8-2022

A Mixed Methods Investigation of Third Grade Academic Achievement Data: Pre- and Post-Google Chromebook Usage in a Midwest Elementary School

Brittany Powell

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by

Brittany Powell

A Dissertation submitted to the Education Faculty of Lindenwood University

In partial fulfillment of the requirements for the

Degree of

Doctor of Education

School of Education

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This dissertation has been approved in partial fulfillment of the requirements for the

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at Lindenwood University by the School of Education

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Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work here at Lindenwood University and that I have not submitted it for any other college or university course or degree here or elsewhere.

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Acknowledgments

First and foremost, praises and thanks to God for His showers of blessing throughout the duration of my research work.

Secondly, I would like to express my sincere gratitude to my dissertation chair, Dr. Robyne Elder for her patience, motivation, encouragement, and immense knowledge. I could not have completed this journey without her. I would also like to thank Drs. Nasser and Steffes for being a part of my committee.

Next, I would like to thank my ever so patient son, Kyle Jr. I have been in school as long as he has been alive and he has never complained.

Lastly, but certainly not least, I'd like to thank my friends and family that encouraged me to keep going when I wanted to give up, held me accountable when I tried to procrastinate, and supported me as I accomplished my wildest dream.

Abstract

Technology in the educational setting has evolved drastically over the last few decades and continues to currently evolve. As technology advances, best practices for teaching and learning, standardized testing, and curriculum also must evolve. The purpose of this study aimed to fill the gap of the lack of research regarding the possible differences in academic achievement data, pre- and post-Google Chromebooks usage. The researcher investigated educators' and administrators' perceptions of technology by conducting in-person interviews at the conclusion of the two-year study. The analysis of qualitative data, gathered from all interviews and researcher journal entries, fell into various thematic categories, including simplified delivery of instruction, tailored individual learning, and collaboration with peers. Participants in the study were third-grade teachers and administrators at a Midwest Elementary School. Academic achievement data in the form of pre- and post-Google Chromebook usage from third-grade students at a Midwest Elementary School were collected and analyzed. Results from the study revealed a significant increase in academic achievement data in the second year of implementation. In consideration of these findings, recommendations for future studies include expanding the study to include academic achievement data from multiple elementary schools within and outside of the same district, as well as increasing the number of educator and administrator interviewees. Such research could provide a more thorough insight into the possible benefits of Google Chromebook usage, as well as educator and administrator perceptions of technology.

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Chapter One: Introduction

Introduction

At the beginning of this study, school districts were just beginning to investigate best practices in technology usage. However, while school districts researched, there was a massive move toward increased technology use in the classroom. For example, iPad classroom usage in the school was becoming increasingly popular. In addition, a new device called a Google Chromebook had just been unveiled and was making its debut in the educational setting.

At the time of this writing, a pandemic ravaged the country. COVID-19, also known as Coronavirus, overwhelmed the nation in the early parts of March 2020. Specifically, drastic changes were made on brief notice to the education system. As the pandemic became more widespread, schools began to shut down. By the end of March, over 100,000 public and private schools were shut down, and more than 50 million students had to make the shift to virtual learning (*Map: Coronavirus and school closures in 2019-2020*,2021, para. 1). This unexpected change completely transformed the delivery method for instruction and the makeup of classrooms across the nation.

Although the researcher completed this study pre-pandemic, the study's implications may have specific information that can assist school districts and teachers. When the pandemic surfaced in March 2020, the study site moved to a completely virtual setting. As a result, instruction moved to a wholly digital environment where Google Chromebooks served as an essential tool used by students to connect with their teachers and classmates. Since students were already using Google Chromebooks daily, it made the transition to virtual learning less daunting. School districts were scrambling to ensure

that all students had equitable access to the Internet, to access the newly formed virtual classrooms. It was evident that technology use amid the pandemic was more of a triage situation. Now that the pandemic is exhibiting signs of its departure, school districts are trying to gain insight into the appropriate level of technology use.

Technology exists in every aspect of our world, including education. Teachers are expected to prepare their students to be influential users of technology in the classroom and prepare them for future career prospects that may depend on technological competency. As the demand for technology increases, schools across the nation are investigating ways to ensure that they are prepared to accommodate the needs of all students.

Advancements in technology have allowed teachers to streamline instructional materials and reach students wherever they are. Smartboards are large interactive boards that project computer screens or learning materials underneath a document camera. iPads and tablets are handheld devices that students and teachers can navigate digital resources and learning tools. Google created a Chromebook computer that is both cost-effective and novice user-friendly. This device can adequately allow for collaboration between teachers and students. Except for the Smartboard, all these devices can be used at an alternate location. Students having access to their devices encourages participation and fosters collaboration. Students can work on assignments simultaneously without the restraint of having to share devices or wait for a peer to complete their portion.

Technology has changed drastically over the years, and these advancements helped lessen the impact of the pandemic. Before the pandemic, many students used technological devices in their classrooms daily. However, teachers had to quickly educate

themselves on converting their lessons to a completely virtual format. This study aimed to determine differences in student achievement pre- and post-Google Chromebook usage. The researcher also investigated teachers' and principals' perceptions of technology, specifically Google Chromebook usage, standardized testing, and professional development. The research explored these topics in the literature review.

Rationale of the Study

At the time of this study, third-grade students in this particular Midwest elementary school were assigned Google Chromebooks to use throughout the day to access learning materials. In the classroom setting, the Chromebooks are used for various supplemental curricular activities such as web-based reading programs, math fact practice drill websites, etc. These digital resources are designed to reinforce skills taught during instruction. Essentially, Google Chromebooks provide students with the tools to navigate the wide variety of digital resources available to suit their individual needs. The researcher investigated the possible differences in academic achievement data pre- and post-Google Chromebooks usage.

"With the worldwide reach of the internet and the ubiquity of smart devices that can connect to it, a new age of anytime anywhere education is dawning" (Purdue University Online, n.d., para. 5). Therefore, the researcher believes that preparing students for an ever-changing world is imperative. Traditional classrooms are evolving into a technology-dependent settings. In the current literature, there is a vast amount of research on the effectiveness of iPads in the classroom. However, little research has been conducted on Google Chromebooks in the classroom. Apple Classrooms of Tomorrow-

Today (ACOT2, 2008) stated that having readily available access to technology and a multidisciplinary approach to instruction will enhance teaching and learning.

Research has shown that using iPads in the classroom has the potential to increase students' engagement. For example, when iPads were integrated into daily instruction, many students read more quickly, were more eager to conduct research, and learned how to use keyboards to write and edit their work on the iPads (Ingle & Moorehead, 2016, para. 11). One of the significant factors documented in the effective use of iPads in the classroom was teacher preparedness with iPad use. The study conducted by Henderson and Yeow (2012) investigated the implementation of one-to-one iPads in primary school (para. 1). In their research, they discussed the positive benefits of implementing iPads in the classroom; however, in the discussion of their study, their results showed the need for teacher development on the appropriate and effective use of the iPads.

> Interviews with teachers and IT staff conclude that the iPad's main strengths are its quick and easy access to information for students and the support it provides for collaboration. However, staff needs to carefully manage both the teaching and the administrative environment in which the iPad is used, and we provide some lessons learned that could help other schools consider adopting the iPad in the classroom. (Henderson & Yeow, 2012, para. 1)

The study conducted by Henderson and Yeow (2012) discussed the importance of teacher development or professional development in implementing iPads in the classroom. The researcher examined whether the same is true for Google Chromebooks.

Purpose of Study

This mixed-methods study investigated third-grade student academic achievement pre- and post-Google Chromebook usage. The researcher also explored the perceptions of teachers and administrators on the use of Google Chromebooks in a third-grade setting. Finally, this study also aimed to investigate whether educators should integrate technology into their instruction more frequently.

To investigate technology usage and student academic achievement, the researcher completed journal entries daily, detailing the frequency and duration of student Chromebook usage. In addition, the researcher analyzed MAP data from the 2015-2016, 2016-2017, and 2017-2018 school years collected from the Missouri Department of Elementary and Secondary Education (MO DESE) website. In 2015-2016, students did not have Google Chromebooks, but had access to eight desktop computers. Google Chromebooks were introduced to students during the 2016-2017 school year. Therefore, the study examined academic achievement pre- and-post-Chromebook usage.

The researcher also transcribed responses to a series of interview questions given to three third-grade teachers and two administrators who were employees of the school where the research took place. By having face-to-face, individual conversations with three classroom teachers and two administrators with varying levels of educational experience, the researcher gathered their perceptions on Google Chromebook Usage. After analyzing the interview responses for commonalities, the researcher was able to offer feedback to the district on how to improve current technology integration expectations.

The Midwestern elementary school involved in the study was located in suburban St. Louis, Missouri. The community consisted of a supportive group of people that took pride in their school. This was evident among the 100 volunteers that worked in the school consistently. The number of staff and teachers with advanced degrees had been steadily increasing. Most of the teachers who had not obtained an advanced degree were pursuing one.

The Midwestern elementary school offered a diverse population of students from many countries, including India, Pakistan, Ukraine, Bosnia, China, and Mexico. Most students were Caucasian, with Asian students making up the second largest group. A small group of students was African American and mainly came from the Voluntary Transfer Program. Approximately 10% of the students qualified for the Free/Reduced Lunch Program. This school historically and presently met AYP in Communication Arts and Mathematics. However, there was an evident achievement gap, between African-American students and those receiving Free and Reduced Lunch services. This gap was being addressed by having Professional Learning Communities create smart goals at each grade level to analyze areas of deficiency.

Questions and Hypotheses

Research Question 1: How do teachers and administrators perceive technology relates to academic achievement?

Research Question 2: How do teachers and administrators perceive the use of Chromebooks in a K-5 public school setting?

Research Question 3: What supports do students need to be technologically independent in the classroom?

Research Question 4: What commonalities are formed when the frequency and duration of student usage of Google Chromebooks are observed and compared with MAP scores and unit benchmarks assessments?

Hypothesis 1a: There is a difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017).

Hypothesis 1b: There is a difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2017-2018).

Hypothesis 2a: There is a difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017).

Hypothesis 2b: There is a difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2017-2018).

Study Limitations

As a result of the MAP Test format and test material changing year-to-year, the results have proven difficult to correlate. During the 2015-2016 school year, the MAP test format was converted from a paper-pencil test with answers recorded via Scantron to a computer-based assessment program. At the same time that a new testing format was introduced, the government also rolled out new state standards. These new standards replaced decades-old learning standards.

> The exams are expected to be more difficult than the traditional spring standardized state exams they replace. In some states, they'll require hours of additional testing time because students will have to do more than just fill in the bubble. The goal is to test students on critical thinking skills, requiring them to describe their reasoning and solve problems. (Hefling & Carr Smith, 2015, p. 1, para. 4)

As with the inception of any new program, a few years are needed to iron out logistics. According to Bock (2015), "The combination of changes in one year have the potential to create not only technical glitches but also to cause a decrease in the percentage of students statewide who pass" (p. 1). Several states reported cyber-attacks, login problems, and technical glitches. Herold (2016) reported that emerging evidence suggested that students who take the paper-pencil version of tests perform better than peers who took the same test online.

Another limitation was the number of participants in the study. The researcher was a third-grade teacher at the study site. Since the focus of the study was concentrated on third-grade academic achievement data and perceptions of technology, the participants included three third-grade teachers and two administrators. All of the participants were employed at the study site. Although the participants had a wide range of teaching and administrative experience, their responses were subjective. Additionally, with only five participants, the perceptions of technology were limited.

Definition of Terms

Asynchronous Learning- For the purpose of this study, Asynchronous Learning is defined as, a method of instruction where teachers upload assignments to a digital platform for students to complete independently.

COVID-19 (Coronavirus)- For the purpose of this study, COVID-19 (Coronavirus) is defined as, a very contagious and deadly virus that sparked a worldwide pandemic.

Google Chromebook- A Chromebook is a laptop that runs Google's Chrome OS operating system and is designed to run cloud-based applications and store data online (Google, n.d., para. 1).

Hybrid Learning- "An educational approach that combines face-to-face classes and online learning" (*Hybrid Learning and Hybrid Education*, 2021, para. 3).

Missouri Assessment Program (MAP)- "The MAP assessments test students' progress toward mastery of the Missouri Show-Me Standards" (Missouri Department of Elementary and Secondary Education, 2017, para. 2).

One-to-One- For this study, each student is given their Chromebook for the duration of the school year as opposed to sharing a class set.

Pandemic- For the purpose of this study, a Pandemic is defined as, the spreading of disease worldwide.

Parkway Access and Reporting System (PARS)- Parkway School District's student academic achievement data reporting system.

Remote Learning- "Remote learning provides an opportunity for students and teachers to remain connected and engaged with the content while working from their homes" (Ray, 2020, para. 6).

Synchronous Learning- For the purpose of this study, Synchronous Learning is defined as, a method of instruction where teachers instruct students via an online conferencing platform.

Technology Integration- For this study, incorporating technology into daily instruction.

Voluntary Transfer Program- For the purpose of this study, the Voluntary Transfer Program is defined as, a program that allows non-residential students that reside in a poor-performing school district to attend school in a satisfactory performing district.

Wi-Fi Hot Spot - For the purpose of this study, a Wi-Fi Hot Spot is defined as, a mobile device that uses wireless data from a cellular provider to give Internet access to phones, computers, tablets, and other Wi-Fi enabled devices.

Summary

The purpose of this study aimed to fill the gap of the lack of research regarding the possible differences in academic achievement data pre- and post-Google Chromebooks usage. According to Kposowa and Valdez (2013), "A review of the extant literature by Penuel (2006) found only 12 studies on classroom laptops, and of these, only one appeared in a peer-reviewed journal" (para. 6). Although there is emerging research on iPads in the classrooms, there is currently little research on Chromebooks. Additionally, of the research conducted, there were not solid recommendations or conclusions based on their findings. However, according to research, there was evidence that iPads effectively enhance learning by providing students with quick and easy access to information and allowing for collaboration. This study examined whether the same is true for Google Chromebooks. Although currently in their design, iPads and

Chromebooks are similar in their capabilities, a few distinctive features led to differences in the effectiveness of classroom use amongst students. For instance, iPads have flat screens that utilize onscreen keyboards, whereas Chromebooks more closely resemble laptops with separate screens and keyboards. In addition, iPad screens display tiles composed of downloaded apps that students tap the screen to access. Chromebook screens utilize browsers like Google Chrome, where students type in web addresses. Additionally, toddlers are introduced to tablet-like devices, such as iPads much more frequently than they are to Chromebooks.

The researcher conducted various interviews with third-grade teachers and elementary principals. The purpose of interviewing this select group of individuals was to gain the perspective of those working closely alongside the targeted students involved in the study. The researcher also kept a journal that detailed observations of student Chromebook usage in the classroom. Finally, the researcher also collected and analyzed MAP data to check for trends. In the next chapter, the researcher will discuss the literature that currently exists on the topic of this dissertation.

Chapter Two: Review of Literature

History of Technology in Education

As teachers, the main priority is to prepare students to become curious, competent, and caring citizens of an ever-changing world. Advances in technology have helped streamline the vital job that teachers have. Technology allows teachers to differentiate to meet the needs of all students in a more efficient manner than ever before. Research has shown that technology is a powerful tool that puts students at the center of their learning.

> Another great benefit that iPads and laptops have is accommodating each student's unique learning style and meeting the needs of learners with disabilities. In a traditional classroom, educators teach to the masses, and students with a learning disability may have trouble focusing or not getting the attention from the teacher they need. However, in a 1:1 classroom or through virtual learning, some apps can meet the needs of all students, which will help keep them engaged. For example, students with dyslexia can use the voice-to-text feature. The freedom to have an individualized approach tailored to each student's needs is a specific benefit to keeping students engaged and participating in their education. (Cox, 2013, para. 3)

However, students have not always had this type of access to innovative technology. Teachers are putting students in the driver's seat, while riding along with them to help facilitate as required, by giving students the equipment they need to be successful. In addition, technology has changed drastically over the last few decades and has become more beneficial and necessary for student learning.

An Ever-Changing World

Haselhorst (2017) found that as the demand for technology increases, the capabilities and functions of technology expand and technology's role in education and society. Students growing up in the current generation have vast technology available at their fingertips. Technology has completely changed the exchange of communication. Teachers can communicate with their students using the Internet in the classroom setting. If a student is absent for a prolonged time, the student can access the curriculum and assignments via computer.

Additionally, the way students research has changed drastically. Students previously had to enter a library and synthesize paper resources to research a topic. Currently, students can access research from anywhere, globally via a computer with Internet access. Technological proficiency is essential in preparing students for an ever-changing world. As Hicks (2011) reported, almost every job requires technology in some capacity.

This chapter begins with a summarized historical overview of technology in education in several countries. The researcher then investigates previous case studies on examinations into the impact technology has had on student engagement and instruction. Although technology has dwelled in education for some time, little research exists about one-to-one Chromebooks. Many variables contribute to academic achievement: teacher perception of Chromebooks in the classroom, educational level, life at home, technological fluency, academic instruction, and student motivation.

Technology has been a cornerstone in the educational setting for centuries. "In the Colonial years, teachers used wooden paddles with printed lessons called Horn-Books to

assist students in learning verses" (Purdue University Online, n.d, para. 2). As technology has evolved, researchers and scientists have found ways to develop programs to keep learners engaged, while still fulfilling their educational purpose. "The history of technology is very complex because of the very complicated relationship between the physical and functional nature of technology, the designers and the users, the connection between technological and societal factors affecting the evolution of technology" (Hallström & Gyberg, 2009, p. 10). Technology is a system made up of many intertwined components to achieve a common purpose of connecting people and enhancing many aspects of daily life and has evolved over many years.

The magic lantern: Two hundred years after the Colonial years, the Magic Lantern was invented (Purdue University Online, n.d.). The magic lantern had the same capabilities as a slide projector. In addition, the Magic Lantern projected images onto glass plates (Purdue University Online, n.d.). The chalkboard replaced the Magic Lantern two decades later.

The chalkboard: The chalkboard gave teachers a much simpler way to share information with the entire class. Teachers also could erase information and write new information (Our ICT, 2015). While the teacher wrote on the chalkboard, the students used slates to solve calculations. Unfortunately, the slates could not hold lengthy assignments (Our ICT, 2015). For almost 100 years, the chalkboard served as the most efficient method of displaying information for students.

The radio: Before the 1920s, the chalkboard allowed students to view information simultaneously if the introduction of radios, students could access on-air classes, as long as they were in listening range (Purdue University Online, n.d.).

Innovative inventions, like the radio, eliminated the limitation of students' access to instruction. In addition, the radio gave teachers the ability to develop radio programs specifically focused on the content taught in class (Koon, 1933). Radios sparked the trend and provided an avenue for people from various places to connect.

The overhead projector: The overhead projector, introduced in 1930, enabled teachers to display information for all students to view, like the chalkboard. However, the overhead projector utilized transparencies created ahead of time. Another benefit of the overhead projector was that it allowed the teacher to face the class instead of the board. (Barroso, 2018). This added benefit encouraged enriched communication and participation.

The videotape: Purdue University Online (n.d.) reported that videotapes were an engaging tool for teachers to deliver instruction. The invention of videotapes helped present information on various topics in a new and highly intriguing way. Additionally, teachers could present information to their students that they prerecorded at home (Fabos, 2004). These advances in technology steadily improved the educational setting.

Skinner testing machine: B. F. Skinner invented the Skinner Testing Machine in 1953. This machine taught students skills and then asked them to identify the students' answers. If a student answered a question correctly, they would get a treat dispensed from the machine. On the other hand, if a student answered incorrectly, the device was programmed to continue on a skill until mastery was reached (Skinner, 1958). As a result of this machine, students gained immediate feedback.

Scantron: Although the Skinner Testing Machine provided students with immediate feedback, it was not efficient. Purdue University Online (n.d.) reported that

Michael Sokolski invented the Scantron in 1972. The Scantron was a device that would allow teachers to grade multiple-choice test questions quickly and accurately.

Photocopier: The photocopier, introduced in 1959, allowed teachers to produce a large volume of documents without simply writing out each paper by hand. Before introducing photocopiers, teachers had to write out multiple copies of the same manuscript to hand out to their students. Teachers being able to make copies of documents quickly freed up class note-taking time and left room for more interactive teaching practices. "The photocopier has changed educational practices by improving literacy and learning due to the ability to create accurate diagrams and worksheets" (Thompson, 2015, para. 10).

Personal digital assistant: Apple began selling PDAs in 1992. Steele (2021) defined a PDA as, “A personal digital assistant is a small, mobile, handheld device that provides computing and information storage and capabilities for personal or business use” (para. 1). Original services for personal digital assistants included calendar and address book storage and retrieval and note-taking capabilities. SRI International conducted a study to prove that PDAs improve the learning process. The study showed PDAs helped teachers organize calendars and phones. PDAs also helped students collect data, write papers, check facts, synch data with desktops and laptops, and collaborate on projects. Dean (2002) shared the results of SRI International’s survey from their study that observed that 89% of teachers found the PDAs to be an efficient teaching tool for teachers. Ninety-three percent believed the PDAs could positively affect students’ learning, and 90% intended to maintain PDA use after the conclusion of the study. Despite affirmative perceptions of PDA usage in education, most teachers expressed that

additional applications were crucial to augment the benefits of PDAs. The results of the study were overall positive and promising.

Early Technology in Education

In the 1960s, Swiss psychologists Jean Piaget and Papert developed a program that allowed children to write and debug programs. Other inventions were soon discovered that enhanced educational practices. In the late 1600s, German mathematician and philosopher Gottfried Wilhelm Leibniz invented a more advanced machine, which he named the Leibniz Stepped Reckoner. This mechanized machine executed multiplication and addition by performing repetitive addition (Norman, 2014, para. 1). The fact that this machine could store and register memory made it a catalyst in the advancement of technology. "Neither the abacus nor the mechanical calculators constructed by Pascal and Leibniz qualified as computers," according to (Woodford, 2021, p. 3). A calculator allows humans to calculate sums quickly. A computer functions as a machine that does not need human involvement to operate.

Charles Babbage designed Analytical Engines that were more complex and advanced than their predecessors. These engines could calculate numbers with up to 31 digits and can formulate any polynomial up to the seventh order. In addition, more inventors refined earlier inventions to align with changing needs as technology advanced. According to Woodford (2021), "Toward the end of the 19th century, other inventors were more successful in their efforts to construct "engines" of calculation" (para. 10). For example, Herman Hollerith invented a faster and more efficient tabulator than earlier models. However, Hollerith realized that his machine had other applications, so he

decided to sell it commercially and changed the company's name to International Business Machines (IBM).

The first large-scale digital computer appeared in 1944 at Harvard University, built by mathematician Howard Aiken (*Timeline of Computer History*, n.d., para. 2). In the 1940s, most computer machines were designed to suit military needs. The first fully electronic computer was called the Colossus (Copeland, n.d., para. 1). Most people were unaware of computers in the early 1940s. One of the limitations of the Colossus was that it was designed to break codes. Therefore, it was difficult to be reprogrammed to serve other purposes.

According to UNIVAC (2010), Universal Automatic Computer (UNIVAC) became the world's first large-scale commercial computer (para. 1). Although the UNIVAC was designed to be an electronic digital device, this large computer used thousands of vacuum tubes for computation. Even with technology advancing at rapid speeds, the machines were unreliable. Vacuum tubes were a considerable advance on relay switches (Swaine & Freiberger, 2014). However, these vacuum tubes consumed abundant energy, electricity, and space. Eventually, transistors were invented. Woodford (2021) reported that the transistors were “much smaller than vacuum tubes, used no power, and were much more reliable" (para. 21). Machines that used transistors had to be wired by hand to be connected, which led to many errors and costly labor. Robert Noyce developed an automated way to link the segments in an integrated circuit, as concluded by Practical Monolithic Integrated Circuit (n.d.).

In the 1960s, Lawrence Roberts refined structures that led to the development of Interface Message Processors (IMPs). Shortly after, in the 1970s, Roberts designed a

program that was used to send and receive electronic mail. As reported by Leiner et al. (2021), “Roberts expanded its utility by writing the first email utility program to list, selectively read, file, forward, and respond to messages” (p. 4).

In 1977, Steve Wozniak created the world's first easy-to-use home 'microcomputer,' as Woodford (2021) reported. Before the invention of computers, a straightforward calculator was used to do basic calculations. The article, "Trusted ICT Support for schools & IT Solutions for the Education Sector,” reported that in 1977, Apple debuted a new and improved version of the Apple desktop computer, which allowed students to access computer games to practice skills in math and social studies (para. 26). Around this time, personal computers were more widely used in collegiate and business settings. However, schools were beginning to see an influx of computer usage in the elementary sector. Williamson (2021) reported that computers became great inventions in the latter part of the 20th century (para. 1).

Apple spearheaded a technological revolution by donating almost 9,000 Apple IIe machines to schools in California in 1983 (Watters, 2015, para. 13). Apple IIe was the third model of personal computer manufactured by Apple Computer. In addition, Steve Jobs launched an initiative called, "Kids Can't Wait," dedicated to providing children with competitive programming knowledge (McLester, 2017, para. 5). As word quickly spread, public school systems and universities began exploring the possible benefits of using personal computers by investing hundreds of millions of dollars in computer systems, software programs, and accessories (Edwards, 2015, para. 1).

Advances in Technology

To explore the rising technology phenomenon, school districts worldwide began to delve into potential ways to integrate technology into their school. One of the most cost-effective ways was creating computer labs filled with shared computers for student usage. Computer labs provided students with equitable access to technology that they otherwise would not have been able to afford. The labs featured scanners and graphic design software and a gateway to the robust research resource, the World Wide Web (Poggi, 2021, para. 3). The computer labs became a popular place for students to convene to complete work in a designated space. By 2018, however, computer labs were quickly becoming a thing of the past. Instead, students as young as elementary age have technology at their disposal right in their classrooms.

As the need for computer labs dwindled, school districts started dedicating more funds to tech education investments. Wireless and cellular access increased, and as a result, students were no longer bound to a specific location, but could choose to work in any equipped area (Poggi, 2021, para. 10). Many analysts noted significant advantages that make laptops more favorable devices over desktop computers in school settings, including reduced computer-to-student ratios, increased home-to-school correspondence, and increased accessibility (as cited in Kposowa & Valdez, 2013).

In 1985, a technology company, Toshiba, initiated the evolution of personal computers in the classroom by releasing the first mass-marketed laptop, the T1100 (Purdue University Online, n.d.). Although the T1100 laptops only included basic features, they were IBM compatible, operated off of rechargeable batteries, and were light enough for students to transport (Bennett, 2005). Teachers could use the computers

to deliver instruction with object-oriented multimedia authoring tools and videodiscs (California State University Long Beach, 2008). Furthermore, "simulations, educational databases and other types of CAI programs are being delivered on CD-ROM disks, many with animation and sound," which allowed teachers to brighten their students' horizons on the endless educational possibilities that they otherwise would not have been exposed to (California State University Long Beach, 2008, para. 26). Laptops provided students and teachers with the option to type information instead of handwriting, making revisions much less time-consuming and tedious.

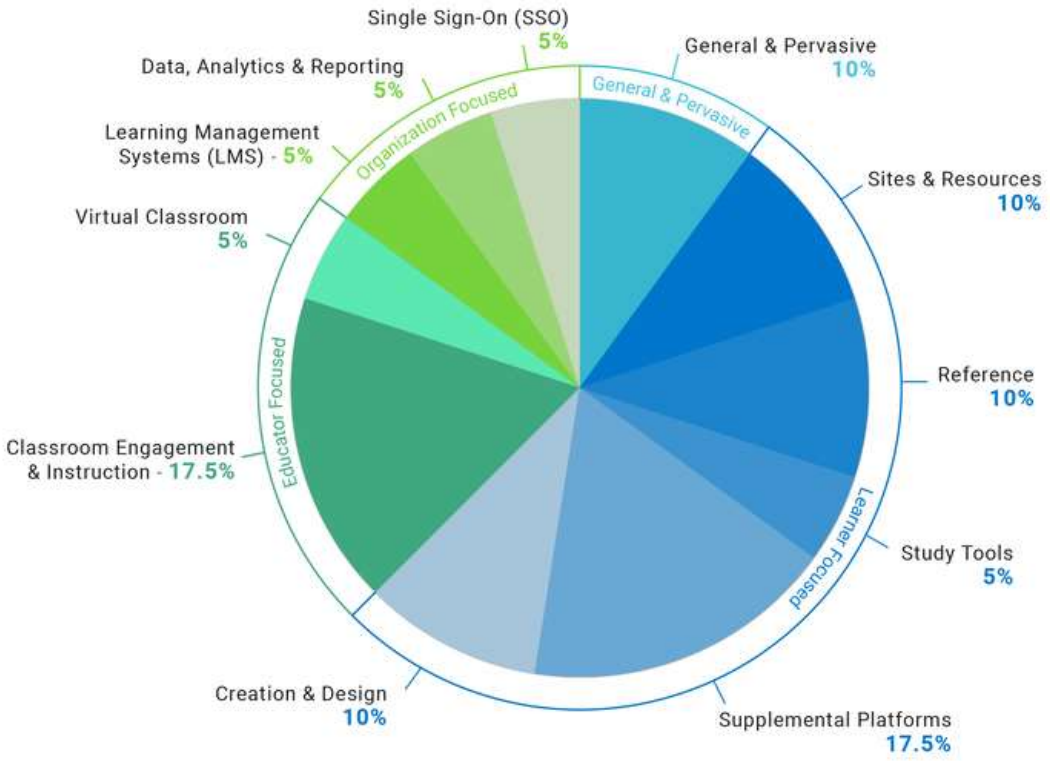
As early as 1988, schools began implementing programs that explicitly provided students with laptops. Around the 1990s, private schools began requiring students to own or have access to laptops (Belanger, 2002). As technology became more widespread, schools realized the endless opportunities computers provide. Schools quickly saw the benefits that computers offered and how they changed instruction delivery and sharing. Belanger (2002) found, “Many schools with laptops, however, remain positive and enthusiastic about the changes observed and benefits their students derive from access to portable computers" (para. 12). Early on, researchers began to look into the possible improvements that computers could make to the traditional educational setting.

The World Wide Web, also known as the Internet, was launched in 1993 when a British researcher developed Hypertext Markup Language or HTML (Purdue University Online, n.d.). The onset of the Internet opened up many possibilities for teaching and learning. The Internet allowed teachers and students to access digital content and information almost instantaneously. Students no longer had to wait until the teacher was available to get the answer to a question; they could simply look it up themselves. This

freed up the teacher's time and allowed for more differentiation. Communication also changed as a result of the Internet. As long as a person had internet access, the distance was no longer an issue. In the classroom, teachers were able to communicate with students about classwork, homework, and give feedback, and students were able to collaborate on projects and presentations (Hamdan et al., 2013).

Figure 1

Digital Tools Accessed by United States Students and Educators via the Internet in 2021



Note: Source: *School year 2020-2021: EdTech Top 40 Report*. (Learn Platform, n.d.).

Learning Management Systems

Brush (2019) defined a learning management system (LMS) as a software application or web-based technology used to plan, implement and assess a specific learning process (para 1). Learning management systems consisted of two components: a

server that executes the base functionality and a user interface that is managed by teachers, students, and administrators (Brush, 2019). Learning management systems provide instructors with a means to design and share curriculum content, gauge student participation, and assess student performance. Learning management systems also provide students with the ability to access interactive features, such as threaded discussions, live video conferencing, and discussion forums. As Brush (2019) explained, "Some popular learning management systems used by education institutions include Moodle, Blackboard, and Schoology (para. 6).

Moodle

About Moodle described Moodle as "a digital platform designed to equip teachers, administrators and students with a secure and integrated system to initiate personalized learning environments" (n.d., para. 1). Using Moodle, teachers setup online courses, add assignments, and track student progress. A major benefit is this program can be accessed using a mobile device. Teachers have the capability to upload assignments, grade student work, and give feedback without opening their computer. Students are able to submit work, check grades, and contact their instructor using a mobile device.

Blackboard

"Blackboard Learn is an application for online teaching, learning, community building, and knowledge sharing" (*What is Blackboard Learn*, 2021). This application allows teachers to post course content, grade assignments, interact with students in discussions, and launch Collaborate sessions. Blackboard also allows students to complete assignments and tests, engage in discussions, and view grades. This platform can also be accessed via mobile device.

Schoology

"Schoology is a digital integrated platform that houses learning management, assessment, and professional development" (Schoology, 2020). Educators can add assignments, and tests to their Schoology pages. Students can access class assignments, tests, and practice skills with educational applications. These applications allow teachers to efficiently give teachers a deeper insight into student performance.

Flipping the Classroom

"Flipping the classroom" essentially means that students read or watch lecture videos at home before the in-class lesson. Teachers are then able to assist students as they delve deeper into problem-solving, discussion, or debates during class time.

> In terms of Bloom's revised taxonomy (2001), this means that students are doing the lower levels of cognitive work (gaining knowledge and comprehension) outside of class, and focusing on the higher forms of cognitive work (application, analysis, synthesis, and/or evaluation) in class, where they have the support of their peers and instructor. This model contrasts from the traditional model in which "first exposure" occurs via lecture in class, with students assimilating knowledge through homework; thus, the term "flipped classroom." (Brame, 2013, para. 2)

Deslauriers et al. (2011) described the study conducted by Carl Weiman and colleagues that proved that flipping the classroom can promote significant academic achievement growth. Weiman and colleagues compared two sections of a large physics class. The classes were both taught using standard interactive lecture methods throughout the semester. Near the end of the semester, one section was "flipped," with first exposure to

new material occurring before class via reading assignments and quizzes, and class time dedicated to small group discussion of clicker questions and written response questions. Instead of a traditional lecture, students in the experimental group partook in a discussion supported by specific instructor feedback. Teachers encouraged students in the control group to read over their assignment before class and directed them to answer similar clicker questions for the summative assessment, but were given the option of whether or not to participate in the active learning exercises during class time. "During the experiment, student engagement increased in the experimental section (from 45 +/- 5% to 85 +/- 5% as assessed by four trained observers) but did not change in the control section" (Brame, 2013, para. 9). Brame (2013) reported,

> At the conclusion of the experimental week, students answered multiple choice questions, subsequently showing an average of score of 41 +/- 1% in the control classroom and 74 +/- 1% in the "flipped" classroom, with an effect size of 2.5 standard deviations." (para. 9)

Through this study, Weiman and his colleagues demonstrated that a "flipped" classroom led to massive gains in student learning.

Validity and Perception of Standardized Tests

History of Standardized Tests (2020) recalled standardized tests have been used in education since the 19th Century. After the No Child Left Behind Act (NCLB) mandated yearly achievement testing for all the states in America, the use of standardized testing skyrocketed.

> Standardized tests are defined by W. James Popham, EdD, former President of the American Educational Research Association, as "any test that's administered,

> scored, and interpreted in a standard, predetermined manner." The tests often have multiple-choice questions that can be quickly graded by automated test scoring machines. Some tests also incorporate open-ended questions that require human grading. (*History of Standardized Tests*, 2020, para. 5)

Of all the different types of standardized tests in circulation, high-stakes achievement tests garnered the most attention. Proponents of standardized testing argued that the tests offer an objective measurement of education and an adequate way to indicate areas of growth, as well as supply schools with meaningful data to assist students in marginalized groups. Proponents also argued that the scores are effective in predicting college and job success. Contrarily, opponents argued that standardized tests lack reliability in measuring meaningful progress, only evaluate students' test-taking skills, and are not indicators of future success. However, both groups agreed that standardized tests are useful measures for teacher evaluations. The pressure to perform well on these assessments can be extensive. *History of Standardized Tests* (2020) explained,

> These assessments carry important consequences for students, teachers, and schools: low scores can prevent a student from progressing to the next grade level, or lead to teacher firings and school closures, while high scores ensure continued federal and local funding and are used to reward teachers and administrators with bonus payments. (para. 6)

As with most initiatives, school districts desire to explore the impact of their investments. For example, Kposowa and Valdez (2013) shared the results of a study conducted by Dunleavy and Heinecke (2007), which focused on the impact of one-to-one laptop use on middle school mathematics and science standardized test scores using a pre-test/post-test

control group design Kposowa and Valdez (2013, para. 5). "The researchers found no compelling effect for mathematics, but they found that one-to-one laptop instruction was more effective in increasing science achievement for male students than for female students" (Dunleavy & Heinecke, 2007, p. 15).

A similar study conducted by Lei and Zhao (2007) focused on the impact of computers on grade point average. Lei and Zhao (2007) examined the outcome of a laptop project developed at a middle school in Ohio in the Fall of 2003 (Kposowa & Valdez, 2013, p. 350). "The outcome variable utilized in the study was grade point average (GPA)" (Kposowa & Valdez, 2013, p. 350). In regression analysis, Lei and Zhao (2007) found that three hours per day was the threshold (p. 288). For instance, in groups of students who used computers fewer than three hours a day, increasing their time spent on computers increased their GPA. Coincidentally, students who used computers for longer than three hours per day saw a decrease in their GPA (Kposowa & Valdez, 2013, p. 350).

Findings from the Lei and Zhao (2007) study alluded to the fact that some law of diminishing returns may be in effect, whereby computer use benefits reach a threshold of three hours, but any length longer than that can cause benefits to turn into deficits (Kposowa & Valdez, 2013, para 12). A potential way that computers can assist students in increasing their overall achievement is that they can aid students in learning problem-solving skills, communication skills, and research skills (Kposowa & Valdez, 2013, p. 374). Barron et al. (2003) found in their study of technology investigation in K-12 schools that computer integration and its use as a problem-solving tool was statistically significant (p. 501). "The same result holds for the association between computers and

their use as a research tool" (Kposowa & Valdez, 2013, p. 374). These studies recommend that public policies to increase frequent laptop use in elementary schools can raise student academic achievement.

Best Practices for Teaching and Learning

Highly regarded educational researchers Hattie and Marzano detailed eight teaching strategies that had the biggest impact on student achievement. The first teaching strategy that Hattie and Marzano agreed on is clear lesson expectations and goals is one of the most potent influences on student achievement (as cited in Killian, 2021). Students must identify and understand the end goal of the lesson. Marzano also found that posing questions at the beginning of the lesson is an effective method to focus students. Killian (2021) provided an example of such questioning: “How do you add mixed fractions with different denominators? That’s what you must know by the end of this lesson” (para. 4). Hattie also suggested posing questions before the lesson. “What do I already know that will help me achieve these goals” (as cited in Killian, 2021, para. 4). Questions like these give students a specific focus for the lesson and encourage critical thinking.

The second teaching strategy the educational researchers agreed on is offering overt instruction. Overt instruction involves explicitly teaching a carefully organized curriculum, with built-in opportunities for cumulative practice.

> Hattie highlighted the power of giving students worked examples when explaining how to multi-step tasks. Marzano also highlights the importance of giving examples and non-examples (similarities and differences) of the concept you are teaching. For example, when teaching prime numbers, it would be useful

> to highlight 2 as an example, and 9, 15 and 21 as non-examples to avoid confusion with odd numbers. (Killian, 2021, para. 8)

Providing students with completed examples allows students to easily compare their independent work to the sample to determine if they are on the right track. The third teaching strategy agreed upon by Marzano and Hattie is centered around engagement (as cited in Killian, 2021). The educational researchers explain that students need to make connections with new material and prior knowledge. By actively linking new and old information, students can confirm prior understanding and clear up misconceptions if necessary. Both Hattie and Marzano described the value of notetaking. Marzano found that asking students to recall information that was just taught by asking basic questions was key to how well they retained the material. Marzano was also a proponent of the use of graphic organizers. Asking students to complete graphic organizers detailing how information is connected, activates deeper levels of critical thinking.

Marzano and Hattie's fourth teaching strategy identified giving feedback as one of the best practices for teaching and learning (as cited in Killian, 2021). Marzano carefully explained that feedback should be given to students while there is still time to make improvements. Essentially, feedback should be given before a formal assessment or conclusion of a topic. Hattie somewhat agreed but offered the alternative that struggling students benefit from immediate feedback whereas proficient students benefit from delayed feedback. According to Killian (2021), "Hattie also highlighted that feedback is a two-way street, where student results tell the teacher the degree to which their efforts are working (or not). When teachers see feedback this way, it has an even larger impact on their students' subsequent results" (para. 17). Teachers using students' results as a

measure of the degree to which students retained and can apply the skills taught is essential in all aspects of teaching.

The fifth teaching strategy Marzano and Hattie referenced centered on multiple exposures (as cited in Killian, 2021). Using this method, students can internalize the information to a greater degree. Hattie revealed the significance of techniques such as rehearsal and review. Rehearsal means consistently repeating new material until achieving quick recall while review involves studying previously learned material. Hattie also emphasized the importance of allowing students to spend time practicing newly acquired skills. “When spaced out over time, Hattie found that having students practice things led to a 26-percentile improvement in their marks” (Killian, 2021, para. 20) The sixth teaching strategy identified by Marzano and Hattie concentrated on assisting students with applying knowledge by a deductive process (as cited in Killian, 2021). Marzano found that teaching students how to think deductively and providing them with guided practice in doing so helps them deepen their understanding. According to Killian (2021), Hattie reiterated deductive processes such as asking students to apply their learning to particular scenarios are much more powerful than inductive teaching which refers to asking students to apply general application from observing specific scenarios.

Marzano and Hattie’s seventh teaching strategy highlighted the benefit of peer collaboration. Killian (2021) reported, “The use of cooperative learning groups adds value to whole-class instruction (d = 0.41) and to individual work (d = 0.59-0.78)” (para. 25). However, Marzano and Hattie cautioned that group work should not replace whole-class instruction or individual work. For cooperative learning groups to be effective, students must be well versed on the topic or skill they are asked to collaborate on. If

students lack sufficient understanding of a topic or skill, it is unlikely that they will be able to make meaningful contributions to their group. Marzano and Hattie agreed that an effective cooperative learning group must be structured intentionally, consist of small groups of students, and include students that can work productively.

The last teaching strategy outlined by Marzano and Hattie delves into the importance of building students' self-efficacy (as cited in Killian, 2021). The American Psychological Association defined self-efficacy as, "An individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments" (American Psychological Association, n.d., para. 1). Marzano and Hattie explained that students' self-efficacy heavily impacted their ensuing performance. Killian (2021) shared, "Students who believed they would master fractions were more likely to do so, while students who saw themselves as poor readers were less likely to improve their reading" (para. 30). Marzano's review of research explained that teachers can help increase students' self-efficacy by providing them with praise and instilling in them that they are capable of achieving success. Hattie presented the notion that self-efficacy and achievement are interdependent. This notion suggests that when students perform well, their self-efficacy is likely to increase and as their self-efficacy increases, they perform better. Both Hattie and Marzano have made significant contributions to teaching and learning and their strategies continue to have a positive impact on classroom instruction.

Numerous studies reported that the effectiveness of computers in raising student achievement depends on teachers (Pflaum, 2004; Zheng et al., 2016). Although technology can enhance education exponentially, the teacher's incorporation of technology determines the beneficial effects. Initial educational experiences were

minimal. The majority of the instruction was teacher-led, and the students responded to questions in chorus. According to Cuban (1993), "Teachers told students when they should sit, stand, where they should hang their coats, and when they should turn their heads" (para. 8). In the following years, technological changes needed to keep up with instructional changes, that new updates or modifications were regularly occurring. Firmin and Genesi (2013) have evidence that "In fact, during the late 1990s, new technologies were being invented and designed almost monthly" (para. 4). Researchers avidly sought ways to transform education through their latest products during this time. "In today's fast-paced world of technological applications to teaching, the tools and media of instruction are constantly evolving" (as cited by Purdue University Online, n.d., para. 7).

These discoveries promised innovations for technology in the classroom. According to Pflaum (2004), one of the promises of the benefits of technology was that classrooms would be student-centered and that instruction on the computers would be tailored to fit individual students' needs. New insights into best practices for student achievement suggested that traditional education that focuses on regurgitating information and following specific directions in a prescribed order needs to be replaced. Lam and Lawrence (2002) concluded that technology gives learners ownership of their learning and provides them with resources. When utilizing technology, teachers become facilitators instead of direct instructors. Still, of more importance is the quality of the activities done, such as doing homework versus playing computer games, writing or taking notes versus emailing friends, and researching for educational purposes versus visiting a non-academic website (Kposowa & Valdez, 2013, para. 13). Educators must consider the students' learning styles. Once that is evident, educators can more easily

determine whether a new gadget or digital platform will enhance or impede active learning. According to Goodwin (2018), it might be time to put technology aside, encourage students to think about their education and write notes manually.

However, some analysts contend that computers may hinder or serve as a diversion (as cited in Kposowa & Valdez, 2013). One path to hindrance noted by some observers is the possible use of computers by students on non-curricular related matters, such as playing video games/computer games, sending email, visiting chat rooms, surfing the Internet for fun, and so on (as cited in Kposowa & Valdez, 2013). Therefore, teachers need proper training to gauge participation and hold students accountable. In addition, students need a specific purpose for using the computer, such as completing assignments and researching information.

Disadvantages of Technology

During Pflaum's (2004) quest to uncover the realities that schools face, he noted several detrimental observations. Pflaum (2004) found that out of every 45-minute lab class, most of the time set aside for computer use was spent logging in, finding the correct program, and turning the computer off. Computers are a technological tool. Pflaum (2004) insisted that teacher training is essential and mandatory for technology to be integrated with fidelity. Pflaum interviewed the school principal where the study was conducted to gain his perception of technology. The principal shared that technology is the main reason students show up to school. Although it was evident throughout the study that technology is vital to the future of both students and staff, there were still necessary technological advances. After his research, Pflaum (2004) reported that students were not frequently immersed in technology-based learning to make a measurable difference in

academic achievement. Technology is increasingly becoming a part of all aspects of life; therefore, technology must be used in the education of students. Herold (2016) pointed out that despite massive investments made by numerous school systems, the evidence that digital learning has the potential to improve student outcomes or narrow achievement gaps remains sparse, at best.

Technology has increasingly provided many advancements and conveniences over the years. The benefits that technology has brought about are insurmountable. However, this phenomenon may come as a detriment to young technology users. Pappas (2020) reported that excluding time spent on schoolwork or homework, Common Sense Media found that eight to 12-year-olds in the United States spend almost five hours per day on screens for entertainment purposes, and 13 to 18-year-olds spend nearly eight hours per day on screens for entertainment purposes (para. 21). With technology usage being so mainstream, the opportunity for over-usage is inevitable. One area that may be negatively affected by increased technology usage is social skills. Increased technology usage might hinder children's ability to interact appropriately with peers face-to-face, as reported by Ortiz (2018, para. 4). Excessive technology use could also impede the development of children's communication skills to express themselves adequately. Tierney (2020) agreed that communication and collaboration are essential skills for students to develop, increased technology usage could hinder the development of these traits. Even though technology has consistently proven its benefits in the classroom and at home, it appears to leave kids socially stunted due to its excessive use, possibly damaging a child’s overall social, emotional, and physical development (Yu, 2012). Social communication and interaction are especially limited when children spend an excessive

amount of time online. Parents and educators should model pertinent social communication skills as permitting a child to neglect proper social development by partaking in exorbitant screen time will harm the child in the future (Healy, 2004). Developing appropriate social communication is a critical human skill. The increase in time spent online is making people more connected but feel less connected.

Another detriment of technology is children's inconsistent ability to identify inappropriate content. Peas (2019) reported that adolescents lack awareness about the online risks even though some of them have engaged with inappropriate content or have experienced pop-ups and integrated purchases (Marano et al., 2008). Children do not understand the ways they are impacted by technology. Behrman and Shields (2000) pointed out that playing violent video games and computer games has a direct correlation to aggression and heightened hostility in children. They also cautioned that excessive use of becoming more gaming technology can cloud children's perception of reality.

Due to the increase in digital note-taking, students are accustomed to receiving information without processing it. The detriment then becomes students who cannot think critically to process information effectively (Osborne, 2019, para. 16). Mueller and Oppenheimer (2014) from Princeton University shared the results of their experiments that yielded the same findings: "Laptop note takers' tendency to transcribe lectures verbatim rather than processing information and reframing it in their own words is detrimental to learning" (para. 1). Mueller and Oppenheimer (2014) concluded that the process of reflection in handwriting is interconnected to better memory recall. When students stop writing, they stop processing and become passive receivers of information. When they become passive receivers of information, they also become passive thinkers.

Mueller and Oppenheimer (2014) assessed whether students at Princeton University understood and retained more information in lecture-based learning when manually scribing notes or by computer. After their study, they found:

> Laptop use can negatively affect performance on educational assessments, even- or perhaps primarily- when the computer is used for easier note-taking. Although more notes are beneficial, at least to a point, if the messages are taken indiscriminately or by mindlessly transcribing content, as is more likely the case on a laptop than when notes are taken longhand, the benefit disappears. Despite their growing popularity, laptops may be doing more harm in classrooms than good. (Mueller & Oppenheimer, 2014, p. 16)

When students are not actively thinking about what they are recording, they are less likely to remember it. For example, a study conducted by James and Engelhardt (2012) asked 15 children in Indiana to write, trace, or type letters, while having their brains scanned, and found that manually writing letters activated the visual processing regions of the brain more than typing letters on the computer (as cited in Goodwin, 2018, p. 4).

Although student collaboration can significantly benefit technology in the classroom, it can also be a drawback. If students that perform on various levels collaborate on group work, this can pose challenges. For example, Tierney (2020) explained that if one student is academically higher than another student in their group, valuable group time may be spent educating and answering questions rather than collaborating.

One of the inconveniences of one-to-one Chromebook usage is teachers' heavy reliance on a properly working infrastructure. Internet issues pose a problem and a major interruption in the learning process. For teachers that have converted the majority of their lessons to a digital format, the lack of a stable Internet signal is imperative. Teachers and administrators in this study agree that technology has greatly enhanced the delivery of lessons.

Teachers and parents may worry that technology could encourage students to develop bad habits such as cheating. Tierney (2020) shared:

> Teachers often appreciate the many ways technology can expand students' worldviews. From Google Maps to virtual museum exhibits to primary source films, technology connects students to other places and times in ways that wouldn't otherwise be possible. Students can access any information they want, which may not always be good. (p. 21)

With technology at their fingertips, students are used to finding answers to questions with the click of a button. Unfortunately, this may be detrimental when students are expected to recall skills without assistance.

Teacher Perceptions of Technology and Professional Development

When technology was first introduced into the classroom, skepticism clouded teachers' thoughts and views on how technology could enhance their teaching. Cope and Ward (2002) concluded that teachers' perceptions about technology in general and their effectiveness as technology users directly impact the type and amount of technology used in their classrooms (para. 4). Professional development is necessary for teachers to enhance technology usage. Multiple researchers agreed that a lack of sufficient, effective

professional development would hinder teachers from using technology to its full capabilities (Johnson et al., 2016) New teachers usually have more experience with technology than veteran teachers. Even if school districts were only to hire teachers proficient in current classroom technology, additional training would be necessary due to constant technological updates (Johnson et al., 2016). This finding further supported the need for ongoing professional development. Cope and Ward (2002) found experienced teachers who had little or no professional development centered around integrating technology were less likely to benefit from technology usage and use it in the classroom. It is important to note that the professional development offered to teachers has to be specifically tailored to fulfill the needs of students.

> A 2006 survey revealed that around two-thirds of teachers felt their training was adequate for using the Internet for research, technical equipment, and administrative software (NEA-AFT, 2008). Fewer teachers regarded the training as sufficient for the following instructional goals: evaluating student progress (57. 6%), integrating technology into instruction (55.7%), and designing individual lessons (45.6 %). (Johnson et al., 2016, para. 9)

To fully implement technology into the classroom, involving the teachers in the planning is essential. In his book, Cuban (1993) explained that the degree to which teachers are willing to alter their current teaching practices depends on how the educational innovation is introduced and implemented into the environment. This is especially true in veteran teachers teaching ten years or longer. Involving teachers in the planning stage for technology implementation leads to a sense of competence. Mundy et al. (2012) found that "the more teachers were involved in actually setting up classroom

technology, the more likely they were to use that technology for instruction" (p. 2). Some teachers have expressed their resistance to becoming technologically fluent because technology advances rapidly. Technology is unique from other trends integrated into the educational setting. Hicks (2011) stated, "technology is here to stay, and it is probable that the use of technology in schools will dramatically increase over time" (p. 3).

Merchant (2012) questioned the purpose of technology integration in the classroom. "Is the fact that we *can* do these things sufficient justification for actually doing them in an educational context-and what specific advantages do we envisage?" (Merchant, 2012, p. 775). During Pflaum's (2004) inquiry to find the results of his research question, a principal shared a potential concern about technology integration. Pflaum (2004) paraphrased, "First, I was afraid that students might be isolated from one another when they were on the computers. Second, I was concerned that teachers might be uncomfortable not being the experts" (p. 14). Many teachers share these same fears or resistances to implementing technology into their classrooms. Pflaum (2004) concluded that the technology investment simply does not pay off (p. 18).

Another concern that many teachers have expressed is the lack of time to properly explore resources to fully implement them. Pflaum (2004) explained the reason why proper training and time to unpack resources is essential: "The software supply far exceeds demand, which is shaped by the number of time teachers have available to evaluate, learn about, and use the software they already possess" (p. 34). According to Gorder (2008), for technology to reach its full potential, it relies on the competence of the teacher and the ability to adapt instructional technology activities to meet the needs of diverse learners. Some teachers may worry about being replaced by technology. Pflaum

(2004) insisted that although technology can benefit the classroom, nothing can replace good teachers who care about kids. Pflaum (2004) found, "If administrators who are distant from the classroom select the program's goals, equipment, materials, and methods, technology implementation is likely to be sluggish" (p. 18). Teachers are the ones who ultimately work through the logistics and planning involved with implementing technology. Therefore, teachers should be the one's spearheading technology initiatives that best meet the needs of their students.

Expectations of Teachers in Relation to Technology Use

Technology should serve as an asset to the teacher instead of turning the teacher into a servant of technology. Perelman (1993) predicted that future technologies would cause schools' demise and, in conjunction, teacher education. Likewise, Kent and McNergney (1999) accurately realized that technology would become the forefront of educational practices. "States are beginning to include new technologies in learning standards for all disciplines, thus increasing the pressure for teacher competence in this area" (Kent & McNergney, 1999, p. 4). As a result, policymakers are inevitably putting extreme pressure on teachers to be competent in integrating technology in their classrooms.

As educational standards evolve to meet the needs of advances in technology, classroom expectations for technology users need to be revised. How lessons are presented has to be adjusted. According to Hicks, teachers must strive to embrace technology. According to Rowand (2000), a survey based on a National Center for Educational Statistics (NCES, 2000, p. 1) found that 39% of teachers indicated that they used computers or the Internet to create instructional materials, 34% for administrative

record-keeping, less than 10% reported to access model lesson plans or to access research and best practices.

Merchant (2012) highlighted the need for further research to investigate how mobile technologies can enhance or transform educational opportunities. "Despite this growing use of computers in schools, however, a paucity of research examines their effectiveness, especially their impact on student academic achievement" (Kposowa & Valdez, 2013, para. 6). Various researchers have examined the same set of variables and have produced contrasting results. For example, Penuel (2006) found a mere 12 studies on classroom laptops, and of these, only one was published in a peer-reviewed journal.

> In general, research findings on the impact of laptop computers on student academic achievement are mixed. Some investigators have found significant effects of laptop use on student achievement (Efaw et al., 2004; Gulek & Demirtas, 2005; Light et al., 2002; Siegle & Foster, 2001). Other analysts report negligible or no statistically significant effects of laptop use on achievement (Dunleavy & Heinecke, 2007; Gardner et al., 1993; Gardner et al., 1994; Rockman, 1999). (as cited in Kposowa & Valdez, 2013, p. 5)

Benefits of Technology Integration

Lam and Lawrence (2002) found that technology allows learners to pursue their own learning goals and provides them with a multitude of information at a much faster rate than a teacher could achieve. Implementing an abundance of technology-related resources in the classroom was proven to have various benefits if appropriately integrated. Firmin and Genesi (2013) reported that "the proper use of available technologies does have the power to enhance and transform education in today's

classroom" (p. 3). However, certain conditions must exist for technology to positively impact the academic achievement of students. Technology possesses significant benefits for academic achievement. These discoveries promised innovations for technology in the classroom. According to Pflaum (2004), one of the promises of the benefits of technology was that classrooms would be student-centered and that instruction on the computers would be tailored to fit individual students' needs. Another promise of technology was that it would transform teachers from just presenting information to students to regurgitating into learning alongside students as facilitators (Pflaum, 2004). Pflaum's list of technology promises has been fulfilled and expanded in unimaginable ways.

Kposowa and Valdez (2013) conducted a study investigating the relationship between ubiquitous laptop use and academic achievement in elementary students.

> Results of data analyses suggest that the provision of 24/7 laptops to students contributes significantly to achievement as measured by standardized scores. In the entire sample studied, which included both 4th and 5th graders, students with ubiquitous laptops scored higher in English/Language Arts than their counterparts without laptops. Likewise, students with ubiquitous laptops had higher scores in Mathematics than those without 24/7 laptops. (Kposowa & Valdez, 2013, p. 372)

Kposowa and Valdez (2013) presented a possible explanation for how or why ubiquitous laptop use increases academic achievement. "One explanation is that if laptops are included in the curriculum, students may learn what is taught in the classroom, but they may look up information faster and learn to take the initiative" (Kposowa & Valdez, 2013, p. 372).

Kukulska-Hulme (2009) reported that mobile technologies could support cross-textual learning and life transitions and bridge formal and informal education gaps. In addition, as referenced in the article by Fulton (2012), free online management systems such as Moodle can allow school districts with extreme budget constraints to provide their students with relevant and current curriculum content.

As schools began to navigate the avenues of learning amid the COVID Pandemic, many school districts implemented hybrid learning. Lieberman (2021) described hybrid learning as a combination of in-person and online instruction. Although most school districts utilized "hybrid learning," the degree of implementation varied greatly. Liebermann (2021) explained, "The precise nature of that mix, though, varies greatly from school to school, based on factors including the local rate of COVID-19 transmission, the availability of funds to support new instructional approaches, and the willingness of students and staff to return to buildings" (para. 1). During the 2020-2021 school year, many students chose to learn entirely online or slowly transition from learning remotely to hybrid learning. Education Week Research Center administered a survey to determine the learning models reflected in various school districts. Twenty-Four percent of families opted for 100% in-person learning versus the 100% remote option. Twenty percent of families chose a hybrid approach with staggered schedules that allows students to attend campus two to three days per week. Less than five percent of families opted for 100% asynchronous learning options, cohorts that rotated between nine-week sessions, and cohorts that rotated between afternoon and morning sessions.

Both remote and hybrid learning has sparked a wide range of emotions from students, parents, staff, and the community. Many parents and students are pleased with

the measures teachers and school districts have exercised to ensure safe, smooth, and efficient transitions back into school buildings. However, some people have expressed confusion over complex schedules, seating charts, and other precautions implemented against COVID-19. Lieberman (2021) recorded Bree Dusseault's, practitioner-in-residence at the University of Washington's Center for Reinventing Public Education, opinion of hybrid learning, "Hybrid learning can be a best of both worlds, or a worst of both worlds reality" (para. 5). The ultimate goal of hybrid learning is to provide a safe environment for staff and students while providing them with valuable in-person instruction that enables them to independently complete schoolwork at home. Potential downfalls of hybrid learning are that teachers may be forced to cut corners on instruction due to time constraints and students may struggle to transition back and forth between in-person and asynchronous learning. In Asynchronous learning, students complete independent tasks assigned by their teacher while they are at home. Many teachers are overwhelmed by the demands of hybrid learning. For students that are learning in a fully remote manner, parents worry that their children may fall behind students that spend at least some time in person. Unfortunately, this is especially true for students that have been identified in the Achievement Gap. Lieberman (2021) shared the results of an *EdWeek* survey from the fall of 2020, "Latino, Black, and Asian parents were more likely than White parents to report their children would engage in full-time remote learning" (para. 7).

Google Chromebooks: Creation and Usage

Earlier versions of laptops were bulky, heavy, and took a great deal of time for the programs to load. These devices were also highly complicated to manufacture with many

pieces, causing them to retail for close to $2,000. Bellis (2019) reported the Osborne 1 laptop computer weighed 24 pounds and cost $1,795 (para. 2). Chromebooks are much faster than laptops which alleviates wasted class instruction for computers to boot up. Chromebooks first became famous after being introduced in schools. As school districts sought ways to enhance technology usage in schools, Chromebooks promoted a more efficient operating system than those previously implemented. Unlike other laptops, Chromebooks utilize Chrome as their operating system and are equipped with cloud data storage. Jeff Nelson spearheaded the creation of Chromebooks' operating system. As a developer, Nelson was frustrated by the length of time the current operating system, Firefox, took to load. He enhanced the Chrome operating system, which ran significantly faster. A case study conducted at King Solomon Academy in Marylebone, London, sought to find replacements for their slow, inefficient laptops.

> At King Solomon Academy, IT competency is seen as a factor in preparing students for university, for life, and future careers, and the academy firmly believes that IT skills are best learned when applied to other subject areas, where they help to advance the overall curriculum. (Google, Inc., 2013, p. 1)

Bruno Reddy, a math instructor at King Solomon Academy, researched the capabilities and logistics of Chromebooks. Reddy educated parents on the expectations of Chromebook usage and the potential they offered. He also established routines and procedures for students on appropriate Chromebook care and use. Reddy added, "Boot-up speed, battery life, and reliability make Chromebooks the best option for schools" (Google, Inc., 2013, p. 2). Students can access documents remotely since documents are saved in the cloud instead of on the hard drive. Students can all collaborate on the same

document simultaneously. One drawback is that internet access is necessary, so they are rendered useless without the Internet. "We could set this all up in three easy minutes, with minimal disruption," said Reddy (Google, Inc., 2013, p. 2).

Although in comparison to traditional laptops, Chromebooks are limited, however, in the educational setting, Chromebooks are sufficient. Chromebooks run faster than other laptops because of reduced hardware and increased web-based applications (History Computer, 2021, p. 3). Chromebooks have been deemed a cost-efficient alternative to traditional laptops. Another advantage of Chromebooks is that they are user-friendly. Chromebooks automatically update and have long-lasting batteries. With the addition of these devices that simplify technology usage, many areas of the educational system can be enhanced. For example, standardized testing has evolved from a paper-pencil format to a digital form over the years.

Evolution of Technology Use in Standardized Testing

Formal written assessments to measure school student achievement began to replace oral examinations in the late 1800s (NEA, 2020, p. 1). In the early 1900s, Edward Thorndike and his students at Columbia University created standardized achievement tests in academic areas, such as arithmetic, handwriting, spelling, reading, language ability, and drawing (NEA, 2020, p. 4). Technology helped aid in scoring standardized tests in the late 1950s. "Today, many state assessments measure more ambitious content like critical thinking and writing and use innovative item types and formats, especially technology-based approaches, that engage students" (Slover & Muldoon, 2020, p. 5). Before 2010, very few standardized tests were computerized. Moving to online testing had numerous benefits.

> Technology-enhanced items allowed for measuring knowledge and skills that paper and pencil tests could not assess, typically deeper learning concepts, computer-delivered tests could also allow for more efficient test administration technology and improve access to the assessments for students with disabilities and English learners. (Slover & Muldoon, 2020, p. 7)

Computer-based tests are cheaper to administer and take less time to score and share results (Slover & Muldoon, 2020, para. 18). Although states were hesitant to convert to computer-based testing, research and development provided to schools and districts helped ease the transition.

Research from previous decades on computer-based testing suggests that scores on multiple-choice tests yield the same results despite the administration method. However, according to Russell et al. (2000), more recent research shows that for students who are accustomed to using computers at school, national and state tests administered via paper-pencil can produce severe underestimates of students' skills to the same tests administered via computer.

In a randomized study conducted at Accelerated Learning Laboratory (ALL) in 1995 and shared by (Russell et al., 2000), two eighth-grade students took math, science, and language arts tests, including both multiple-choice and open-ended items. One group took the tests on the computer, and the other took the tests using paper and pencil. Before scores were calculated, paper-pencil answers were transcribed to eliminate bias. The results uncovered two significant findings. First, the multiple-choice test results were very similar despite the test administration method. Second, for all of the students accustomed to writing on the computer, response results were scored higher than those

reported by hand. The findings were consistent across all three subjects and with short-answer and extended-answer questions. The results were translated into numerical values. 30% of students who wrote their responses on paper performed at a "passing" level, and 67% of students who typed their responses on the computer "passed" (Russell et al., 2000).

Two years later, a more refined study was conducted using open-ended items from the new Massachusetts state test (Massachusetts Comprehensive Assessment [MCAS]) and the National Assessment of Educational Progress (NAEP) in the same areas as the previous study. Eighth-grade students from two middle schools in Worcester, Massachusetts, were randomly assigned to groups. Each group was given identical test questions within each subject area, with one group completing the tests paper-pencil and the other on the computer. This time, data on students' keyboarding speed and previous computer use were collected. To keep things consistent, written answers were transcribed to computer text. This study showed results similar to those of the first study, with significant disparities evident on language arts tests. Computer performance was better for students who exhibited decent keyboarding skills (20 words per minute or more) than on paper. However, study results were not consistent across all levels of keyboarding abilities. As keyboarding speed decreased, the benefit of taking tests via computer decreased. For students with low keyboarding speed, taking the test via computer negatively affected students’ performance.

Similarly, taking the math test via computer diminished students' scores, which became less noticeable as keyboarding speed increased. These studies highlight a large discrepancy between school computer use and testing procedures used for school

enhancement. This will encourage growth as more students become more familiar with writing on computers.

Summary

The COVID-19 pandemic brought about a need for complete remote learning in the Spring of the 2019-2020 school year. The school district's buildings in which this study took place were closed to slow the spread of the Coronavirus. This caused teachers and students to alter how instruction is delivered and received quickly. One significant benefit of the district's precocious technology usage is that students were already accustomed to using Chromebooks to access assignments, gather research materials, and collaborate with peers. The pandemic also caused many districts to explore the way their technology funds are allocated and make shifts to try to meet the needs of all of their students. "In 2013, the United States Government increased their spending on k-12 e-learning, yet it still only accounted for less than one percent of the total k-12 expenditures" (Delgado et al., 2015, p. 405). The pandemic is a classic example of investing technological resources to enhance learning for students. Penuel (2006) observed that the educational technology community's collective knowledge about one-to-one initiatives has not kept up with the rapid expansion of these initiatives or their breadth (p. 329). This study was designed to eliminate further some of the inconsistencies observed in past research and fill existing gaps in knowledge about One-to-One Chromebook usage and academic achievement.

Chapter Three: Research Method and Design

Purpose

This mixed-methods study aimed to investigate third-grade student academic achievement pre- and post-Google Chromebook usage. The researcher also explored the perceptions of teachers and administrators on the use of Google Chromebooks in a third-grade setting. This study further aimed to investigate whether educators should integrate technology into their instruction more frequently.

To investigate technology usage and student academic achievement, the researcher completed journal entries daily, detailing the frequency and duration of student Chromebook usage. In addition, the researcher analyzed MAP data from the 2015-2016, 2016-2017, and 2017-2018 school years collected from the Missouri Department of Elementary and Secondary Education (MO DESE) MO website. In 2015-2016, students did not have Google Chromebooks but had access to eight desktop computers. Google Chromebooks were introduced to students during the 2016-2017 school year.

The researcher scribed responses to a series of interview questions given to three third-grade teachers and two administrators of the school where the research took place. By having face-to-face, individual conversations with three classroom teachers and two administrators with varying levels of educational experience, the researcher gathered their perceptions on Google Chromebook Usage. After analyzing the interview responses for commonalities, the researcher was able to offer feedback to the district on how to improve current technology integration expectations.

Research Site and Participants

The study took place in a third-grade elementary classroom in the Midwest.

Elementary school. During the 2015-2016 school year, the elementary school served Students in grades K-5 had a population of 495 enrolled at the inception of this study.

Table 1

The Ethnicity of All Students Represented

Ethnicity	Percentage represented by students
African American	4.6%
White	73.3%
Asian	12.2%
Multiracial	7%
Hispanic	2.3%
Native American	0.6%

According to Niche.com (n.d.), 12% qualified for free or reduced lunch. Additionally, the school ranking website, Niche.com (n.d.), ranked the research site as in the top 76 of 1,135 schools in Missouri. Sixty percent of the students scored proficient in math, and 67% of the students scored proficient in reading. The research site had an average teacher ratio of 16 to 1 and showed a population of 46% female students and 54% male students.

At the time of the study, the researcher was a teacher in the third-grade classroom, which was the research site. However, the researcher only observed the frequency and duration of Chromebook usage and academic achievement data. For this information, student information remained anonymous. For teacher and administrative data, the researcher is a colleague or in a subordinate role, so this posed no coercive role. Also, no names were used in the published research.

Interviews

Individual face-to-face interviews seek to cultivate knowledge about individual experiences and outlook on a specific set of topics as shared by (DiCicco-Bloom & Crabtree, 2006). “The integration of qualitative research into clinical research in the 1970s and 1980s introduced many distinct formats of qualitative interviews that greatly expanded the process of data collection and the depth of information being gathered” (DiCicco-Bloom & Crabtree, 2006, para. 3). Qualitative research encourages authentic descriptions of experiences while relying on the researcher’s analysis of the findings. The purpose of qualitative research interviews is to enrich the current body of knowledge. The researcher chose individual, in-depth interviews to accomplish this task. By utilizing individual in-depth interviews, the researcher gained the perceptions of technology and experiences involving technology through the interviewees. During in-depth interviews, an established positive relationship is necessary. According to DiCicco-Bloom and Crabtree (2006), “The process of establishing rapport is an essential component of the interview and is described in the classic works of Palmer and Douglass” (p. 3, para. 12). By conducting the study at the school where the researcher is employed, a positive relationship had been established with the interviewees prior to the inception of the study. The researcher interviewed three teachers and two administrators about their perceptions of Google Chromebooks. The researcher created the interview questions to align with the research questions. Demographic information, as presented in Table 2, denotes the five interviewees, which is significant, due to the amount of qualitative data collected in each interview. Themes were discovered by analyzing participant interview responses.

Table 2

Interview Participant Demographics

Participant	Gender	Career Length	Position
Teacher 1	F	9 years	Classroom teacher
Teacher 2	F	33 years	Classroom teacher
Teacher 3	F	7 years	Classroom teacher
Administrator 1	M	11 years	Administrator
Administrator 2	M	17 years	Administrator

Recruitment Method

After gaining Institutional Review Board approval from Lindenwood University and permission to complete the study from the school district where the study took place, the researcher began the process of selecting participants. Since this study analyzed secondary data, the researcher did not need permission from individual students. To gain a clear perspective on the possible differences in academic achievement data pre- and post-Google Chromebooks usage, the researcher collected MAP scores from all third graders at the research site. Additionally, several interviews were conducted with teachers and administrators to gain their perception of technology usage. At the time the study was completed, current third-grade teachers were asked to be a part of the study, because they worked with students using Chromebooks. Administrators were asked to be a part of the study, because they evaluate teachers involved in the study. Teachers and administrators were advised on the nature and purpose of the study, and a time and location were established to conduct the interviews. Each teacher interview was given in

the respective teacher's classroom. The administrators' interviews were conducted in the respective administrator's office. The researcher asked each participant the interview questions outlined in the interview questions document during the discussions. Each interview lasted between 15 and 20 minutes. After the interviews were conducted, the researcher compiled the responses to analyze for themes.

The interview questions consisted of 10 to 15 open-ended, free-response questions, which assessed teachers' and principals' overall perceptions of Chromebooks in the classroom environment. These interviews allowed the researcher to gain insight into how teachers and administrators perceived technology in the classroom.

Data Analysis

This study utilized academic achievement data from third-grade students and the perceptions of third-grade teachers and administrators on Chromebooks. The Midwest school district purchased enough Chromebooks to allow each upper elementary student to have their Chromebook. The students were not allowed to take the Chromebooks home, but they were able to access them anytime throughout the school day. The researcher sought to investigate the possible differences in academic achievement data pre- and post-Google Chromebook usage. The researcher (also the classroom teacher where the data were collected) kept a daily journal log of her perception of Chromebook usage in the classroom. Additionally, the researcher was given a report from the district technology department that automatically logged students' Chromebook usage. This provided the researcher with an accurate report of the frequency and duration of Chromebook usage in the classroom. From the journal entries, a list of frequently used websites and programs were compiled. This allowed the researcher to

gauge the frequency and duration of specific activities and programs accessed by the students using the Chromebooks.

The researcher gathered student academic achievement data from the school district data reporting system. The data collected were student test scores from quarterly Unit Benchmarks, End of Unit assessments, and Missouri Assessment Program tests. End of Unit assessments were given at the end of each unit, and the MAP test was given one time in April. Prior to collecting any data, the researcher completed a permission to conduct research form supplied by the Midwest School District. After the researcher was granted permission to conduct the study, the researcher gained permission via a completed adult consent form from three third-grade teachers and two administrators that participated in the study.

The researcher conducted one-on-one interviews with each of the adult participants of the study. After a minimum of five interviews had been completed, the researcher transcribed the interviews and double-checked with the participants to lessen the chance of inaccuracy in their perceptions of Google Chromebooks. After all of the academic achievement data had been collected, the researcher analyzed the data and determined if the hypotheses were correct or not and answered the research questions. The researcher then published the results of the study and reported back to the Midwest School District and presented a plan for the next steps.

Research Question 1: How do teachers and administrators perceive technology as it relates to academic achievement?

Research Question 2: How do teachers and administrators perceive the use of Chromebooks in a K-5 public school setting?

Research Question 3: What supports do students need to be technologically independent in the classroom?

Research Question 4: What commonalities are formed when the frequency and duration of student usage of Google Chromebooks are observed and compared with MAP scores and unit benchmarks assessments?

Hypothesis 1: There is a difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017 & 2017-2018).

Hypothesis 2: There is a difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017 & 2017-2018).

Null Hypothesis 1a: There is no difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017).

Null Hypothesis 1b: There is no difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2017-2018).

Null Hypothesis 2a: There is no difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017).

Null Hypothesis 2b: There is no difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2017-2018).

Limitations

As a result of the MAP Test format and test material changing year-to-year, the results have proven difficult to correlate. For example, in 2015, the MAP test format was converted from a paper-pencil test with answers recorded via Scantron to a computer-based assessment program. At the same time that a new testing format was introduced, new state standards were also rolled out. These new standards replaced decades-old learning standards. According to Bock (2015), "The combination of changes in one year have the potential to create not only technical glitches but also to cause a decrease in the percentage of students statewide who pass" (p. 1).

Although having an already established positive relationship with the interviewees has been proven to be beneficial in the interview process, this also led to a miniscule group of interviewees. The interview participants were all from the same school. The study was conducted at one elementary school in one school district. Additionally, the researcher opted to use journaling and interviewing as the sole qualitative methods for data gathering.

Threat to Validity

To align with updated Missouri State Standards, different versions of the MAP were designed, and throughout the data collection period, the test changed more than three times. During the time of data collection, technology usage was steadily increasing. Toward the end of the study, the test evolved from a paper-and-pencil format to a completely virtual format. This change in structure could have impacted students' achievement scores. Students familiar with using computers may have had an advantage over those not accustomed to using computers. Many states reported technological

difficulties when administering the tests, such as login errors and cyber-attacks. For the interview portion of the study, there were only five participants. Additionally, all of the interview participants are of the same race. This could have had an impact on their perceptions of technology.

Reflexivity

The researcher was an African American student who attended schools in a high-poverty area with extremely sparse resources. The researcher and peers experienced infrequent access to technology. Lack of resources, personal perceptions of the benefits of technology, and a new technology initiative at the research site led the researcher to inquire how other teachers and administrators perceived technology and one-to-one Chromebook usage and academic achievement. As stated by Palaganas et al. (2017), "Through reflexivity, researchers acknowledge the changes brought about in themselves as a result of the research process and how these changes have affected the research process" (para. 1). As a close friend to the teacher participants in the study, the teachers were willing to be open and honest about their perceptions of technology.

McLeod (2015) explained why reflexivity may have promoted a level of comfort with the researcher from the teacher participants by detailing, "previous personal experience of a topic may sensitize the researcher to the deeper significance of that topic in the lives of informants, and may make the researcher more credible and trustworthy to informants" (p. 98). The participants of the study exhibited no resistance in answering the interview questions or providing anecdotal examples to support their perceptions. Reflexivity served as an asset to the current study because the interview questions asked

specific questions about their technology use in the classroom that could have been sensed as invasive.

Summary

The current mixed methods investigation of Google Chromebook usage related to third-grade academic achievement data and perceptions of teachers and principals in a Midwest elementary school was completed over several years, beginning during the 2015-2016 school year. Additionally, this study sought to identify the perceptions of teachers and administrators on the use of Google Chromebooks in a third-grade setting. Specifically, this study aimed to investigate whether educators should integrate technology into their instruction more frequently. The researcher compiled daily journal entries detailing the frequency and duration of student Chromebook usage for the study. The researcher analyzed student test scores from Unit Benchmarks, End of Unit assessments, and Missouri Assessment Program tests. Data analysis and study results will be discussed in the next chapter.

Chapter Four: Results

Introduction

The analysis in Chapter Four aimed to examine third-grade student academic achievement pre- and post-Google Chromebook usage. The researcher also explored the perceptions of teachers and administrators on the use of Google Chromebooks in a third-grade setting. This study also investigated whether educators should integrate technology into their instruction more frequently. In addition, the researcher sought to determine if the data resulted in a rejection of the null hypotheses. The researcher utilized a mixed-methods approach to analyze achievement data, journal entries, and interview question responses. The findings in this chapter address the following research questions:

Research Question 1: How do teachers and administrators perceive technology as it relates to academic achievement?

Research Question 2: How do teachers and administrators perceive the use of Chromebooks in a K-5 public school setting?

Research Question 3: What supports do students need to be technologically independent in the classroom?

Research Question 4: What commonalities are formed when the frequency and duration of student usage of Google Chromebooks are observed and compared with MAP scores and unit benchmarks assessments?

Null Hypotheses

The researcher investigated the following two null hypotheses for the study:

Null Hypothesis 1a: There is no difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017).

Null Hypothesis 1b: There is no difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2017-2018).

Null Hypothesis 2a: There is no difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017).

Null Hypothesis 2b: There is no difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2017-2018).

Results

Table 3

MAP Assessment Results

MAP Test	M	SD	M	SD	DF	T	P
ELA15/16 & 16/17	478.37	51.56	485.68	45.43	156	-1.88	0.265
ELA15/16 & 17/18	478.05	50.81	386.60	40.06	172	13.18	0.028
Math 15/16 & 16/17	470.27	51.10	484.98	50.83	164	-3.714	0.964
Math 15/16 & 17/18	470.27	51.10	377.44	44.03	172	11.84	0.169

Null Hypotheses 1a & 1b:

Third Grade: Mathematics

The researcher conducted a *t*-test of two means to see if third-grade students during the 2016-2017 school year scored higher on Math MAP tests after implementing one-to-one Chromebooks than the third-grade students before implementing Chromebooks during the 2015-2016 school year. The analysis revealed that the Math MAP scores of students after the implementation of Chromebooks (M = 484.98, SD = 50.83) were not significantly higher than the Math MAP scores of students prior to the implementation of Chromebooks (M = 470.27, SD = 51.10); $t(164) = -3.714$, $p = 0.964$. The researcher failed to reject the null hypothesis 1a (one-tailed *t*-critical = 1.69) and concluded no significant difference between third-grade Math MAP scores pre-and post-Chromebook implementation.

The researcher conducted a *t*-test of two means to see if third-grade students during the 2017-2018 school year scored higher on Math MAP tests after implementing one-to-one Chromebooks than the third-grade students before implementing Chromebooks during the 2015-2016 school year. The analysis revealed that the Math MAP scores of students after the implementation of Chromebooks (M = 377.44, SD = 44.03) were not significantly higher than the Math MAP scores of students prior to the implementation of Chromebooks (M = 470.27, SD = 51.10); t (172) = 11.84, p = 0.169. The researcher failed to reject the null hypothesis 1b (one-tailed *t*-critical = 1.654) and concluded a significant difference between third grade Math MAP scores pre- and post-Chromebook implementation.

Null Hypotheses 2a & 2b:

Third Grade: English Language Arts

To begin the examination of student achievement in the area of third-grade English language arts, the researcher applied a *t*-test. Table 3 displays the *t*-test results of the scores achieved by third graders represented in the MAP assessments for 2015-2016, 2016-2017, and 2017-2018.

The researcher conducted a *t*-test of two independent means to see if third-grade students during the 2016-2017 school year scored higher on ELA MAP tests after implementing one-to-one Chromebooks than the third-grade students before implementing Chromebooks during the 2015-2016 school year. The analysis revealed that the ELA MAP scores of students after the implementation of Chromebooks (M = 485.68, SD = 45.43) were not significantly higher than the ELA MAP scores of students prior to the implementation of Chromebooks (M = 478.37, SD = 51.56); t (156) = -1.88, p = 0.265. The researcher failed to reject the null hypothesis 2a (one-tailed *t*-critical = 1.655) and concluded that there is no significant difference between third grade ELA MAP scores pre- and post-Chromebook implementation.

The researcher conducted a *t*-test of two means to see if third-grade students during the 2017-2018 school year scored higher on ELA MAP tests after implementing one-to-one Chromebooks than the third-grade students before implementing Chromebooks during the 2015-2016 school year. The analysis revealed that the ELA MAP scores of students after the implementation of Chromebooks (M = 386.60, SD = 40.06) were not significantly higher than the ELA MAP scores of students prior to the implementation of Chromebooks (M = 478.05, SD = 50.81); t (172) = 13.18, p = 0.028. The researcher rejected the null hypothesis 2b (one-tailed *t*-critical = 1.69) and concluded

a significant difference between third grade ELA MAP scores pre- and post-Chromebook implementation.

Results of Interviews for Teachers and Administrators

The interview for teachers and administrators was responded to by the researcher's carefully selected five staff members to interview at the school where the research study was conducted. In addition, the researcher conducted all one-on-one interviews in person. Several distinct themes emerged due to the interviews and researcher journal entries. For complete responses to the discussions, see full transcripts in Appendix A. The analysis of qualitative data gathered from all five interviews and researcher journal entries fell into various thematic categories, including simplified delivery of instruction, tailored individual learning, and collaboration with peers. Conducting the interviews allowed the researcher to gain the perception of technology from teachers and administrators in the building in which the study took place. A benefit of conducting the interviews face to face as opposed to asking research participants to complete a written survey, afforded the researcher the opportunity to ask clarifying questions and the access to gaining a deeper insight on the responses.

Research Question 1: How do teachers and administrators perceive technology as it relates to academic achievement?

The open-ended questions developed by the researcher gathered the perception of technology as it relates to academic achievement through the eyes of teachers and administrators. Three meaningful themes were revealed after a thorough analysis: (a) student engagement, (b) tailored individual learning, and (c) student motivation to complete assignments.

Student Engagement

Student engagement was positive as a result of the implementation of Chromebooks. All of the teachers reported frequent use of the Chromebooks throughout the day. Three participants noted that their students used the Chromebooks at least four-to-five times a day. One of the participants further explained the specific purposes for which Chromebooks are used in the classroom. "We use Chromebooks all the time. Each morning, we do Xtra Math to practice math facts and chart our data." Xtra math is an online math fact fluency program that guides students through the practice of various math facts to help them develop automaticity.

Another teacher shared, “Students in my class often use Chromebooks to read independently using a website, EPIC." EPIC reading is a digital reading platform that houses thousands of books on various topics and reading levels. Students can search through specific issues, categories, reading levels, and genres. Administrators asserted their expectations for Chromebook usage. One administrator mentioned, "When entering a classroom, I expect to see students using Chromebooks for research, coding, writing or reading Google slides to present . . . not silly games." Another administrator expressed similar expectations.

> Depending on the time of day, I would expect to see Chromebooks used as an extension of the curriculum. The types of activities I would expect to see vary from using writing and presentation applications to web-based activities designed to supplement traditional curricular materials.

The researcher asked the administrators to explain specific scenarios in which they have witnessed students using Chromebooks. One administrator revealed, "I have

witnessed students using Chromebooks a lot during indoor recess. Some educational, some a stretch, very good presentations, and coding with NXT robots." NXT robots are computer-controlled machines that can be programmed to complete various tasks. Another administrator explained,

> Chromebooks are used for a variety of activities including reading such as Epic to math activities like Savvas. One time that comes to mind is watching kindergarten students using Dreambox during math workshop time. The design of the lesson included time for students to explore and use Dreambox to supplement their math curriculum.

Chromebooks have significantly impacted student engagement and have been a welcome addition to the classroom.

Tailored Individual Learning

One commonality noted among the participants was the individualized learning afforded to students using the Chromebooks. One teacher communicated, "The Chromebooks have helped by providing more individualized learning at the student's pace." Another teacher shared that the Chromebooks have allowed students to complete projects independently. Another teacher stated, "One of the programs we use for math workshop is Dreambox. It is an adaptive program that meets students where they are academically." Dreambox is an excellent program, because it automatically adapts to fit the needs of each student individually. So often, teachers have to give most of their attention to the lowest-performing students leaving little time for the high achieving students. This adaptive program eases the burden that teachers often feel. The researcher recalled a specific time when a new student was introduced into the classroom. The

student had obvious learning difficulties that made it impossible to progress at the expected level. While waiting on special education testing to be completed so that the proper accommodations and modifications could be made, the researcher was able to show the student how to access Dreambox, and the program tailored itself to that student's level.

Student Motivation to Complete Assignments

The hope is that Chromebooks motivate students who are otherwise unmotivated to complete assignments in a timely matter. Often students are reluctant to complete tasks that they deem challenging, especially if writing is involved. The Chromebooks have allowed students to show their understanding of skills taught in the classroom without the added worry of being able to capture it all on paper. One administrator noted, "I have noticed that students are more eager to complete assignments when they can use their Chromebooks. They are also able to work on assignments at the same time." A teacher revealed that, "I notice my student's confidence in their computer skills." The researcher recalled a time when students began cheering when given a task using the Chromebooks. Students were asked to sign into a test review website, Kahoot. Kahoot is a test review website where teachers can add multiple-choice test questions, and the program converts the questions into a timed game format. The correct answers are revealed after the time is up, and students receive their results in real-time.

Research Question 2: How do teachers and administrators perceive the use of Chromebooks in a K-5 public school setting?

Research question two was designed to gather information about teachers' and administrators' perceptions of Chromebooks in a K-5 public school setting. Two

meaningful themes were revealed after a thorough analysis: (a) collaboration with peers and (b) simplified delivery of instruction.

Collaboration with Peers

With the implementation of Chromebooks, group work is much more seamless. Students no longer have to share a device or wait until their partners are finished to complete their portion of a project. With tools like Google Slides, students can work on the same presentation simultaneously. One of the teachers explained, "My students collaborate with peers using the Chromebooks to research animals and create a Google Slide presentation." Before implementing one-to-one Chromebooks, if a student is absent for an extended time, they would have to wait until they returned to get caught up on missed work. However, with each child having a Chromebook, students who are out for planned extended absences can still collaborate with their peers from where they are. This is especially true for Indian students at the school where the study took place who travel to India for weeks.

Simplified Delivery of Instruction

All of the participants concurred that the Chromebooks have decreased the difficulty of delivering instruction. According to one teacher, "Chromebooks just make learning easier in all areas of the curriculum-saves time-kids work independently. They know so much-have been a welcome addition." Another teacher explained that Chromebooks allowed for "Fewer technology headaches, more organized learning, enhanced technology skills, and quicker results for kids using websites like Pearson, Xtra Math, and Read Works." Websites such as these give students immediate feedback on their progress and provide a method for teachers to keep track of the data. To aid students

in the goal-setting process, the researcher set up a system in which students would record their daily progress on websites like those previously mentioned.

Research Question 3: What supports do students need to be technologically independent in the classroom?

Research question three was designed to gather information about students' support to be technologically independent in the classroom. Four meaningful themes were revealed after a thorough analysis: (a) increased efficient access to information and materials, (b) more instructional tools, (c) student-led instruction, and (d) professional development.

Increased Efficient Access to Information and Materials

With one-to-one Chromebooks at the students' disposal, teachers could enhance their lessons to maximize class time. As an administrator shared, "Now that a lot of writing is done on Chromebooks, research is done in the classroom instead of going to the library." Before implementing Chromebooks, when the whole class needed to gather information for research, teachers had to reserve a time in the computer lab shared with the entire school. A teacher pointed out, “Many of the assignments that used to be completed via paper and pencil are now completed digitally." This eliminates the time teachers spend in the copy room preparing materials for class. One teacher explained, "The kids can work independently. I no longer need to schedule time in a lab. We get through lessons and projects at a quicker pace." An administrator expressed a benefit brought about through the implementation of one-to-one Chromebooks.

> One thing that springs to mind is formative assessments. Whether they are included in Quick-checks like Savvas, formative assessments created by the

teacher and uploaded to Schoology, or shared docs via Google Docs. Teachers can look at students' work as the unit progresses rather than at the end or with a traditional paper/pencil quiz.

Data being so easily accessible cuts down on the time teachers spend searching for the data.

More Instructional Tools

With the World Wide Web at their fingertips, students have many digital resources to support their learning. For example, math facts had to be practiced using bulky flashcards before implementing Chromebooks. Now that students have their Chromebooks, they can practice their skills using online platforms such as Xtra Math. One teacher declared, "A lot more online resources have been introduced. (Xtra Math, Quick Checks in Math, Read Works, publishing writing on computers, learning games, Typing Agent, etc.)." Another benefit is that students can access these digital resources all at the same time. There is no longer a need for students to wait until their classmates are finished with a program so that the computer can be shared.

Additionally, the programs mentioned above are adaptive. Questions, activities, and reading passages can be altered based on students' performance. Depending on the program, if students are doing exceptionally well, the teacher can seamlessly increase the difficulty level with the click of a button. Some programs automatically adapt to students' performance, such as Xtra Math and Typing Agent.

Student-Led Instruction

Research has proven that many students have various learning styles. Therefore, a one size fits all approach is not beneficial for students. Chromebooks have made it

possible for students to decide the best way to show their learning. One teacher said, “I think students now have more choice in how they're going to present information." One of the administrators communicated a specific time that he observed student-led instruction.

> I was watching a 4th-grade math lesson. Students participated in the instruction as a whole group. They then did their quick-check to gauge their understanding. After the quick-check, students could access a Google Slides presentation shared by their teacher. This gave the students access to their "must-do" and "may-do" activities. Some of the may-do was technology-based. The teacher used her computer to monitor quick-check results, and complete ongoing instruction as the students worked through games and web-based math instruction supplemental activities.

By giving students a choice on how they want to practice skills taught in the lesson, students get the opportunity to explore and determine which activity fits their needs. The teacher was also able to monitor student progress and seamlessly make the necessary adjustments.

Professional Development

Research has proven that teachers are more willing to implement technology into their classrooms when they feel they have been adequately trained. The researcher asked the participants about the professional development they received and provided before implementing one-to-one Chromebooks. The researcher noted a discrepancy amongst the responses. One teacher acknowledged that professional development was provided but was unsure of the length. "Yes, I received professional development, but I am unsure how

many hours it lasted." Another teacher remarked, "We were shown how to use them, and each teacher also has a Chromebook. It was maybe an hour-very simple." Another teacher went into great detail about the professional development received.

> Yes, we had a couple of professional development sessions that were about 1 hour in length directed by the librarian. We also have a computer specialist that splits her time between two schools and is readily available to help with our technology needs.

One of the administrators claimed, “Teachers received district level Google Training, and the Librarian showed some Google programs.” Another administrator shared these details,

> Before we secured 1-to-1 Chromebooks, the district had been adding technology to classrooms (moving away from a lab setting). As a school, we provided technology integration training. The district even provided Technology Integration Specialists to help with learning how to include technology during instruction. As a school, we did provide several learning opportunities on an ongoing basis for technology. The district has also provided opportunities for teachers to learn about Google-based applications.

The researcher asked about future opportunities for professional development, and one administrator shared, "We plan to boost our development opportunities around using technology for ongoing assessment information." A teacher receiving proper professional development related to technology is essential for adequate implementation.

Research Question 4: What commonalities are formed when the frequency and duration of student usage of Google Chromebooks are observed and compared with MAP scores and unit benchmarks assessments?

Research question four was designed to gather information about the potential commonalities formed when the frequency and duration of student usage of Chromebooks are observed and compared with MAP scores and unit benchmarks. Three meaningful themes were revealed after a thorough analysis: (a) preparation for tests, (b) enhanced technological skills, and (c) increased student engagement as a result of the ability to differentiate.

Preparation for Tests

When the participants were asked about the impact of Chromebook usage on MAP scores, there was a split between positive and negative sentiments. During the interviews, MAP scores from the 2015-2016 school year were not published. One teacher shared, "I notice my student's confidence in their computer skills. They practice taking assessments on computers multiple times throughout the year." Another teacher remarked, "I do think that students will do better on MAP testing since they are using Chromebooks more." However, one of the teachers countered, "Not sure, but I personally feel test scores probably have gone down." The same teacher also shared, "I feel that students are doing better on normal tests in Math and ELA." One of the principals agreed, "At some point, it might negatively affect MAP scores because they aren't competent, so they make silly mistakes. The testing program is to blame, not 100% user friendly." The researcher recalled a journal entry that included a discussion held between the researcher and the students in the class. The researcher explained to the

students that they would be using their assigned Chromebooks to complete the MAP assessment. The district loaded practice assessments to help students become more familiar with the program. Since the Chromebooks were familiar to the students, they could focus and get comfortable using the MAP assessment program without the added stress of learning how to use an unfamiliar device.

Enhanced Technological Skills

The perceptions of Chromebooks related to enhanced technological skills were positively unanimous. One teacher shared that there are "many less technology headaches, more organized learning, enhanced technology skills, and quicker results for kids because of Chromebooks." Another teacher said, "Chromebooks just make learning easier in all areas of the curriculum, save time, and kids can work independently. They know so much. The Chromebooks have been a welcome addition." Students quickly learn how to use technology to gain answers to questions. Students finding the answers to their inquiries rapidly allows the teacher more time to focus on assisting low-performing students.

Increased Student Engagement as a Result of the Ability to Differentiate

One significant added benefit of one-to-one Chromebooks is differentiating instruction quickly. One teacher noted, "I have noticed that students are more eager to complete assignments when they are able to use their Chromebooks. They are also able to work on assignments at the same time." An administrator expressed, "I think students now have more choice in how they're going to present information." Before implementing Chromebooks, students were limited in their ability to show their understanding of the skills being taught. The researcher recalled a specific instance when

student choice was involved in establishing a sense of understanding of taught skills. After students completed research on an inventor that made a significant impact on the world, students were given the option to create a poster or PowerPoint detailing biographical information. The poster was an excellent alternative for one of the students who get easily distracted by technology.

Summary

In Chapter Four, the researcher presented findings and analysis for Null Hypotheses 1a, 1b, 2a, 2b, and Research Questions 1, 2, 3, and 4. The quantitative analysis presented evidence to suggest no significant difference between third grade ELA and Math MAP scores before one-to-one Chromebook implementation and in the first year of one-to-one Chromebook implementation. Contrarily, there was a substantial difference between third grade ELA and Math MAP scores before one-to-one Chromebook implementation and in the second year of one-to-one Chromebook implementation. The quantitative data analyzed by the researcher supported the results that show there was a significant difference between third grade ELA and Math MAP scores during the second year of one-to-one Chromebook implementation. Qualitative results supported quantitative findings through the themes of: student engagement, tailored individual learning, student motivation to complete assignments, collaboration with peers, simplified delivery of instruction, increased efficient access to information and materials, more instructional tools, student-led instruction, professional development, preparation for tests, enhanced technological skills, and increased student engagement as a result of the ability to differentiate.

A discussion of the implications of the study, recommendations for further research, and recommendations for the school district in which the study was conducted are discussed in Chapter Five.

Chapter Five: Discussion

Overview

To evaluate best practices in technology, use at a Midwestern elementary school, the researcher investigated the possible differences between pre- and post-Chromebook usage and student achievement. The researcher also examined the perceptions of technology of teachers and administrators. To evaluate the best practices in technology usage, the researcher analyzed the ELA and Math MAP scores from the 2015-2016, 2016-2017, and the 2017-2018 school years. By completing quantitative analyses of the comparisons, the researcher hoped to prove that one-to-one Chromebooks possibly led to increased academic achievement.

Null Hypotheses

Null Hypothesis 1a: There is no difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017).

Null Hypothesis 1b: There is no difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2017-2018).

Null Hypothesis 2a: There is no difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017).

Null Hypothesis 2b: There is no difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2017-2018).

The current study failed to reject Null Hypothesis 1a - There is no difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2018). The current study also failed to reject Null Hypothesis 2a - There is no difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017). However, there was a significant difference for Null Hypothesis 2b - There is no difference between English Language Arts MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2017-2018). The researcher proposes that future research continues to explore one-to-one Chromebook usage and academic achievement since there was a difference in the second year of implementation for ELA.

Discussion

As explained in Chapter Two, the research was a mixed-methods study of academic achievement and pre-and-post, one-to-one Chromebook usage. The research also included perceptions of teachers and administrators as it relates to technology in the classroom. Using purposeful, convenience sampling, the researcher contacted the administrative department in a Midwestern school district to obtain permission to complete the study. Once permission was granted, the researcher then asked current third-grade teachers and administrators to be a part of the study. After the teachers and administrators agreed to participate in the study, interviews were scheduled. The researcher aimed at including five participants, and all five participants agreed to participate in the study. The qualitative component of the study relied on the interviews and the researcher’s daily journal entries. The interviews were conducted at the school

where the study was completed. The interviews varied in length from 10 to 20 minutes. Each interview was checked for accuracy, and the participants were allowed to make revisions. The researcher coded the interviews and researcher journal entries and analyzed them for common themes.

Interpretation of Findings

This study addressed the following research questions:

Research Question 1: How do teachers and administrators perceive technology as it relates to academic achievement?

Research Question 2: How do teachers and administrators perceive the use of Chromebooks in a K-5 public school setting?

Research Question 3: What supports do students need to be technologically independent in the classroom?

Research Question 4: What commonalities are formed when the frequency and duration of student usage of Google Chromebooks are observed and compared with MAP scores and unit benchmarks assessments?

The researcher found three main themes stemming from the first research question. First, all of the participants interviewed observed increased student engagement as a positive effect of one-to-one Chromebook usage. Secondly, the participants shared specific examples of how one-to-one Chromebooks enhanced tailored individual learning. Lastly, students' motivation to complete assignments increased as one-to-one Chromebooks have afforded students a choice in how they want to demonstrate their level of skill mastery. Based on the data collected during this study, the researcher

concluded that the implementation of one-to-one Chromebooks positively impacted student engagement.

The second research question addressed the teachers' and administrators' perceptions of using Chromebooks in a K-5 public school setting. This question revealed two themes. First, teachers and administrators explained that Chromebooks had made collaboration with peers much smoother. Teachers appreciated the fact that students no longer had to share devices. Specifically, teachers detailed specific scenarios in which Chromebooks have assisted in the simplified delivery of instruction.

Supports needed by students to be technologically independent in the classroom were addressed for the third research question, and four meaningful themes emerged. First, all teachers and administrators concurred that the one-to-one Chromebooks increased efficient access to information and materials. Trips to the library are virtually non-existent, and the length of time teachers spend preparing paper-pencil materials for the class has been significantly reduced. Secondly, teachers reported that the addition of one-to-one Chromebooks provided students with many instructional tools. Thirdly, administrators and teachers shared their appreciation for how one-to-one Chromebooks encouraged student-led instruction. Student-led instruction puts students in the driver's seat to produce creative ways to demonstrate their learning. Lastly, professional development surfaced as a need. There was a discrepancy regarding the amount of professional development offered to teachers before implementing one-to-one Chromebooks. From the administrators' perspective, the district provided adequate professional development. However, teachers recalled receiving very little professional development.

The fourth and final research question addressed the commonalities formed when the frequency and duration of student usage of Chromebooks were observed and compared with MAP scores and unit benchmarks. In an attempt to explore this question, three themes were identified. First, although at the time the interviews were conducted, MAP scores had not been revealed; teachers remained optimistic that one-to-one Chromebooks would help improve academic achievement. Second, overwhelmingly, the participants agreed that having the one-to-one Chromebooks has enhanced students' technological skills. Third, teachers emphasized that the Chromebooks made learning easier in all curricular areas and decreased the number of technology headaches. The researcher hypothesized that there was a difference between Math MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017 & 2017-2018). The results of the study found significant difference in Math MAP after Chromebook implementation. The researcher believes this was due to problems with the test format, logistics, and students being more acquainted with general Chromebook usage. Additionally, the researcher hypothesized that there was a difference between ELA MAP scores pre-Chromebook implementation (2015-2016) and post-Chromebook implementation (2016-2017 & 2017-2018). The results of the study also found that there was a significant difference in ELA MAP scores during the second year of Chromebook implementation. The researcher believes this is due to a more refined testing program, students being more acquainted with general Chromebook usage, and the absence of writing tasks. On previous paper-pencil MAP assessments, students were given a writing task in which they had to write a letter in response to a prompt. Due to the adoption of new State Standards, testing format, and testing expectations, the writing task

was eliminated. Students often struggled with this section of the test in particular since it was not a skill that was heavily covered in the curriculum. The researcher suggests credit be aimed at the removal of the letter writing section and the addition of more multiple-choice questions. As students become more familiarized with Chromebook usage in the classroom, the researcher believes the MAP test scores will continue to increase. The researcher recommends that this study be replicated now that Chromebooks have been implemented for five years. This means current students in third grade have had access to one-to-one Chromebook usage for their entire educational career, thus far. Whereas, when this study was conducted, third-grade students had only used Chromebooks for two years, beginning in first grade.

Recommendations for Technology Use for the Study Site

As with any new technology initiative, administrators need to acknowledge the absorbent amount of planning and preparation involved in such implementation. Technology initiatives, in general, incur immense costs; however, that cost is even higher when one-to-one devices are involved. Coupled with the immense cost of devices, many districts face problems with infrastructure and lack the bandwidth to accommodate numerous students using the Internet simultaneously (Herold, 2016). Both administrators in this study agreed that technology has had a positive impact on teaching and learning for students. The upper-grade students at the school in this study have one-to-one Chromebooks. The researcher recalled in her daily journal, a day when a fiber optic wire had accidentally been cut leaving the entire school without Internet access. Instances like this are inevitable. The lack of Internet rendered the Chromebooks useless. Teachers had to quickly alter their lesson plans to compensate for the lack of Chromebooks. This

incident created a major disruption in the learning process. Administrators and teachers need to plan for such unexpected dilemmas in advance, so that planning and preparations can be made accordingly to decrease the impact of the lack of Internet and interruption in student learning. This study helped to identify the need for alternative Internet sources such as Wi-Fi Hot Spots that can be used in the event of an Internet outage. Wi-Fi Hot Spots equipped with wireless data from a cellular provider grant the users with Internet access. Teachers must also have access to paper-pencil tasks ready and available for students.

Results from this study confirmed that administrators need to have guidelines in place to monitor and prevent inappropriate website access. Students are especially curious and with the internet at their fingertips, they can search a variety of information in a short amount of time. The researcher noted a time when a student was searching for an inappropriate topic on Google. Luckily, the school district utilized a web content monitoring program called GoGuardian that blocked the content from being displayed as well as alerting the technology specialist of what was searched. “GoGuardian software helps schools easily manage their devices, better understand their students, and keep them safer online” (GoGuardian, n.d.). Administrators were then notified of the time, device, and specific inquiry made by the student. The solution was to have a talk with the student and put them in the penalty box. When students are put in the penalty box, they are only able to access specific websites designated by the teacher and administrator. Before the implementation of this program, students would completely lose computer privileges for a designated length of time. This method added a burden on teachers to shift online resources, activities, and assignments from digital format to a paper-pencil format. The

researcher also recalled another instance where a student gained another student's Google credentials and used it to access their account and send mean emails to peers and teachers. Even though the login breach occurred off-campus, the technology department was able to compare the IP address attached to the emails and the IP address of students in the class to determine the culprit. These gatekeeping mechanisms deter students from inappropriately using their devices.

Recommendations for Further Research

The findings of this study are significant to any school district that is contemplating adding one-to-one Chromebooks into their curriculum. This study suggests that implementing one-to-one Chromebooks can increase student engagement, increase efficient access to information materials, and simplify the delivery of instruction. Administrators and teachers maintained that the benefits of implementing one-to-one Chromebooks were worth the initial stress involved in adding them to the classroom. For school districts considering implementing one-to-one Chromebooks, purposeful and efficient professional development and adequate technical support are essential. The researcher recommends the study be extended using data from the 2018-2019 and 2019-2020 school years. As teachers and students gain more familiarity with Chromebooks, especially following the e-learning period of the pandemic, the researcher believes that a larger increase in academic achievement will be observed. Throughout the study, the MAP test changed every year. This made it difficult to compare data results year-to-year. For further research, the researcher recommends the version of the test and the standards covered be consistent throughout the study, as this would reduce the number of limitations. This study only included academic achievement data from students in the

third grade. For future research, the study should be extended to grades three through five in all elementary schools in the district. Gathering and analyzing the data from a larger group will provide the school district with a clearer picture of the impact one-to-one Chromebooks have on academic achievement. Additionally, only three teachers and two administrators were interviewed to gain their perceptions of technology in the classroom. For future studies, the researcher recommends more teachers and administrators be interviewed. Another recommendation for future research would be analyzing the data from the same groups of students using their third, fourth, and fifth-grade data. The longevity of a multi-year study would allow school districts to examine the impact of one-to-one Chromebooks over several years.

Conclusion

As previously mentioned in Chapter Two, few studies have been conducted on one-to-one Chromebook usage and academic achievement at the elementary level (Dunleavy et al., 2007; Greaves et al., 2012; Grimes & Waschauer, 2008; Penuel, 2006; Zucker & Mcghee, 2005). This gap in the literature identified a need for further research on one-to-one Chromebook usage at the elementary level. While future research in this area should still be conducted, this study serves as one case in discovering the possible effects of one-to-one Chromebook usage on academic achievement in elementary classrooms and the perceptions of technology from teachers and administrators. In addition, one-to-one Chromebook implementation is still a relatively new concept and should continue to be studied and researched as technology evolves.

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