *International Journal of Technology and Design Education, 18*(1), 59-77.

Missouri Community Action Network (2020). *2020 Missouri poverty report*. Retrieved from http://missouripovertyreport.org.

Missouri Department of Elementary and Secondary Education (2018). *Online end-of-course assessments: Guide to interpreting results 2017-18*. Retrieved from https://dese.mo.gov /sites/default/files/asmt-eoc-gir-1718.pdf

Mitchell, C., & Sackney, L. (2009). *Sustainable improvement: Building learning communities that endure*. Sense.

Montessori, M. (1912). *The Montessori method*. Stokes.

Morrissey, T.W., Hutchison, L., & Winsler, A. (2014). Family income, school attendance, and academic achievement in elementary school. *Developmental Psychology, 50*(3), 741–753.

Moynihan, D.P. (1967). The Moynihan Report: The Negro Family: The Case for National Action. In Lee Rainwater and William L. Yancey, *The Moynihan Report and the Politics of Controversy*, pp. 39–124. MIT Press.

Murphy, E. (1997). *Constructivism: From philosophy to practice*. Retrieved from http://www.stemnet.nf.ca/~elmurphy/emurphy/cle.html

The Nation's Report Card (n.d.). *NAEP data explorer*. Retrieved from https://www.nationsreportcard.gov/ndecore/xplore/nde

National Center for Education Statistics (2012). *The nation's report card: Writing 2011* (NCES 2012-470). Institute of Education Sciences, U.S. Department of Education.

National Center for Education Statistics (2015). *Mathematics literacy: School poverty indicator*. Institute of Education Sciences, U.S. Department of Education. Retrieved from https://nces.ed.gov/surveys/pisa/pisa2015/pisa2015highlights_5d.asp

National Center for Education Statistics (2017). *Student access to digital learning resources outside of the classroom* (NCES 2017-098). Institute of Education Sciences, U.S. Department of Education.

National Center for Education Statistics (2019). *The nation's report card: Results from the 2019 mathematics and reading assessments*. Institute of Education Sciences, U.S. Department of Education.

National Center for Learning Disabilities (2020). Significant disproportionality in special education: Current trends and actions for impact. https://www.ncld.org/wp-content/uploads/2020/10/2020-NCLD-Disproportionality_Trends-and-Actions-for-Impact_FINAL-1.pdf

National School Lunch Program (2020). *Federal food assistance program*. Retrieved from https://www.feedingamerica.org/take-action/advocate/federal-hunger-relief-programs/national-school-lunch-program#:~:text=Low%2Dincome%20children%20are%20eligible,qualify%20for%20reduced%2Dprice%20meals.

Neppl, A. (2019). *The correlation between classroom engagement strategies and student behavior* (Master's thesis, Minnesota State University Moorhead). Retrieved from https://red.mnstate.edu/thesis/281

Nie, Y., & Lau, S. (2010). Differential relations of constructivist and didactic instruction to students' cognition, motivation, and achievement. *Learning and Instruction, 20*, 411-423.

No Child Left Behind Act of 2001, P.L. 107-110, 20 U.S.C. § 6319 (2002).

Noguera, P.A. (2011). A broader and bolder approach uses education to break the cycle of poverty. *The Phi Delta Kappan, 93*(3), 8-14.

Olszewski-Kubilius, P., Steenbergen-Hu, S., Thomson, D., & Rosen, R. (2017). Minority achievement gaps in STEM: Findings of a longitudinal study of Project Excite. *Gifted Child Quarterly, 61*, 20-39.

Organization for Economic Co-Operation and Development (2019). *Programme for international student assessment results from PISA 2018*. OECD, Paris. Retrieved from https://www.oecd.org/pisa/publications/PISA2018_CN_USA.pdf

Orlando, J. (2014). Veteran teachers and technology: Change fatigue and knowledge insecurity influence practice. *Teachers and Teaching, 20*(4), 427-439.

Palasigue, J. T. (2009). Integrating whole brain teaching strategies to create a more engaged learning environment. *Online Submission*. Retrieved from https://files.eric.ed.gov/fulltext/ED507407.pdf

Papert, S. (1980). *Mindstorms: Children, computers and powerful ideas*. Basic Books.

Papworth, R. (2016). A multi-disciplinary, social constructivist approach to promoting student engagement, retention and achievement in higher education. *Dialogue, 3*, 52-68

Parker, W.C., Lo, J., Yeo, A.J., Valencia, S.W., Nguyen, D., Abbott, R.D., Nolen, S.B., Bransford, J.D., & Vye, N.H. (2013). Beyond breadth-speed-test: Toward deeper knowing and engagement in an advanced placement course. *American Educational Research Journal, 50*(6), 1424-1459.

Parr, J.M., & Ward, L. (2011). The teacher's laptop as a hub for learning in the classroom. *Journal of Research on Technology in Education*, *44*(1), 53-73.

Partnership for 21st Century Skills (2019). *Framework for 21st century learning definitions*. Washington DC: P21. Retrieved from http://static.battelleforkids.org/documents/p21/P21_Framework_DefinitionsBFK.pdf

Payne, R. (1996). *A framework for understanding poverty*. Aha! Process, Inc.

Penuel, W. (2006). Implementation and effects of one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education, 38*(3), 329–348.

Petko, D. (2012). Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the 'will, skill, tool' model and integrating teachers' constructivist orientations. *Computers & Education, 58*(4), 1351-1359.

Piaget, J. (1937). *The child's construction of reality*. Basic Books.

Piaget, J. (1953). *To understand is to invent*. Grossman.

Picower, B. (2021). *Reading, writing, and racism: Disrupting whiteness in teacher education and in the classroom*. Beacon Press.

Plummer, L. (2012). 1-to-1: Bar none. *T.H.E. Journal, 39*(6), 74-83.

Poonam, S. (2017). Constructivism: A new paradigm in teaching and learning. International *Journal of Academic Research and Development, 2*(4), 183-186.

Porche, M.V., Pallante, D.H., & Snow, C. (2012). Professional development for reading achievement: Results from the collaborative language and literacy instruction project. *The Elementary School Journal, 112*(4), 649-671.

Powell, K.C., & Kalina, C.J. (2009). Cognitive and social constructivism: Developing tools for an effective classroom. *Education, 130*(2), 241-250.

Puentedura, R. (2006). *Transformation, technology, and education*. Retrieved from http://hippasus.com/resources/tte/part1.html.

Rainwater, L., & Yancey, W.L. (1967). *The Moynihan Report and the Politics of Controversy*. MIT Press.

Ravizza, S.M., Uitvlugt, M.G., & Fenn, K.M. (2017). Logged in and zoned out: How laptop Internet use relates to classroom learning. *Psychological Science, 28*(2), 171-180.

Reardon, S.F. (2011). The widening achievement gap between the rich and the poor: New evidence and possible explanations. In G.J. Duncan & R.J. Murnane (Eds.), *Whither opportunity? Rising inequality, school and children's life chances* (pp. 91-116). Russell Sage Foundation.

Reardon, S.F. (2013). The widening income achievement gap. *Educational Leadership, 70*(8), 10-16.

Rehmat, A., & Bailey, J. (2014). Technology integration in a science classroom: Preservice teachers' perceptions. *Journal of Science Education & Technology, 23*(6), 744-755.

Rideout, V.J., & Katz, V.S. (2016). *Opportunity for all? Technology and learning in lower-income families*. A report of the Families and Media Project. The Joan Ganz Cooney Center at Sesame Workshop.

Risko, E.F., Buchanan, D., Medimorec, S., & Kingstone, A. (2013). Everyday attention: Mind wandering and computer use during lectures. *Computers & Education, 68*, 275-283.

Rivkin, S. (2016). Desegregation since the Coleman report: Racial composition of schools and student learning. *Education Next, 16*(2), 29-37.

Robinson, S. A. (2020). Culturally Responsive Representation in Graphic Novels Matter for African American Boys with Reading Disability. *Journal of African American Males in Education, 11*(1), 23-36.

Robinson, V. (2011). *Student-centered leadership*. Jossey-Bass.

Rofesky, A., & Opfer, D. (2012). Learning 21st-century skills requires 21st-century teaching. *Phi Delta Kappan, 94*(2), 8-13.

Rose, T. (2016). *The end of average: How we succeed in a world that values sameness*. HarperOne.

Rosen, Y. & Beck-Hill, D. (2012). Intertwining digital content and a one-to-one laptop environment in teaching and learning: Lessons from the time to know program. *Journal of Research on Technology in Education, 44*(3), 225-241.

Roth, K.J., Wilson, C.D., Taylor, J.A., Stuhlsatz, M.A., & Hvidsten, C. (2019). Comparing the effects of analysis-of-practice and content-based professional development on teacher and student outcomes in science. *American Educational Research Journal, 56*(4), 1217-1253.

Rothstein, R. (2008). Whose problem is poverty? *Educational Leadership, 65*(7), 8-13.

Rumberger, R. (2015). *Student mobility: Causes, consequences, and solutions*. National Education Policy Center.

Ryan, C., & Lewis, J.M. (2017). Computer and internet use in the United States: 2015. *American Community Survey Reports*. United States Census Bureau.

Ryan, R.M., & Deci, E. L. (2009). Promoting self-determined school engagement: Motivation, learning, and well-being. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook on motivation at school*. (pp. 171-196). Routledge

Saeed, S., & Zyngier, D. (2012). How motivation influences student engagement: A qualitative case study. *Journal of Education and Learning, 1*(2), 252–267.

Samatova, G. (2019). Effectiveness of classroom technology. In R. Draut (Ed.), *Bridge to science: Research works* (pp. 83-85). B&M Publishing.

Sana, F., Weston, T., & Cepeda, N.J. (2013). Laptop multitasking hinders classroom learning for both users and nearby peers. *Computers & Education, 62*, 24-31.

Saphier, J. (1993). *How to make supervision and evaluation really work: Supervision and evaluation in the context of strengthening school culture*. Research for Better Teaching, Inc.

Saunders, W.L. (1992). The constructivist perspective: Implications and teaching strategies for science. *School Science Mathematics, 92*(3), 136-141.

Saunders-Stewart, K. S., Gyles, P. D. T., Shore, B. M., & Bracewell, R. J. (2015). Student outcomes in inquiry: students' perspectives. *Learning Environments Research: An International Journal, 18*(2), 289–311.

Savasci, F., & Berlin, D.F. (2012). Science teacher beliefs and classroom practice related to constructivism in different school settings. *Journal of Science Teacher Education, 23*(1), 65-86.

Schafft, K. (2006). Poverty, residential mobility, and student transiency within a rural New York school district. *Rural Sociology, 71*(2), 212-231.

Schaffhauser, D. (2016, January 19). Report: Education tech spending on the rise. *THE Journal.* Retrieved from https://thejournal.com/articles/2016/01/19/report-education-tech-spending-on-the-rise.aspx

Scheer, A., Noweski, C., & Meinel, C. (2012). Transforming constructivist learning into action: Design thinking in education. *Design and Technology Education: An International Journal, 17*(3), 8-19.

Schein, E.H. (1985). How culture forms, develops, and changes. In R.H. Kilmann, M.J. Saxton, R. Serpa (Eds.). *Gaining control of the corporate culture* (pp. 17-43). Josey-Bass.

Schell, G.P., & Janicki, T.J. (2012). Online course pedagogy and the constructivist learning model. *Journal of the Southern Association for Information Systems, 1*(1), 26-36.

Schildkamp, K. (2019). Data-based decision-making for school improvement: Research insight and gaps. *Educational Research, 61*(3), 257-273.

Schoen, C., Radley, D., Riley, P., Lippa, J., Berenson, J., Dermody, C., & Shih, A. (2015). *Health in the two Americas*. Retrieved from http://www.commonwealthfund.org/%7E/ media/files/publications/fundreport/2013/ sep/1700_schoen_low_income_scorecard_full_report_final_v4.pdf

Schwartz, A. E., Hopkins, B. G., & Stiefel, L. (2021). The effects of special education on the academic performance of students with learning disabilities. *Journal of Policy Analysis and Management, 40*(2), 480–520.

Schwartz, D.L., Lindgren, L., & Lewis, S. (2009). Constructivism in an age of non-constructivist assessments. In Tobias, S. & Duffy, T. (Eds.), *Constructivist theory applied to instruction: Success or failure?* Taylor and Francis.

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, *2*(1), 151-158.

Siemens, G. (2020). Connectivism: A learning theory for the digital age. In A. Ottenbreit-Leftwich & R. Kimmons (Eds.), *The K-12 Educational Technology Handbook*. EdTech Books. https://edtechbooks.org/-dio

Semega, J., Kollar, M., Creamer, J., & Mohanty, A. (2019). *Income and poverty in the United States: 2018*. United States Census Bureau.

Shah, R.K. (2019). Effective constructivist teaching in the classroom. *Shanlax International Journal of Education, 7*(4),1–13.

Shapley, K., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2010). Evaluating the implementation fidelity of technology immersion and its relationship with student achievement. *Journal of Technology, Learning and Assessment, 9*(4), 4-68.

Shapley, K., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2011). Effects of technology immersion on middle school students' learning opportunities and achievement. *The Journal of Educational Research, 104*(5), 299-315.

Shepherd, A.C., & Taylor, R.T. (2019). An analysis of factors which influence high school administrators' readiness and confidence to provide digital instructional leadership. *International Journal of Educational Leadership Preparation, 14*(1), 52-76.

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, *2*(1), 1-9.

Silvernail, D.L., & Gravelle, P. (2008). Condition of k-12 public education in Maine 2008. *Maine Education Policy Research Institute, 94*, 1-84.

Silvernail, D.L., & Gritter, A.K. (2008). *Maine's middle school laptop program: Creating better writers*. Retrieved from http://maine.gov/mlti/resources/Impact_on_Student_ Writing_Brief.pdf

Silvernail, D. L., Pinkham, C. A., Wintle, S. E., Walker, L. C., & Bartlett, C. L. (2011). *A middle school one-to-one laptop program: The Maine experience*. Maine Policy Education Institute, University of Southern Maine. Retrieved from https://usm.maine.edu/sites/ default/files/cepare/A_Middle _School_ One-to-One_Laptop_Program_the_Maine_ Experience.pdf

Smidt, H., Thornton, M., & Abhari, K. (2017). The future of social learning. A novel approach to connectivism. In *Proceedings of the 50th Hawaii international conference on system sciences*. https://scholarspace.manoa.hawaii.edu/bitstream/10125/41410/ paper0261.pdf

Smith, L., Dockrell, J., & Tomlinson, P. (Eds.). (1997). *Piaget, Vygotsky and beyond*. Routledge.

Snellman, K., Silva, J., Frederick, C.B., & Putnam, R.D. (2015). The engagement gap: Social mobility and extracurricular participation among American youth. *Annals of the American Academy of Political and Social Science, 657*(1), 194-207.

Snyder, R.R. (2017). Resistance to change among veteran teachers: Providing voice for more effective engagement. *International Journal of Educational Leadership Preparation, 12*(1), 1-14.

Soland, J., & Sandilos, L. E. (2021). English language learners, self-efficacy, and the achievement gap: Understanding the relationship between academic and social-emotional growth. *Journal of Education for Students Placed at Risk* (JESPAR), *26*(1), 20-44.

Stanley, R.K. (2015). *1:1 laptop initiative and teacher practice change: An exploratory study of constructivist teaching practice* (Doctoral dissertation, University of Kansas). Retrieved from https://kuscholarworks.ku.edu

Stelitano, L., Doan, S., Woo, A., Diliberti, M., Kaufman, J. H., & Henry, D. (2020). *The digital divide and COVID-19: Teachers' perceptions of inequities in students' internet access and participation in remote learning*. Insights from the American Educator Panels [Research Report No. RR-A134-3]. RAND Corporation.

Suárez, N., Regueiro, B., Estévez, I., del Mar Ferradás, M., Guisande, M. A., & Rodríguez, S. (2019). Individual precursors of student homework behavioral engagement: The role of intrinsic motivation, perceived homework utility and homework attitude. *Frontiers in Psychology*, *10*, 941.

Suhr, K.A., Hernandez, D.A., Warschauer, M., & Grimes, D. (2010). Laptops and fourth-grade literacy: Assisting the jump over the fourth-grade slump. *Journal of Technology, Learning and Assessment, 9*(5), 1-45.

Summers, E.J., & Dickinson, G. (2012). A longitudinal investigation of project-based instruction and student achievement in high school social studies. *Interdisciplinary Journal of Problem-Based Learning, 6*(1), 82-103.

Swanson, R.A., & Holton III, E.F. (2005). *Research in organizations: Foundations and methods of inquiry*. Berrett-Koehler Publishers.

Szech, L. (2021). How the funds of knowledge theory shifted teachers' dominant narratives of family involvement. *School Community Journal, 31*(1), 149-170.

Tallvid, M. (2014). Understanding teachers' reluctance to the pedagogical use of ICT in the 1:1 classroom. *Education and Information Technology, 21*(3), 53-519.

Tate, T., & Warschauer, M. (2022) Equity in online learning, *Educational Psychologist, 57*(3), 192-206

Taylor, H. (2015, December 3). Google's chromebooks make up half of US classroom devices sold. *CNBC*. Retrieved from https://www.cnbc.com/2015/12/03/googles-chromebooks-make-up-half-of-us-classroom-devices.html

Taylor, K., & Silver, L. (2019). *Smartphone ownership is growing rapidly around the world, but not always equally*. Pew Research Center.

Teo, T., Huang, F., & Hoi, C. K. W. (2018). Explicating the influences that explain intention to use technology among English teachers in China. *Interactive Learning Environments, 26*(4), 460-475.

Tetard, F., & Patokorpi, E. (2008). *A theoretical framework for mobile learning and e-inclusion in Finland*. ICIS 2008 Proceedings. Paper 52. Retrieved from http://aisel.aisnet.org/icis2008/52

Thannimalai, R., & Raman, A. (2018). The influence of principals' technology leadership and professional development on teachers' technology integration in secondary schools. *Malaysian Journal of Learning and Instruction, 15*(1), 201-226.

The Abell Foundation. (2008). *One-to-one computing in public schools: Lessons from "laptops for all" programs*. Retrieved from https://files.eric.ed.gov/fulltext/ED505074.pdf

Thomas, T., Alexander, K., Jackson, R., & Abrami, P.C. (2013). The differential effects of interactive versus didactic pedagogy using computer-assistant instruction. *Journal Educational Computing Research, 49*(4), 403-436.

Thompson, S., Meyers, J. & Oshima, T. (2011). Student mobility and its implications for schools' AYP. *The Journal of Negro Education, 80*(1), 12-21.

Thompson, V. (2016). *How can behavior affect academics for students*? Retrieved from http://everydaylife.globalpost.com/can-behavior-affect-academics-students9290.html

Tileston, D., & Darling, S. (2008). *Why culture counts: Teaching children of poverty.* Solution Tree.

Toraman, C., & Demir, E. (2016). The effect of constructivism on attitudes towards lessons: A meta-analysis study. *Eurasian Journal of Educational Research, 62*, 115-142.

Tschofen, C., & Mackness, J. (2012). Connectivism and dimensions of individual experience. *International Review of Research in Open and Distributed Learning, 13*(1), 124–143.

Tullis, J.G., & Benjamin, A.S. (2011). On the effectiveness of self-paced learning. *Journal of Memory and Language, 64*(2), 109-118.

Ultanir, E. (2012). An epistemological glance at the constructivist approach: Constructivist learning in Dewey, Piaget, and Montessori. *International Journal of Instruction, 5*(2), 195-212.

United States Census Bureau (1994). *Geographic areas reference manual*. Retrieved from https://www2.census.gov/geo/pdfs/reference/ GARM/Ch13GARM.pdf

United States Census Bureau (2017). *American community survey 1-year estimates, poverty status in the past 12 months*. Washington, D.C.: United States Census Bureau. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/ productview.xhtml?pid=ACS_17_5YR_S1702&prodType=table

United States Census Bureau (2019). *Poverty thresholds by size of family and number of children* [Spreadsheet]. Retrieved from https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html

United States Department of Agriculture (2020). *Child nutrition programs: Income eligibility guidelines.* Retrieved from https://www.fns.usda.gov/cnp/fr-032019

Uro, G., & Lai, D. (2019). *English Language Learners in America's great city schools: Demographics, achievement, and staffing*. Council of the Great City Schools.

Utecht, J., & Keller, D. (2019). Becoming relevant again: Applying connectivism learning theory to today's classrooms. *Critical Questions in Education, 10*(2), 107-119.

Vaill, P.B. (1996). *Learning as a way of being: Strategies for survival in a world of permanent white water*. Jossey-Bass.

Valencia, R.R. (1997). Introduction. In R. R. Valencia (Ed.), *The evolution of deficit thinking* (pp. ix-xvii). Falmer.

Valencia, R. R. (2010). *Dismantling contemporary deficit thinking: Educational thought and practice*. Routledge.

VanGronigen, B.A., & Meyers, C.V. (2019). How state education agencies are administering school turnaround efforts: 15 years after no child left behind. *Educational Policy, 33*(3), 423-452.

Van't Hooft, M., & Swan, K. (Eds.) (2007). *Ubiquitous computing in education: Invisible technology, visible impact*. Routledge.

Varier, D., Dumke, E.K., Abrams, L.M., Conklin, S.B., Barnes, J.S., & Hoover, N.R. (2017). Potential of one-to-one technologies in the classroom: Teachers and students weigh in. *Educational Technology Research and Development, 65*(4), 967-992.

Vavrus, M. (2008). Culturally responsive teaching. In T. L. Good (Ed.), *21st century education: A reference handbook* (pp. 49–77). Sage.

Vigdor, J.L., Ladd, H.F., & Martinez, E. (2014). Scaling the digital divide: Home computer technology and student achievement. *Economic Inquiry, 52*(3), 1103-1119.

Vongkulluksn, V.W., Xie, K., & Bowman, M. A. (2018). The role of value on teachers' internalization of external barriers and externalization of personal beliefs for classroom technology integration. *Computers & Education, 118*(3), 70-81.

Vygotsky, L.S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Vygotsky, L.S. (1986). *Thought and language* (A. Kozulin, Trans.). The MIT Press.

Vygotsky, L.S. (1997). *Educational psychology* (R. Silverman, Trans.). St. Lucie Press.

Wachira, P., & Mburu, J. (2017). Culturally responsive mathematics teaching and constructivism: Preparing teachers for diverse classrooms. *Multicultural Learning and Teaching, 14*(1), 17-48.

Walker, L., Rockman, S., & Chessler, M. (2000). *A more complex picture: Laptop use and impact in the context of changing home and school access*. Retrieved from https:// rockman.com/docs/downloads/microsoft-anytime-anywhere-evaluation.pdf

Walter, C., & Briggs, J. (2012). *What professional development makes the most difference to teachers.* Oxford University Press.

Wang, Z., Anderson, T., & Chen, L. (2018). How learners participate in connectivist learning: An analysis of the interaction traces from a cMOOC. *International Review of Research in Open and Distributed Learning, 19*(1), 45-67.

Wang, M.C., Haertel, G.D., & Walberg, H.J. (1997). Learning influences. In H.G. Walberg & G. Haertel (Eds.). *Psychology and educational practice* (p. 199-211). McCutchan.

Wang, M.T., & Degol, J. (2014). Staying engaged: Knowledge and research needs in student engagement. *Child development perspectives, 8*(3), 137-143.

Warschauer, M. (2016). Addressing the social envelope: Education and the digital divide. In Greenhow, C., Sonnevend, J., and Agur, C. (Eds.), *Education and social media: Toward a digital future* (p. 29-48). MIT Press.

Warschauer, M., & Ames, M. (2010). Can one laptop per child save the world's poor? *Journal of International Affairs, 64*(1), 33-51.

Warschauer, M., Zheng, B., Niiya, M., Cotten, S., & Farkas, G. (2014). Balancing the one-to-

one equation: Equity and access in three laptop programs. *Equity & Excellence in Education, 47*(1), 46-62.

Weber, E.G. (2012). *The impact of one-to-one laptop computer program on the literacy achievement of eight-grade students with differing measured cognitive skill levels who are eligible and not eligible for free or reduced price lunch program participation* (Doctoral dissertation, University of Nebraska-Omaha). Retrieved from ProQuest Dissertations and Theses Database. (ProQuest Number 3504211).

Weers, A.J. (2012). *The impact of socioeconomic status on achievement of high school students participating in a one-to-one laptop computer program* (Doctoral Dissertation, University of Nebraska-Omaha). Retrieved from ProQuest Dissertations and Theses Database. (ProQuest Number 3504212).

Weston, M.E., & Bain, A. (2010). The end of techno-critique: The naked truth about 1:1 laptop initiatives and educational change. *The Journal of Technology, Learning, and Assessment, 9*(6), 5-25.

Whalan, F. (2012). *Collective responsibility: Redefining what falls between the cracks for school reform*. Sense.

Whewell, E., Caldwell, H., Frydenberg, M., & Andone, D. (2022). Changemakers as digital makers: Connecting and co-creating. *Education and Information Technologies, 27*(5), 6691–6713.

Wijnia, L., Loyens, S.M., van Gog, T., Derous, E., & Schmidt, H.G. (2014). Is there a role for direct instruction in problem-based learning? Comparing student-constructed versus integrated model answers. *Learning and Instruction, 34*, 22-31.

Williams, C. (2007). Research methods. *Journal of Business & Economic Research, 5*(3), 65-72.

Wilson, A. (2017, October 4). DESE throws out two tests tied to Missouri schools' APR. *Hannibal Courier-Post.* Retrieved from https://www.hannibal.net/archive/article/dese-throws-out-two-tests-tied-to-missouri-schools-apr/article_f7efa95e-4ab0-5b42-acd0-5c94dda3df50.html.

Wilson, J., & Hunt, J. H. (2022). Marginalized within the margins: Supporting mathematics meaning making among students with learning disabilities. *The Journal of Mathematical Behavior, 67*, 100982. https://doi.org/10.1016/j.jmathb.2022.100982

Wise, A.F., & O'Neill, K. (2009). Beyond more versus less: A reframing of the debate on instructional guidance. In S. Tobias & T.M. Duffy (Eds.), *Constructivist instruction: Success or failure?* (pp. 82-105). Routledge.

Wivell, J., & Day, S. (2015). Blended learning and teaching: Synergy in action. *Advances in Social Work and Welfare Education*, *17*(2), 86-99.

Wongwatkit, C., Thongsibsong, N., Chomngern, T. & Thavorn, S. (2023). The future of connectivist learning with the potential of emerging technologies and AI in Thailand: Trends, applications, and challenges in shaping education. *Journal of Learning Sciences and Education, 2*(1), 122–154.

Wood, D., Halfon, N., Scarla, D., Newacheck, P., & Nessim, S. (1993). Impact of family relocation on children's growth, development, school function, and behavior. *Journal of the American Medical Association, 270*(11), 1334-1338.

Woolfolk, A., & Margetts, K. (2007). *Educational psychology*. Pearson Education.

Wrigley, C., & Straker, K. (2017). Design thinking pedagogy: The educational design ladder. *Innovations in Education and Teaching International, 54*(4), 374-385.

Yoders, S. (2014). Constructivism Theory and Use from 21st Century Perspective. *Journal of Applied Learning Technology*, *4*(3), 12-20.

Youngs, P., & King, M.B. (2002). Principal leadership for professional development to build school capacity. *Educational Administration Quarterly, 38*(5), 643-670.

Zepeda, S.J. (2013). *Professional development that works* (2nd ed.). Routledge.

Zheng, B., Warschauer, M., & Farkas, G. (2013). Digital writing and diversity: The effects of school laptop programs on literacy processes and outcomes. *Journal of Educational Computing Research, 48*(3), 267–299.

Zheng, B., Warschauer, M., Lin, C. & Chang, C. (2016). Learning in one-to-one laptop environments: A meta-analysis and research synthesis. *Review of Educational Research, 20*(10), 1-33.

Zuber, E.N., & Anderson, J. (2013). The initial response of secondary mathematics teachers to a one-to-one laptop program. *Mathematics Education Research Journal, 25*(2), 279-298.

Zucker, A. (2004). Developing a research agenda for ubiquitous computing in schools. *Journal of Educational Computing Research, 30*(4), 371–386.

Zucker, A. A., & Hug, S. T. (2007). *A study of the 1:1 laptop program at the Denver School of Science & Technology*. Denver School of Science and Technology.

Zulela, M.S., & Rachmadtullah, R. (2019). Constructivism approach in learning to write narrative at elementary school. *Advances in Social Science, Education, and Humanities Research, 178*, 287-290.

VITA

Mark Louis Rorvig was born on May 30, 1983 in Columbia, Missouri. He grew up and attended kindergarten through 12th grade at Odessa High School in Odessa, Missouri. After completing high school, he attended William Jewell College in Liberty, MO where he graduated with a bachelor's degree in business administration.

After completing his undergraduate work, he decided to enter the field of education and completed courses at the University of Central Missouri to earn certification to teach business education. After student teaching, he accepted his first teaching position at Harrisonville High School as a Personal Finance teacher and assistant basketball coach. During his time in the classroom, he completed his master's degree in secondary education administration through the University of Central Missouri and took on several different coaching positions. After eight years as a teacher and coach at Harrisonville High School, Mark transitioned into an administrative role within the high school, as he was hired as the Assistant Principal. He served in this role for seven years before being named as the building principal of Harrisonville High School.

Mr. Rorvig continues to enjoy his work in this field and proudly serving the community in which he works. He looks forward to the continued progress and growth of the school as they work to become a model for other buildings and districts in the area.