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The Impact of One-to-One Technology Initiatives on the Racial Achievement Gap in the High School Setting.

by:

Jaysen Walter Anderson

A dissertation submitted to the faculty of Bethel University

in partial fulfillment of the requirements for the degree of

Doctor of Education

Saint Paul, MN

2019

Approved by:

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Abstract

The purpose of the study was to analyze the racial achievement gap between high schools that had a one-to-one technology program and schools without this program. Minnesota Comprehensive Assessment reading and math data were collected on 20 Minnesota high schools, 10 with a one-to-one program and 10 without for the 2016-2018 school years. Along with math and reading proficiency data for the 20 schools, achievement gaps were calculated for each school and averaged for each group of schools for the three years studied. Data was collected from a publicly available resource, the Minnesota Department of Education Report Card website. The findings of the study demonstrated that there were no statistically significant differences in the racial achievement gaps between schools that had a one-to-one technology program and schools that did not have a one-to-one technology program.

Acknowledgments

A sincere thank you to my Bethel team of Dr. Krista Soria, Dr. Mike Lindstrom, and advisor Dr. Tracy Reimer. Your guidance and honest feedback helped shape this study into something I am very proud of. I'd like to also thank Ms. Rhonda Gilbraith in the Bethel library for her lessons in proper APA formatting which was extremely helpful as I neared the completion of this project.

Finally, thank you to my entire family for your support and patience through this process. To my amazing wife, thank you for your encouragement in all my endeavors. Without you this would not have been possible.

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Chapter 1: Introduction

Introduction of the Problem

The racial achievement gap is one of the most stubborn, persistent, and troubling issues affecting not only the American education system but American society as a whole as well (Williams, 2011). The racial achievement gap, in which White students outperform African American students and other racial minorities, has been long documented. Disparities between White citizens and racial minorities are not new, nor are they relegated to the education of youth (Boyd, 2018).

Time and time again, in schools throughout the nation, Black students achieve proficiency on state standardized assessments at a significantly lower rate than those of their White peers (Barton & Coley, 2010). While this is largely true throughout the United States, Minnesota has had one of the largest gaps in the nation in performance between its White and Black students (Pearlstein, 2014). According to the Minnesota Department of Education (2018c), Black students comprise approximately 11% of Minnesota students and are outperformed on state assessments by White students by 20% or greater (2019). Figures 1 and 2 illustrate this concern, with the proficiency for Math and Reading scores on the Minnesota Comprehensive Assessment tests by White and Black students listed for academic years 2016-2018. In each year and subject White students outperformed their Black peers by nearly two to one.

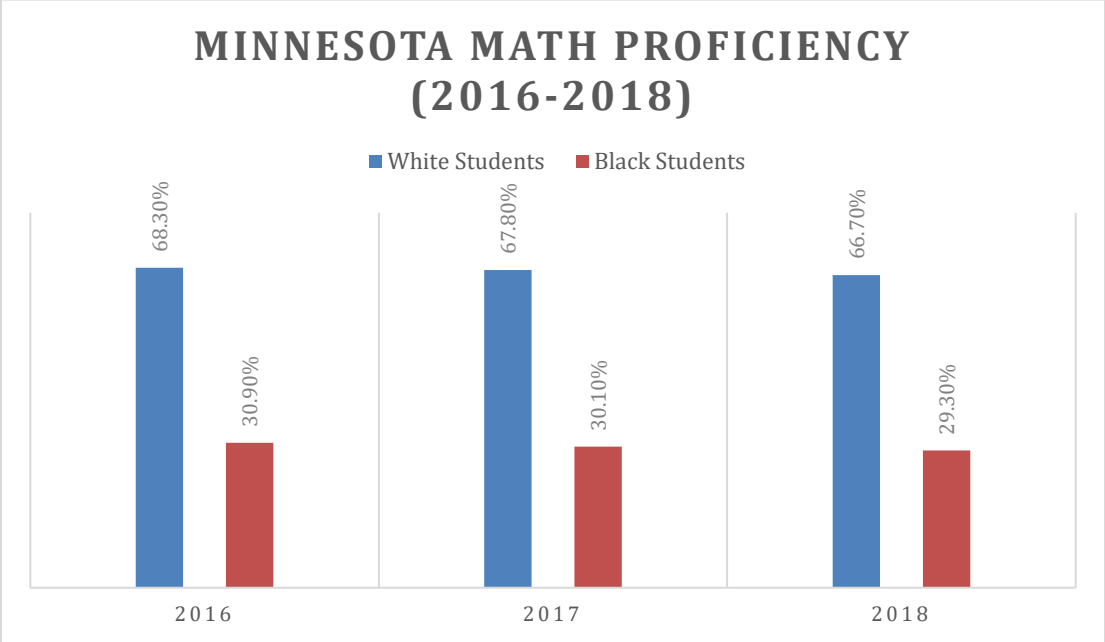

Figure 1. Minnesota math proficiency scores for Black and White students.

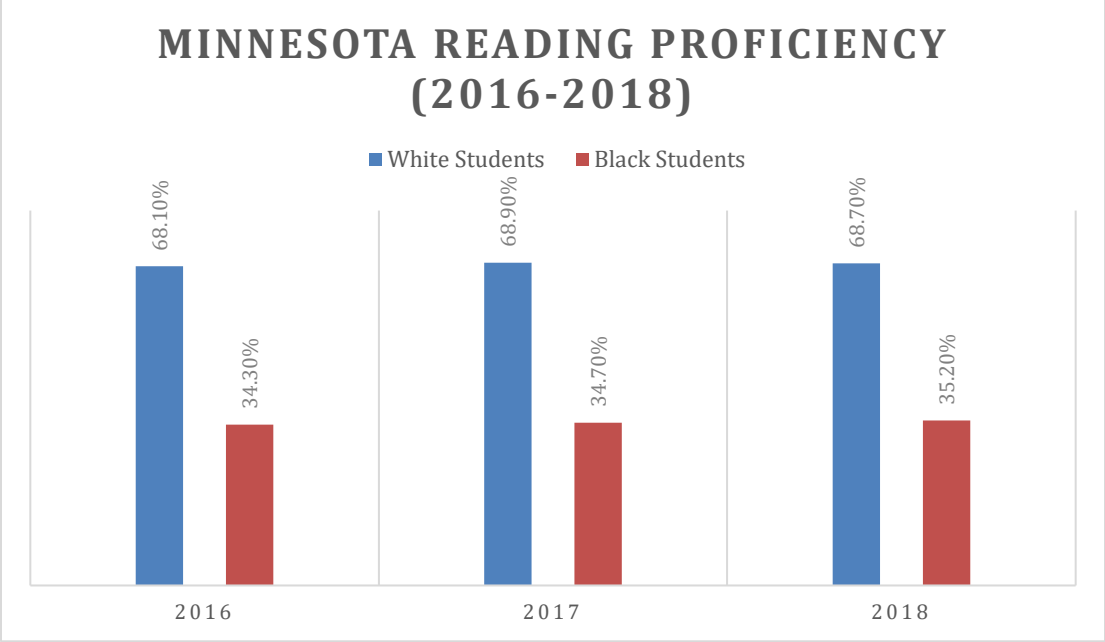

Figure 2. Minnesota reading proficiency scores for Black and White students.

A cornerstone desire for most educators, politicians, and community members is to close the education achievement gap, and in turn, create more equitable high school and college graduation rates among African American students (de Brey et al., 2019).

Schools throughout Minnesota and the nation have long attempted to close the racial achievement gap between their White students and their Black students through a variety of means, including pedagogical shifts, staff training around culture and diversity, and other systemic changes (Elias, White, & Stepney, 2014). Unfortunately, a sustained narrowing of the racial achievement gap, as evidenced by the last three years of achievement data in Minnesota, has been elusive.

School leaders and teachers have long struggled to meet society's demand to close the racial achievement, therefore leaders are considering alternative methods (Basch, 2011; Brown, Benkovitz, Muttillo, & Urban, 2011). One such method is increased student access to technology through a one-to-one technology plan. For schools or districts that adopt a one-to-one technology plan, every student is issued an electronic device such as an iPad or Chromebook to keep throughout the school year. As much of education is increasingly digital and online, one-to-one technology ensures that there is no concern around equity to access ("One-to-One," 2013).

School and district leaders support one-to-one technology programs so that students of color, who are more likely to be from low-income backgrounds and qualify for free or reduced price lunch programs, have the same level of access as their more

affluent peers (Kirkpatrick, Brown, Searle, Sauder, & Smiley, 2017). School leaders who deploy resources in this direction often believe that a lack of access to digital technology and resources could be a contributing factor to the racial achievement gap.

Due to the limited resources many district and school leaders manage, the decision to invest in a one-to-one student technology program is significant. The rationale for investing in a one-to-one technology program is the goal of increased student learning; however, the decision to purchase and maintain hundreds or thousands of devices cannot be made lightly (Howard & Howard, 2017). Educational leaders must be equipped with a broader understanding of the context and impact of the decision to implement digital platforms, especially whether implementing one-to-one technology will lead to decreases in the achievement gap. Further study is needed to provide information to assist school leaders with making that decision.

Purpose of the Study

The purpose of this study was to analyze the Minnesota Comprehensive Assessment (MCA) proficiency data for Minnesota high schools who have a one-to-one technology plan and compare that data to Minnesota high schools without this program to determine the difference, if any exists, between the schools' racial achievement gaps. This study examined the impact of technology on racial achievement gaps to aid leaders in making more informed decisions in the future.

School leaders have to make important decisions both in terms of financial

management and in terms of program allocation to support students' learning and achievement. Limited financial resources and limited ability to direct system-wide pedagogies require leaders to weigh decisions very carefully. According to Burns and Dimock (2007), school leaders often look to technology plans as a means to enhance both students' engagement as well as increase access to 21st century learning. Increased technology purchases, specifically one-to-one computing programs, are expensive investments; therefore, school leaders must decide if a technology investment, both in financial cost and philosophical direction, is the best method to increase student achievement.

In addition to financial prioritization challenges, most high schools struggle with the racial academic achievement gap in which White students outperform Black students on measures of academic assessment. School leaders have often struggled with successful efforts to close this achievement gap, with middling long-term successes (Garcia & Weiss, 2017). As one-to-one technology programs focus on student engagement and more modern 21st century learning, it is reasonable for school leaders to hope that this increased access and individualization will have a positive impact on the racial achievement gap in their district and school (Mucetti, 2017).

School and district leaders make many difficult decisions, weighing multiple factors and constituencies to support student learning and success. This study may illuminate the decision of whether to invest in a one-to-one student technology program

based on the impact on academic achievement and how these programs impact the racial academic achievement gap.

Research Questions

This secondary data analysis attempted to answer the following questions:

1. Is there a significant difference in the 11th grade MCA math proficiency racial achievement gap between Black and White students, over a three-year period between schools with a one-to-one student technology platform and schools without a one-to-one technology platform?
2. Is there a significant difference in the 10th grade MCA reading proficiency racial achievement gap between Black and White students, over a three-year period between schools with a one-to-one student technology platform and schools without a one-to-one technology platform?

Hypotheses

Null Hypothesis One: There is no significant difference in the MCA Math Proficiency racial achievement gap over a three-year period between one-to-one technology schools and those without a one-to-one technology plan.

Alternative Hypothesis One: There is a significant difference in the MCA Math Proficiency racial achievement gap over a three-year period between one-to-one technology schools and those without a one-to-one technology plan.

Null Hypothesis Two: There is no significant difference in the MCA Reading

Proficiency racial achievement gap over a three-year period between one-to-one technology schools and those without a one-to-one technology plan.

Alternative Hypothesis Two: There is a significant difference in the MCA Reading Proficiency racial achievement gap over a three-year period between one-to-one technology schools and those without a one-to-one technology plan.

Significance of this Study

The results of this study will benefit school and district leaders as they contemplate both whether to invest in a one-to-one technology platform and how to best remedy their racial achievement gaps. The moral importance of closing the racial achievement gap and serving all students is commonly cited by educators. In addition to the moral imperative, the closing of these gaps also has significant potential economic impact. If underserved populations achieved at the level of White students over the past few decades, hundreds of billions of dollars could have been added to the United States' economy (Auguste, Hancock, & Laboissiere, 2009). If the United States were able to close its racial achievement gaps, the U.S. economy would be nearly $2.3 trillion larger by the year 2050 (Lynch & Oakford, 2014). These figures demonstrate that not only does closing the racial achievement gap have moral implications, it has significant economic implications as well.

There have been multiple studies documenting the racial achievement gap, as well as efforts to close it (Garcia & Weiss, 2017). One of the most troubling realities of the

racial achievement gap is its persistence and how difficult it is to identify an adequate working solution that is universally applicable (Barton et al., 2010). One potential treatment for this ailment is a wide scale technology initiative, often involving distributing devices to every student. While technology distribution may rarely, if ever, be designed to close the achievement gap, its potential impact cannot be ignored.

Although there may be other benefits of a one-to-one technology program, there is a gap in existing research in whether technology directly impacts student achievement or the racial achievement gap and further study is needed to inform decision makers (Mucetti, 2017). This study's findings may guide schools and districts with limited financial resources regarding investment choices. Schools and districts, especially those in large, urban areas, have extremely difficult decisions to make regarding how they spend their funds, and what will have the most impact on student achievement.

Financial constraints were magnified with the accountability measures that were included in the No Child Left Behind (NCLB) legislation that was passed in 2001. NCLB required growth indicators that measured a plethora of data, including the academic achievement of a school's and district's racial groups (Heise, 2017). In addition to the achievement measurement of specific subgroups of students, the federal government maintained the power to sanction states for not meeting achievement benchmarks, which included the reduction of the racial academic achievement gap on state mandated assessments. Pressure on the states leads to similar pressure on districts,

schools, and teachers in the achievement of specific subgroups of students, and the shrinking of their achievement gaps (Mintrop & Zane, 2017). School leaders employed a variety of strategies, pedagogies, and philosophy shifts to address this demand. Examples of such shifts include intervention specialists, extended learning days, instructional coaches, and direct support from state teams and experts, and more (McNeil, 2014).

In 2015 the Federal legislation around educational achievement shifted from No Child Left Behind (NCLB) to Every Student Succeeds Act (ESSA) and the focus on the growth and achievement of a school's subgroups continued to be a major priority for the state, district, and individual schools (Heise, 2017). With the increase in technology in the schools, including the growth of one-to-one technology programs for students, school leaders need to understand how these technologies impact their racial academic achievement gaps. Understanding this impact will be critical for leaders to make informed decisions on what their students and schools need to be successful both in 21st century learning as well as closing academic achievement gaps.

Definition of Terms

Black or African American: A person having origins in any of the black racial groups of Africa (United States Census Bureau, 2018).

White: A person having origins in any of the original peoples of Europe, the Middle East,

or North Africa (United States Census Bureau, 2018).

Achievement gap: Can be used to describe differences between multiple groups, but for this study, the term "Achievement Gap" will be used to define the academic achievement differences between assessment scores of Black students and the assessment scores of White peers (National Education Association, 2019).

One-to-one technology: Sometimes abbreviated as 1:1, this term refers to a school, district or state providing *every* student with a laptop, Chromebook, tablet, or other device (One-to-one, 2013).

MCA: Minnesota Comprehensive Assessment. Yearly standardized assessments taken by Minnesota Students to measure achievement and knowledge in the subjects of mathematics, reading, writing, and science (Minnesota Department of Education, 2018a).

Organization of the Remainder of the Study

Chapter Two reviews literature relevant to this study, including literature related to the racial academic achievement gap, methods of reducing the achievement gap, descriptions of educational technology, and impact of one-to-one technology in schools. Chapter Three describes the research procedures and methodologies. Chapter Four discusses findings from the study. Chapter Five shares potential impacts and implications of the study findings and concludes with suggestions for additional research.

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Chapter 2: Literature Review

Defining the Racial Achievement Gap

The racial achievement gap, beginning in its current form in the 1970s and 1980s, has continued to perplex schools, districts, and communities throughout the nation (Barton & Coley, 2010). Schools have struggled to close the achievement gap with any consistency or efficiency in the long run, despite several short term increases and decreases in achievement gaps throughout the last few decades (Barton & Coley, 2010).

Though the mission of educating all children has been a demonstrated goal for decades, society has struggled to achieve that goal with established long-term success (Barton & Coley, 2010). Since 1954, with the landmark Brown vs. Board of Education decision by the United States Supreme Court, U.S. law has adhered to the rule that separate is in fact not equal, not in society at large, and most certainly not in the classroom (Barton & Coley, 2010). It was the hope of the leaders of this era that children of all colors and backgrounds would receive the same equitable education to provide fair access to the workforce upon completion of their schooling (Armor, 2006). The unfortunate reality, however, is that this vision of educational equity has not developed quite as hoped (Ogletree Jr., 2007). The racial achievement gap, which documents the academic achievement of White students far exceeding African American peers, as well as other racial minorities, has been an unfortunate reality for schools throughout the United States with wide sweeping political, moral, and economic implications (Braun,

Chapman, & Vezzu, 2010).

The National Assessment of Educational Progress (NAEP) is a congressionally mandated series of assessments designed to measure what United States' students know (Aud et al., 2010). The NAEP program began in 1969 and is known as the Nation's Report Card and compares U.S. students from state to state, and to other countries (National Center for Education Statistics, 2018). There are many instances of data documenting the racial achievement gap, at the local, state, and national levels (Gillborn, Demack, Rollock, & Warmington, 2017). Since overall academic achievement continues to rise and improve, there remains a consistent racial achievement gap, although many states have differing levels of achievement and gaps (Vanneman, Hamilton, Anderson, & Rahman, 2009). In both the core subjects of reading and math, the achievement gap has remained steady between White and Black students. In 2009, on the National Assessment for Educational Progress (NAEP), the 8th grade reading achievement gap between White and Black students was 26%, which was not measurably different than the gaps recorded in 2007 or 1992 (Aud et al., 2010). Research reports from the national level to the local level report similar results, proving that the racial achievement gap is a reality for many school leaders and educators to try to rectify with interventions and strategies (Gillborn et al., 2017). Achievement gaps between Black and White students persist for mathematics and reading from the individual assessment's first versions through their most recent. The Nation's Report Card website tool (n.d.), documents the

scale score racial achievement gaps on the NAEP for numerous groups, including the achievement gap between Black and White students over the years as indicated in Figures 3 and 4. The figures demonstrate that over the years the achievement gaps between White and Black students in math has mostly held steady, however the gap in reading scores has grown over time.

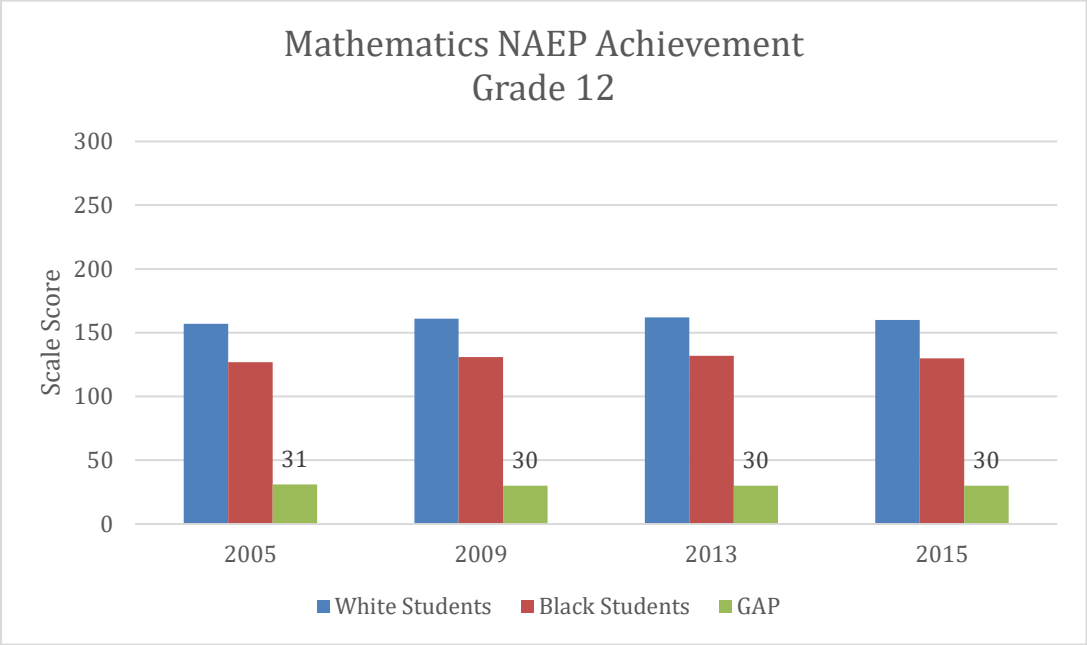

Figure 3. NAEP Mathematics Achievement by race and gap for Grade 12.

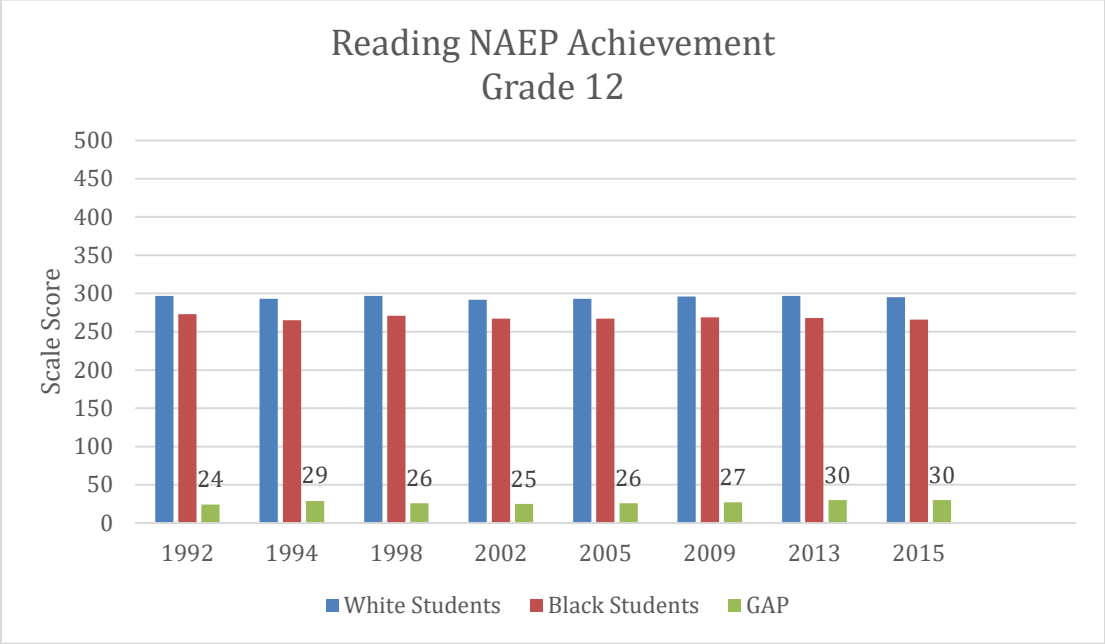

Figure 4. NAEP Reading Achievement by race and gap for Grade 12.

There is significant research that points to the importance of the early educational years and opportunities in relation to the racial academic achievement gap (Nelson, 2006). When students enter high school, however, there exist complexities that can exacerbate this including challenging school transitions, increased impact of class failures, and higher retention rates (Bernstein, Edmunds, & Fesler, 2014). Several researchers have demonstrated consistent trendlines around racial achievement gaps exist until the ninth grade, and they often grow wider during the high school years (Kotok, 2017). There are many potential reasons for this widening gap including peer group influence, shifting socio-economic status realities, and school-based factors beyond the students' control (Kotok, 2017). Students of color often find themselves in schools with

disproportionate numbers of minority students, lower socio-economic statuses, and lower quality teachers, which have been correlated with the widening achievement gap (Goldsmith, 2011).

Historical Factors of the Racial Achievement Gap

According to Garcia and Weiss (2017), academic achievement gaps have persisted for decades in the United States and significant exacerbation occurred around the late 1970s when economic disparities increased. During the 1970s, the upper 10% of American income increased greatly, while the rest of the population's share declined rapidly. Since the vast majority of this top 10% of economic wealth holders are White, this economic gap contributed greatly to the racial academic achievement gap that is evident today (Garcia & Weiss, 2017).

There have been several periods of progress, as well as struggles in changes in the racial achievement gap over the past few decades (Barton et al., 2010). There is a multitude of reasons for both the achievement gaps and how they have widened and narrowed through time, including a distinct history of the racial achievement gap, with certain factors tracing back throughout societal expectations based on America's history with race, culture, and integration (Rothstein, 2013). Therefore, how racial groups have been perceived and provided less economic opportunity throughout generations has led to the current educational discrepancies specific to race and academic achievement (Barton et al., 2010).

Although specific causes of the academic achievement gap can vary depending on demographic groups, geographic location, and socio-economic circumstances, much of the gap can be generally attributed to opportunities or lack thereof (Johnston, 2011). The author stated that schools, communities, and jurisdictions have inequitable opportunities for students and families, such as access to libraries, before and after school programs, or summer enrichment opportunities. Communities with fewer available opportunities generally perform lower regarding academic achievement than their more advantaged peers (Rothstein, 2013). Johnston (2011) contended that the common-sense conclusion was that when more equitable opportunities are provided for all youth and families, racial achievement gaps will begin to close.

In addition to these opportunity gaps, educators must understand the social structure behind the poor academic achievement of African American students. Much research on the racial achievement gap fails to recognize the underlying or hidden social issues around underachieving communities (Madyun, 2011). According to Sampson and Garrison-Wade (2011), there are unique cultures and histories that impact how African American students perform in American educational systems. Even though some educators view African American students as incomplete versions of students from a Western background and rely on reinforcing this pedagogy, a focus on culturally relevant curriculum and pedagogy will pay higher dividends for most students of color (Sampson & Garrison-Wade, 2011).

A contributing factor to the racial achievement gap is the teacher quality gap, a theory stemming from the idea that the quality of educator professionals diverges markedly between upper middle class, mostly White communities and that of more urban, poorer, and diverse communities (Goldhaver, Quince, & Theobald, 2016). There is significant research attesting to the importance of quality teaching on student outcomes, and therefore teacher quality is central to school improvement (Slater, 2013). Adamson and Darling-Hammond (2012) demonstrated the impact highly qualified teachers have on their students, with significantly stronger academic gains compared to students with less qualified teachers. Scholars have documented that students of poverty and students of color are much more likely to have lower quality teachers as defined by advanced degrees and years of experience, than their white, middle class peers (Cloterfelter, Ladd, & Vigdor, 2005). Access to quality educators is vitally important to the long term educational and economic success of all students, and if students of color were assigned high quality teachers more often, it could reasonably reduce the achievement gap over time (Adamson & Darling-Hammond, 2012).

Closing the Achievement Gap

Studies, books, journals, and education programs related to closing the racial achievement gap have been published and resulted in recommendations for schools to consider when crafting their educational plans. Closing the achievement gap often involves comprehensive, bold, and long-term strategies that go beyond accountability and

punitive reactions (Kober, 2001).

Mindset and expectations.

Academic optimism and high expectations are viewed as key to schools who have had success in closing the gap (Brown, Benkovitz, Muttillo, & Urban, 2011). Brown et al.'s comprehensive study examined the culture of high performing schools with diverse student populations and documented common features concerning equity. According to the researchers, the differences between schools with a large achievement gap and a smaller achievement gap can be explained by three key frameworks: encouraging academic achievement for all students, offering strong instructional feedback, and expecting excellence from all students. Two of the three recommendations come in the form of mindset, which can be difficult to measure in a potential candidate and develop within the teaching staff (Sparks, 2016).

Leadership.

Levine and Marcus (2007) focused on understanding the variety of experiences and opportunities that teachers had in curriculum and school program decision making. The authors found that there are two responses by school leadership when the racial achievement gap becomes too large. The first is to take control of teaching and curriculum, the second is to empower groups of teachers and give them the autonomy to develop the educational program for their students. Levine and Marcus (2007) found that empowering teachers resulted in a more positive learning environment. The researchers

postulated that with expanded opportunities and empowerment teachers were more capable of working with a diverse student body and they asserted that closing the achievement gap will not occur with any simplistic or single-minded approach.

A less discussed remedy for the achievement gap is the role of district level leadership. Successful schools see an increased role for the superintendent and district leadership promoting high school graduation, dropout prevention, and creative means of credit recovery to ensure on time graduation (Mac Iver, 2010). School boards also have a potentially very powerful role in closing the achievement gap in their community. District school boards have the authority to allocate resources and determine district priorities, which if focused on equity and their achievement gap, could have significantly positive results (Darden, 2011).

School leadership involving students in the problem-solving process to close the racial achievement gap is another approach to closing the achievement gap. Students of color are often the best resource regarding the barriers faced and what potential solutions would be beneficial (Soumah & Hoover, 2013). This study made it clear that students of color often feel that educators have lowered academic expectations, which can create a cycle of low achievement and low support. It is important to challenge the assumptions of educators and school leaders and use student voice to assist in the evaluation of current practices and in determining strategies to close the racial achievement gap (Lee, 1999).

Comprehensive approaches.

A focus group panel of administrators and teachers revealed that success was found in high expectations, standards-based instruction, change focused leadership, and hiring well (Billig, Jaime, Fitzpatrick, & Kendrick, 2005). There is much speculation over whether these schools that close the achievement gap are isolated, or if real interventions can be analyzed and replicated (de la Torre et al., 2013). Additional comprehensive approaches include focusing on student attendance and student engagement (Fisher, Frey, & Lapp, 2011). These often-overlooked components of student achievement can have positive results in narrowing the achievement along with more conventional methods.

Whole child and community approaches.

There is a fundamental challenge in closing the achievement gap in the high school years; that is the idea that many skills are rooted early in a student's life. If educators delay significant strategies and resources until high school, there could already be a significantly large gap that may not be adequately addressed in those four years. Researchers advocate for very early intervention in students' lives, especially in the years before kindergarten. One example detailed by Wilder Research (2010), was an experimental program in 2005 known as "Project Early Kindergarten" (PEK), which took place in Saint Paul Public Schools. This program targeted at-risk students before they entered kindergarten providing a rigorous curriculum with the hope of closing the district's achievement gap. Research finds that the achievement gap can be largely

rooted in children not being properly ready for kindergarten, with those gaps persisting throughout the rest of the educational career (Garcia & Weiss, 2017). While there have been multiple strategies to close the racial achievement gap, most have had modest long-term success, if at all (Garcia & Weiss, 2017). While complex, community ownership over these racial and economic concerns with significant actions connected to these needs had more positive and longer lasting results (Garcia & Weiss, 2017).

There are less traditional suggestions for closing the academic achievement gap. One such example is schools that have success with closing the achievement gap address the students' health, because healthier students achieve better (Basch, 2011). School health programs that address the needs of students are often a strong component to overall academic success, and schools who implement other interventions aimed at closing the achievement gap without addressing the whole student may not get the full measure of return as hoped (Basch, 2011).

One-to-One Computing

The role of technology has most certainly evolved in our society and economy in the past several decades, and our current educational system must make a purposeful commitment to intensive investment in technology use and infrastructure (Vockley, 2007). Researchers have pointed to the original language in the No Child Left Behind Act of 2001, which mandated schools and districts integrate technology into schools and curriculum, institute high quality professional development to support those programs,

and continuously examine the conditions of the positive impact technology has in increasing student achievement (U.S. Department of Education, 2001).

An additional factor in the national discussion and standardization of educational technology came with the creation and implementation of the International Society for Technology Education (ISTE) standards in 1998, and which were revised in 2007 and 2016 (International Society for Technology in Education, n.d.). In an attempt to create a more active voice, ISTE standards have influenced how schools formulate technology plans and how technology impacts curriculum. There are standards outlined for teachers, administrators, and students. The student-focused standards ask students to become:

1) An empowered learner,
2) Digital citizen,
3) A knowledge constructor,
4) An innovative designer,
5) A computational thinker,
6) A creative communicator, and
7) A global collaborator.

As ISTE standards represent a high bar for students and educators, it is the belief that they are essential skills that truly align with 21st century learning and outcomes (Sharp, 2014). A research study conducted by Bebell and Kay (2010) found that consistent technology use in a one-to-one setting led to increased engagement,

collaboration, and research skills. These findings highly correlate with the ISTE standards and demonstrate a positive correlation between increased use of technology and these skills.

Schools have attempted to use modern technology for educational gain, and one relatively new phenomenon is the spread of one-to-one computing, where each student is issued a personal device to use throughout the day and school year. Beginning in the late 1990s, with rapid expansion in the 2000s and 2010s, school districts have purchased laptops, Chromebooks, and tablets by the millions (Doran & Herold, 2016). With decreasing costs in both infrastructure and the devices themselves, school district leaders have found themselves in a position to purchase devices for every student they serve (Hockly, 2016). States such as Maine and Michigan have adopted one-to-one computing programs statewide. However, many school districts make these decisions themselves based on what works for their school system and what works within their system's current financial reality (Abell Foundation, 2008).

There are multiple methods of technology inclusion in the schools and one trend that has become more common is the universal adoption of a technology platform (Raths, 2012). There are different frameworks of technology adoption that should be considered, along with strengths and weaknesses and infrastructure issues (Mucetti, 2017). Some of the more common programs include a one-to-one initiative, which involves giving every student a wirelessly connected device such as an Apple iPad or Google Chromebook to

access a variety of digital tools and web-based software (Abell Foundation, 2008).

Schools and educators attempt to individualize learning to meet curricular, state, and global standards. As recent surveys have demonstrated, educators believe the biggest challenge in education today is adequately meeting each student's needs, levels, and goals (Edmentum, 2014). Due to these concerns, some educational leaders hope that through one-to-one technology they will be better equipped to meet each student's needs. Even though some studies have demonstrated that increased technology availability and use has been shown to increase student engagement, it is far less conclusive if a one-to-one technology program positively impacts actual student learning and achievement outcomes (Bebell & Kay, 2010; Bebell & O'Dwyer, 2010).

One-to one Educational Technology Tools

The specific tool in a one-to-one computing environment can vary and are dependent on both curricular and financial processes. In general, though, there are three major options: a personal and dedicated laptop, a personal and dedicated tablet device such as an Apple iPad, or a personal and dedicated Chromebook (Varier et al., 2017). School districts must weigh the financial costs of the product they wish to invest in, as the differences in the costs of the device are critical when multiplied over hundreds or thousands of students.

In addition to the device school leaders choose to invest in, schools must consider their wireless infrastructure in supporting these devices, as well as how their technical

support teams and professional development will assist teachers with this new method of instruction (Demski, 2012). The author continued that these considerations can come at great cost to the district, both in terms of initial investment but also in terms of continual support, maintenance, and replacement of devices.

Comprehensive laptop. Computer laptop one-to-one programs are found in thousands of schools throughout the country (Manniger & Holden, 2009). Laptops were one of the first technology tools to be leveraged in the one-to-one movement and have generally the same computing power as their desktop counterparts. Schools that choose fully powered laptops often prefer the advantages these devices have over tablets or chrome books, but can cost upwards of a thousand dollars per device or more (Butrymowicz & Mathewson, 2018).

Apple iPad. Tablet devices like the Apple iPad are portable, flexible, and provide easy and steady access to educational materials. Apple iPads cost a school district from $300 and higher depending on the make and model they choose (Warren, 2018). Tablet computers are often cheaper and easier to maintain than traditional computers or laptops which can have significant impacts on the school curriculum and environment (Varier et al., 2017).

Google Chromebook. Google Chromebooks, which are produced from a variety of companies, are internet dependent laptops with quick and student friendly accessibility that run on the web-based software platform Chrome OS. Even though these are often

cheaper than full-fledged laptops, there is limited offline functionality (Donovan, 2019). The device's costs can vary, but generally cost a school between $200 to $500 per device. Although Chromebooks cannot meet the same performance requirements as a full-fledged desktop or laptop computer, they have enough performance and productivity tools for most students and teachers (Anderson, 2018). The author elaborated that Chromebooks are generally cheaper than full scale computers but rely on Wi-Fi, collaboration, and cloud-based applications.

Although there are a variety of devices that could be included in the one-to-one technology category, it is reasonable to conclude that experiences around student engagement and related outcomes are similar (Howard & Howard, 2017). According to Winkler (2014), Apple iPads were the most common device found in schools with over 40% of the market, however, Chromebooks have increased in popularity to gain nearly 20% of the K-12 market.

The unique power of technology, as demonstrated by the growth of online programs and one-to-one technology systems, has a direct connection to well-prescribed 21st century skills such as collaboration, communication, digital literacy, and self-directed learning (Varier et al., 2017). With this expansion, students have the power and authority to determine where, what, when, and with whom learning occurs (Cook & Gregory, 2018). According to a study conducted by Varier et al. (2017), this inclusive environment can support learners from a variety of environments and abilities and is

designed to transition the classroom from a teacher centric environment to that of one focused on the students.

School and District Adoption of New Technologies

Schools adopt technology for multiple reasons, but primarily to increase student engagement and better target 21st century teaching and learning (Burns & Dimock, 2007). Depending on the level of implementation, schools must consider how deep they wish to implement the technology into the existing educational programs (Donovan, Green, & Hartley, 2010). A district or school adoption of a wide sweeping technology initiative requires an implementation plan to ensure a smooth transition focusing on curriculum and consideration of the needs of those that will use it daily (Farrell & Gring, 1993).

It is essential that teachers, students, and families become familiar with the appropriate and effective use of these devices in the classroom setting (Howard & Howard, 2017). With a strong plan as its base, the technology, whatever its form, can become an essential tool in the school and classroom. Leaders, along with teachers, need to have a realized plan about what the technology looks like in the school (Weston & Bain, 2010).

According to Donovan, Green, and Hartley (2010), there are student-centered challenges to overcome when teachers implement a new technology platform in the classroom, including off task behaviors and equitable access to technology. Many teachers struggle to find consistent success with student engagement which can result in

off-task behaviors (Groff & Mouza, 2008). A consistent concern with an influx of digital tools and student access to an internet-connected device is off task behaviors (Howard & Howard, 2017). There are no conclusive studies that demonstrate increased technology leads to increased off task behaviors, but these changing dynamics should encourage teachers to reflect and collaborate on student technology use and discuss what off task behaviors look like and their impact in a student-centered classroom (Donovan, Green, & Hartley, 2010).

School leaders are encouraged to set an instructional vision around technology and address challenges and barriers so that teachers feel empowered to seek collaboration and growth around technology use (Means, 2010). Varier et al. (2017) demonstrated that when students have access to an individual device, teachers often find new methods of instruction, shifting more to that of a facilitator due to students working independently and an increased ability to offer more timely and effective formative feedback.

Success in large changes, such as adopting one-to-one computer programs, often hinges on the ability to successfully systematize these changes to include ensuring equitable access, building the infrastructure, and integrating the technology throughout all groups and levels (Mucetti, 2017). One-to-one technology programs are generally a system-wide initiative, but the role of the individual teacher is critical. Bebell and Kay (2010) elaborated that success, defined by student engagement, access to resources, and academic outcomes is often dependent on the individual classroom teacher. Quite often

the determining factor in whether or not that technological initiative is of value to the student's growth depends quite heavily on the teacher (Howard & Howard, 2017).

History of Minnesota Comprehensive Assessments (MCAs)

The Minnesota Comprehensive Assessments (MCAs) are a series of standardized exams designed to measure student learning and achievement of Minnesota's educational standards (Minnesota Department of Education, 2018a). The current iteration of these exams began in 1995 when the Minnesota state legislature passed a series of laws aimed to ensure a "rigorous and results oriented" graduation rule for Minnesota's public-school students.

In 1997, the Minnesota legislature created a model of testing and accountability for students in the third, fifth, and seventh grade (Minnesota Department of Education, 2018a). This design set forth a precedent of measuring all Minnesota students in those particular grades by one statewide test and subject. Subsequently, there were expansions to the MCAs in 2004 and 2006. In this design, all students in Grades 3-8 tested in math and reading, 5th and 8th graders tested in science, and standardized exams in mathematics in grade 11, and reading in Grade 10 were added. According to the Minnesota Department of Education, these standard expectations continue today (2018a).

Between 2006 and 2018 there were several other evolutions to the Minnesota Comprehensive Assessment program. There were MCA program changes specific to students receiving special education services as well as English as a second language

support. Students with an Individualized Educational Programming Plan (IEP) were allowed various accommodations on these exams, and students identified as English Language Learners were given a test known as the ACCESS exam which measures English proficiency (Minnesota Department of Education, 2018a). The MCA exam underwent several revisions, with changes to the exam, its measurement of proficiency and growth, and its delivery labeled as MCA-II in 2008 and then subsequently the MCA-III in 2011.

The Minnesota Comprehensive Assessment program holds several key purposes for students, schools, and districts. One purpose is to measure student knowledge and progress. Through the MCA exam, results, and data points, students and parents can evaluate what their student knows relative to Minnesota state standards (Minnesota Department of Education, 2018a). As success in state standards can be used for acceptance and placement in Minnesota state colleges, parents and students need to understand how they are performing relative to the standards expectations (Minnesota Department of Education, 2018b).

Another purpose of the MCAs is to measure the success and areas of growth of both schools and districts. Once the MCA student data is complete, schools receive the data, including individual student measurements and school wide measurements. This serves the purpose of demonstrating an overall picture of where the school is at relative to the standards but also guides academic areas of improvement (Minnesota Department of

Education, 2018b). These reports, which can be publicly accessed on the Minnesota Department of Education's Report Card Website, are a public record of school and district performance (Minnesota Department of Education, 2018c). Reports indicate individual strands of student data, which demonstrate success gaps between different classifications of students, such as special education students, students on free and reduced lunch, and students of different ethnic backgrounds. This subgroup achievement and gap data are carefully analyzed to determine short and long-term trends, the majority of which point to racial achievement gaps in Minnesota growing more often than shrinking (Center on Education Policy, 2009).

Chapter Three: Methodology

Purpose of the Study

The purpose of this study was to analyze the MCA proficiency data for Minnesota High Schools that have a one-to-one technology program and compare those data to Minnesota High Schools without this program to determine the difference, if any exists, between the schools' racial achievement gap. This study compared both the academic outcomes of Black and White students in Minnesota high schools that have a one-to-one technology program against high schools that do not. The study compared the average achievement gaps between these two types of schools in an attempt to determine if the technology program had any impact on the achievement gaps shrinking or widening.

Theoretical Framework

In an attempt to frame this study and provide a lens for analysis, Critical race theory was used. The core framework of the critical race theory is that racism in our educational institutions is pervasive and endemic and that only through identifying these concerns can we adequately seek solutions (Sleeter, 2016). The author elaborated that with systems that are seemingly neutral, such as state standardized assessments, the convergence of historical and social injustices often leads to disproportionate results. Powers (2007) detailed that analyzing these systems through critical race theory can assist in identifying the social processes that occur and the results that are observed.

Through active acknowledgment of the impact of race and culture, neutral systems and outcomes can be revised.

Critical race theory has often been applied to the social sciences field, not always lending itself to quantitative analysis; however, Sablan (2018) argued that critical race theory and quantitative analysis are natural partners. By analyzing our systems and outcomes quantitively, researchers can better identify inequalities for further study (Sablan, 2018).

The results of this study are discussed through the lens of the critical race theory to continue the conversation on how race and culture impact academic achievement on standardized assessments and potential action steps for improvement. Although academic achievement gaps exist in reading and math throughout much of Minnesota, those gaps do not occur and continue in a vacuum.

Research Design

This was a non-experimental, quantitative study exploring whether one-to-one technology implementation has the potential to impact the racial achievement gap in Minnesota high schools. 10 Minnesota high schools that have implemented a one-to-one technology program were compared to 10 similar Minnesota high schools that have not adopted a one-to-one technology program. Publicly available data on the Minnesota Department of Education (2018c), Report Card website were used to

measure the racial achievement gaps from these schools based on standardized assessments.

Minnesota high school students take the MCA Math assessment in 11th grade, and the Reading assessment in the 10th grade (Minnesota Department of Education, 2018a). The study examined the data of average MCA proficiency scores of these 20 high schools in academic years 2016, 2017, and 2018. The math and reading MCA data were gathered and analyzed by racial subgroups to determine achievement gaps.

The average scores in both reading, math, and their resulting achievement gaps were examined in schools that have implemented the one-to-one technology program and were compared to those that have not. As it was a non-experimental secondary analysis, no new data were gathered but existing data were examined around unique variables.

Research Questions

This secondary data analysis attempted to answer the following questions:

1. Is there a significant difference in the 11th grade MCA math proficiency racial achievement gap between Black and White students, over a three-year period between schools with a one-to-one student technology platform and schools without a one-to-one technology platform?
2. Is there a significant difference in the 10th grade MCA reading proficiency racial achievement gap between Black and White students, over a three-year period

between schools with a one-to-one student technology platform and schools without a one-to-one technology platform?

Hypotheses

Null Hypothesis One: There is no significant difference in the MCA Math Proficiency racial achievement gap over a three-year period between one-to-one technology schools and those without a one-to-one technology plan.

Alternative Hypothesis One: There is a significant difference in the MCA Math Proficiency racial achievement gap over a three-year period between one-to-one technology schools and those without a one-to-one technology plan.

Null Hypothesis Two: There is no significant difference in the MCA Reading Proficiency racial achievement gap over a three-year period between one-to-one technology schools and those without a one-to-one technology plan.

Alternative Hypothesis Two: There is a significant difference in the MCA Reading Proficiency racial achievement gap over a three-year period between one-to-one technology schools and those without a one-to-one technology plan.

Variables

This study was a secondary analysis of existing data, including the MCA reading and math proficiency data from 20 Minnesota high schools from 2016, 2017, and 2018.

The dependent variables for this analysis were the Minnesota Comprehensive Assessment proficiency achievement gaps for math and reading for these 20 high schools' White and Black students. The independent variable for the study were Minnesota high schools that had an established one-to-one technology program and those that did not have an established one-to-one technology program.

Instrument and Measures

The instrument for this study was the Minnesota Comprehensive Assessments (MCA). The MCAs are the state assessments that comply with national Every Student Succeeds Act legislation and have been tested for validity and reliability (Minnesota Department of Education, 2017). Minnesota high school students take the reading exam in 10th grade and the math exam in 11th grade (Minnesota Department of Education, 2018a). These assessments measure students' knowledge and ability in accordance with Minnesota state educational standards (Minnesota Department of Education, 2019).

In both the reading and math assessments students can earn the following marks:

- Does Not Meet the Achievement Standards
- Partially Meets the Achievement Standards
- Meets the Achievement Standards
- Exceeds the Achievement Standards

Students earn a label of "proficient" when earning a "Meets the Achievement Standards" or "Exceeds the Achievement Standards" benchmark (Minnesota Department of Education, 2014). This "proficiency" label was used in this study.

Sampling Design

Due to the nature of the variables studied, the researcher selected a convenient and purposive sample of schools. The researcher identified schools that had and did not have a one-to-one technology program through information found on the schools' websites, as well as through confirmations through phone calls and emails. Ultimately 20 unique high schools were selected to be studied, 10 that had a one-to-one technology program and 10 that did not. All schools chosen had relatively similar sizes and demographics. Schools that had a one-to-one technology program were labeled as "School A," "School B," and so on through "School J." Schools that did not have a one-to-one technology program were labeled "School K," School L," and so on through "School T."

The following figures illustrate the enrollment of all 20 schools, as well as the demographics of the schools which demonstrate their general similarities in both size and makeup.

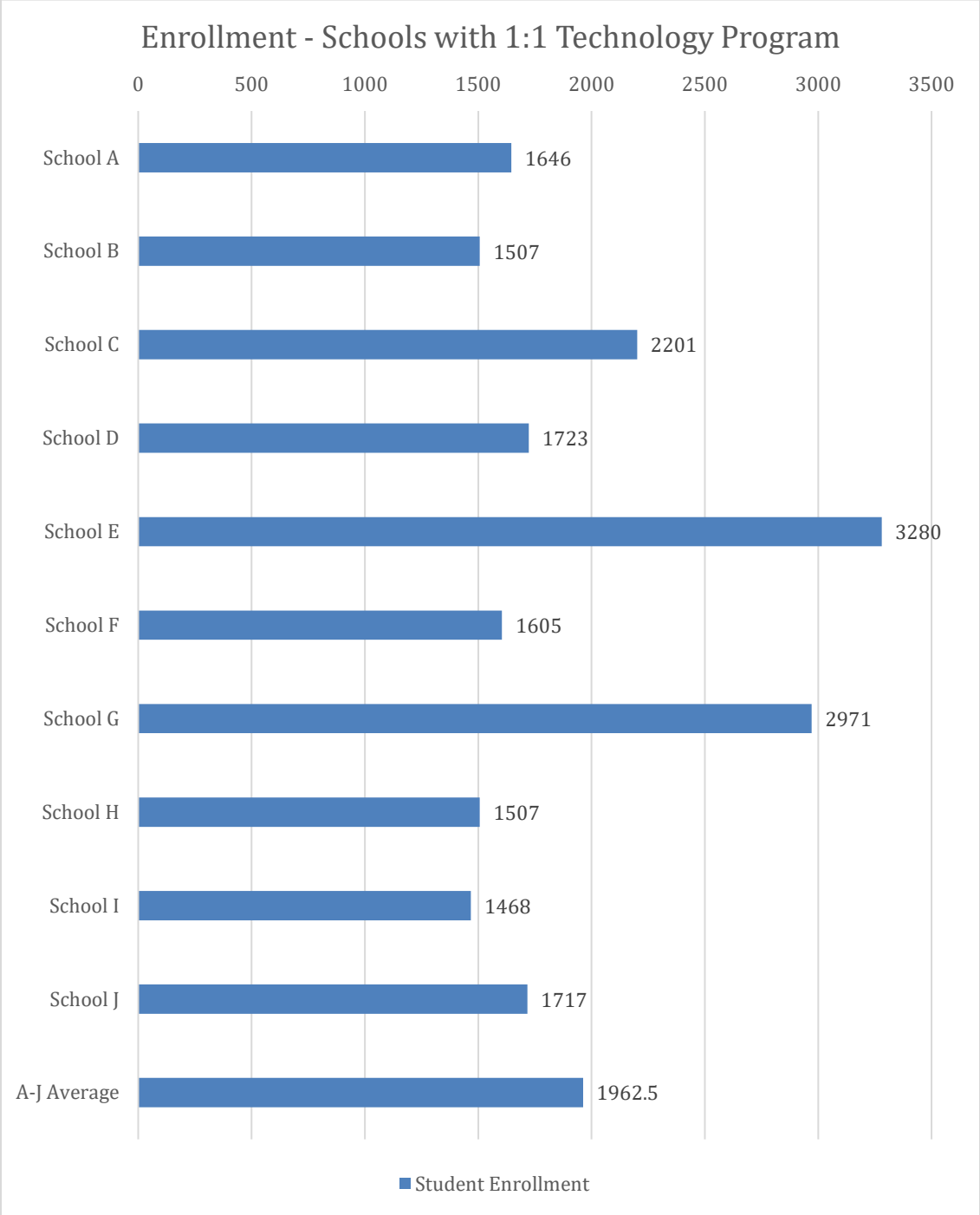

Figure 5. Enrollment of schools with a one-to-one technology program.

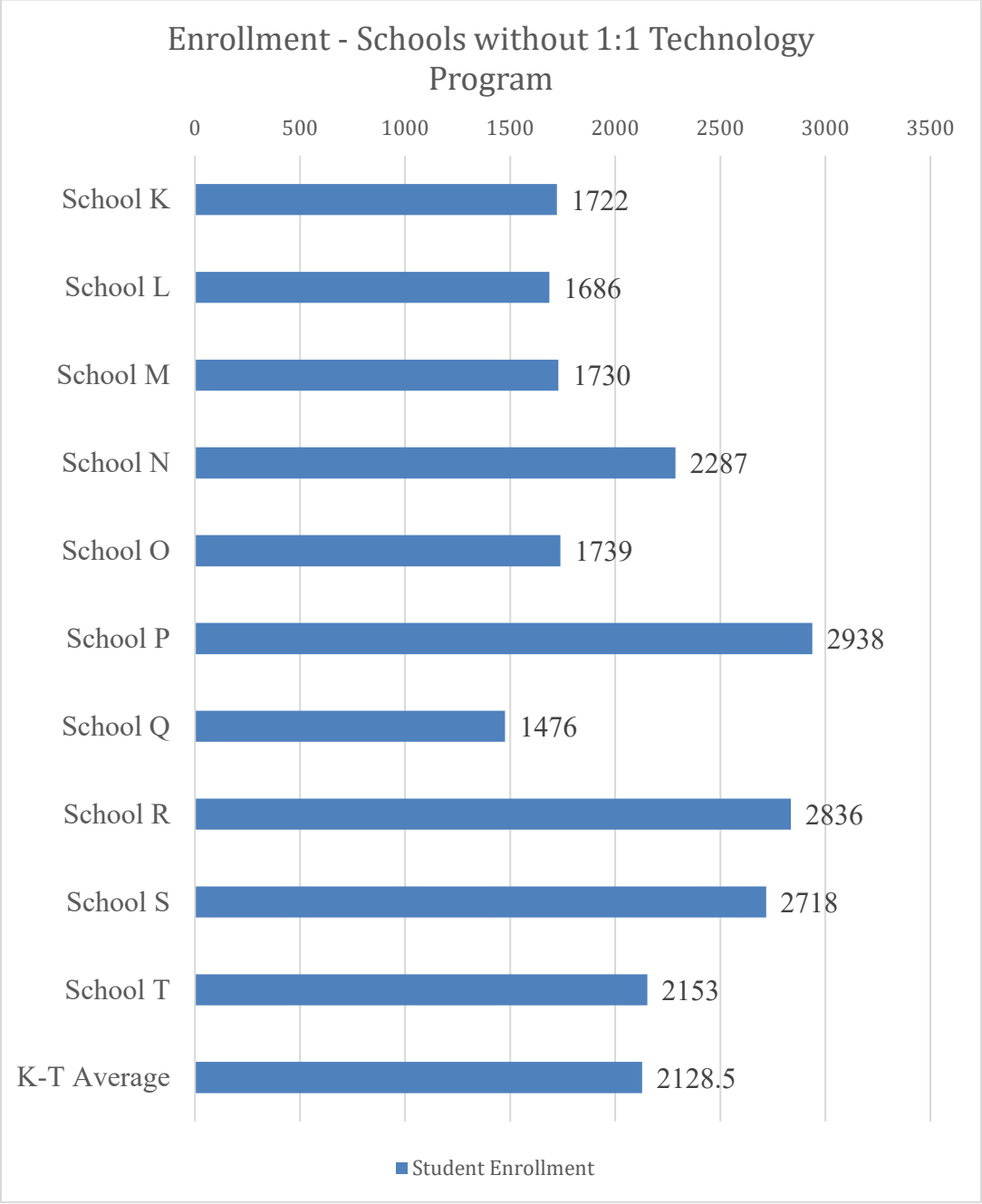

Figure 6. Enrollment of comparative schools without a one-to-one technology program.

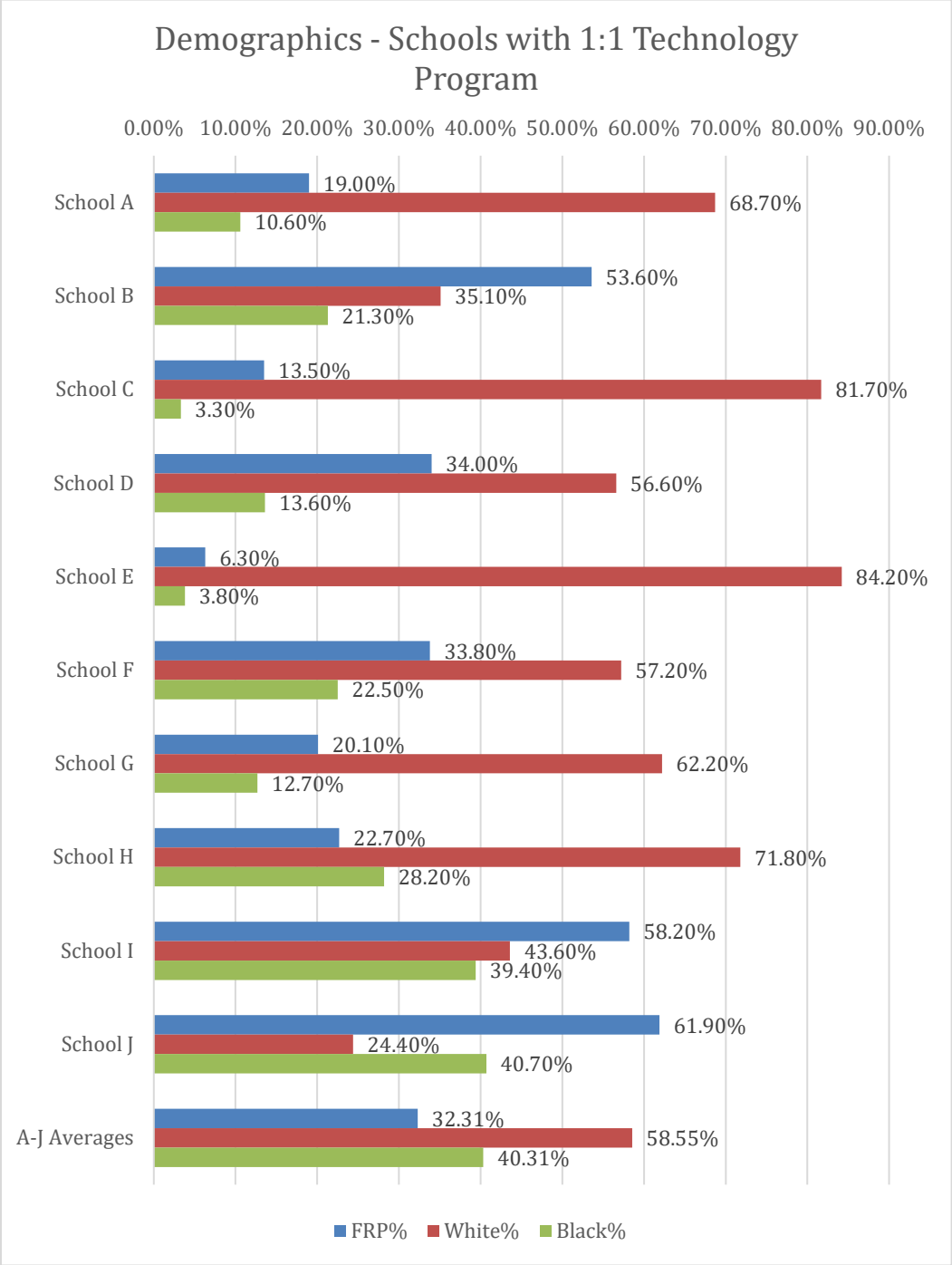

Figure 7. Demographics of schools with one-to-one technology program.

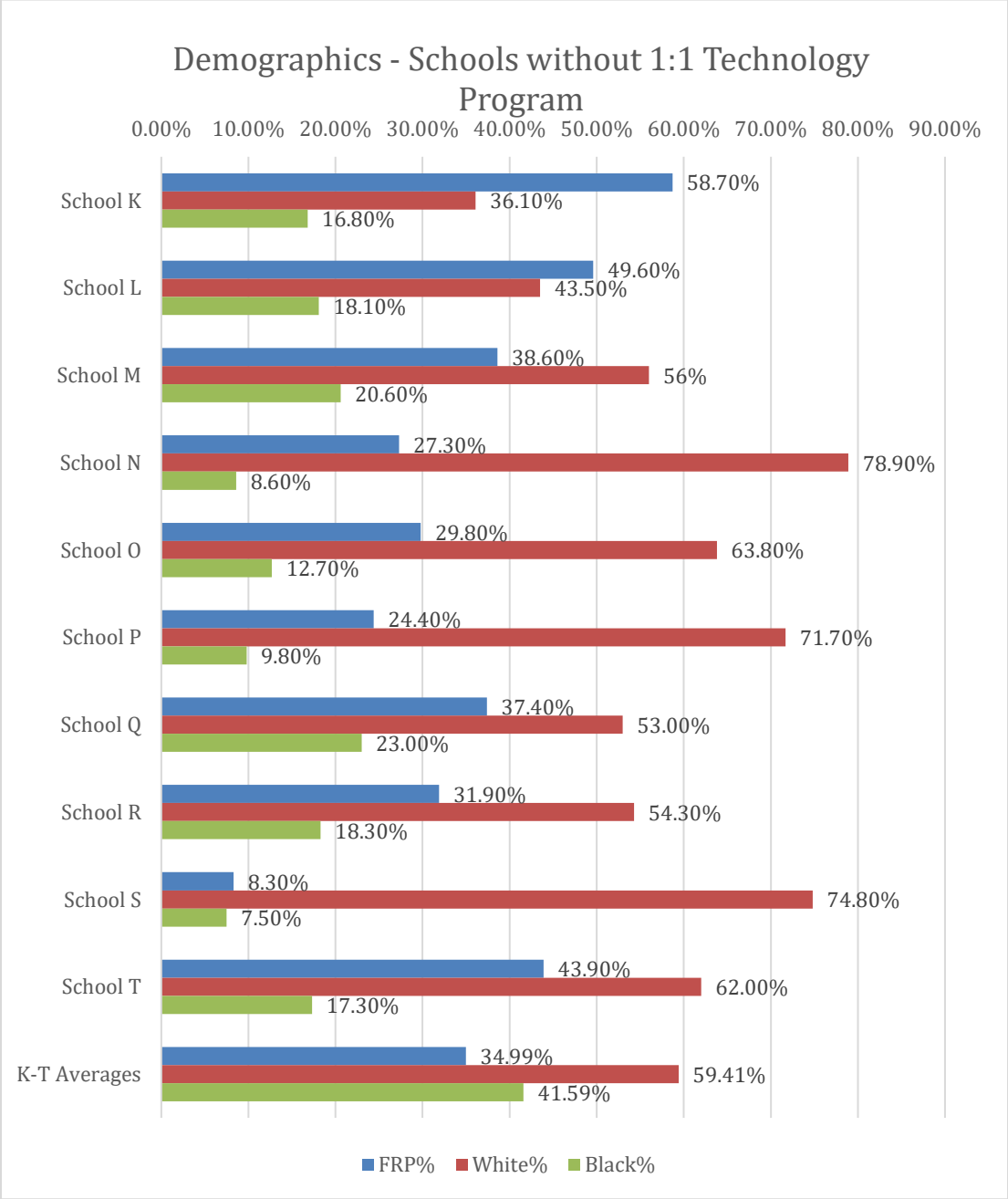

Figure 8. Demographics of comparative schools without one-to-one technology program.

The average student enrollment for schools with a one-to-one technology program was 1962.5 students. The average student enrollment for schools without a one-to-one technology program was 2128.5. These two figures create an average difference of 166 students per school.

The average free and reduced-price lunch population for schools with a one-to-one technology program was 32.31%. The average free and reduced-price lunch population for schools without a one-to-one technology program was 34.99%. These two figures create an average difference of 2.68% per school.

The average percentage of White students for schools with a one-to-one technology program was 58.55%. The average percentage of White students for schools without a one-to-one technology program was 59.41%. These two figures create an average difference of .86% per school.

The average percentage of Black students for schools with a one-to-one technology program was 19.61%. The average percentage of Black students for schools without a one-to-one technology program was 15.27%. These two figures create an average difference of 4.34% per school.

School demographics and achievement data were gathered using the Minnesota Department of Education Report Card site (2018c). This publicly available website contains multiple data sets, including school and district demographics, school and district MCA achievement, and school and district sub-group MCA achievement.

Data Collection Procedures

Minnesota high school students take the Minnesota Comprehensive Assessment (MCA) exams in the spring as a measure of students' knowledge of standards in reading, math, writing, and science. Data analysis examined the results of the reading assessment which students take in 10th grade and the results of the math assessment which students take in the 11th grade.

Students are marked as "proficient" if they earn a score of "meets standards" or "exceeds standards." Through using the Minnesota Department of Education (2018c) Report Card site, the proficiency scores for all high school districts, schools, and students were accessed. These proficiency scores were gathered for 20 Minnesota High Schools over three years from 2016-2018, and 10 of these high schools had a one-to-one technology program over that period and 10 did not. The data was entered into an Excel spreadsheet, and the schools were assigned a pseudonym. Finally, to complete the *t*-test, MCA achievement gap data was entered into the SPSS system for analysis.

Data Analysis

Data analysis was completed using an independent *t*-test model. This form of analysis determined whether there was a statistically significant difference between the means of two separate groups. The dependent variables were the average racial achievement gaps in proficiency for the schools' White and Black students. The

independent variable was the type of school assessed, schools that had a one-to-one technology program or not.

A *t*-test analysis is designed to inform the researcher whether mean differences are statistically significant ($p < .05$), which is the key indicator for the study (Vogt, 2007). A *t*-test is an excellent tool to compare two similar populations with a singular difference to be studied. A *t*-test can measure the statistical significance of the difference between two populations, which is often used to evaluate the effectiveness of an intervention or program, in this case, a one-to-one technology program (Weiss & Sosulski, 2003).

This study researched whether or not there was a statistically significant difference in MCA reading and math proficiencies specific to the related achievement gaps between schools that have a one-to-one technology program and those that do not. Achievement gaps were measured by comparing the proficiency scores of White students against those of Black students. The outcomes of this analysis assisted in accepting or rejecting the null hypotheses.

Limitations of Methodology

The first limitation of this study was a relatively limited sample size. Due to the still somewhat limited spread of one-to-one technology initiatives the researcher chose 10 Minnesota high schools with a one-to-one technology program and compared them against 10 similar high schools without such a program. A larger sample size would be

beneficial for future similar studies as it would add a more exhaustive data set to draw further conclusions.

A second limitation of the study was the variation in the device the one-to-one schools used. While all 10 schools studied in the "one-to-one" cohort had an identified one-to-one technology program, some schools used iPads, while others used Chromebooks or full laptops. This variation in the device could have a variety of unknown impacts on the study and its outcomes, and further studies may be inclined to analyze data by individual devices to determine whether or not the device impacts the outcomes of similar studies.

A third limitation of the study was the technology use of the schools that do not have a one-to-one technology program. These 10 schools studied were selected due to their not having an identified one-to-one technology program. However, these schools could have other technology programs in place to assist student learning, and further studies may identify how other technology programs impact student achievement beyond a one-to-one program.

A fourth limitation of the study was the time frame. The study only covered academic years 2016, 2017, and 2018. Even though three years is a statistically relevant time frame, more longitudinal data would aid in identifying trends and outcomes.

A fifth limitation of the study was the instrument itself, the MCA exam. State standardized assessments have come under increased scrutiny over the years, with many

questioning the assessments measures, use, and value to the education of students (Center on Standards and Assessments Implementation, 2016). MCA exams are not the only important academic measure in existence as there are several other potential measures that could be analyzed to determine growth and progress. Therefore, it is possible that other measures of growth and attainment could yield different results. Additionally, the researcher did not administer the exam but studied 20 Minnesota high schools that did, and therefore cannot attest to any potential differences in testing procedures.

Ethical Considerations

Even though this study was a quantitative, non-experimental study of existing data, there was still an opportunity for bias. Due to the nature of the study, a purposive and convenient sample was chosen. The researcher attempted to identify 20 similar high schools in Minnesota, with similar demographics and student population to ensure compatibility. Concerns around selection effects and the bias of either the selection process of schools, or even what qualifying characteristics schools needs to be studied (Vogt, 2007). In selecting subjects in anything but random fashion, researchers run the risk of creating a study resulting in a bias.

The Collaborative Institutional Training Initiative (2013) framework informs those conducting research studies to be constantly cognizant of the implications of the study, and its effect on the institution, families, and children. In attempts to minimize any potential harm to districts, schools, and students no identifying information was

included in the results of this study. The Minnesota Department of Education (2018c) facilitates the Minnesota Report Card site which houses MCA data does not include any student names, and although the Report Card site does identify schools and districts by name, the researcher used pseudonyms in place of the school names.

Finally, the researcher received CITI certification and IRB approval which ensured an ethical study following Bethel University's standards.

Chapter 4: Results

Review of the Study Plan

There has been significant research conducted on the historical racial achievement gap and the role of technology in education; however, there has been little recent research on how the two variables impact each other at the high school level. The purpose of this study was to begin the dialogue on the potential impact of modern educational technology on the racial achievement gap. Through examining standardized assessment data of schools that have a one-to-one technology program and comparing it to those that do not, we may gain insights as to how to better address the racial achievement gap.

The dependent variables in this study were the Minnesota Comprehensive Assessment reading and math average achievement gaps across a three-year time frame. The independent variable was an implementation of a one-to-one technology program, comparing Minnesota high schools that had this program against high schools that did not. The sample size for the study was 20 high schools located in Minnesota with relatively similar demographics and student populations. The sample consisted of 10 schools had an established one-to-one technology program over the three years, and 10 did not.

The null hypotheses of the research study stated there is no significant difference in the MCA Math and Reading Proficiency racial achievement gap over three years between one-to-one technology schools and those without a one-to-one technology plan.

Whether or not the null hypotheses were rejected would assist in informing school leaders looking to adopt one-to-one technology programs. If the hypotheses were rejected then school leaders seeking to effectively address the racial achievement gaps may desire to invest in this technology platform.

Review of the Study Procedures

Due to the needs of the study, a purposive and convenient identification method was implemented. Therefore, the primary action step in this study was to identify 10 Minnesota high schools that had an established one-to-one technology program for three consecutive years spanning the years 2016, 2017, and 2018. The next step in the study was to identify 10 Minnesota high schools that did not have an established one-to-one technology program over those years. Through this identification, the researcher attempted to identify the 10 Minnesota high schools without a one-to-one technology with similar demographics to the 10 Minnesota high schools that did have this program.

The data points measured were the academic racial achievement gaps between these 20 comparative schools as indicated by the differences in the proficiency scores of White and Black students in their reading and math Minnesota Comprehensive Assessments. These scores were collected from the 20 schools for three years from 2016-2018 to establish trend patterns.

This data was collected from the Minnesota Department of Education's Report Card website (2018c), which is a publicly accessible resource. MCA math and reading

data was gathered for the 20 schools and was entered into an Excel spreadsheet. Individual school data; including school demographics, MCA math scores, MCA reading scores, and each schools' correlating achievement gaps were entered. Each school was issued a pseudonym to protect identity with schools labeled "School A," "School B," and so on through "School T." Schools A through J were schools that possessed a one-to-one technology program, and Schools K through T were schools that did not have a one-to-one technology program over the same period.

In addition to collecting demographic data and MCA math and reading data, achievement gaps were tabulated for each school by subtracting the proficiency rate of Black students from White students for each school. There was a total of 10 schools in each group, and after individual gaps were listed an average gap was measured by averaging the proficiency rate from all 10 schools.

To assess the level of significance between the schools' average racial achievement gaps and the null hypothesis an independent t-test was completed. The t-test determined the level of significance of the average racial achievement gaps of the schools that had a one-to-one technology program and schools that did not in the years 2016-2018. For this study, a *p*-value of less than or equal to .05 would determine a statistically significant correlation. A lower *p-value* is evidence against the null hypothesis, while a higher *p-value* indicates affirmation of the null hypothesis.

Research Question One

Research Question One: Is there a significant difference in the 11th grade MCA math proficiency racial achievement gap between Black and White students, over a three-year period between schools with a one-to-one student technology platform and schools without a one-to-one technology platform?

Null Hypothesis One: There is no significant difference in the MCA Math Proficiency racial achievement gap over three years between one-to-one technology schools and those without a one-to-one technology plan.

Alternative Hypothesis One: There is a significant difference in the MCA Math Proficiency racial achievement gap over three years between one-to-one technology schools and those without a one-to-one technology plan.

Tables 1 and 2 detail the MCA proficiency scores of each school's White and Black students. Figures 9 and 11 demonstrate the racial achievement gaps of each school over the three years, and Figures 10 and 12 show the average math racial achievement gaps for each group of schools. Figure 13 shows the average math racial achievement gap for each group of schools on the same graph and illustrates the fact that schools without a one-to-one technology program had a smaller math racial achievement gap each of the three years studied.

A *t*-test was conducted for school years 2016, 2017, and 2018 to analyze the significance of the math racial achievement gaps between schools that had a one-to-one

technology program and schools that did not. Table 4 shows that for each year studied, the *p-value* for each analysis was above the baseline of .05, with *t* values at .640 in 2016, .196 in 2017, and 1.875 in 2018. Additionally, schools that had a one-to-one technology program had a higher mean achievement gap than schools that did not have a one-to-one technology program during each year of the study (35.49 to 31.83 in 2016, 34.78 to 33.77 in 2017, and 41.17 to 31.54 in 2018). Due to these results, the null hypothesis was not rejected and the alternative hypothesis was rejected as the mean between the two groups of schools was not significantly different.

Table 1

MCA Math Proficiency Average by School with one-to-one Technology

2016/	*2016/*	*2017/*	*2017/*	*2018*	*2018/*

	White	*Black*	*White*	*Black*	*White*	*Black*
School A	76.10%	62.50%	72.50%	36.10%	74.60%	33.30%
School B	67.80%	23.10%	54.00%	20.90%	57.40%	15.50%
School C	33.30%	18.20%	36.70%	9.10%	39.30%	8.30%
School D	57.50%	20.60%	58.00%	37.00%	50.00%	31.70%
School E	71.80%	30.00%	70.10%	52.40%	70.90%	30.00%
School F	48.30%	14.30%	61.40%	9.40%	74.60%	21.60%
School G	65.90%	21.30%	70.30%	27.60%	69.50%	27.10%
School H	71.00%	18.80%	57.40%	18.80%	70.20%	12.50%
School I	53.20%	3.70%	50.70%	5.80%	48.70%	6.60%
School J	35.50%	13.00%	39.60%	5.80%	51.10%	8.00%

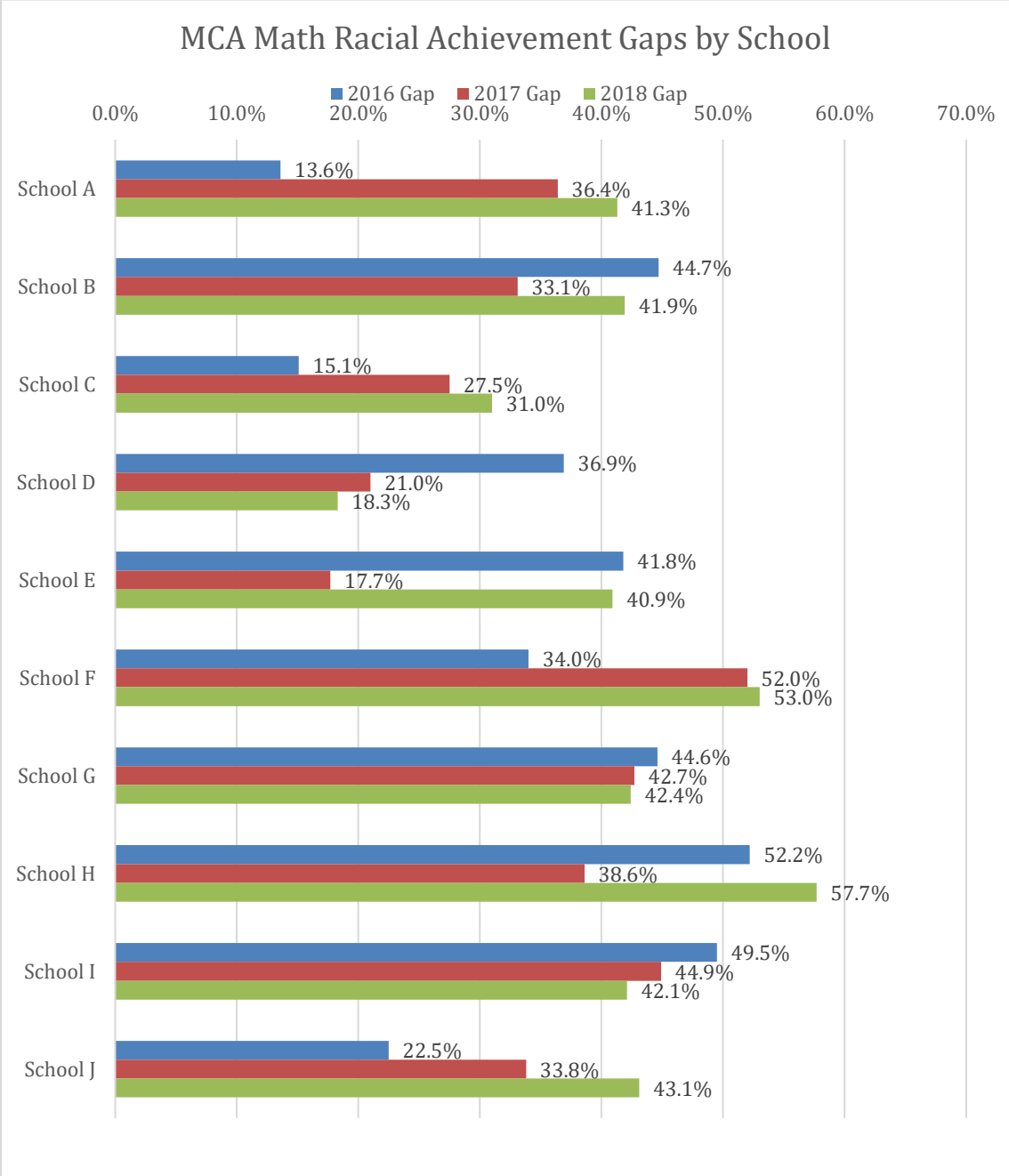

Figure 9. MCA Math Racial Achievement gaps by school with one-to-one.

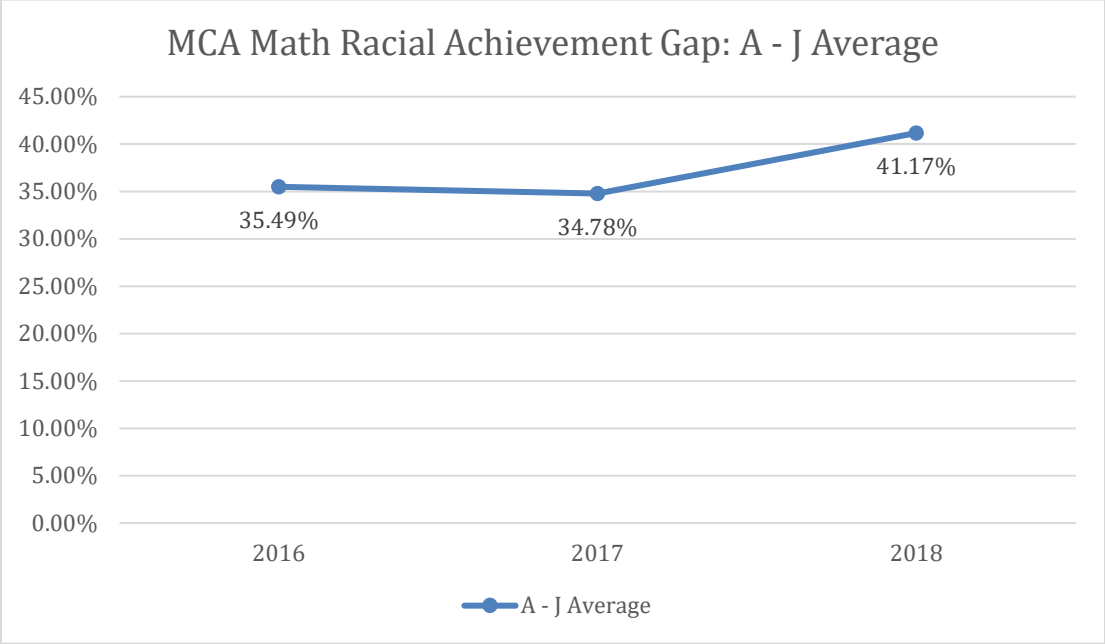

Figure 10. Average MCA Math racial achievement gaps for schools A – J.

Table 2

MCA Math Proficiency Average by School without one-to-one Technology

	2016/ White	*2016/ Black*	*2017/ White*	*2017/ Black*	*2018 White*	*2018/ Black*
School K	50.00%	16.70%	50.20%	23.30%	55.80%	30.90%
School L	73.00%	28.30%	67.40%	27.70%	62.20%	22.20%
School M	48.10%	18.90%	48.10%	17.60%	51.80%	17.20%
School N	42.20%	25.00%	49.80%	14.70%	46.90%	25.80%
School O	70.20%	18.50%	66.50%	19.00%	60.40%	17.10%
School P	38.30%	18.40%	51.70%	38.50%	58.10%	40.60%
School Q	60.80%	31.80%	55.40%	24.00%	55.20%	22.60%
School R	57.40%	22.60%	60.20%	24.80%	56.80%	23.10%
School S	77.00%	36.80%	71.30%	14.90%	68.90%	15.80%
School T	43.70%	25.40%	41.60%	20.00%	41.90%	27.30%

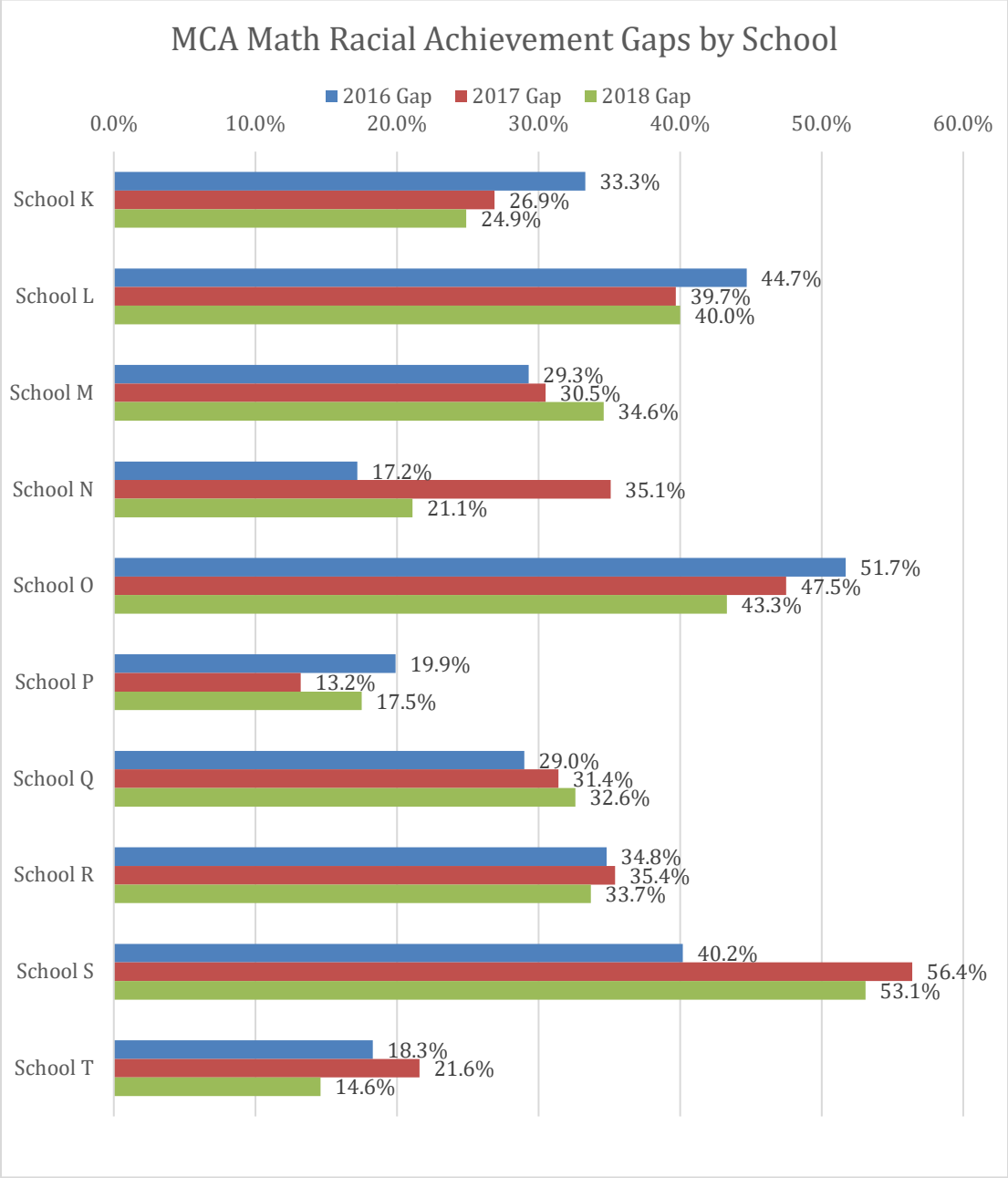

Figure 11. MCA Math Racial Achievement Gaps by School without one-to-one technology.

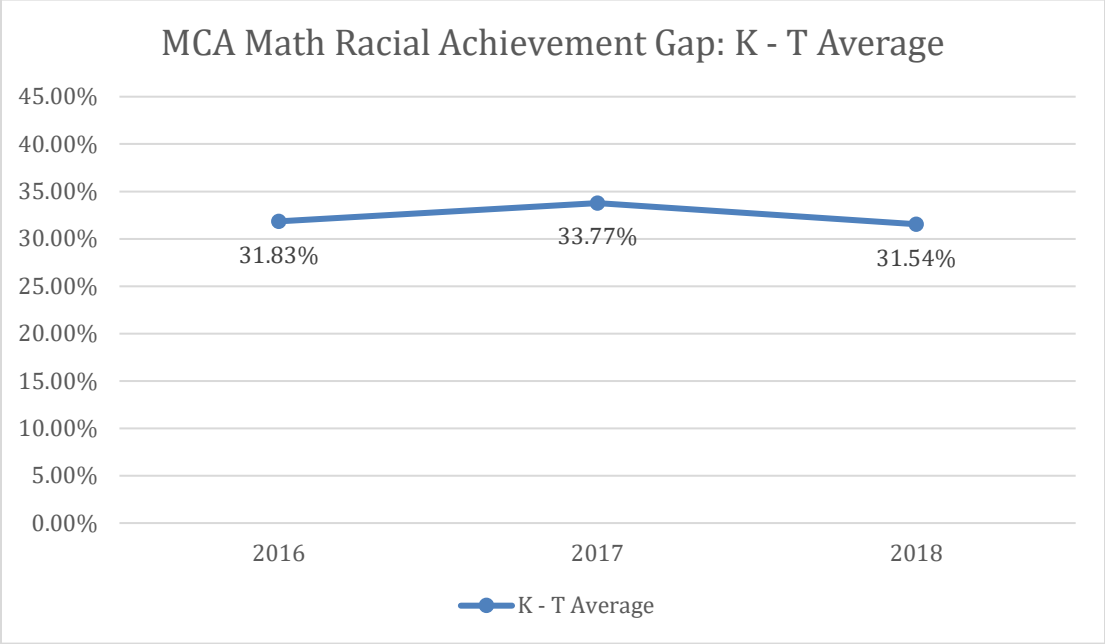

Figure 12. Average MCA Math Racial Achievement Gaps for Schools K – T.

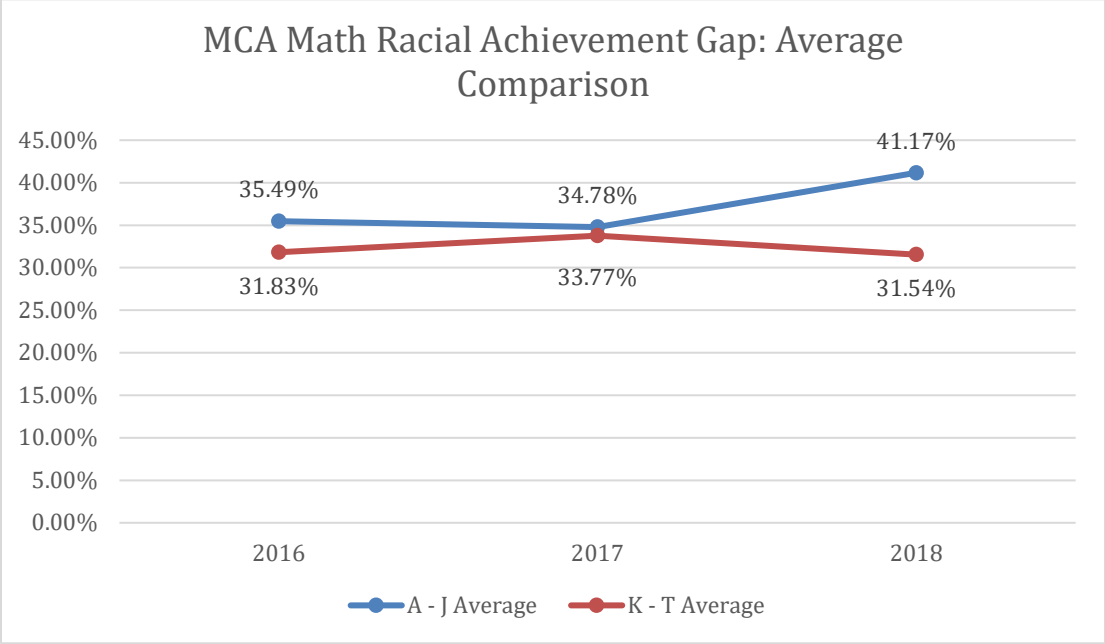

Figure 13. Comparative Average MCA Math Racial Achievement Gaps for Schools.

Table 3

Math Racial Achievement Gap Group Statistics

		N	Mean	Standard Deviation	Standard Error Mean
Racial Achievement Gap 2016	With one-to-one	10	35.49000	13.948353	4.410857
	Without one-to-one	10	31.83000	11.526978	3.645151
Racial Achievement Gap 2017	With one-to-one	10	34.78000	10.624061	3.359623
	Without one-to-one	10	33.77000	12.360156	3.908624
Racial Achievement Gap 2018	With one-to-one	10	41.17000	10.782604	3.409759
	Without one-to-one	10	31.54000	12.142780	3.839884

Table 4

Math Racial Achievement Gaps Independent T-Test

		F	*p*	*t*	*df*
Racial Achievement Gap 2016	Equal variances assumed	.546	.469	0.640	18
Racial Achievement Gap 2017	Equal variances assumed	.082	.778	0.196	18
Racial Achievement Gap 2018	Equal variances assumed	.779	.389	1.875	18

Research Question Two

Research Question Two: Is there a significant difference in the 10th grade MCA reading proficiency racial achievement gap between Black and White students, over a three-year period between schools with a one-to-one student technology platform and schools without a one-to-one technology platform?

Null Hypothesis Two: There is no significant difference in the MCA Reading

Proficiency racial achievement gap over a three-year period between one-to-one technology schools and those without a one-to-one technology plan.

Alternative Hypothesis Two: There is a significant difference in the MCA Reading Proficiency racial achievement gap over a three-year period between one-to-one technology schools and those without a one-to-one technology plan.

Tables 4 and 5 detail the MCA reading proficiency scores of each school's White and Black students. Figures 14 and 16 demonstrate the reading racial achievement gaps of each school over the three years, and Figures 15 and 17 show the average reading racial achievement gaps for each group of schools. Figure 18 shows the average reading racial achievement gap for each group of schools on the same graph. Not only do schools without a one-to-one technology program have a smaller reading racial achievement gap each year, but these schools also shrunk their gaps while schools with a one-to-one technology program held mostly flat.

A t-test was conducted for school years 2016, 2017, and 2018 to analyze the significance of the reading racial achievement gaps between schools that had a one-to-one technology program and schools that did not. Table 8 shows that for each year studied, the p-value for each analysis was above the baseline of .05, with *t* values at .341 in 2016, .937 in 2017, and 1.721 in 2018. Additionally, schools that had a one-to-one technology program had a higher mean achievement gap than schools that did not have a one-to-one technology program during each year of the study (35.53 to 34.12 in 2016,

35.50 to 30.59 in 2017, and 34.67 to 26.08 in 2018). Due to these results, the null hypothesis was not rejected, and the alternative hypothesis was rejected as the mean between the two groups of schools was not significantly different.

Table 5

MCA Reading Proficiency Average by School with one-to-one Technology

	2016/ White	*2016/ Black*	*2017/ White*	*2017/ Black*	*2018 White*	*2018/ Black*
School A	78.90%	39.50%	78.00%	39.50%	79.90%	55.30%
School B	62.00%	31.60%	70.30%	23.80%	67.50%	33.80%
School C	58.00%	27.30%	47.10%	33.30%	39.50%	29.40%
School D	57.80%	42.60%	61.80%	35.90%	64.40%	36.20%
School E	78.80%	50.00%	80.10%	54.50%	80.30%	41.70%
School F	65.10%	17.30%	71.00%	27.30%	69.70%	23.60%
School G	74.80%	33.30%	79.50%	43.10%	75.30%	39.10%
School H	77.50%	43.80%	65.90%	33.30%	74.20%	40.00%
School I	59.50%	11.40%	64.80%	15.40%	62.90%	14.60%
School J	69.00%	29.30%	67.60%	25.00%	77.80%	31.10%

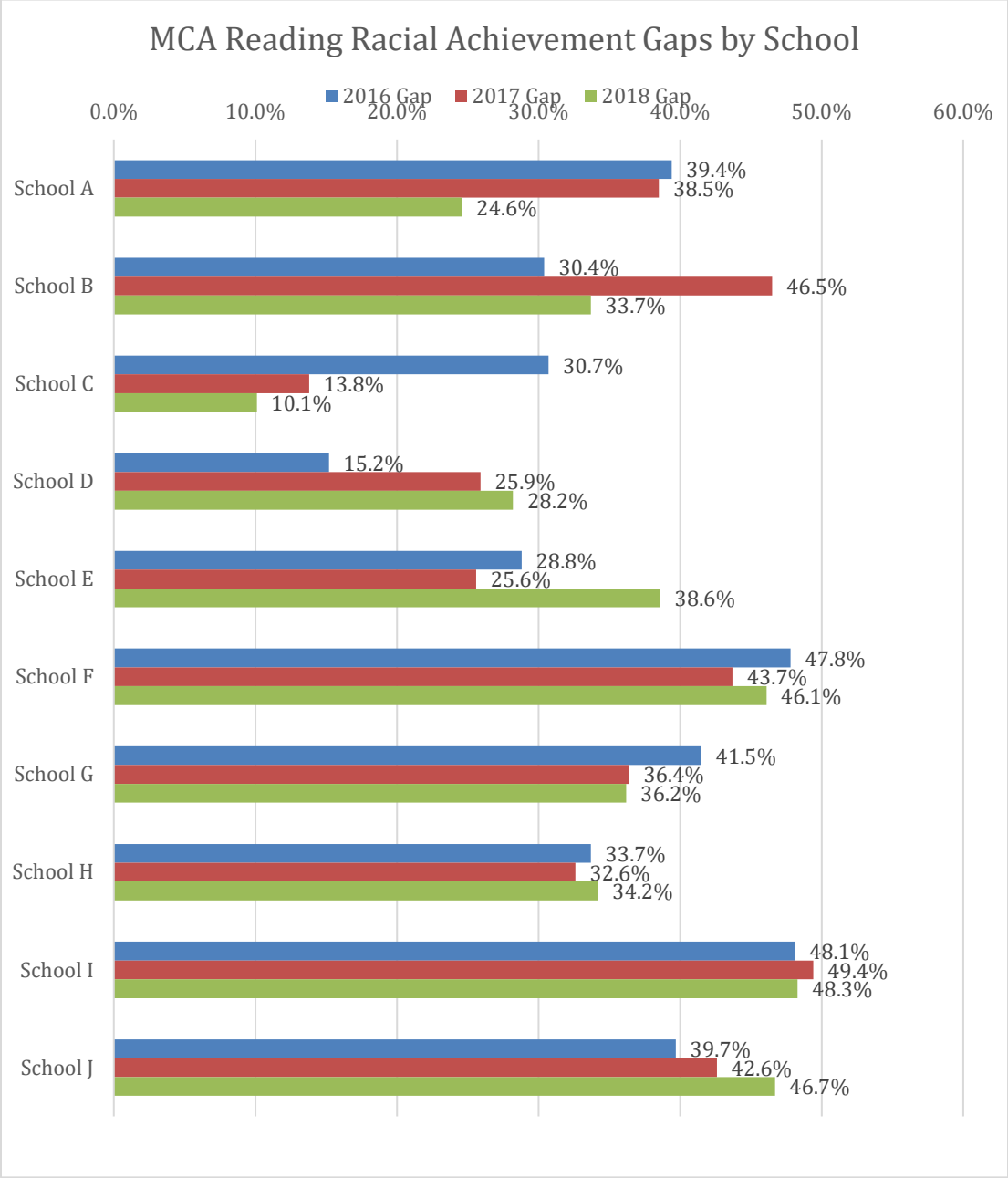

Figure 14. MCA Reading Racial Achievement Gaps by School with one-to-one.

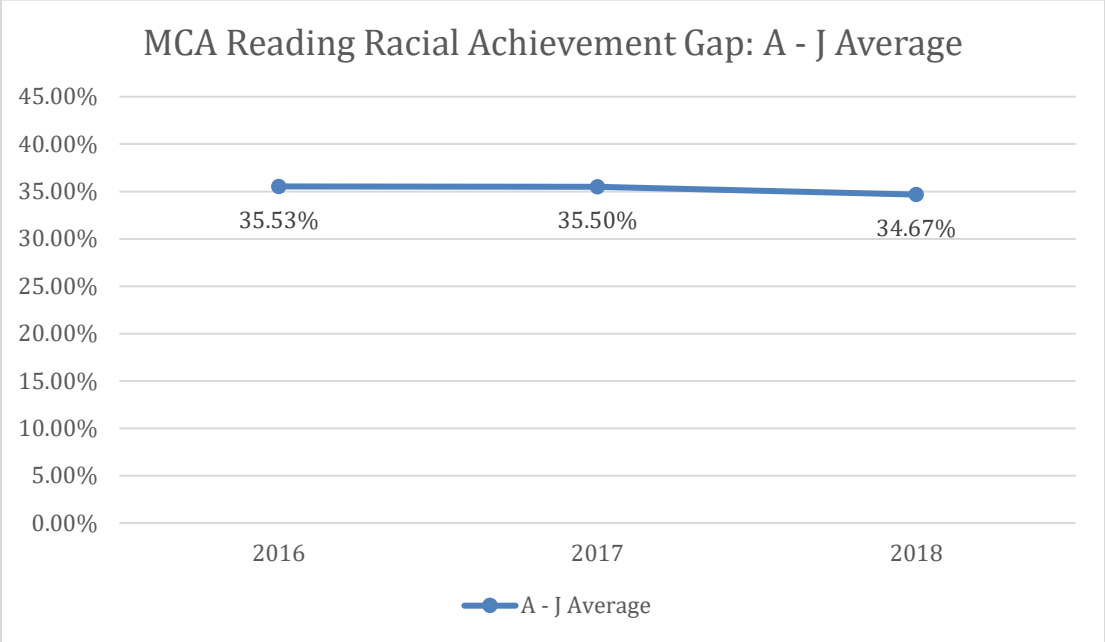

Figure 15. Average MCA Reading Racial Achievement Gaps for Schools A – J.

Table 6

MCA Reading Proficiency Average by School without One-to-One Technology

	2016/ White	*2016/ Black*	*2017/ White*	*2017/ Black*	*2018 White*	*2018/ Black*
School K	53.60%	19.70%	65.90%	44.10%	68.50%	46.80%
School L	76.40%	45.20%	75.50%	38.50%	76.80%	46.10%
School M	67.10%	23.10%	72.00%	27.90%	60.80%	32.00%
School N	59.60%	30.30%	66.10%	43.30%	61.00%	39.50%
School O	78.20%	33.30%	66.00%	29.40%	64.90%	39.50%
School P	62.00%	33.30%	71.50%	68.90%	74.00%	67.70%
School Q	64.40%	28.60%	63.10%	25.50%	65.40%	19.20%
School R	68.20%	36.10%	70.30%	36.70%	68.60%	45.70%
School S	81.60%	37.90%	83.30%	41.90%	76.60%	40.00%
School T	56.00%	38.40%	59.70%	31.30%	61.30%	40.60%

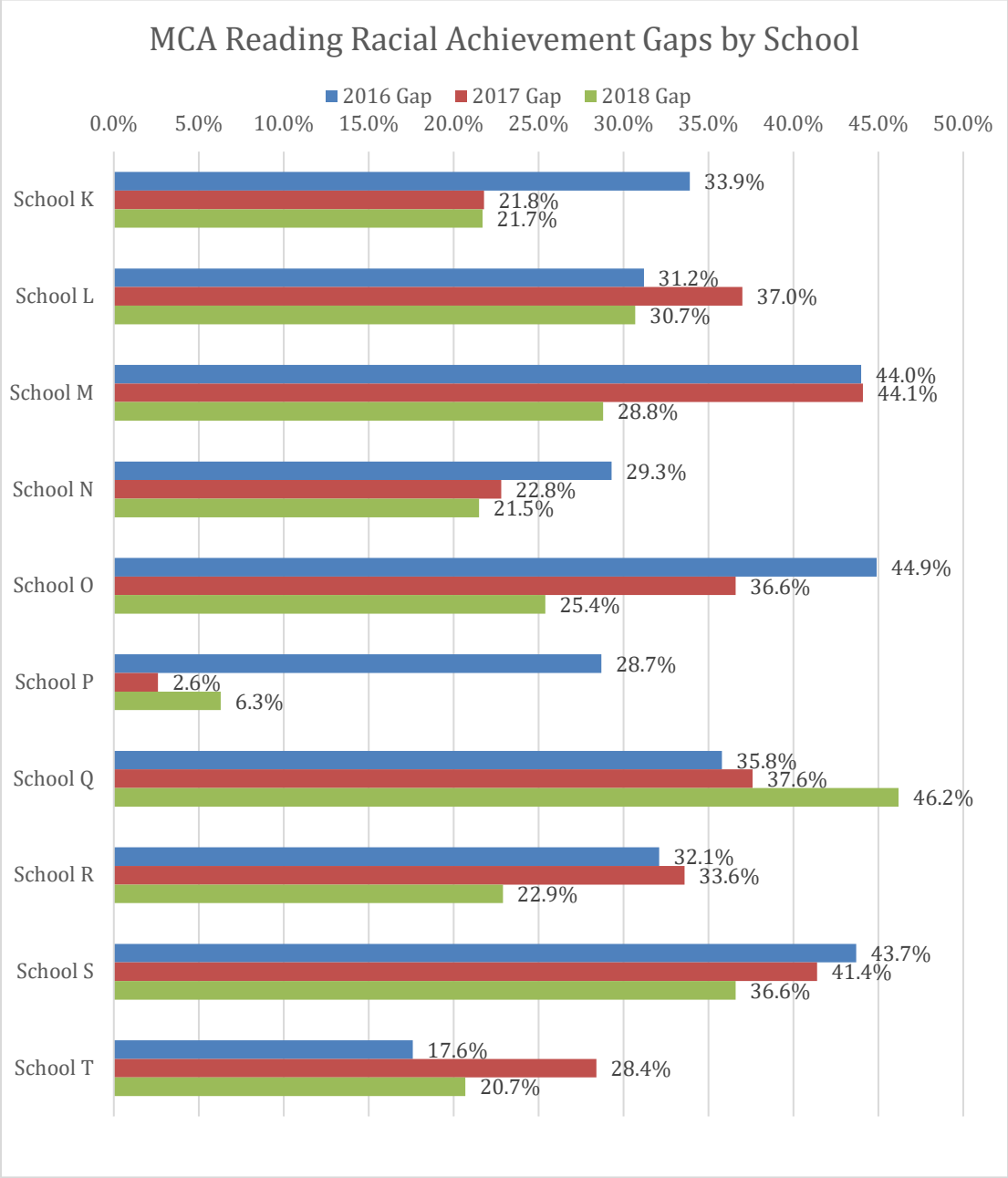

Figure 16. MCA Reading Racial Achievement Gaps by School without One-to-One.

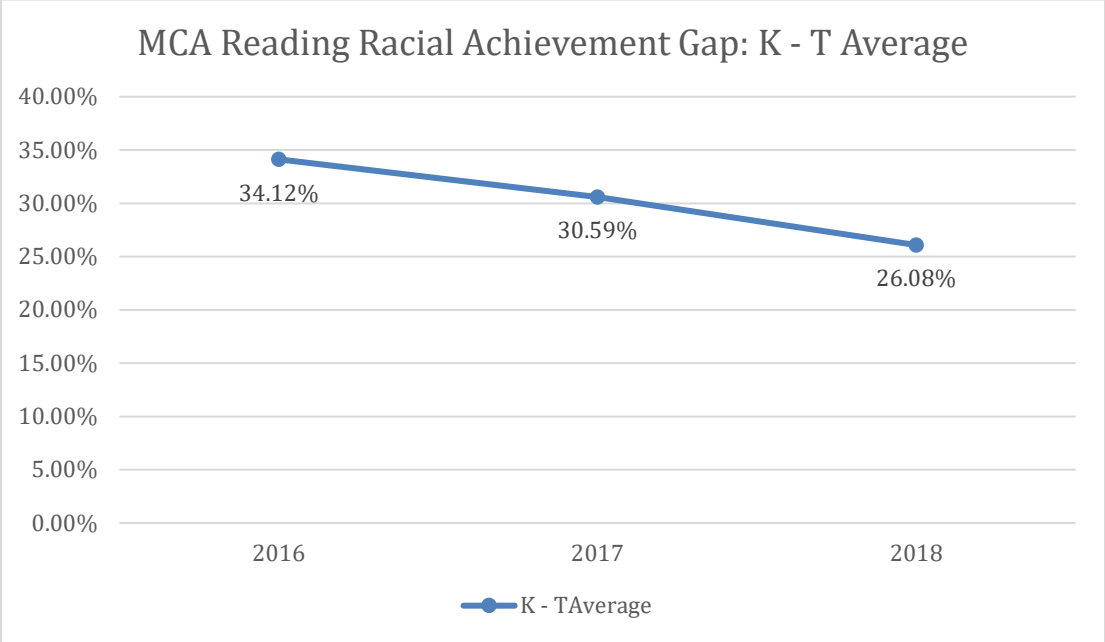

Figure 17. Average MCA Reading Racial Achievement Gaps for Schools K – T.

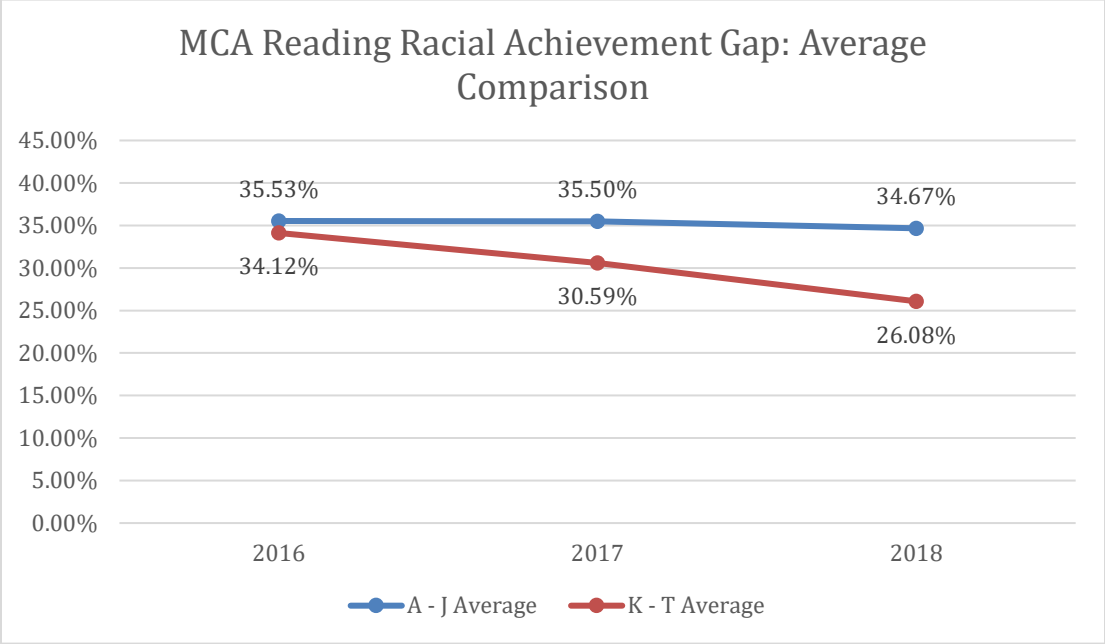

Figure 18. Comparative Average MCA Reading Racial Achievement Gaps for Schools A-J and Schools K – T.

Table 7

Reading Racial Achievement Gap Group Statistics

		N	Mean	Standard Deviation	Standard Error Mean
Racial Achievement Gap 2016	With one-to-one	10	35.53000	9.934010	3.141410
	Without one-to-one	10	34.12000	8.476084	2.680373
Racial Achievement Gap 2017	With one-to-one	10	35.50000	11.111256	3.513688
	Without one-to-one	10	30.59000	12.297104	3.888686
Racial Achievement Gap 2018	With one-to-one	10	34.67000	11.676382	3.692396
	Without one-to-one	10	26.08000	10.620504	3.358498

Table 8

Reading Racial Achievement Gaps Independent *t*-test.

		F	*p*	*t*	*df*
Racial Achievement Gap 2016	Equal variances assumed	0.330	0.573	0.341	18
Racial Achievement Gap 2017	Equal variances assumed	0.031	0.862	0.937	18
Racial Achievement Gap 2018	Equal variances assumed	0.080	0.781	1.721	18

The results of the data analysis suggest that there is not a significant difference in the math or reading MCA racial achievement gaps between schools that have a one-to-one technology program and those that do not. Further summary and presentation of findings are discussed in the next chapter.

Chapter 5: Discussion, implications, & recommendations

The final chapter of this study provides an overview of the study, including the research questions and a summary of the problem. Following that, several conclusions and implications are shared and recommendations for practitioners as well as for further study are provided.

Overview of the Study

This study was an analysis of the racial academic achievement gap between schools that had implemented a one-to-one technology program and schools that did not. Minnesota Comprehensive Assessment data was gathered and analyzed in both math and reading for the school years 2016, 2017, and 2018. In total, 20 schools were studied, 10 of which had the one-to-one technology program and 10 that did not. Identifying the schools entailed a convenient and purposive sampling method, with the schools that had the technology program were all high schools found in Minnesota. The schools that did not have the technology program were also high schools in Minnesota and possessed similar demographics to those that did have the program.

Along with this data collection, independent sample *t*-tests were run to establish whether there was a significant difference in the racial achievement gaps of the schools that possessed the one-to-one program and those that did not have a one-to-one program.

Research Questions

The study sought to answer the following questions:

1. Is there a significant difference in the 11th grade MCA math proficiency racial achievement gap between Black and White students, over a three-year period between schools with a one-to-one student technology platform and schools without a one-to-one technology platform?
2. Is there a significant difference in the 10th grade MCA reading proficiency racial achievement gap between Black and White students, over a three-year period between schools with a one-to-one student technology platform and schools without a one-to-one technology platform?

Conclusions

After collecting all relevant data, including MCA proficiency scores for reading and math for the 20 schools, racial gaps for the schools on both assessments were tabulated. Achievement gaps were then averaged in both math and reading for schools that had the one-to-one technology program and schools that did not. For schools that had a one-to-one technology program, the average math racial achievement gap in 2016 was 31.73%, 33.97% in 2017, and 39.70% in 2018. For schools that did not have a one-to-one technology program, the average math racial achievement gap was 31.83% in 2016, 33.77% in 2017, and 31.54% in 2018. Each of the years studied saw schools without a one-to-one technology program with similar sized or smaller average racial achievement gap than schools that did have a one-to-one technology program. technology program. Over the three years of the study, both groups of schools saw modest but

similar declines in their math racial achievement gaps with neither group improving by a single percentage point.

The reading MCA results saw very similar outcomes to the math data analysis. Schools that had a one-to-one technology program had an average reading racial achievement gap of 35.53% in 2016, 35.50% in 2017, and 34.67% in 2018. Schools that did not have a one-to-one technology program had an average reading racial achievement gap of 34.12% in 2016, 30.59% in 2017, and 26.08%. Not only did schools that did not have a one-to-one technology program have a smaller racial achievement gap than its counterpart, these schools on average were able to shrink their reading racial achievement gap by over 8% over the three years, while schools that did have a one-to-one technology program only saw a reduction of less than 1% in the same time frame.

In terms of determining whether there is a significant difference between in math racial achievement gaps between schools that had a one-to-one technology program and those that did not, the *t*-test *p*-value demonstrated that the mean difference between the two types of schools was not significantly different. The *p*-value was .469 in 2016, .778 in 2017, and .389 in 2018, all well above the .05 baseline measure. This result indicates that the null hypothesis was not rejected and there was no significant difference in math racial achievement gaps between schools that had a one-to-one technology program and schools without this program.

For the second research question, the *t*-test *p*-value demonstrated that the mean

difference between the two types of schools was not significantly different for reading MCA racial achievement gaps. The *p*-value in 2016 was .573, .862 in 2017, and .781 in 2018, all well above the .05 baseline measure. This result indicates that the null hypothesis was also not rejected and there was no significant difference in reading racial achievement gaps between schools that had a one-to-one technology program and schools without this program.

Levin and Schrum (2013) stated that technology integration along the lines of a fully implemented one-to-one program can transform student engagement and lead students towards more individualized and project-based approaches. What is less clear, partially informed by the result of this study, is how technology can assist in closing racial achievement gaps. According to the findings of this study, one-to-one technology programs did not positively influence racial achievement gaps in math or reading. It is possible to conclude that not only do one-to-one technology programs not aide in closing the racial achievement gap it could, potentially, exacerbate the gap.

Implications for Practitioners

The task of school improvement is one of the key duties of school leaders but is one filled with complexities and challenges. Nearly every school in the United States works towards improving their school; whether that means their student achievement, their culture and climate, or their student and staff well-being and safety (Center for Mental Health in Schools, 2011). Implementing a new one-to-one technology program,

or evaluating a currently existing program, must be done with care and precision and in the context of all of the things school leaders are expected to do and accomplish. School leaders would be wise to address technology use holistically and focus on assessing the attitudes of their teaching staff on the use of technology to maximize the impact of any technology program, especially one so significant like a one-to-one program (Bahr, Shaha, Farnsworth, Lewis, & Benson, 2004). For educators considering a one-to-one technology program for their school, it is important to look at the data results of this study, but also consider the value of increased technology use and access. More and more authentic technology use supports students in developing 21st century skills such as communication, collaboration, and problem solving (Bebell & Kay, 2010).

It is essential for school leaders to understand the wide sweeping impact of their decisions on teachers, students, and the community. The growth of technology in our schools has resulted in learning outside the walls of the classroom with digital and web-based resources providing greater instruction and a more connected system of communication for feedback and collaboration (Powell et al., 2015). However, increased technology use is not a complete solution and programs like a one-to-one project should be undertaken with great care and thoughtfulness.

School improvement, especially improvement in closing academical racial achievement gaps is challenging and complex with socio-economic complications, sub-group differences, and varied teaching and learning strategies to contend with (Murphy,

2009). Implementing a school or district wide one-to-one technology program should be viewed through the lens of how it will impact the achievement of student sub-groups and how it will potentially impact the racial achievement gap. If one of the objectives of a school implementing a one-to-one technology program is that it will aide in closing their gaps, the results of this study may give them pause. It is not impossible of course, that a one-to-one technology program will positively impact their racial achievement gaps, but it will most likely not occur without other supporting factors. Schools that choose to adopt a one-to-one technology program may be wise in marketing benefits beyond basic academic measures. Closing racial achievement gaps has been historically challenging, and while success may include a one-to-one technology program it is unlikely to be the only answer.

Recommendations for Future Research

This study constitutes one small, non-experimental lens on the very large topics of racial achievement gaps and technology. There have been numerous studies on both racial achievement gaps and technology, but few that combine the two topics in the method of this study.

A similar, but more comprehensive study would greatly add to the dialogue and educational field. This study analyzed the data from a sample of 20 Minnesota high schools with similar sizes and demographics, 10 that had a one-to-one technology program, and 10 that did not. A research project that studied similar data from a much

larger and more nationally representative sample of schools may yield more tangible results.

A future study may find value in studying the MCA exam itself to determine if using this assessment as its primary data source impacted the outcome of this study. Researchers could examine the potential impacts of bias, sensitivity, and measurement applications in an effort to discern measurable differences in outcomes. Additionally, future researchers could examine assessments other than the MCA in an attempt to determine if other measures generated different results. Studies focusing on graduation rates, grade point averages, college acceptance rates, and more could prove valuable.

Another area for further research would center on device selection and implementation practices more closely. This study compared one-to-one schools against those that did not have one-to-one initiatives, but there were still great variations within each sample group. Amongst the one-to-one schools studied there were Chromebooks, iPads, and MacBooks and perhaps there would be different outcomes for specific devices. Furthermore, this study examined schools with an identified one-to-one program but did not assess the implementation plans or professional development plans in these schools. According to Pierson & Borthwick, technology professional development has been notoriously hard to measure and its effectiveness challenging to ascertain so further examination of this would be beneficial (2010).

Another study that could be explored would be examining schools that beat the

odds to determine success measures. Throughout Minnesota and the nation there are high schools that are able to close their racial achievement gaps and a thorough investigation of these schools in a more detailed approach might illustrate strategies that other school leaders could replicate. This study would be well served to include an in depth look at the schools' technology use to determine if any correlative programs existed.

Concluding Comments

The impact of technology has forever changed our communities, societies, and educational realities (Berry, 2013). The growth of one-to-one technology programs in our schools is evidence that more school leaders realize how important it is for every student to be able to access the internet and collectively collaborate. Additionally, the American education system is growing more diverse, with more students of color producing at very uneven rates of achievement (Otto, 2014). Though this study did not elicit significant findings, the descriptive statistics are cause for continued conversation. The intersection of these two growing trends calls for further examination to add to a growing body of important research.

References

Abell Foundation. (2008). *One-to-one computing in public schools: Lessons from "laptops for all" programs.* Retrieved from ERIC database. (ED505074)

Adamson, F., & Darling-Hammond, L. (2012). Funding disparities and the inequitable distribution of teachers: Evaluating sources and solutions. *Education Policy Analysis Archives, 20*(37). Retrieved from https://epaa.asu.edu/ojs/article/view/1053

Anderson, T. (2018). Chromebooks and G Suite: A good working alternative. *Computer Weekly,* 17–20. Retrieved from https://www.computerweekly.com/news/252450595/Chromebooks-and-G-Suite-a-good-working-alternative

Armor, D. J. (2006). Brown and Black-White achievement. *Academic Questions, 19*(2), 40–46. Retrieved from ERIC database. (EJ844507)

Aud, S., Hussar, W., Planty, M., Snyder, T., Bianco, K., Fox, M. A.,... Drake, L. (2010). *The condition of education 2010. NCES 2010-028.* National Center for Education Statistics. Jessup, MD.

Auguste, B., Hanckock, B., & Laboissiere, M. (2009). The economic cost of the US education gap. Retrieved from https://www.mckinsey.com/industries/social-sector/our-insights/the-economic-cost-of-the-us-education-gap

Bahr, D. L., Shaha, S. H., Farnsworth, Briant J. Lewis,Valerie K., & Benson, L. F. (2004). Preparing tomorrow's teachers to use technology: Attitudinal impacts of technology-supported field experience on pre-service teacher candidates. *Journal of Instructional Psychology, 31*(2), 88-97. Retrieved from ERIC database. (EJ774062)

Barton, P. E., & Coley, R. J. (2010). *The Black-White achievement gap: When progress stopped. Policy information report.* Educational Testing Service. Princeton, NJ.

Basch, C. E. (2011). Healthier students are better learners: High-quality, strategically planned, and effectively coordinated school health programs must be a fundamental mission of schools to help close the achievement gap. *Journal of School Health, 81*(10), 650-662. https://doi.org/10.1111/j.1746-1561.2011.00640.x

Bebell, D., & Kay, R. (2010). One-to-one Computing: A Summary of the quantitative results from the Berkshire wireless learning initiative. *Journal of Technology, Learning, and Assessment, 9*(2). Retrieved from https://ejournals.bc.edu/index.php/jtla/article/view/1607

Bebell, D., & O'Dwyer, L. M. (2010). Educational outcomes and research from 1:1 computing settings. *Journal of Technology, Learning, and Assessment, 9*(1). Retrieved from https://ejournals.bc.edu/index.php/jtla/article/view/1606

Bernstein, L., Edmunds, J., & Fesler, L. (2014). *Closing the performance gap: The impact of the early college high school model on underprepared students*. Society for Research on Educational Effectiveness. Retrieved from ERIC database. (ED562689)

Berry, P. (2013). The impact of globalization and technology on teaching business communication: Reframing and enlarging world view, methods, and content. *American Journal of Business Education, 6*(1), 57-66. Retrieved from ERIC database. (EJ1054207)

Billig, S. H., Jaime, I. I., Abrams, A., Fitzpatrick, M., & Kendrick, E. (2005). *Closing the achievement gap: Lessons from successful schools.* US Department of Education. Retrieved from ERIC database. (ED491863)

Boyd, K. (2018). Using critical race theory to solve our profession's critical race issues. *Journal of Financial Planning*, 30–31. Retrieved from https://www.onefpa.org/journal/Pages/MAY18-Using-Critical-Race-Theory-to-Solve-Our-Professions-Critical-Race-Issues.aspx

Braun, H., Chapman, L., & Vezzu, S. (2010). The Black-White achievement gap revisited. *Education Policy Analysis Archives, 18*(21), 1-99. Retrieved from ERIC database. (EJ899515)

Brown, K. M., Benkovitz, J., Muttillo, A. J., & Urban, T. (2011). Leading schools of excellence and equity: Documenting effective strategies in closing achievement gaps. *Teachers College Record, 113*(1), 57-96. Retrieved from https://epaa.asu.edu/ojs/article/view/772

Burns, M., & Dimock, K. V. (2007). *Technology as a catalyst for school communities: Beyond boxes and bandwidth.* Blue Ridge Summit, PA: Rowman & Littlefield Education.

Butrymowicz, S., & Mathewson, T. G. (2018). "Tired of fighting that fight": School districts' uphill battle to get good deals on ed tech. *The Hechinger Report.* Retrieved from https://hechingerreport.org/tired-of-fighting-that-fight-school-districts-uphill-battle-to-get-good-deals-on-ed-tech/

Center on Education Policy. (2009). Subgroup Achievement and Gap Trends: Minnesota. *Center on Education Policy*. Retrieved from ERIC database. (ED507967)

Center for Mental Health in Schools. (2011). *What every leader for school improvement needs to know about student and learning supports. A center policy and practice brief*. Retrieved from ERIC database. (ED544301)

Center on Standards and Assessments Implementation (2016). A review of statewide assessment opt-outs. CSAI report. *Center on Standards and Assessments Implementation.* Retrieved from ERIC database. (ED588529)

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. (2005). Who teaches whom? Race and the distribution of novice teachers. *Economics of Education review, 24*(4), 377-392. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0272775704001153

Cook, V. S., & Gregory, R. L. (2018). Emerging technologies: It's not what "you" say – it's what "they" do. *Online Learning, 22*(3), 121–130. Retrieved from https://olj.onlinelearningconsortium.org/index.php/olj/article/view/1463

Darden, E. (2011). The Same Starting Line: How School Boards Can Erase the Opportunity Gap between Poor and Middle-Class Children. *Appleseed.* Retrieved from ERIC database. (ED539607)

de Brey, C., Musu, L., McFarland, J., Wilkinson-Flicker, S., Diliberti, M.,…& Wang, X. (2019). Status and trends in the education of racial and ethnic groups 2018. NCES 2019-038. *National Center for Education Statistics*. Retrieved from https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2019038

de la Torre, M., Allensworth, E., Jagesic, S., Sebastian, J., Salmonowicz, M., Meyers, C., & Gerdeman, R. (2013). *Turning around low-performing schools in Chicago: Research report*. Consortium on Chicago School Research. Retrieved from https://consortium.uchicago.edu/publications/turning-around-low-performing-schools-chicago-full-report

Demski, J. (2012). The hard(ware) choice. *T.H.E. Journal, 39*(9), 28-35. Retrieved from https://thejournal.com/articles/2012/11/01/1-to-1-computing-the-hardware-choice.aspx

Donovan, L., Green, T., & Hartley, K. (2010). An examination of one-to-one computing in the middle school: Does increased access bring about increased student engagement? *Journal of Educational Computing Research, 42*(4), 423-441. Retrieved from ERIC database. (EJ884285)

Donovan, J. (2019). *What is a Chromebook and should you buy one*? Digital Trends. Retrieved from https://www.digitaltrends.com/computing/what-is-a-chromebook/

Doran, L., & Herold, B. (2016). 1-to-1 laptop initiatives boost student scores, study finds. *Education Week, 35*(31), 11. Retrieved from https://www.edweek.org/ew/articles/2016/05/18/1-to-1-laptop-initiatives-boost-student-scores-study.html

Edmentum Inc. (2014). ISTE Survey reveals individualized learning is educators' biggest challenge. *Business Wire*. Retrieved from https://www.businesswire.com/news/home/20140716005432/en/ISTE-Survey-Reveals-Individualized-Learning-Educators%E2%80%99-Biggest

Elias, M. J., White, G., & Stepney, C. (2014). Surmounting the challenges of improving academic performance: Closing the achievement gap through social-emotional and character development. *Journal of Urban Learning, Teaching, and Research, 10,* 14–24. Retrieved from ERIC database. (EJ1044191)

Fisher, D., Frey, N., & Lapp, D. (2011). Focusing on the participation and engagement gap: A case study on closing the achievement gap. *Journal of Education for Students Placed at Risk, 16*(1), 56-64. https://doi.org/10.1080/10824669.2011.545976

García, E., & Weiss, E. (2017). *Reducing and averting achievement gaps: Key findings from the report "education inequalities at the school starting gate" and comprehensive strategies to mitigate early skills gaps*. Economic Policy Institute. Retrieved from ERIC database. (ED587806)

Gillborn, D., Demack, S., Rollock, N., & Warmington, P. (2017). Moving the goalposts: Education policy and 25 years of the Black/White achievement gap. *British Educational Research Journal, 43*(5), 848–874. https://doi.org/10.1002/berj.3297

Goldhaber, D., Quince, V., Theobald, R. (2016). *Has it always been this way? Tracing the evolution of teacher quality gaps in U.S. public schools. Working paper 171.* National Center for Analysis of Longitudinal Data in Education Research (CALDER). Retrieved from ERIC database. (ED573189)

Goldsmith, P. R. (2011). Coleman revisited: School segregation, peers, and frog ponds. *American Education Research* Journal*, 48*(3), 508–535. Retrieved from https://www.jstor.org/stable/27975300?seq=1#page_scan_tab_contents

Groff, J., & Mouza, C. (2008). A framework for addressing challenges to classroom technology use. *AACE Journal, 16*(1), 21-46. Retrieved from ERIC database. (EJ805720)

Heise, M. (2017). From No Child Left Behind to Every Student Succeeds: Back to a future for education federalism. *Columbia Law Review, 117*(7), 1859–1896. Retrieved from https://columbialawreview.org/content/from-no-child-left-behind-to-every-student-succeeds-back-to-a-future-for-education-federalism/

Hockly, N. (2017). One-to-one computer initiatives. *ELT Journal, 71*(1), 80-86. https://doi.org/10.1093/elt/ccw077

Howard, N. R., & Howard, K. E. (2017). Using tablet technologies to engage and motivate urban high school students*. International Journal of Educational*

Technology, 4(2), 66–74. Retrieved from https://educationaltechnology.net/ijet/index.php/ijet/article/view/15

International Society for Technology in Education. (n.d.). ISTE standards for students. Retrieved from https://www.iste.org/standards/for-students

Johnston, H. (2011). *Closing the gaps. Research brief*. Education Partnerships, Inc. Retrieved from ERIC database. (ED538320)

Kirkpatrick, L. C., Brown, H. M., Searle, M. J., Sauder, A. E., & Smiley, E. (2017). The impact of a school board's one-to-one iPad initiative on equity and inclusion. *Exceptionality Education International, 27*(2), 26–53. Retrieved from https://ir.lib.uwo.ca/eei/vol27/iss2/2/

Kober, N. (2001). *It takes more than testing: Closing the achievement gap*. *A report of the center on education policy.* Center on Education Policy. Retrieved from ERIC database. (ED454358)

Kotok, S. (2017). Unfulfilled potential: High-achieving minority students and the high school achievement gap in math. *High School Journal, 100*(3), 183–202. Retrieved from ERIC database. (EJ1131990)

Lee, P. W. (1999). In their own voices: An ethnographic study of low-achieving students within the context of school reform. *Urban Education, 34*(2), 214–44. https://doi.org/10.1177/0042085999342005

Levine, T. H., & Marcus, A. S. (2007). Closing the achievement gap through teacher collaboration: Facilitating multiple trajectories of teacher learning [PDF file]. *Journal of Advanced Academics, 19*(1), 116-138. Retrieved from https://pdfs.semanticscholar.org/892b/154b332e0c374e6a02fdf8e072ee266f0d88.pdf

Levin, B. B., & Schrum, L. (2013). Technology-rich schools UP CLOSE. *Educational Leadership, 70*(6), 51-55. Retrieved from http://www.ascd.org/publications/educational_leadership/mar13/vol70/num06/Technology-Rich_Schools_Up_Close.aspx

Lynch, R., & Oakford, P. (2014). The economic benefit of closing the educational achievement gaps. Retrieved from https://www.americanprogress.org/issues/race/reports/2014/11/10/100577/the-economic-benefits-of-closing-educational-achievement-gaps/

Mac Iver, M. A. (2010). Beginning with the end in mind: The school district office leadership role in closing the graduation gap for at-risk students. *Educational Considerations, 38*(1), 8-16. Retrieved from ERIC database. (EJ932061)

Madyun, N. H. (2011). Connecting social disorganization theory to African-American outcomes to explain the achievement gap. *Educational Foundations, 25*(3-4), 21-35. Retrieved from ERIC database. (EJ954986)

Maninger, R. M., & Holden, M. E. (2009). Put the textbooks away: Preparation and support for a middle school one-to-one laptop initiative. *American Secondary Education, 38*(1), 5–33. Retrieved from ERIC database. (EJ862699)

McNeil, M. (2014). Minnesota pushes to ratchet down achievement gap. *Education Week, 33*(22), 1–19. Retrieved from https://www.edweek.org/ew/articles/2014/02/26/22minnesota.h33.html

Means, B. (2010). Technology and education change: Focus on student learning. *Journal of Research on Technology in Education, 42*(3), 285-307. Retrieved from https://www.sri.com/work/publications/technology-and-education-change-focus-student-learning

Minnesota Department of Education. (2014). *Minnesota comprehensive assessments – series III. Achievement level descriptors*. Retrieved from: https://education.mn.gov/mdeprod/idcplg?IdcService=GET_FILE&dDocName=MDE086101&RevisionSelectionMethod=latestReleased&Rendition=primary

Minnesota Department of Education. (2017). *Technical manual for Minnesota standards-based accountability and English language proficiency assessments.* Retrieved from: https://education.mn.gov/mdeprod/idcplg?IdcService=GET_FILE&dDocName=MDE070999&RevisionSelectionMethod=latestReleased&Rendition=primary

Minnesota Department of Education. (2018a). *Technical manual for Minnesota standards-based and English language proficiency accountability assessments.* Retrieved from https:// https://education.mn.gov/MDE/dse/test/mn/Tech/

Minnesota Department of Education. (2018b). *Parent fact sheet.* Retrieved from https:// https://education.mn.gov/MDE/fam/tests/

Minnesota Department of Education. (2018c). *Minnesota report card*. Retrieved from https://rc.education.state.mn.us

Minnesota Department of Education. (2019) *Minnesota assessments reports interpretive guide.* Retrieved from: https://education.mn.gov/mdeprod/idcplg?IdcService=GET_FILE&dDocName=MDE071820&RevisionSelectionMethod=latestReleased&Rendition=primary

Mintrop, H., & Zane, R. (2017). When the achievement gap becomes high stakes for special education teachers: Facing a dilemma with integrity. *Teachers College Record, 119*(9), 1–39. Retrieved from https://www.researchgate.net/publication/327895649_When_the_Achievement_Gap_Becomes_High_Stakes_for_Special_Education_Teachers_Facing_a_Dilemma_With_Integrity

Mucetti, R. (2017). From forty-to-one to one-to-one: Eliminating the digital divide and making equity actionable. *Educational Leadership and Administration: Teaching and Program Development, 28*, 28–36. Retrieved from ERIC database. (EJ1161900)

Muijs, D. (2004). *Quantitative methods in educational research.* London, England: SAGE.

Murphy, J. (2009). Closing achievement gaps: Lessons from the last 15 years. *Phi Delta Kappan, 91*(3), 8-12. Retrieved from ERIC database. (EJ867795)

National Center for Education Statistics. (2018). About NAEP. *A common measure of student achievement.* Retrieved from https://nces.ed.gov/nationsreportcard/about/

National Education Association. (2019). *Students affected by achievement gaps*. Retrieved from http://www.nea.org/home/20380.htm

Nelson, A. (2006). Closing the gap: Early childhood education. *Early Childhood Education Info Brief, 45.* Retrieved from http://www.ascd.org/publications/newsletters/policy-priorities/apr06/num45/toc.aspx

Ogletree Jr., C. J. (2007). The demise of BROWN vs. Board of Education: Creating a blueprint to achieving racial justice in the 21st century. *Crisis 114*(1), 1–7. Retrieved from https://www.thecrisismagazine.com

One-to-one. (2013). Retrieved from https://www.edglossary.org/one-to-one/

Otto, R., (2014). Toward equitable education. Grantmakers for Education. Retrieved from ERIC database. (ED558188)

Pearlstein, M. (2014). *Minnesota's Immense Achievement Gaps: The Untapped Promise of Vouchers.* Retrieved from https://www.americanexperiment.org/reports-books/minnesotas-immense-achievement-gaps-untapped-promise-vouchers/

Pierson, M., & Borthwick, A. (2010). Framing the assessment of educational technology professional development in a culture of learning. *Journal of Digital Learning in Teacher Education, 26(4),* 126-131. Retrieved from ERIC database. (EJ893870)

Powell, A., Watson, J., Staley, P., Patrick, S., Horn, M., Fetzer, L.,...& Verma, S. (2015*). Blending learning: The evolution of online and face-to-face education from 2008-2015. Promising practices in blended and online learning series*. International Association for K-12 Online Learning. Retrieved from https://www.inacol.org/resource/blending-learning-the-evolution-of-online-and-face-to-face-education-from-2008-2015/

Powers, J. M. (2007). The relevance of critical race theory to educational theory and practice. *Journal of Philosophy of Education, 41*(1), 151–166. https://doi.org/10.1111/j.1467-9752.2007.00546.x

Raths, D. (2012). Are you ready for BYOD? *T.H.E. Journal, 39*(4), 28-32. Retrieved from ERIC database. (EJ980597)

Rothstein, R. (2013). Why our schools are segregated. *Educational Leadership, 70*(8), 50–55. Retrieved from http://www.ascd.org/publications/educational-leadership/may13/vol70/num08/Why-Our-Schools-Are-Segregated.aspx

Sablan, J. R. (2019). Can you really measure that? Combining critical race theory and quantitative methods. *American Educational Research Journal, 56*(1), 178-203. https://doi.org/10.3102/0002831218798325

Sampson, D., & Garrison-Wade, D. F. (2011). Cultural vibrancy: Exploring the preferences of African American children toward culturally relevant and non-culturally relevant lessons. *Urban Review: Issues and Ideas in Public Education, 43*(2), 279–309. doi: 10.1007/s11256-010-0170-x

Sharp, L. A. (2014). Literacy in the digital age. *Language and Literacy Spectrum, 24*, 74–85. Retrieved from ERIC database. (EJ1034912)

Slater, L. (2013). *Building high-performing and improving education systems: Teachers. Review*. CfBT Education Trust. Retrieved from ERIC database. (ED546816)

Sleeter, C. E. (2017). Critical race theory and the whiteness of teacher education. *Urban Education*, *52*(2), 155–169. https://doi.org/10.1177/0042085916668957

Soumah, M. A., & Hoover, J. H. (2013). A Conversation on inequality with students of color. *Reclaiming Children and Youth, 22*(1), 18–23. Retrieved from ERIC database. (EJ1023627)

Sparks, S. D. (2016). Caution urged on measuring social-emotional skills. *Education Week, 35*(28), 6. Retrieved from https://www.edweek.org/ew/articles/2016/04/20/scholars-better-gauges-needed-for-mindset-grit.html

The Nation's Report Card. (n.d.). *Achievement gaps dashboard*. Retrieved from https://www.nationsreportcard.gov/dashboards/achievement_gaps.aspx

United States Census Bureau. (2018). *Race*. Retrieved from https://www.census.gov/topics/population/race/about.html

Vanneman, A., Hamilton, L., Anderson, J. B., & Rahman, T. (2009). *Achievement gaps: How Black and White students in public schools perform in mathematics and reading on the national assessment of educational progress. Statistical analysis report. NCES 2009-455.* National Center for Education Statistics. Retrieved from ERIC database. (ED505903)

Varier, D., Dumke, E., Abrams, L., Conklin, S., Barnes, J., & Hoover, N. (2017). Potential of one-to-one technologies in the classroom: teachers and students weigh in. *Educational Technology Research & Development, 65*(4), 967–992. Retrieved from ERIC database. (EJ1147972)

Vockley, M. (2007). *Maximizing the impact: The pivotal role of technology in a 21st century education system*. Partnership for 21st Century Skills. Retrieved from ERIC database. (ED519463)

Vogt, W. P. (2007). *Quantitative research methods for professionals.* Boston, MA: Pearson/Allyn and Bacon.

Warren, T. (2018) *Apple's new iPad with Pencil support is just $299 for schools.* The Verge. Retrieved from https://www.theverge.com/2018/3/27/17167054/new-apple-ipad-announced-cheap-price-students-2018

Weston, M. E., & Bain, A. (2010). The end of techno-critique: The naked truth about 1:1 laptop initiatives and educational change. *Journal of Technology, Learning, and Assessment, 9*(6). Retrieved from https://ejournals.bc.edu/index.php/jtla/article/view/1611

Williams, A. (2011). A call for change: Narrowing the achievement gap between White and minority students. *Clearing House: A Journal of Educational Strategies, Issues and Ideas, 84*(2), 65-71. Retrieved from ERIC database. (EJ913725)

Winkler, R. (2014). *Chromebooks take other mobile PCs to school*. Retrieved from https://www.wsj.com/articles/chromebooks-take-other-mobile-pcs-to-school-1390518236?tesla=y