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A Quantitative Study on the Impact of Adapted School Instruction as a Result of COVID-19 Pandemic on Student Standardized Math Scores in a Midwest Public School District at the Middle School Level

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A Quantitative Study on the Impact of Adapted School Instruction as a Result of

COVID-19 Pandemic on Student Standardized Math Scores in a

Midwest Public School District at the Middle School Level

by

Matthew Walker Buschman

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Declaration of Originality

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

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Abstract

The COVID-19 Pandemic has presented the educational system with challenges that have caused adaptive instruction techniques for all student populations in one way or another. The researcher chose to focus specifically on the impact of adaptive instruction as a result of the COVID-19 Pandemic in the area of mathematics by evaluating student growth on STAR Math Assessments at the Middle School level for a Midwest Public School District. Through evaluating the data from pre-adaptive instruction to post-adaptive instruction as a result of COVID-19, the researcher aimed to identify possible declines in growth as a result of adaptive learning from the entire population, students who learned at-home versus students who learned in the classroom, students with 504 plans, students with IEPs, Asian students, Black students, Hispanic students, White students, and students who receive free or reduced meal plans. For this study, student growth was defined as the change (increase or decrease) from consecutive mathematic STAR Assessment scores. The researcher utilized left-tailed *t*-tests of dependent and independent means to determine statistical significance on student growth. By completing the quantitative analyses through utilizing populations derived from the total student population of 4,982 students, the researcher found there was not a statistically significant decline in growth for the entire population, students who learned at-home versus students who learned in the classroom, students with IEPs, Asian students, Black students, Hispanic students, White students and students who receive free or reduced meal plans. There was a statistically significant decline in student growth for students with 504 plans. The researcher suggests future studies to analyze the correlation between parent support and student success learning at home, and identify if there was a correlation between

students with anxiety or other mental health illnesses and a decline in growth across all content areas.

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Chapter One: Introduction

Introduction

The purpose of this quantitative study was to identify the effects of adaptive instruction, due to the COVID-19 pandemic, on middle school mathematics students in a Midwest Public School District. From March 2020 through June 2021, U.S. public schools had to alter their instructional methods, due to the severity of COVID-19 in their geographical areas (Bhamani et al., 2020). During this time, many students were forced to learn from home or given the option to learn from home or at school, due to the social distancing recommendations from the Center for Disease Control (CDC, 2021). Teachers and school leaders explored alternative methods of instruction that kept the students safe, complied with the guidelines from the CDC, and provided a quality education. This study aimed to provide insight into the impacts of student growth in mathematics during the time of adaptive instruction, by analyzing data collected from a standardized math assessment tool, STAR mathematics assessment. The data were analyzed for a variety of student subgroups to identify the impacts on various populations.

In the spring of 2020, schools went from normal operating procedures on February 1, 2020, to all U.S. public schools being physically closed and operating virtually by the end of March 2020 (Education Week, 2021). This expedited school shut down required school districts and educators to quickly adjust their instructional techniques and to instruct students virtually, while they were learning from home. The study focused on identifying if students learned from home at a similar rate as students who learned in the school building. The population of this study was approximately 4,900 students from grades six through eight, across six different middle schools in a Midwest

Public School District. This study provided data and insight on how well students learned mathematics from home compared to students in the classrooms, by analyzing student growth prior to adaptive instruction as a result of COVID-19 and post adaptive instruction as a result of COVID-19. The literature review provides the reader with background information regarding the various instructional techniques and effectiveness from previous studies; however, COVID-19 was in effect during the duration of this study, therefore this study aimed to bring awareness and knowledge to this new topic.

Rationale of the Study

For years the education system was based on traditional learning patterns with students learning in a brick and mortar setting (Bhamani et al., 2020). To minimize the spread of COVID-19, schools had to adapt their instruction to comply with government-issued social distancing guidelines. “In the United States, this translates to the disruption of the academic year for more than 55 million K-12 students” (Crosby et al., 2020, para. 4). There was little research on the effects of adapted instruction during the COVID-19 pandemic for students in the Midwest in mathematics. Students were instructed in math through in-person, hybrid-concurrent, blended, and online learning models since March 2020, as a result of the COVID-19 pandemic. Kuhfeld and Tarasawa (2020) used data from studies of student regression, or “summer slowdown” over a typical summer, to predict the potential impact of the COVID-19 pandemic. They stated that “projections suggest major academic impact from COVID closures for students, especially in mathematics” (Kuhfeld & Tarasawa, 2020, p. 2). Students typically saw a larger set back or less retention of information in mathematics, as compared to reading retention over the summer months (Kuhfeld & Tarasawa, 2020). Chicago Public Schools surveyed students regarding participation in adaptive instruction during the early parts of the COVID-19 Pandemic. The results of their study showed that there was a 15% gap in participation between Whites and Asians as compared to Blacks, and one-third of all students with disabilities did not actively participate in remote learning (Center on Reinventing Public Education, 2020). With the major shift in education to adaptive instruction, due to COVID-19, that ultimately resulted in children's learning being compromised (Bhamani et al., 2020).

This study aimed to provide administrators and teachers data that represent the effects on student growth in middle school mathematics, as a result of the adapted learning due to the COVID-19 pandemic. For this study, student growth was defined as the change (increase or decrease) from consecutive mathematics STAR tests. The assessment tool used to measure student growth in mathematics for this study was the STAR assessment. The STAR assessment is described as, “computer-adaptive tests designed to give educators accurate, reliable, and valid data quickly so that they can make good decisions about instruction and intervention” (Learning and Teaching, 2020, para. 1). The assessment was given to students in the school district of study three times a year to track progress and measure student growth in mathematics. The STAR assessment scores students using

> a scaled score (SS), which is based on the difficulty of the questions and the number of correct answers. Scaled scores are useful for comparing your child’s performance over time and across grades. STAR Math scaled scores range from 0–1400. (Renaissance Place, 2020, p. 3, para. 4)

In an article published by Data Quality Campaign et al. (2020), the author stated that "states can and should continue to measure student growth in 2021. Growth data will be crucial to understanding how school closures due to COVID-19 have affected student progress and what supports they will need to get back on track" (p. 4). The researcher chose to use student growth as the comparison indicator, because according to the Data Quality Campaign,

> growth measures use multiple years of data to capture changes in student learning over time. This information paints a richer picture of student performance than proficiency data alone because proficiency data shows student performance at a single moment in time. (Data Quality Campaign et al., 2020, p. 1)

By comparing student growth prior to the COVID-19 pandemic and post-adapted learning due to the COVID-19 pandemic, the researcher hoped to see the real effect of the adapted instruction on student populations.

Teachers and administrators could potentially use this data to better understand the effectiveness of adapted instructional methods and specific subgroup populations' growth, to provide additional interventions and support. By conducting an analysis of the various subgroups' growth prior to adaptive learning and post adaptive learning, the researcher hoped to bring awareness to the various impacts on differing student populations, as a result of adapted instructional methods due to the COVID-19 pandemic. The information from this study may provide school district officials in the district of study with information related to the effectiveness of the strategies implemented for adaptive learning as a result of the COVID-19 pandemic, help them develop a plan for making up potential growth deficits, and also provide them information so they can better plan for future adaptive learning.

At the time of the study, there was little research conducted on the academic growth of middle school mathematics students during the COVID-19 pandemic. For years researchers tried to identify and prevent the learning loss that took place in students over the summer months. Parents, teachers, school administrators, and educational researchers had grown more concerned, due to the abundance of physical school closures from March 2020 to August 2020 and beyond. Dorn et al. (2020) reported that the U.S. education system was not built to deal with extended shutdowns, like those imposed by the COVID-19 pandemic. Many researchers used studies that identified learning loss during the summer months to project the possible learning loss in students during the COVID-19 shutdown. Quinn and Polikoff (2017), reported that on average, students' achievement scores declined over summer vacation by one month's worth of school-year learning, declines were sharper for math than for reading, and the amount of learning loss was larger at higher grade levels. The researcher believed this study would add to the existing body of knowledge on the ability of middle school mathematics students learning from at home at a similar rate as students who learned from at school.

Purpose of Study

The purpose of this quantitative case study was to identify the impact of adaptive learning during the COVID-19 pandemic on student growth in the area of mathematics, between grades three and eight in a Midwest public school district. In March of 2020, the Corona Virus began its spread across the United States. This resulted in schools having to adapt instruction to comply with government-issued social distancing guidelines and

Center of Disease Control recommendations. This resulted in schools implementing a combination of learning models from online learning, hybrid concurrent instruction model, blended instruction, and students learning synchronously and asynchronously. To identify the impact of adaptive instruction, the researcher analyzed annual student STAR Assessment scores from grades three through eight to find the average student growth prior to the COVID-19 pandemic and compared that data to student growth during adaptive instruction and the COVID-19 pandemic. The data were analyzed as a whole group and broken down into student subgroups to identify the impact of COVID-19 on student growth. The quantitative data were analyzed using a combination of *t*-tests for differences and descriptive statistics. Results of the study could be used to gain a deeper understanding of the impact of COVID-19 on student growth in mathematics, compare student growth from students learning from at-home vs. at-school learning, and identify the impact of COVID-19 on students with different demographics. Educational leaders could use the results of this study to take a more proactive approach if the education system is ever forced to socially distance or use distance learning for an extended amount of time, in the future.

Hypotheses

Hypothesis 1: There is a decrease in student growth in mathematics, as measured by the STAR assessment prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Hypothesis 2: There is a decrease in student growth in mathematics, as measured by the STAR assessment between students who learned at-home compared to at-school learners post adaptive learning, as a result of the COVID-19 pandemic.

Hypothesis 3: There is a decrease in student growth in mathematics, as measured by the STAR assessment for students with a 504 plan prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Hypothesis 4: There is a decrease in student growth in mathematics, as measured by the STAR assessment for students with an Individualized Education Plan (IEP) prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Hypothesis 5: There is a decrease in student growth in mathematics, as measured by the STAR assessment for Asian students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Hypothesis 6: There is a decrease in student growth in mathematics, as measured by the STAR assessment for Black students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Hypothesis 7: There is a decrease in student growth in mathematics, as measured by the STAR assessment for Hispanic students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Hypothesis 8: There is a decrease in student growth in mathematics, as measured by the STAR assessment for White students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Hypothesis 9: There is a decrease in student growth in mathematics, as measured by the STAR assessment for students who receive free or reduced meal plans prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Learning at School

Research has outlined the success of middle school students based on an eagerness to learn, a love for reading, respect for authority and others, quality social and emotional skills, and accustomed to routine, responsibility, and self-motivation (Chen, 2020). Chen (2020) went on to say that these characteristics were demonstrated by successful students, no matter their gender or ethnic background. There were many qualities that make for a successful middle school, and it required a collaborative effort from students, parents, teachers, administration, and the community (Meier, 2016). Meier (2016) stated that middle schools had a dynamic learning environment and successful schools had a strong shared vision, external support, focused on student learning, and created a caring environment through counselling and support services. The Association for Middle Level Education (AMLE, 2020) described a successful middle school as a place that cultivated high expectations, empowered students to take responsibility of their learning and character, equitable for every student, responsive to students who were underperforming, and fostered a learning environment that motivated all students.

History and research have proven that not all students learn at the same rate in a mathematics classroom at school. Many studies have proven that low-income or low socioeconomic student groups directly correlate to low achievement in mathematics (Davenport & Slate, 2019). In addition to low-income students, Black students have also historically underperformed in middle school mathematics (Parke, 2016). Research also indicated that Asian students were one of the few student subgroups that traditionally outperformed White students in mathematics performance (Carnoy et al., 2017). Research has proven that ethnic backgrounds are correlated to different student success rates, but that does not hold true in regard to gender. Evidence from multiple studies showed that there was no difference between genders in math performance (Scafidi & Bui, 2010; Time & Gotlieb, 2013).

Learning at Home

The main benefit from learning at home during the COVID-19 Pandemic was the ability for students and staff to socially distance and reduce the chance of COVID-19 exposure (Pediatric Care Group. 2020). The Huntington Learning Center identified some potential benefits from learning at home to be how it built independence and helped students learn to be self-starters (Huntington, 2021). Huntington (2021) continued by saying that learning at home brought a focus back to the learning and curriculum and mitigated some of the distractions within a classroom. Learning from home allowed students to move at their own pace; this benefited advanced students and allowed them opportunities for extension activities to deepen their knowledge in the curriculum. Learning from home was the least beneficial for students who were unmotivated or had unsupportive homes. The students' homes must have also had the necessary technology for the student to be successful. In addition, collaboration with peers during the educational process was restricted when students were learning from home.

Study Limitations

A limitation in this study was the unknown factors or challenges that students faced while learning from home. The district of study provided students with food, a Chromebook, Wi-Fi hotspots, if needed, and offered curbside pick-up of textbooks and paper material to connect with school. For students or parents who could not drive to school, supplies were delivered to their homes. However, there were still many unknown factors that impacted the educational process for students who learned from home. The unknown factors included, but were not limited to, a variety of parental support, a distraction-free learning environment, motivational factors, organizational skills, home dynamics, and structure. For future studies, the researcher would recommend to survey students and parents to obtain a better understanding of the factors at home that could have impeded, or supported, the educational process.

Definition of Terms

504 Plan: "a plan developed to ensure that a child, with a disability pursuant to Section 504 of the Rehabilitation Act of 1973 attending an elementary or secondary educational institution, receives accommodations providing him/her access to the learning environment" (U.S. Legal, 2019, para. 1).

Achievement Gap: "the persistent disparity in academic achievement between minority and disadvantaged students and their white counterparts" (Porter, 2021, para. 2).

Adaptive Instruction: "apply different instructional strategies to different groups of learners so that natural diversity prevailing in the classroom does not prevent any learner from achieving success" (Borich, 2011, p.41).

Asynchronous Instruction was when students conducted learning or exploration on their own and at their own pace (Bennett, 2020).

Blended Instruction was where a teacher only had one group of students and those students attended class in-person some days and attended class virtually other days (Steele, 2021).

Coronavirus Disease 2019 (COVID-19):

Coronavirus disease 2019 (COVID-19) is caused by a new coronavirus first identified in Wuhan, China, in December 2019. Because it is a new virus, scientists are learning more each day. Although most people who have COVID-19 have mild symptoms, COVID-19 can also cause severe illness and even death. Some groups, including older adults and people who have certain underlying medical conditions, are at increased risk of severe illness. (Center for Disease Control and Prevention, 2019, para. 1)

Distance learning: “also called distance education, e-learning, and online learning, a form of education in which the main elements include physical separation of teachers and students during instruction and the use of various technologies to facilitate student-teacher and student-student communication” (Berg, 2016, para. 1).

Hybrid Concurrent Instruction: was when the teacher was teaching one group of students in class while simultaneously teaching another group of students online (Tucker, 2021).

Individualized Education Plan (IEP): “An IEP lays out the special education instruction, supports, and services a student needs to thrive in school” (Belsky, 2021, para. 2).

Learning Loss: any specific or general loss of knowledge and skills or to reversals in academic progress, most commonly due to extended gaps or discontinuities in a student’s education. (Educational Reform, 2013, para. 1).

Online Learning: For the purpose of this study, online learning was when students learned from online at home, due to the inability to being at school during COVID-19.

Pre-Adaptive Instruction: For the purpose of this study, pre-adaptive instruction was the instructional time before the onset of the COVID-19 Pandemic. More specifically, the assessment window from Fall 2019 to Winter 2020 in the district of study.

Post-Adaptive Instruction: For the purpose of this study, post-adaptive instruction was the instructional time after the onset of the COVID-19 Pandemic. More specifically, the assessment window from Fall 2020 to Winter 2021 in the district of study.

Standardized Test:

> is any form of test that (1) requires all test takers to answer the same questions, or a selection of questions from common bank of questions, in the same way, and that (2) is scored in a "standard" or consistent manner, which makes it possible to compare the relative performance of individual students or groups of students. While different types of tests and assessments may be "standardized" in this way, the term is primarily associated with large-scale tests administered to large populations of students. (Education Reform, 2015, para. 1)

STAR Assessment:

> computer-adaptive tests designed to give educators accurate, reliable, and valid data quickly so that they can make good decisions about instruction and intervention. STAR Reading (grades 2-12), STAR Math (grades 1-12), and STAR

> Early Literacy (grades K-1) include skills-based test items, learning progressions for instructional planning, and in-depth reports. They bridge testing and instruction. The STAR assessments are good tools for data-driven schools. They are practical and sound, and provide a wealth of information about your child's reading and math skills. (Learning and Teaching, 2020, para.1)

Student Growth: For the purpose of this study, student growth was the change (increase or decrease) from consecutive mathematical STAR tests.

Student Subgroups: "any group of students who share similar characteristics, such as gender identification, racial or ethnic identification, socioeconomic status, physical or learning disabilities, language abilities, or school-assigned classifications" (Education Reform, 2015, para. 1).

Synchronous Instruction: was when students were working with teachers in real-time, the teacher was facilitating the discussion and encouraged students to actively participate (Bennett, 2020).

Traditional In-Person Instruction: For the purpose of this study, traditional in-person instruction was one where students and teachers were all located within the classroom and there were no restrictions placed on the daily functions of the school due to COVID-19.

Summary

In summary, this study analyzed data to determine the impacts on student growth in mathematics as a result of alternative education methods, because of COVID-19. This study was very timely, as during the construction of this dissertation, the COVID-19 pandemic was happening concurrently. The results of this study can be used to create future studies to investigate the findings more in depth for subgroups. Results can also help guide education entities and employees for future similar adverse situations they may encounter that would call for alternative instructional techniques. Measuring the impacts of our educational techniques and instructional models was vital to determine effectiveness and promote growth opportunities within education for our students that accommodated student needs.

Chapter Two: Review of Literature

Introduction

For years, traditional learning patterns had been the foundation of the educational system, with students learning in a brick-and-mortar setting (Bhamani et al., 2020). To minimize the spread of COVID-19, schools adapted their instruction to comply with government-issued social distancing guidelines. "In the United States, this translates to the disruption of the academic year for more than 55 million K-12 students" (Crosby et al., 2020, para. 4). Students were instructed in math through in-person, hybrid, blended, asynchronous, and online learning models from March 2020 through June 2021, as a result of the COVID-19 pandemic. In the literature review, which was current at the time of writing, the researcher reviewed the effects of COVID-19 in the middle school mathematics classroom, instructional strategies used during adaptive instruction, growth and demographics in mathematics, and the assessment tool used to measure student growth.

Organization of Literature Review

The literature review first discusses how COVID-19 spread across the United States and the impact it had on the K-12 Education system. Then, the review of literature presents the instructional strategies that educators used due to the CDC's (2021) social distancing requirements.

Next, the review targets growth in mathematics during times before social distancing and adaptive instruction. The following section breaks down the student subgroups and how those subgroups traditionally perform in K-12 mathematics. The categories used to break down the student subgroups were: Blacks, Hispanics, Asians, Whites, low-income, and students with disabilities. Finally, the researcher described the assessment tool used to measure student growth during the study.

COVID-19 Pandemic

Although Coronavirus and COVID-19 were seemingly interchangeable terms, they referred to two different virus classifications. A Coronavirus, as defined by Stanford Health Care (SHC)

> are members of the coronavirus family of viruses — one of the many families that include viruses able to infect people and animals. Seven members of the coronavirus family can make people ill, one of which is the new coronavirus strain SARS-CoV-2, which causes COVID-19. COVID-19 refers to the human infection caused by the new coronavirus strain SARS-CoV-2. (Stanford Heath Care, 2021, para. 3)

Additionally, Merriam-Webster (n.d.) defined a pandemic as "an outbreak of a disease that occurs over a wide geographic area (such as multiple countries or continents) and typically affects a significant proportion of the population: a pandemic outbreak of a disease" (para. 2). The COVID-19 pandemic was reported in the United States in the early part of 2020 and impeded traditional school functions from the Spring of 2020 into the Fall of 2021.

Timeframe

The World Health Organization (WHO, 2021) and *American Journal of Managed Care* (AJMC Staff, 2021) reported the COVID-19 Pandemic timeline as follows: On December 31, 2019, Wuhan Municipal Health Commission reported cases of 'viral pneumonia' in Wuhan, the People's Republic of China. This was later confirmed to be

COVID-19. On January 10, 2020, the Strategic and Technical Advisory Group on Infectious Hazards (STAG-IH) met for the first time regarding the COVID-19 outbreak. On January 14, 2020, the WHO (2021) tweeted preliminary investigations by the Chinese authorities had found no clear evidence of human-to-human transmission. On January 21, 2020, a Washington state resident became the first confirmed case of COVID-19 in the United States; in China, there were over 200 confirmed cases and four deaths. Chinese medical officials confirmed that the virus could be transmitted from human to human. On February 2, 2020, global air traffic was restricted, and on February 3rd, 2020, the United States declared a public health emergency. On March 11, 2020, the WHO (2021) declared COVID-19 a Global Pandemic. On March 19, 2020, California issued a statewide stay-at-home order, and other states were soon to follow. At this point, the majority of school districts in the United States were implementing adaptive instruction, due to the CDC's (2021) social distancing recommendations.

On May 28, 2020, U.S. COVID-19 deaths surpassed 100,000. On June 10, 2020, U.S. COVID-19 total cases reached 2 million. On August 17, 2020, COVID-19 became the third leading cause of death in the United States, behind heart disease, first, and cancer, second. On December 10, 2020 the Federal Drug Administration (FDA) endorsed the first COVID-19 vaccine. Johns Hopkins University reported, as of August 9, 2021, there were 35,763,785 confirmed COVID-19 cases in the United States and 616,829 total COVID-19 deaths in the United States, with a 1.7% death rate.

Transmission and Prevention of COVID-19

Scientists believed there were multiple ways in which COVID-19 could be transmitted. The Center for Disease Control and Prevention (CDC, 2021) reported there were three ways to transmit COVID-19:

> (1) inhalation of very fine respiratory droplets and aerosol particles, (2) deposition of respiratory droplets and particles on exposed mucous membranes in the mouth, nose, or eye by direct splashes and sprays, and (3) touching mucous membranes with hands that have been soiled either directly by virus-containing respiratory fluids or indirectly by touching surfaces with virus on them. (para. 7)

The WHO (2021) reported the most likely way for COVID-19 to spread was through respiratory particles that floated through the air from person to person. In addition to the primary three forms of transmission, the Mayo Clinic reported that evidence showed that cats and dogs could carry the COVID-19 virus (Marshall, 2021). However, evidence indicated that the virus would spread most efficiently in crowded indoor settings with poor ventilation (World Health Organization [WHO], 2021). Public schools were deemed a high-risk setting due to the proximity of students, duration of time spent indoors, and poor ventilation in most public schools (WHO, 2021).

The CDC (2021) and WHO (2021) agreed on three preventative steps for the public to utilize in an effort to combat the transmission of COVID-19. Research showed that social distancing, avoiding large crowds, wearing a face-covering that covered your nose and mouth, and maintaining a six-foot distance between individuals, would prevent the spread of the virus (Center for Disease Control [CDC], 2021). In addition to social distancing, the CDC (2021) and WHO (2021) recommended individuals wear a mask covering the mouth and nose when in public. Finally, the CDC (2021) and WHO (2021) recommended individuals frequently wash their hands for longer than 20 seconds. Even though there had been some debate on how COVID-19 was transmitted, the CDC (2021) and WHO (2021) remained unified in their recommendation strategies to prevent the transmission of COVID-19.

Symptoms of COVID-19 included, but were not limited to, difficulty breathing, fever, cough, fatigue, congestion, vomiting, diarrhea, and new loss of taste and smell (CDC, 2021). Maragakis (2020) from Johns Hopkins Medical reported that individuals with heart disease, a lung disease that included asthma, diabetes, and the elderly were more likely to have long-term effects from COVID-19. The Asthma and Allergy Foundation of American (AAFA, n.d.) reported that approximately 7% of United States children were diagnosed with asthma, which placed them at high risk of having long-term effects from COVID-19 (AAFA, 2021). Research on the long-term effects of COVID-19 was limited. The majority of COVID-19 survivors experienced no long-term effects from the virus. However, early studies indicated possible long-term effects, which included multi-inflammatory syndrome, heart inflammation, neurological complications, and almost all organs could be impacted (Downey, 2021). Researchers were working tirelessly to learn more about the COVID-19 virus. However, there were many unknowns with the virus, from how it spread to the long-term effects. These unknowns created controversy and debate over how to best educate children, while keeping staff and students safe.

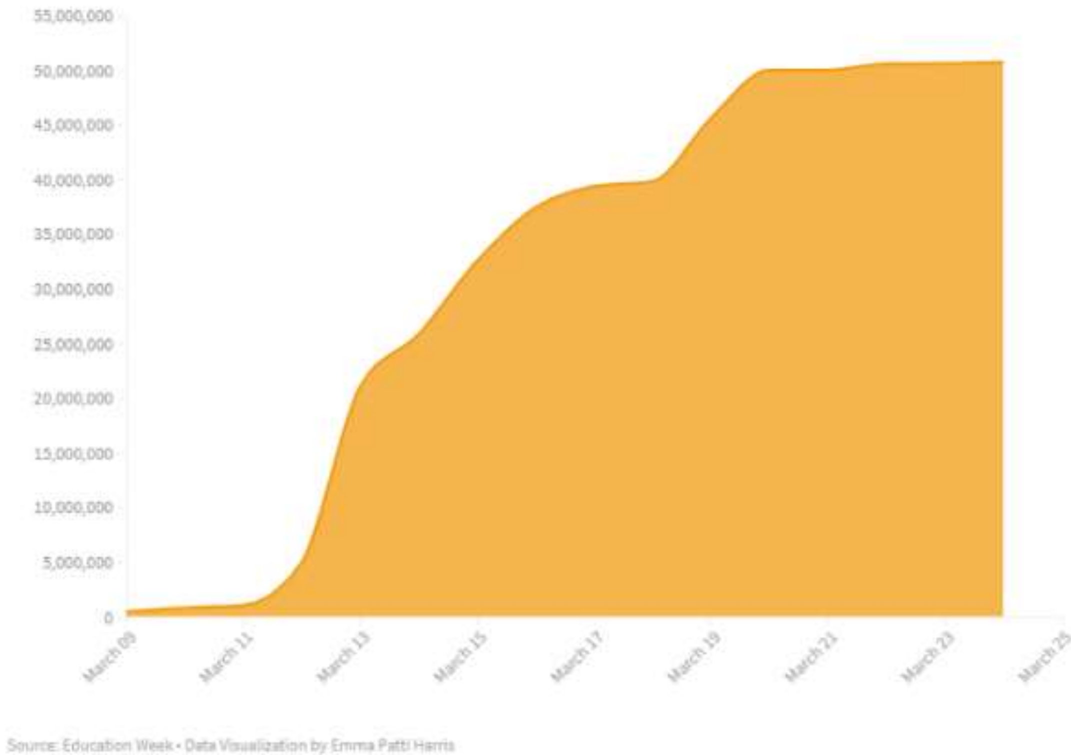
COVID Impact on Schools: Logistics, Social and Emotional Well-being, and Reopening Guidelines

Covid-19 Logistical Impact on Schools

Due to the lack of knowledge about the virus and how quickly the virus spread, U.S. public schools acted out of an abundance of caution to keep students and staff safe. Public schools were forced to alter the way they educated students during the COVID-19 pandemic, due to the recommendations of social distancing by the CDC (2021). In the Spring of 2020, schools went from normal operating procedures on February 1, 2020, to all U.S. public schools being physically closed and/or operating virtually by the end of March 2020 (*Education Week*, 2021). The quick switch from learning in-person to virtual learning left teachers and school districts scrambling to develop adaptive instructional methods. Figure 1, from *Education Week* (2021), illustrated how quick public schools across the United States began to shut down.

Figure 1

Number of Students Impacted by Coronavirus School Closures



Note. This figure illustrates how many students were affected by school closures, due to COVID-19. The vertical y-axis represented the number of students affected and the horizontal x-axis represented the timeline in March of 2020.

Education Week (2021) reported that Ohio became the first state to issue a statewide public school shut down on March 11, 2020. By March 25, 2020, all U.S. public schools were closed. Even though the buildings were closed, schools made an effort to provide an education to students and essential services to the families within the community. Many districts organized food pick-up locations; this allowed families in need to obtain breakfast and lunches throughout the early weeks of the COVID-19 pandemic (*Education Week*, 2021).

During the school shutdown, teachers were forced to adapt how they delivered their content and how grades were reported. Since classes were unable to meet in person and schools resorted to distance learning. Distance learning was “a method of study where teachers and students do not meet in a classroom but use the Internet, email, mail, etc., to have classes” (Merriam-Webster, n.d., para, 2). In the Spring of 2020, many schools focused on reteaching prior knowledge and only allowed students to increase their grades and not lower their current grades (Olneck-Brown, 2021). Olneck-Brown (2021) went on to state that many school districts, in support of their underprivileged students, supplied families with portable Wi-Fi Hotspots. In addition to Wi-Fi Hotspots, some school districts would park buses equipped with Wi-Fi in underprivileged neighborhoods, so those in need would have access to the internet (Olneck-Brown, 2021). Due to the fact that not all students had equal access to distance learning, many school districts enacted a grading policy of “Hold Harmless” for students' grades in the Spring of 2020. This stated that for the remainder of the 2020 school year students’ grades could not lower; students only had the opportunity to increase their grades. Chicago Public schools reported that participation in distance learning drastically dropped with the “Hold Harmless” grading policy (Center on Reinventing Public Education, 2020). Castro et al. (2020) from The California Collaborative on District Reform stated school districts had the following options regarding district grading policies in the Spring of 2020:

- Assign final grades based on students’ third-quarter grades or their grades when the school shutdown occurred.
- Allow students to opt-out of completing a course, thereby students received an “incomplete” until they could finish the course.

- Allow students to choose whether they wanted to accept their current grade or continue with independent study.
- Assign students pass/no pass or credit/ no credit.
- Assess students on essential standards that used a rubric model instead of percentages.

Castro et al. (2020) went on to clarify that the grading policy should be individually analyzed by each school district, while keeping two main points of focus. One, doing no harm to students, and two, developing the grading policy with a high priority on being equitable and accessible for all students (Castro et al., 2020).

Students' Social and Emotional Well-being during COVID

Due to the quick and abrupt interruption of daily life, the COVID-19 pandemic took a toll on the social and emotional well-being of students. The CDC (2021) reported that many adolescents' social, emotional, and mental well-being had been impacted by the pandemic in the areas of changed routines, breaks in the continuity of learning, breaks in the continuity of healthcare, missed significant life events, and loss of security and safety. The CDC (2021) went on to say that many parents avoided taking their children to healthcare providers during the COVID-19 pandemic, due to stay-at-home orders. The staff at EdSource (2021) reported a survey of middle school and high school teachers that stated: 46% of teachers reported that distance learning was not effective in meeting students' social and emotional needs, 65% reported that a substantial number of their students were in significant danger of suffering long-term mental health issues, and teachers reported that their colleagues were even more worried and believed that nearly all of their students were in danger of suffering long-term mental health issues. Gallup surveyed 1,200 parents and found that 29% said their child was already experiencing harm to their emotional or mental health, because of social distancing and closures, and another 14% stated that their child was approaching their limit (Calderon, 2021). Research had proven that students must have had their social and emotional needs met before they could have begun to actively engage and learn their grade-level curriculum. The effects of the COVID-19 pandemic on students' social and emotional well-being may not be fully understood until years down the road. Calderon (2021) added that school closures not only upended most students' learning, it deeply disrupted students' social networks and interactions with classmates and teachers. Researchers indicated that it was highly important that teachers monitor and teach students how to emotionally cope with social distancing and learning remotely. Reports stated that many school districts promoted lessons that incorporated self-care for the students and allowed virtual students to interact with their peers.

School Reopening Guidelines and Quarantining during COVID

The U.S. government, state governments, and the CDC all issued mandates and guidelines for schools when they reopened for the 2020-2021 school year. KSDK News reported that the Missouri Department of Elementary and Secondary Schools (DESE) issued guidelines and mitigation strategies for schools (as cited in Anderson, 2020). DESE (2020) stated that schools should implement health screenings of all students before they enter school each day. The health screening monitored the students' symptoms of fever, chills, cough, headache, muscle aches, nausea, vomiting, diarrhea, new loss of taste or smell, shortness of breath, sore throat, new runny nose or congestion, and/or close contact with a person who had COVID-19 in the last 14 days (Anderson, 2020). Students who reported any of the symptoms were asked to stay home from school and contact their healthcare provider. Students who tested positive for COVID-19 were asked to report the positive case to the school, were placed under a stay-at-home quarantine, and were allowed to return to school after 10 days of the positive test (Anderson, 2020). Once a COVID-19 positive case was reported to the school, the administration was to contact everyone in the school that day and place individuals who were within six feet for over 15 minutes under a 14-day quarantine (Anderson, 2020). Schwartz (2021) from *Education Week*, reported how difficult it was for teachers to keep students engaged and caught up with the curriculum when a student was placed in quarantine. To prevent quarantining students, schools had all students facing the same direction within the classroom, kept the student desks six feet apart within the classroom, and schools placed physical distancing cue markers throughout the building (Anderson, 2020). It was highly recommended that students and staff wear masks that covered the nose and mouth while in a school building. In addition to masks and maintaining a six-foot distance between student desks, DESE recommended that secondary schools rotated teachers from class-to-class and left students in cohorts in the same classroom all day, if possible (as cited in Anderson, 2020). The CDC (2021) reported that several studies from the 2020-2021 school year showed low COVID-19 transmission levels among students in schools that had less than six feet of physical distance when the school used other prevention strategies, such as the use of masks. During the 2020-2021 school year, schools took drastic measures to the layout, logistics, and function of the school to prevent the spread and transmission of COVID-19.

2020-2021 School Year Instructional Strategies

The 2020-2021 K-12 school year was severely impacted by COVID-19 and social distancing guidelines that were put in place by the CDC (2021). Public schools across the United States offered students a variety of adaptive instructional and learning strategies that kept students safe and still provided an education. The adaptive instructional strategies included virtual instruction, traditional in-person instruction, hybrid instruction, blended learning, asynchronous learning, and synchronous learning, and many teachers were asked to teach concurrently. When teaching hybrid concurrently, teachers were to instruct an in-person class and virtual class at the same time. The National Center for Educational Statistics (NCES, 2021) reported in February 2021, for students in fourth and eighth grades in the U.S. public schools, that 43% of students were enrolled in remote or virtual instruction, 21% were enrolled in hybrid instructions, and 35% were enrolled in in-person instruction. Across the United States, school districts took individualized approaches to learning, based on how severe the COVID-19 cases were in their geographic location. This section of the literature review was aimed to break down the various types of adaptive instruction or learning that took place during the 2020-2021 school year.

Virtual Instructional Model

In September, 2020, Chalkbeat, a non for profit educational news organization, surveyed 1,000 U.S. public schools and found that 58% of the students were learning entirely online (Bernum, 2020). Instructing students completely online took a different approach than the traditional classroom learning model. Research suggested that when teaching online or virtually, teachers should focus on clear communication with students and families, adapt lessons for an online setting, set clear expectations with students both behaviorally and academically, take time to build a strong online classroom community, utilize the right educational technology resources, collaborate with colleagues, and utilize discussion and message boards within the online classroom (Abert Resources, 2021). Kamenetz (2020) from National Public Radio (NPR) reported that student and teacher relationships were extremely important to maintain a high level of student engagement. Joliet Public School District, in Illinois, spent the first three weeks of the 2020-2021 school year focused on social and emotional well-being, building relationships, and setting the expectations for the virtual school year (Kamenetz, 2020). Albert Resources (2021) reported that students who learned best from a hands-on approach were some of the most negatively impacted students by virtual learning. Kamenetz (2020) went on to say that online instruction could be highly effective, however, the majority of teachers were ill-prepared and under-supported starting the 2020-2021 school year. Ralph (2020) conducted a study that examined the instructional strategies that were consistent among top-rated online teachers. Ralph (2020) identified that the top online teachers incorporated authentic and relevant course material, used a variety of multimedia resources, students created content both individually and collaboratively, instructors created space for students to reflect on their learning, and instructors were clear about the learning purposes and connection of activities. The research indicated that successful virtual teachers were intentional and well thought-out in how they built relationships with students, created a classroom culture, and communicated expectations with students and families. The Organization for Economic Co-operation and Development (OECD, 2020) stressed the importance of schools and families working as a team to support students through virtual instruction. The OECD (2020) stated that now more than ever, schools and families needed to communicate to create a team that motivated, supported, and guided students through the challenges of learning at home. The OECD (2020) suggested that parents could provide emotional and learning support to their children, while teachers could act as mentors, encourage active learning, motivate, and check that nobody fell behind. The research indicated that when teaching virtually, teachers needed to focus on student engagement in the course, build relationships with the students, communicate clearly with students and families, and build a team with students' families to support the student through the challenges of learning virtually.

Hybrid Concurrent Instructional Model

Many school districts during the 2020-2021 school year gave students the option to learn in-person or learn from home. Some school districts even afforded students the opportunity to switch their learning location each quarter as the number of COVID-19 cases fluctuated. This created a situation where many teachers in U.S. public schools were forced into a hybrid concurrent instructional model. Hybrid concurrent teaching was when the teacher was teaching one group of students in class, while simultaneously teaching another group of students online (Tucker, 2021). Teaching two groups of students in two different learning locations at the same time created many obstacles for teachers to overcome. Tucker (2021) stated that concurrent teaching was difficult because teachers had to manage students in person and online, managed their time and instruction evenly between both groups of students, created lessons that would work with both in-person students and virtual students, and kept students engaged in both settings. Weissinger (2020) stated that hybrid concurrent teaching was difficult to pull off, because schools and students relied heavily on having the necessary technology and internet access. Teachers and students at the minimum needed to have video conferencing or streaming capabilities that were effectively communicated through concurrent teaching (Weissinger, 2020). However, Weissinger (2020) went on to say that if technology issues were overcome that hybrid concurrent teaching created a one classroom community and allowed virtual students to interact with their in-person peers. Researchers indicated that a flipped classroom model paired well with teachers that were concurrently teaching. TeachThought Staff (2021) defined the flipped classroom model as,

> a type of blended learning where students are introduced to content at home and practice working through it at school. This is the reverse of the more common practice of introducing new content at school, then assigning homework and projects to be completed by the students independently at home. (TeachThought Staff, 2021, para. 3)

A flipped classroom model with concurrent teaching allowed students to explore new content or instructional videos at home at their own pace, while it also created deeper discussions and more rich questioning by the students during the in-class time (TeachThought Staff, 2021). Steele (2021) from Leading Learning, posted an article that stated that hybrid concurrent teaching aligned best with a 100% lecture-style class. When students were only asked to listen to a lecture it did not matter if the lecture came from in-person or a face on a computer screen (Steele, 2021). Steele (2021) went on to say that 100% lecture classes did not create the ideal learning environment for the K-12 setting. As was indicated with a virtual classroom, one of the main challenges with concurrent teaching was student engagement and motivation. It was difficult for teachers to motivate their students through a computer screen. However, when virtual students were interacting with in-person students, they felt more connected to the class and engaged in the curriculum (Tucker, 2021). Weissinger (2020) argued that the hybrid concurrent instructional model was the most taxing and stressful on teachers during the 2020-2021 school year. Teachers were torn daily from assisting in-person students with questions and issues to fixing technology problems and answering questions from the students learning virtually (Weissinger, 2020). Researchers indicated that the main benefit from hybrid concurrent teaching was the ability for teachers to create a one-classroom community and still allowed students the flexibility to learn from an environment that he or she felt safe in.

Blended Instruction

Blended instruction was where a teacher only had one group of students and those students attended class in-person some days and attended class virtually other days (Steele, 2021). Blended instruction was different from hybrid concurrent instruction, because teachers had all of their students in one setting each day; the school decided if the class would all meet virtually or in-person for that day (Steele, 2021). However, even though blended instruction and hybrid concurrent instruction were different, they both had students learning from a mix of in-person and virtual settings. Blended learning allowed more flexibility and teachers were able to determine instructional formats, based on what worked best for that particular situation (Steele, 2021). Weitzel (2021) stated that blended instruction cultivated higher student engagement, as compared to strictly virtual or in-person classes. Some students naturally engaged more in an in-person class setting, while other students did not feel comfortable talking in front of their peers and engaged at a higher rate virtually (Weitzel, 2021). Effective teachers that used the blended learning instructional model identified the learners' needs and developed an appropriate approach either in-person or virtually (Steele, 2021). In addition to higher student engagement, school districts could still have kept students safe in a blended learning instructional model. School districts had students complete the majority of work at home and only met in person a few days a week, to keep down the transmission of COVID-19 and allow custodians to complete a deep clean of the school (Weitzel, 2021). A large obstacle with blended learning that teachers came across was student completion of work prior to meeting in person (Steele, 2021). When students did not complete the assigned work, teachers were faced with the decision to recap the assignment and slow down the entire class or move on as scheduled, and the teacher knew that the student would be lost within the lesson (Steele, 2021). Steele (2021) stated that students had more buy-in to complete the at-home assignments, knowing that they would be lost in class if the assignment was not completed. From a teacher's perspective, the main advantage of the blended learning instructional model over the hybrid concurrent instructional model was that teachers only had to focus their attention on one group of students at any given time (Steele, 2021). The research indicated that the blended learning instructional model had the ability to take advantages from virtual learning and in-person learning and combine them into one class.

Synchronous vs. Asynchronous Learning

Social distancing recommendations, due to COVID-19, forced students to learn from multiple settings during the 2020-2021 school year. When students were learning from home, teachers often delivered curriculum, instructions, and assignments in the form of synchronous or asynchronous learning. Synchronous learning was when students were working with teachers in real-time; the teacher was facilitating the discussion and encouraged students to actively participate (Bennett, 2020). Asynchronous learning was when students conducted learning or exploration on their own and at their own pace (Bennett, 2020). Minero (2020) reported that synchronous virtual learning took a similar approach to in-class instruction, just through a computer screen rather than face-to-face. Effective instructional strategies for synchronous instruction could include structured discussions, verbal questions and answers, the chat feature in the online classroom, show and tell, and adapting other effective classroom strategies to the virtual classroom (Minero, 2020). Asynchronous learning offered a learning style that was much more flexible and allowed learners to set their own schedules and work at their own pace (Anthony & Thomas, 2020). Minero (2020) stated asynchronous discussions were more equitable, because they allowed participation from students with low bandwidth, students who had schedule conflicts, or students who were uncomfortable engaging with full class discussions. Bennett (2020) and Minero (2020) identified some effective strategies that paired with asynchronous learning as online forums, to create dialogue among the students, observing and analyzing peer work through virtual gallery walks, and independent readings that allow students to move at their own pace. In an asynchronous learning course, teachers needed to have clear grading rubrics or procedures, so students could fully understand how their grades were calculated (Minero, 2020). Anthony and Thomas (2020) advised that fully asynchronous online learning was probably best suited for adults and was not recommended for young learners. Asynchronous instruction was only effective if the students were motivated, organized, and independent learners

(Bennett, 2020). Anthony and Thomas (2020) noted that asynchronous learning was inaccessible for the special education population. Synchronous learning was better for younger learners, because it established a classroom community and fostered personal connections better than asynchronous learning (Anthony & Thomas, 2020). The research proved that synchronous and asynchronous learning both had their advantages and drawbacks. However, the research was clear that synchronous learning was a better model for students in kindergarten through middle school, and asynchronous learning could better benefit adult students.

Traditional In-Person Instructional Model

The traditional instructional model for middle school mathematics was one where students and teachers were all located within the classroom. Research proved that in-person instruction was the most conducive, with the development of building a positive teacher-student relationship. The instructional styles within the traditional in-person instructional model could include, but were not limited to, direct instruction, 5E instructional model, three act tasks, and a launch, explore, summarize model (Colorado Department of Education [CDE], 2019). Engelmann (2015) defined direct instruction as

> a model for teaching that emphasizes well developed and carefully planned lessons designed around small learning increments and clearly defined and prescribed teaching tasks. It is based on the theory that clear instruction eliminating misinterpretations can greatly improve and accelerate learning. (para. 1)

Turan and Matteson (2021) broke the 5Es instructional model into five phases: engagement, exploration, explanation, elaboration, and evaluation. The 5E model structured the lesson around the following: introduce the lesson by engaging students with a new concept, have students explore an *International Journal of Education in Mathematics, Science, and Technology* (IJEMST), explain the result of the targeted concept, elaborate each idea or skill through additional practice, and finally evaluate their progress in a new setting throughout the lesson (Turan & Matteson, 2021).

Three-act-tasks instruction and a launch, explore, summarize instructional model were very identical, with a few subtle differences. Both instructional models shifted the doing of mathematics from the teachers to the students; however, teachers still guided, interrogated student thinking, and facilitated sensemaking (CDE, 2019). The main differences between the two instructional models were that three-act-tasks involved more of a media component that was based around a story, while the launch, explore, summarize model challenged students with a problem to solve (CDE, 2019). Overall, in-person instruction helped students feel connected to their school and their teacher.

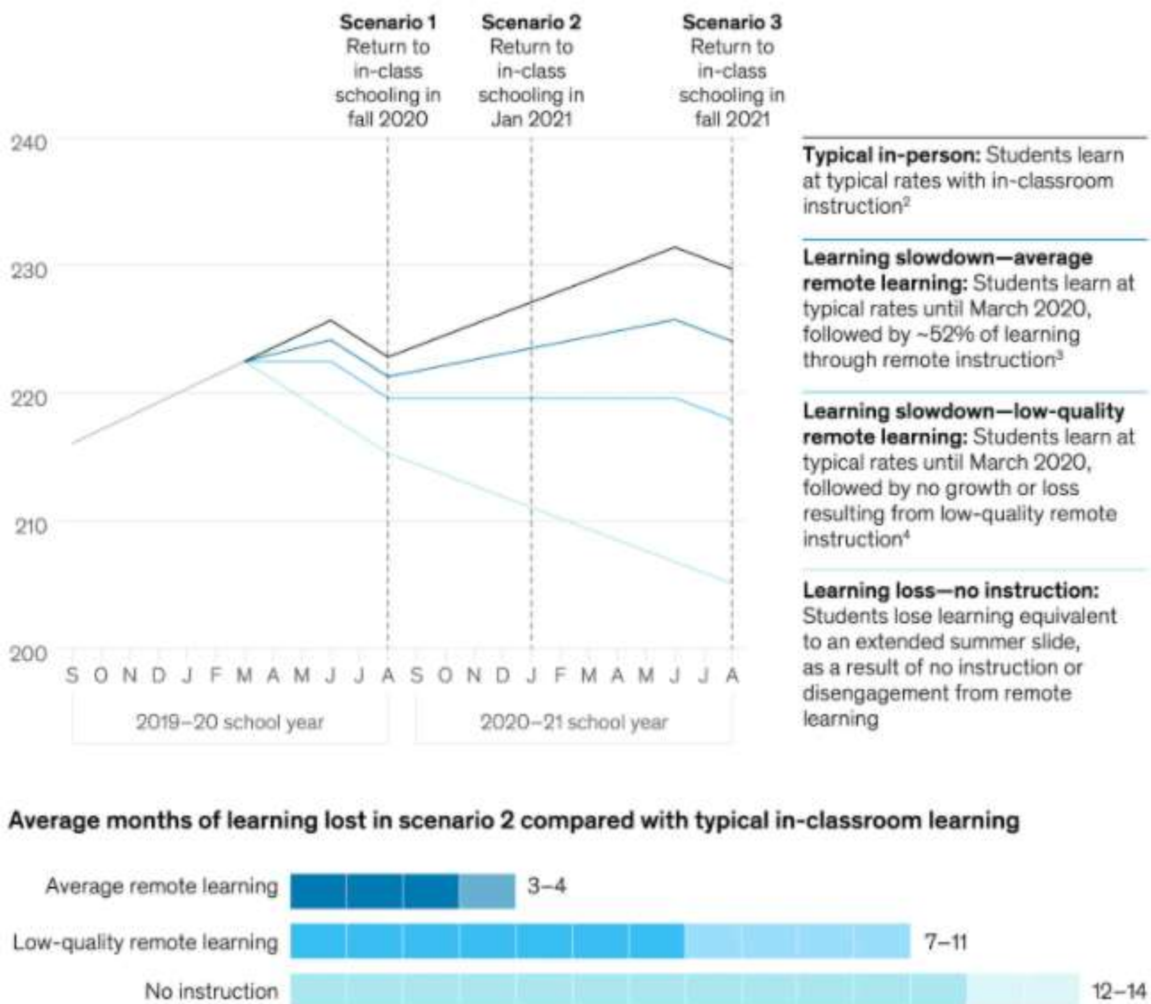
Research had not been fully conducted on the true effects of the various instruction models that school districts implemented during the 2020-2021 school year. The research and articles indicated that the blended instructional model had the most upside for both students and teachers that were required to implement social distancing. Although it was important to note, all of the instructional models discussed took years of training and experience to master, and teachers in U.S. public schools were only afforded a few months of preparation and training. When effectively utilized, the blended learning instructional model allowed teachers to draw on the advantages from both in-person instruction and virtual instruction, while the teacher could still keep the entire class together as one group. In addition, the blended learning model allowed for the teacher to utilize a combination of synchronous and asynchronous learning, as the teacher saw best fit. However, for the U.S. public schools that were able to meet in person during the 2020-2021 school year, students were not able to learn collaboratively, due to social distancing recommendations of group work kept to a minimum. The research had indicated that there was not one instructional strategy that had been proven to be the most effective for K-12 students. However, some U.S. public schools, mostly in urban areas, were not capable of meeting in person, due to the severity of the COVID-19 cases and could only conduct class in a virtual setting. Researchers predicted that students who learned solely from an online setting would have larger gaps in knowledge, as compared to students who learned from in-person instruction.

Learning Loss and the Covid-Slow Down

For years, researchers have tried to identify and prevent the learning loss that took place in students over the summer months. Now parents, teachers, school administrators, and educational researchers had grown more concerned, due to the abundance of physical school closures from March 2020 to August 2020 and beyond. Dorn et al. (2020) reported that the U.S. education system was not built to deal with extended shutdowns like those imposed by the COVID-19 pandemic. Many researchers had used studies that identified learning loss during the summer months to project the possible learning loss in students during the COVID-19 shutdown. Quinn and Polikoff (2017) reported that on average, students’ achievement scores declined over summer vacation by one month’s worth of school-year learning, declines were sharper for math than for reading, and the amount of learning loss was larger at higher grade levels. Additionally, Quinn and Polikoff (2017) stated that income, race, and gender groups did not affect the amount of learning loss in mathematics, unlike that of reading. The learning loss of students during March 2020 to August 2020 school closures varied significantly, due to access to remote learning, the quality of remote instruction, home support, and the degree of engagement (Dorn et al., 2020). Dorn et al. (2020) used data from over 9,500 schools across the United States, provided by the Northwest Evaluation Association (NWEA), to predict the learning loss that would take place in a sixth-grade math student during the COVID-19 shutdown. Figure 2 classifies students into four different learning groups: group one, students who learned in person without disruption; group two, students who experienced average remote instruction; group three, students who experienced low-quality remote instruction; and group four, students who experienced no remote instruction. In addition to the classifications, Figure 2 also identifies three different scenarios: scenario one, students who returned to school in the Fall of 2020; scenario two, students who returned to school in January, 2021; and scenario three, students who returned to school in the Fall of 2021.

Figure 2

Projected Sixth Grade Mathematics Performance Due to Learning Loss from the COVID-19 Shutdown



Note. Projections for Figure 2 started in March of 2020 at the same point the COVID-19 shutdown hit U.S. public schools.

As illustrated in Figure 2, average remote instruction resulted in approximately learning at half the rate of a student learning from in-person instruction. Research had shown that students show a loss of learning during the summer; however, there was still a lack of research on how students performed in mathematics, as a result of adaptive instruction during the 2020-2021 school year.

Growth in Mathematics

Students in middle school mathematics had experienced important crossroads in their mathematical education; they formed conclusions about their mathematical abilities, interest, and motivation that influenced how they approach mathematics in later years (Protheroe, 2007). Growth in mathematics for middle school students could be linked to a variety of different factors. Hattie (2018) broke down the educational process into six different subcategories, which included the student, the home, the teacher, the curriculum, the school, and teaching and learning practices. Other researchers identified the factors as parent support, competency of the teacher, peer influence, concepts learned, motivation of the student, and how the student viewed the importance of mathematics. This section of the literature review was focused on the various factors in the educational process that contributed to or hindered the growth of students in mathematics.

Teacher Impact

Arguably, teachers had one of the largest impacts on student achievement in mathematics. It could be difficult to measure true teacher impact due to the variance in available resources between school districts. Teachers could be deemed effective in a variety of ways from content knowledge, rapport with students, motivation of students, and teachers who had the ability to understand and meet the needs of their students. Hattie (2018) identified 256 teacher influences and their effect size on student achievement. The most effective teachers demonstrated the characteristics of collective teacher efficacy, estimates of student achievement, high expectations, and used a jigsaw method within the classroom. The jigsaw method was a method of organizing classroom activities that made students dependent on each other to find success or solve the problem (Hattie, 2018). Leon et al. (2017) conducted a study on the quality of teachers and how they affected student achievement. The study concluded that teacher quality promoted students' efforts, and the effort from the student promoted math achievement. The study concluded that teachers who had better teaching quality moved students to put more effort into their school activities, which, in turn, resulted in higher math achievement. Crawford (2018) from Stanford Graduate School of Education, stated that recent research showed that teachers who adopted a growth mindset showed students test scores and attitudes toward math drastically increased. Crawford (2018) identified a growth mindset for teachers as one who changed from the belief that only some students could learn math well, to the belief that all students could succeed. Crawford (2018) quoted Boaler, a professor at Stanford Graduate School of Education, who stated: "As teachers reevaluate their own potential as learners, they are more likely to embrace new forms of teaching. This helps their students build confidence, develop positive attitudes and, ultimately, achieve better test scores" (para. 4). Research agreed that teachers had a large impact on student achievement in mathematics. However, the research was not consistent with what exact traits made for an effective teacher.

Parental Support and Mathematical Achievement

Parental support played a large role in students' mathematical ability as they progressed through the K-12 education system. Researchers have shown that parents who are involved in their children's education contribute not only to higher academic achievement, but also to positive behavior and emotional development (Cai et al., 1999).

Sheldon et al. (2010) conducted a study in 41 schools, located in multiple states, from grades K through 8, on the involvement of parents and the effects of mathematics achievement. The study found that over 90% of the schools knew that increased parent involvement resulted in higher mathematical achievement for the students. However, 29 out of 41 schools in the study were identified as having a low quality of communication or structures put in place that developed a school, parent, and student relationship (Sheldon et al. 2010). The study further indicated that only six of the 41 schools implemented community activities to help students develop math skills, such as the connection of business and community leaders to students as mentors and inviting community members to school to talk about how they used math in their work or hobbies (Sheldon et al., 2010). Sheldon et al. (2010) concluded that schools knew that parent involvement was vital to student success, but schools needed to foster a higher quality of collaboration between all stakeholders. Cai et al. (1999) conducted a study of 220 middle school students and revealed that the students with the most supportive parents not only had higher proficiency levels, but also had more positive attitudes toward mathematics than those students with the least supportive parents.

Research has proven that middle school mathematical achievement had a large impact on whether a student graduated high school, went on to a post-secondary school, or accomplished their career goals. Renaissance (2019) identified through a longitudinal study that 81% of students who failed sixth-grade mathematics also failed to graduate from high school. Baker (2013) from the University of Nebraska conducted a study that found that children who began first grade with low number system knowledge were at heightened risk for low functional numeracy scores in seventh grade. Baker (2013) went on to state that teachers and parents who were able to spot math deficits early and provided remediation could yield big benefits, but most students who were behind in first grade never fully achieved at the same level as their peers in mathematics. Many studies have shown that the most successful mathematical students have academic support from their parents and began kindergarten and first grade performing at or above grade level. Students whose mathematical achievement fell below grade level in early grades continued to struggle throughout their educational careers. Additionally, mathematical intervention programs lacked the focus of creating activities that involved parents in the educational process.

Getting Underperforming Students Performing Back on Grade Level

Students who were identified as performing below grade level could not simply make average growth to catch up to their peers. Cornin (2016) from NWEA, stated that below-average students must have made above-average growth to return to the mathematical performance that was on grade level. Many researchers stated that schools should set a goal of one and a half years of growth, during one school year, for students who were performing below grade level. Cornin (2016) stated that the goal of 1.5 years of growth was a misconception and an unrealistic goal for schools to set. In fact, Cornin (2016) conducted a study that identified that 62% to 72% of middle school students who were identified as below grade level did not meet the goal of 1.5 years growth in one school year. Cornin (2016) suggested that schools should not make broad sweeping goals with underperforming students, but rather focus on individual goals and growth that found more success. Burns (2007) stated that the best way to get students caught up was to pair individual student goals with a response to intervention (RTI) program that focused on key mathematical concepts for conceptual understanding. Research has shown that for underperforming students, schools should set goals that measure growth rather than grade-level performance standards.

Mathematical Achievement Gap and Student Subgroups

This section of the literature review breaks down how gender, Black, Hispanic, Asian, White, low income, and students with disabilities traditionally performed in mathematics. The researcher analyzed a variety of articles and studies that targeted students in the K-12 U.S. public education setting prior to the COVID-19 Pandemic. This section discusses the achievement gap and was defined by the University of Pennsylvania as, "the persistent disparity in academic achievement between minority and disadvantaged students and their white counterparts" (Porter, 2021, para. 2).

Ethnicities

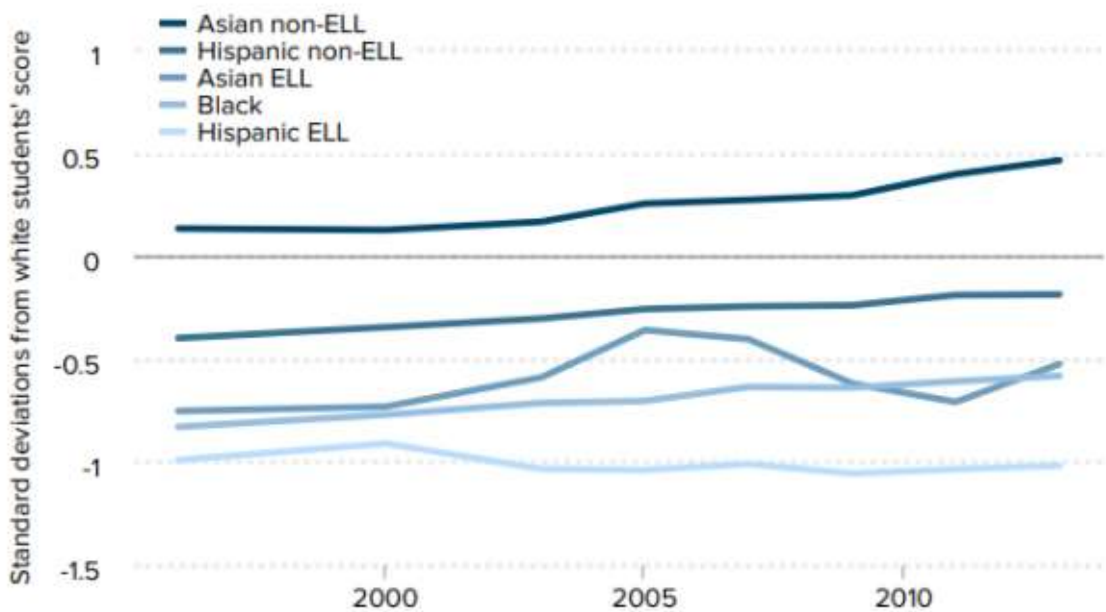
Black

Historically, the education system in the United States had seen a performance gap in mathematics between Black and White students (Parke, 2016). There have been numerous studies over the years in regards to the progression of students academically, based on their race. Gonzalez et al. (2020) stated, there was a gap between the learning of Black and Brown students and White students. Although all researchers agreed that there was an achievement gap in mathematical academic performance between Black and White students, there was a bit of controversy on why or how that gap existed. Porter (2021) reported that there was a gap of one standard deviation between Black and White performance at age four, and that gap did not increase as students progressed through school. Black and White students learned at a similar rate throughout the school year, but

Black students regressed more over the summer months, as compared to White students (Porter, 2021). Carnoy et al. (2017) conducted a study that used "individual student microdata" that covered a time frame of 10 to 17 years, depending on the student of study. By the use of individual student data, the study was able to gain a more accurate picture of how student subgroups compared. Figure 3 shows a portion of the results of their study of how student subgroups compared to White students on an eighth-grade mathematics standardized test.

Figure 3

Black-White, Hispanic-White, and Asian-White Mathematics Test Score Gaps for Eighth-Graders, 1996-2013



Notes: Race/ethnicity coefficients in this graph are based on regression estimates that, in addition to race/ethnicity,control only for students' gender, special education status, free or reduced-price lunch eligibility, and mother's education.

Source: EPI analysis of National Assessment of Educational Progress microdata, 1996–2013

Economic Policy Institute

Note. Figure 3 used White students' math test scores as the baseline, or 0, and compared the performances of the student subgroups to the performance of the White students.

As seen in Figure 3, Black students were beginning to close the performance gap, but still remained 0.5 standard deviations below White students’ math performance. Although Black students academically performed at a lower rate than White students in mathematics, a study from Garcia and Economic Policy Institute (2020) stated that when Black children have the opportunity to attend the same schools that White children routinely attended, Black children performed better on standardized math tests, as compared to Black children that attended predominantly Black schools. The researcher found it important to note that the district of the study was composed of 78% White students and 9% Black students (as cited in Waldman & Groeger, 2018).

Extensive research indicated that the achievement gap was correlated with the opportunities given to White students, as compared to Black students. Kelly (2009) from SAGE Journals, argued that the Black-White gap in mathematics course enrollments was the greatest in integrated schools where Black students were in the minority. Kelly (2009) went on to say that the majority of AP and advanced math courses were taken by White students and there was a disproportionate amount of Black students who were in the remedial courses, and Kelly believed that course placement was compounding the Black-White achievement gap. Porter (2021) agreed by saying the research showed that Black students had less access to high-quality teachers than White students, and less access to quality curriculum and resources. Porter’s (2021) statement was confirmed by a study reported by The University of North Carolina Press (2007), stating that 16% of minority students were taught by a teacher who was underprepared, as compared to 4% of students who were not a minority. The study defined underprepared as teachers who were "out of field teaching" or do not have at least a minor in the field they were teaching (Flores, 2007). In conclusion, the research clearly indicated that there was an achievement gap between Black and White students in mathematics, but it was uncertain as to the exact cause of the gap and was most likely due to a combination of causes.

Hispanic

Traditionally, Hispanic students performed lower in mathematical performance as compared to White students. The researcher found it important to note that most studies broke Hispanic students down into two categories, English Language Learners (ELL) and Non-English Language Learners (Non-ELL). As Figure 3 illustrated, Hispanic ELL students were the lowest-performing student subgroup in the study and performed about one standard deviation lower than White students (Carnoy et al., 2017). Figure 3 also showed that Hispanic Non-ELL students performed at a level just below White students and were trending in a direction that closed the gap between the two groups.

The National Assessment of Educational Progress (NAEP) was the standard by which the United States assessed student performance in mathematics at grades 4, 8, and 12 in both public and private schools across the nation. They found in 2019, that at grade 4, Hispanic students scored 18 scale points lower than White students, at grade 8 Hispanic students scored 24 scale points lower than White students, and at grade 12 Hispanic students scored 21 scale points lower than White students (The National Assessment of Educational Progress [NAEP], 2020).

An article from *The Atlantic* noted that history showed that Hispanic and Black students traditionally performed below White and Asian students in mathematical performance. This resulted in teachers lowering their expectations for Hispanic and Black students and teaching lower-level curriculum in addition to using lower instructional strategies (Anderson, 2017). It could be concluded that Non-ELL Hispanic learners had been closing the achievement gap, but still remained 0.2 standard deviation points below White students. Conversely, Hispanic ELL learners were not making progress to close the achievement gap and had consistently remained one standard deviation level below White students for numerous years.

Asian

Research indicated that Asian students were one of the few student subgroups that traditionally outperformed White students in mathematics performance. As seen in Figure 4, the study from Carnoy et al. (2017) indicated that English-speaking Asians outperformed White students in mathematics by nearly a 0.5 level of standard deviation and the gap had grown in recent years. Hsin and Xie (2014) conducted a study to understand why Asian Americans consistently outperformed White students. They found that Asian American students simply worked harder than White students and this contributed to parent expectations. Hsin and Xie (2014) went on to say that Asian American students paid a high psychological and social price for their high achievement; often Asian students lacked the social engagement to enjoy school. Thompson (2015) had a different theory as to why Asian Americans traditionally achieved at the highest level in math. Her research indicated that it started with the Immigration Laws in 1965 that gave immigration priority to Asians who were highly educated or possessed a desired skill (Thompson, 2015). Thompson (2015) went on to say that from 1965, positive racial stereotypes grew in the education field with Asian Americans. As a result of stereotyping

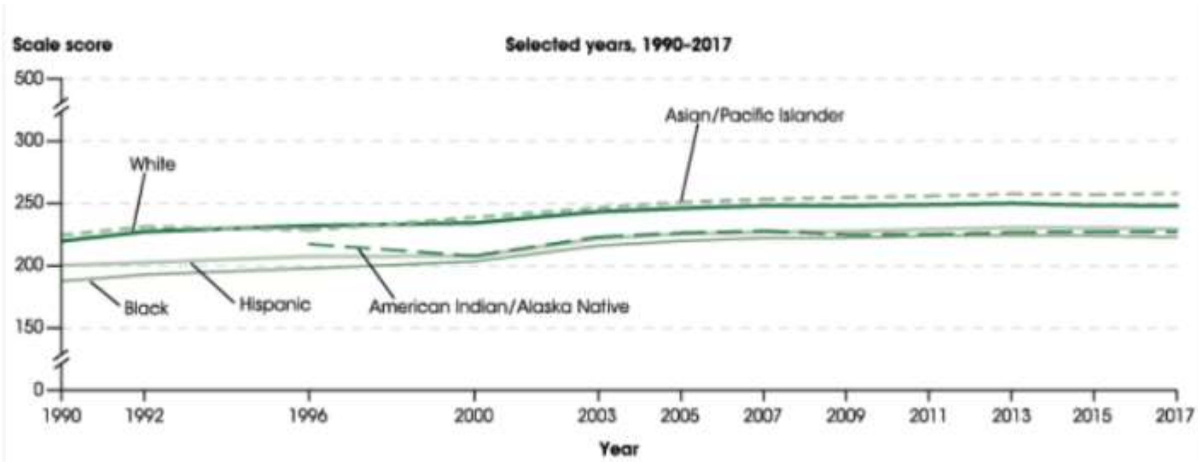
Asian Americans as being smart, high-achieving, and hard-working, educators frequently placed Asian Americans in more competitive educational environments when the student was borderline as compared to their peers. Thompson (2015) stressed that when comparing student subgroups, one should take into consideration the historical immigration starting point. It was without controversy that Asian Americans traditionally were the highest achieving student subgroup in mathematics. However, the research does not clearly indicate why this subgroup was the highest achieving and was still debated among educational researchers.

White

When broken down by race, White students traditionally performed just below Asian students in mathematical ability. The achievement gap was not new to education and had been a problem in education for years, since before the 1960s. Porter (2021) argued that schools were not the major cause for the achievement gap, but as a society, we looked at schools for a solution. Since the 1960s, when schools were becoming integrated, there have been multiple attempts to close the achievement gap that could be categorized as preschool reforms, teacher reforms, instructional reforms, and standards-based reforms (Porter, 2021). Research indicated that White students had greater opportunities in K-12 education, were held to higher standards by their teachers, had a higher representation in gifted education and AP courses, and experienced a higher level or more experienced teachers in their educational experience, as compared to their peers. The table from the NAEP illustrated that White students, along with Asian students in the fourth grade outperformed the Black and Hispanic minorities. When comparing Figure 3 to Figure 4, mathematical performance among student subgroups remained consistent from fourth grade to eighth grade.

Figure 4

Average National Assessment of Educational Progress (NAEP) Mathematics Scale Scores of 4th-Grade Students, by Race/Ethnicity from 1990-2017



Note. Figure 4 illustrated the fourth-grade mathematics scale scores broken down by student subgroups.

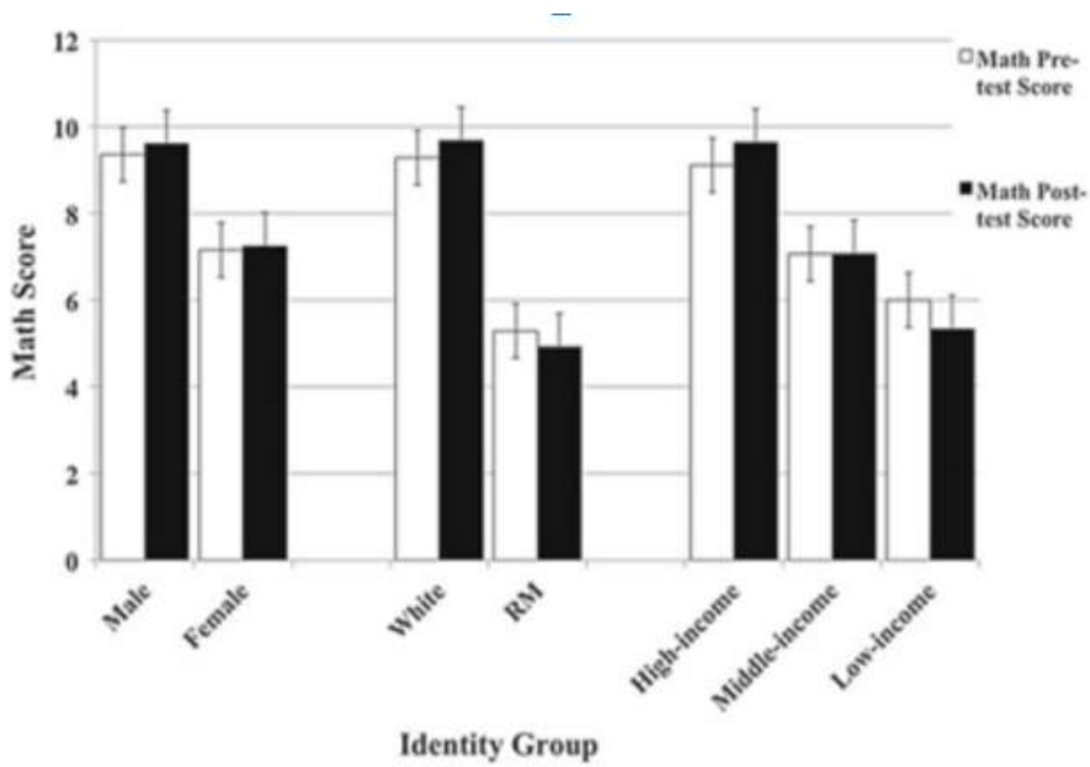
Bjorklund-Young and Plasman (2020) conducted a study of 1,651 schools that spanned across six states and Washington D.C. Their study focused on measuring schools' abilities to consistently close the achievement gap in middle school mathematics. Bjorklund-Young and Plasman (2020) measured the percentage of students and student subgroups that scored proficient or advanced in sixth-grade math and compared that to the test results when the students were tested in eighth grade; the same cohort of students. Their research found that 9% of the 1,651 schools were able to consistently make progress on closing the achievement gap in middle school mathematics (Bjorklund-Young & Plasman, 2020). However, 0% of the schools were able to completely close the achievement gap in middle school mathematics. Bjorklund-Young and Plasman (2020) suggested that schools focused on measuring student growth, rather than comparing student achievement to proficiency scales. Schools could not control the level of support a student has at his or her house or how much knowledge that student had when he or she entered school. When schools were focused on student growth, rather than performance standards; schools then identified more accurately how effective their instructional strategies were (Bjorklund-Young & Plasman, 2020).

Gender

For years there had been the stereotype that girls performed lower than boys in the area of mathematics (Scafidi & Bui, 2010). Studies from Tine and Gotlieb (2013) and Scafidi and Bui (2010) found that stereotype to be false. Tine and Gotlieb (2013) stated that there were effects on math performance in race and income, but not gender. In the study from Tine and Gotlieb, (2013), 71 students were studied, with the results illustrated in Figure 5.

Figure 5

Student Subgroup Performance on Mathematics Standardized Test



Note. Figure 5 indicates that both males and females show a small increase from the pre-test to post-test scores and there was no statistical difference between the genders (Tine & Gotlieb, 2013).

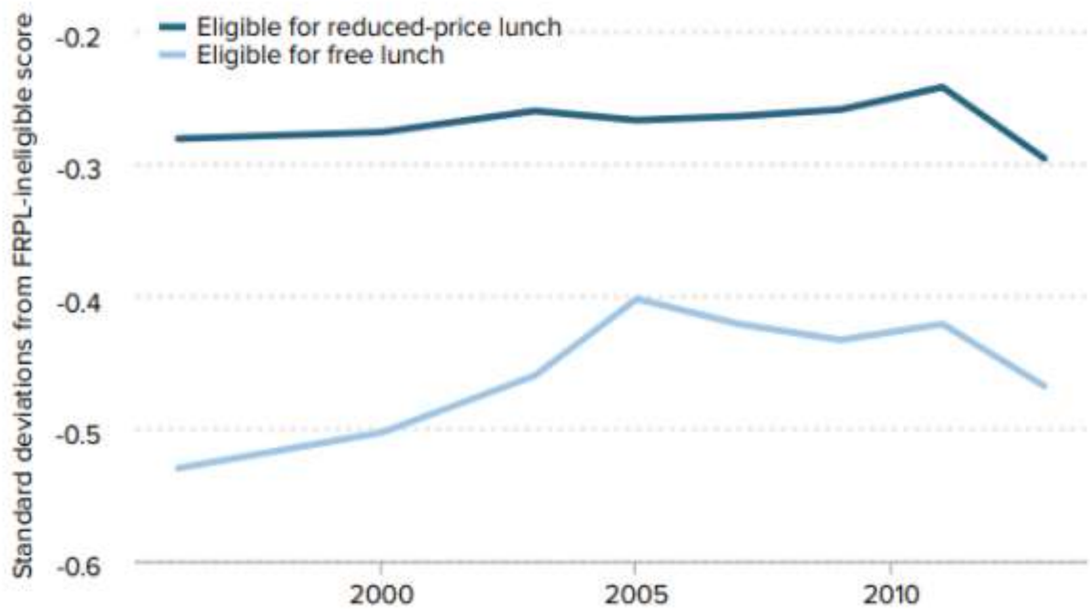
Scafidi and Bui (2010) conducted a study of 9,813 students, across 10 states, within grades 2 through 11 and found similar results to the Tine and Gotlieb (2013) study. The 10 states used in the study came from all regions of the United States and accurately represented the nation. The study yielded a mean effect size of 0.0065, which indicated no gender difference in math performance (Scafidi & Bui, 2010). Evidence from multiple studies showed that there was no difference between genders in math performance.

Low-Income

Research has proven that low-income or low socioeconomic student groups directly correlate to low achievement in mathematics. A study from Davenport and Slate (2019) broke down students' family income into three groups: Not Poor, Moderately Poor, and Very Poor. The study found that the percentage of students who were Very Poor were four times more likely to score below average on standardized math tests than students who were Not Poor. Davenport and Slate (2019) went on to say that the percentage of students who did not meet each performance standard increased as the level of poverty increased from Not Poor to Moderately Poor to Very Poor. For many high-poverty students, the middle school level was a period in which achievement gaps in mathematics became exacerbated (Balfanz & Byrnes, 2006). Balfanz and Byrnes (2006) stated that nearly all high poverty students entered kindergarten knowing the basic math skills, but entered high school well behind their peers who were not in poverty. A study from Carnoy et al. (2017), illustrated in Figure 6, confirmed that the lower socioeconomic status of the student resulted in lower achievement in mathematics for eighth-grade students.

Figure 6

Socioeconomic Mathematics Test Score Gaps for Eighth-Graders from 1996-2013



Notes: Coefficients of reduced-price lunch and free lunch in this graph are from regression estimates that, in addition to students' free or reduced-price lunch (FRPL) status, include only students' race/ethnicity, gender, and special education status.

Source: EPI analysis of National Assessment of Educational Progress microdata, 1996–2013

Economic Policy Institute

Note. Figure 6 illustrates that students who qualified for government funding to pay for school lunches or part of lunch generally performed below average on eighth-grade mathematics standardized tests.

As shown in Figure 6, students who qualified for free lunch performed on average 0.4 to 0.5 levels of a standard deviation below students who did not qualify for free lunch; and students who qualified for reduced lunch were about 0.25 levels of a standard deviation below students who did not qualify for reduced lunch (Carnoy et al., 2017). Research showed that a family's income level had a direct correlation to a student's math achievement.

Students with Disabilities

The researcher grouped students with disabilities into one category, this included, but was not limited to, students with a 504 plan, IEP, vision impairment, hearing impairment, information processing, dyslexia, or any other disability that would negatively affect a student's ability in math. Students with learning disabilities were traditionally seen to have low achievement in mathematics (Jones et al., 1997). A 2019 article in *Time* Magazine from Boaler and LaMar stated that students with disabilities could thrive in a mathematics classroom. Students with disabilities needed more freedom of thinking and expressing their knowledge than traditional students (Boaler & Lamar, 2019). Boaler and Lamar (2019) went on to say that "these students do not have less mathematical ability" (para. 6). However, the reality was that students with disabilities had lower achievement in mathematics, due to gaps in prior knowledge, low expectations, and inadequate instructional methods (Jones et al., 1997). Research indicated that math instructors did not teach to the variety of learning styles seen in students with disabilities. Jones et al. (1997) agreed with Boaler and LaMar (2019) that teachers were inadequately prepared to teach students with disabilities. In addition to below-average instruction, students with disabilities often had low expectations for themselves and viewed themselves as "not being a math person" (Boaler & LaMar, 2019). Gervasoni and Lindenskov (2011) continued the same theme and stated that students with "special needs" historically had not had access to high-quality mathematics programs and instruction. Studies had shown that teachers used conventional teaching strategies and curriculum but moved at a slower pace when working with students with disabilities (Gervasoni & Lindenskov, 2011).

Boaler and LaMar (2019) conducted a study at Stanford University that used 84 special education students who identified themselves as “not being a math person.” The students were taught 18 lessons that used non-traditional teaching styles that focused on deeper understanding and allowed students to express their thinking by modeling, drawing, problem-solving, and multiple representations. At the completion of the study, students improved their standardized test achievement level by an average of 2.7 years. Research had shown that students with disabilities could perform at levels similar to students who were not identified with a learning disability. However, teachers and public-school educators were not equipped with the time, knowledge, instructional strategies, or resources to adequately educate students with learning disabilities.

Assessment Tool

The assessment tool used to measure student growth in the area of mathematics for the study was the STAR math assessment. The STAR math assessment was described as, “computer-adaptive tests designed to give educators accurate, reliable, and valid data quickly so that they [educators] can make good decisions about instruction and intervention” (Learning & Teaching Overview, 2020, para. 1). A computer adaptive assessment, like the STAR math assessment, adjusted the difficulty of questions throughout the assessment, based on the student’s response. If a student answered a question correctly, the next question would increase in difficulty and if a student answered incorrectly, the next question would be of lower difficulty (Testing Technology, 2021). The assessment was given to students in the school district of study three times a year (Fall, Winter, and Spring), and measured student growth in the area of mathematics. For this study, student growth was defined as the change (increase or decrease) from consecutive mathematical STAR tests. The STAR math assessment compared an individual student score to a nationally representative sample of students, called student norms (Renaissance Place, 2020). The STAR assessment gave educators and parents many different performance indicators on the completion of each assessment. The assessment performance indicators were domain scores, grade-level equivalency, percentile rankings, scale scores, and student growth percentile (Renaissance Place, 2020). For this study, the researcher would be analyzing the scaled score; defined as

> a scaled score (SS), which is based on the difficulty of the questions and the number of correct answers. Scaled scores are useful for comparing your child's performance over time and across grades. STAR Math scaled scores range from 0–1400. (Renaissance Place, 2020, p. 3, para. 4)

An article published by Data Quality Campaign et al. (2020) stated, "States can and should continue to measure student growth in 2021. Growth data will be crucial to understanding how school closures due to COVID-19 have affected student progress and what supports they will need to get back on track" (p. 4). The researcher chose to use student growth as the comparison indicator because according to the Data Quality Campaign et al. (2020),

> growth measures use multiple years of data to capture changes in student learning over time. This information paints a richer picture of student performance than proficiency data alone because proficiency data shows student performance at a single moment in time. (p. 1)

The researcher compared student growth prior to the COVID-19 pandemic and post-adapted learning due to the COVID-19 pandemic, the researcher intended to identify the real effect of the adapted instruction on students learning virtual, in person, and the affected student subgroups within the study. Robinson (2017) from Classroom Synonym, conducted a third-party study that analyzed the validity of the STAR math assessment. Robinson (2017) analyzed 7,389 student assessments and found that the assessments had a reliability coefficient that ranged from 0.7 to 0.8, for which +1.00 was considered a strong direct relationship.

Chapter Three: Research Method and Design

Introduction

The research in Chapter Two indicated that school districts across the United States varied in their instructional approach during adaptive instruction, due to the COVID-19 Pandemic. Research also stated it was still important for school districts to continue to measure the academic growth of their students. This case study was aimed to identify how adaptive instruction affected students' growth in a Midwest Public School District at the middle level and identify if students could learn at-home at a similar rate as students who learned in-person. In Chapter Three, the researcher described the outline of the study by presenting the methodology, indicating the purpose of the research, highlighting the design and rationale behind the study, identifying the null hypotheses, data collection techniques, and explaining students' scores selected for the study and how student identities were kept anonymous.

Overview

The COVID-19 Pandemic affected schools across the United States and worldwide. The actual effects of the pandemic on student learning is a topic that has been researched little as the pandemic was still occurring at the time of the study. The researcher identified student growth in mathematics as a relevant topic of study, and he used student data from a Midwest Public School District to determine the impacts of adaptive instruction, as a result of the pandemic on student growth. The literature review revealed that the lack of information on this topic indicated the need for such a study. The review of literature also highlighted the math assessment data used in the study, the

STAR math assessment, to be an accurate assessment used to measure student growth in the area of mathematics throughout the world.

The study identified various subgroups of students to determine the impact of different populations, as a result of the adaptive learning methods. The researcher first looked at the overall population of the study to determine if there was a difference in growth prior- and post-pandemic. Next, the researcher looked at home versus in-person adaptive learning student growth differences post-pandemic. Finally, the researcher investigated student growth prior- and post-pandemic for the subgroups of students with 504s, students who received IEP services, Asian students, Black students, Hispanic students, White students, and students who received free or reduced meal plans. The identification of student growth, or lack thereof, could lead to changes in instructional strategies for populations, ultimately providing appropriate interventions or targeted adaptations to instruction for students in a Midwest Public School District.

Purpose

The purpose of this quantitative case study was to evaluate the difference in student growth on the STAR math assessment during adaptive instruction, as a result of the COVID-19 pandemic, in a Midwest Public School District. The researcher gathered student growth data on the STAR math assessment by collecting de-identified middle school student STAR math assessment data district-wide prior- and post-adaptive learning. The researcher then identified a random stratified sampling of 60 students per hypothesis to use for a *t*-test of either dependent or independent means. The researcher looked at the left-tailed test to determine if the difference in student growth was statistically significant to either reject or fail to reject the null hypothesis for each of the nine hypotheses in the study. If there was a significant difference in growth identified, intervention techniques could be used to help students make up for learning growth lost during adaptive instruction as a result of COVID-19 by the school district. By testing the possibility of difference in student growth for a variety of populations, the district could use instructional techniques targeted at specific populations that experienced significant differences in student growth.

Research Design and Rationale

The literature suggested that student growth in mathematics can often occur during summer breaks when no instruction is occurring; however, there was little literature related to adaptive learning strategies as a result of COVID-19 because, at the time of the study, the pandemic was still occurring. The lack of prior knowledge and literature on the topic made the study relevant and timely. Educational techniques and programs used to target various populations had been implemented in educational settings for many years. The ultimate goal of this study was to identify the impacts of adaptive instruction as a result of COVID-19 in hopes to provide appropriate interventions and influence future studies that could be more in-depth for one or more of the populations studied in this study.

Student Participant Data

The student data used for the duration of this study were all secondary quantitative data provided by the district of study's administrative data team. The researcher submitted a data request form to the district's administrative data team that identified which data points were required for the study. Then, the district's administrative data team de-identified the data before the researcher had access to the data. The de-identification of the data removed any potential confidentiality issues or researcher bias. At the time of the study, the initial data set consisted of all middle school students' STAR math assessment data from third grade through the students' current grade at the time of the study. The researcher removed students from the initial data set provided who did not have a STAR math assessment score during the Winter or Fall testing sessions in the 2019-2020 school year or the Winter or Fall testing sessions in the 2020-2021 school year. These data were removed as the lack of these data would not allow the researcher to measure student growth prior- and post-adaptive instruction needed for the study. The initial data set consisted of 4,982 de-identified student data STAR math assessment scores across six middle schools, within a Midwest Public School District. Of the 4,982 student participants, 1,770 were removed from the study data set as a result of missing a data point within the 2019-2020 school year or the Winter or Fall testing sessions in the 2020-2021 school year. Therefore, there were 3,212 students' assessment data included in the total unstratified data group. Then, the researcher identified the populations for each of the subgroups tested. For example, for Null Hypothesis 3 the researcher removed any student that did not have a 504 plan out of the 3,212 overall student assessment data provided. For the 504-student population, this resulted in 120 students that were left, as that was the total out of the 3,212 that had 504 plans. Next, the researcher used stratified random sampling to identify 20 students from each grade level (6, 7, and 8) for each null hypothesis tested.

Null Hypotheses

During the literature review, the researcher found there were discrepancies between various subgroups in relation to their learning and student growth in the area of mathematics, including students with 504s, IEPs, Black, White, Hispanic, Asian, and students that received free or reduced meal plans from lower socioeconomic backgrounds. Null Hypotheses 3, 4, 5, 6, 7, 8, and 9 addressed these areas by looking at the difference in these subgroups' growth in the area of mathematics, as measured by the STAR assessment prior to adaptive learning because of COVID-19 and post adaptive learning because of COVID-19. The researcher also identified various adaptive learning strategies and the effectiveness of each in the literature review. However, given there was little to no research regarding at-home learning versus in-person learning and overall student growth in mathematics as a result of adaptive learning because of COVID-19, the researcher focused on these two areas through Null Hypotheses 1 and 2. The researcher tested overall student growth at the Midwest Public School District at the middle school level prior to adaptive learning as a result of COVID-19 and post adaptive learning as a result of COVID-19 for Hypothesis 1. For Null Hypothesis 2, the researcher focused on two independent groups, students that learned at-home and students that learned in school, to determine if a difference in growth occurred.

Null Hypothesis *1*: There is no decrease in student growth in mathematics as measured by the STAR assessment prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Null Hypothesis *2*: There is no decrease in student growth in mathematics, as measured by the STAR assessment between students who learned at-home compared to at-school learners post adaptive learning, as a result of the COVID-19 pandemic.

Null Hypothesis *3*: There is no decrease in student growth in mathematics as measured by the STAR assessment for students with a 504 plan prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Null Hypothesis *4*: There is no decrease in student growth in mathematics, as measured by the STAR assessment for students with an Individualized Education Plan (IEP) prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Null Hypothesis *5*: There is no decrease in student growth in mathematics, as measured by the STAR assessment for Asian students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Null Hypothesis *6*: There is no decrease in student growth in mathematics, as measured by the STAR assessment for Black students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Null Hypothesis *7*: There is no decrease in student growth in mathematics, as measured by the STAR assessment for Hispanic students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Null Hypothesis *8*: There is no decrease in student growth in mathematics, as measured by the STAR assessment for White students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

Null Hypothesis *9*: There is no decrease in student growth in mathematics as measured by the STAR assessment for students who receive free or reduced meal plans prior to and post adaptive learning, as a result of the COVID-19 pandemic.

STAR Mathematics Assessment

The researcher collected secondary data STAR Mathematics testing scores to evaluate the student growth from one assessment to the next prior to adaptive learning and post adaptive learning, as a result of COVID-19. The STAR math assessment was described as, "computer-adaptive tests designed to give educators accurate, reliable, and valid data quickly so that they [educators] can make good decisions about instruction and intervention" (Learning & Teaching Overview, 2020, para. 1). A computer-adaptive assessment, like the STAR math assessment, adjusted the difficulty of questions throughout the assessment, based on the student's response. If a student answered a question correctly, the next question would increase in difficulty; if a student answered incorrectly, the next question would be of lower difficulty (Testing Technology, 2021). The assessment was given to students in the school district of study, three times a year (Fall, Winter, and Spring) and measured student growth in the area of mathematics. For this study, student growth was defined as the change (increase or decrease) from consecutive mathematical STAR tests. The STAR math assessment compared an individual student score to a nationally representative sample of students, called student norms (Renaissance Place, 2020). The STAR assessment gave educators and parents many different performance indicators on the completion of each assessment. The assessment performance indicators were domain scores, grade-level equivalency, percentile rankings, scale scores, and student growth percentile (Renaissance Place, 2020). For this study, the researcher analyzed the scaled score defined as

> a scaled score (SS), which is based on the difficulty of the questions and the number of correct answers. Scaled scores are useful for comparing your child's

> performance over time and across grades. STAR Math scaled scores range from 0–1400. (Renaissance Place, 2020, p. 3 para. 4)

Procedures

Initially, the researcher completed an application to perform research, Appendix A, within the district of study by requesting approval to use district-wide middle school students' STAR mathematics testing data for the case study. The application included the purpose of the study, the rationale for the study, confirmation that student information would be de-identified and confidential, and be in agreement that all findings would be presented and available to the district office. Upon approval of the application and case study from the district data administrative team, the researcher was asked to provide the district data administrative team the exact data needed for the study, along with a spreadsheet for data to be placed. The researcher also designed a prospectus after the initial approval of the application for the case study and submitted it to the Lindenwood University Dissertation Committee for the researcher. After the prospectus was approved, the researcher completed the Lindenwood IRB application, submitted it to the Lindenwood University Institutional Review Board, and was approved for data collection for the study. Following the IRB approval, the specific data request was submitted to the district data administrative team, which provided to the researcher de-identified via email. All data collected were secondary data from student STAR mathematics assessment scores.

As noted in the Student Participant Data, the initial data set consisted of 4,982 de-identified student data assessment scores, and 1,770 were removed if they missed a data assessment point. These students were removed as student growth prior- and post-adaptive learning could not have been measured without all of these data points for each student. Therefore, there were 3,212 students' assessment data included in the total unstratified data group.

The researcher then found the growth of each student prior- and post-adaptive instruction. Next, the researcher broke down the secondary data to evaluate student growth pre-adaptive instruction, which is the window from Fall 2019 to Winter 2020, and post adaptive instruction as a result of COVID-19, which is the window from Fall 2020 to Winter 2021. Due to COVID-19, there was no testing performed or assessment data to evaluate for Spring 2020.

The researcher then had to identify which students fit the subgroups assessed through the various hypothesis testing. For Null Hypothesis 2, the researcher separated the total student population of 3,212 into at-home learners, which was 469, and in-person learners, which was 2,743 students. Then, each of those populations was reduced to 60 students (20 from grade 6, 20 from grade 7, and 20 from grade 8), using random stratified sample methods. For Null Hypothesis 3, of the 3,212 students overall, the researcher found that 120 students had 504 plans; that population was then decreased to 60 students using the random stratified sample process. For Null Hypothesis 4, of the 3,212, the researcher found that 484 students had IEP Plans; that population was then decreased to 60 students using the random stratified sample process. For Null Hypothesis 5, of the 3,212, the researcher found that there were 253 Asian students total, which then was decreased to 60 students using the random stratified sample process. For Null Hypothesis 6, of the 3,212, the researcher found that there were 232 Black students total, which then was decreased to 60 students using the random stratified sample process. For Null

Hypothesis 7, of the 3,212, the researcher found that there were 117 Hispanic students total, which then was decreased to 60 students using the random stratified sample process. For Null Hypothesis 8, of the 3,212, the researcher found that there were 2,472 White students total, which then was decreased to 60 students using the random stratified sample process. For Null Hypothesis 9, of the 3,212, the researcher found that 474 students received free or reduced meal plans; that population was then decreased to 60 student growth data points, using the random stratified sample process. The researcher re-ran the stratified random sample for the IEP student subgroup evaluated for Null Hypothesis 4 due to ambiguous data. Finally, the researcher ran a *t*-test of two dependent means for Null Hypotheses 1, 3 through 9, and a *t*-test of two independent means for Null Hypothesis 2 with the students from the stratified random sample. The researcher ran the *t*-tests with a 95% confidence interval and used a threshold of statistical significance of $p = 0.05$.

Threats to Validity

The two main threats of validity to the study were the unknowns of students' environments when learning and taking assessments from home, and the obligation of removing student data that was missing a test score. In the district of study, students who did not have access to wireless internet were provided that by the district. However, educators had little control over the environment at home in which students learned and took assessments. The district of study provided parents and students with resources on how to create a distraction-free environment that was conducive to learning when students were learning at home. Students were also encouraged to turn on their cameras, so educators could witness the learning environment and provide interventions to create a distraction-free learning environment at home when needed. The second main threat was the constraint to remove students who were missing a test score, since the researcher could not measure growth if there was a missing test score. The researcher believed that the size of the study, 4982 students, helped to mitigate the impact of removing students from the study due to missing assessment data points.

Summary

The researcher conducted a quantitative case study to identify the impact of adaptive instruction on academic growth in middle school mathematics. The study took place across six middle schools in a Midwest Public School District. The study population began with 4,982 students and was paired down to 3,212 students after removing students who were missing an assessment data point. The overall goal of this quantitative case study was to identify if students could learn at a similar rate online as those who learned in person, and to identify how adaptive instruction impacted students' growth in middle school mathematics.

Chapter Four: Analysis

Introduction

Chapter Four targeted explaining the analysis and results of each of the nine null hypotheses within the case study. At the time of the study, there was a lack of research on the impact of student growth in mathematics during adaptive instruction and research on the ability of students to learn at-home compared to students learning in-person. The researcher intended to identify the impact of adaptive instruction in a Midwest Public School District on middle school mathematics students. The results of the *t*-tests measuring student growth in middle school mathematics were outlined in this chapter. For this study, student growth is defined as the change (increase or decrease) from consecutive STAR mathematics tests, pre-adaptive instruction was the window from Fall 2019 to Winter 2020, and post-adaptive instruction was the window from Fall 2020 to Winter 2021.

Purpose of Study

The purpose of this quantitative study was to identify the effects of adaptive instruction, due to the COVID-19 pandemic, on middle school mathematics students in a Midwest Public School District. This study aimed to provide insight into the impacts of student growth in mathematics during the time of adaptive instruction, by analyzing data collected from a standardized math assessment tool, STAR mathematics assessment. The researcher evaluated student growth through testing nine different null hypotheses, which looked at the total student population and subgroups at a Midwest Public School District. The researcher looked at the left-tailed *t*-test to determine if the differences in student growth were statistically significant to either reject or fail to reject the null hypothesis for each of the nine null hypotheses. If there was a significant difference in growth identified given the tests run, intervention techniques could be used to help students make up for learning loss during adaptive instruction, as a result of COVID-19, by the school district. By testing the possibility of difference in student growth for a variety of populations, the district could use instructional techniques targeted at specific populations that experienced either positive or negative significant differences in student growth.

Explanation of Quantitative Data Collected

The quantitative data collected investigated student growth on the STAR mathematics assessment for the overall population and nine different student subgroups to determine if the decrease in growth was statistically significant. The researcher chose the nine subgroups, by the makeup of the population breakdown available through the database of the district of study. It was found that several populations evaluated in this study were evaluated in previous studies that focused on the achievement gap in mathematics, which findings were noted in Chapter Two. The initial data set consisted of 4,982 de-identified student data assessment scores across six middle schools within a Midwest Public School District. Of the 4,982 student participants, 1,770 were removed from the study data set as a result of missing a data point within the 2019-2020 school year or the winter or fall testing sessions in the 2020-2021 school year. Therefore, there were 3,212 students' assessment data included in the total unstratified data group. The researcher then used stratified random sampling to identify 20 students from each grade level (sixth, seventh, and eighth) for each null hypothesis tested. The test used to evaluate Null Hypotheses 1, 3, 4, 5, 6, 7, 8 and 9 was the *t*-test of two dependent means. The researcher chose this quantitative test because it evaluated the student growth of populations at two different intervals, pre-adaptive instruction and post-adaptive instruction, as a result of COVID-19 and using the same population samples. The test used to evaluate Null Hypothesis 2 was a *t*-test of two independent means. The researcher chose this as it compared the means of two independent groups, at-home vs. in-person learners, to statistically determine if the means were significantly different. All the data used in the study were secondary quantitative STAR mathematics assessment data that was de-identified by the district administrative data team and later provided to the researcher.

Null Hypotheses

Null Hypothesis 1: There is no decrease in student growth in mathematics as measured by the STAR assessment prior to and post adaptive learning, as a result of the COVID-19 pandemic. The researcher ran a *t*-test of two dependent means to see if there was no decrease in student growth in mathematics prior to and post adaptive learning, as a result of the COVID-19 pandemic. The results showed that the slight decrease in scores (M = -10.75, SD = 84.9) were not significant; $t(59) = -0.981$, $p = 0.1654$. The researcher failed to reject the null hypothesis and concluded that there was a slight decrease in overall student growth in mathematics, but not statistically significant when comparing student scores before and after adaptive instruction.

Table 1

Hypothesis 1: Overall Student Growth STAR Assessment
t-test of two-dependent means

Variable	Mean (M)	Standard Deviation (SD)	Degrees of Freedom (d.f.)	*t*-value	*p*-value (left tail)
Overall Student Growth	-10.75	84.9	59	-0.981	0.1654

Null Hypothesis 2: There is no decrease in student growth in mathematics as measured by the STAR assessment between students who learned at-home compared to at-school learners' post adaptive learning, as a result of the COVID-19 pandemic. The researcher conducted a *t*-test of two independent means to see if there is no decrease in student growth in mathematics between students who learned at-home compared to at-school learners' post adaptive learning, as a result of the COVID-19 pandemic. A preliminary test of variances revealed that the variances were equal. The analysis revealed that the growth scores for students learning at home (M = 18.283, SD = 75.342) were not significantly lower than those of students learning in person (M = 20.93, SD = 67.153); $t(59) = 0.203$, $p = 0.5802$. The researcher failed to reject the null hypothesis and concluded that there was a slight difference in growth in mathematics of students who learned from home compared to students who learned in person, but not statistically significant when comparing student scores from at-home to in-person after adaptive instruction.

Table 2

Hypothesis 2: At-Home vs. In-Person Growth STAR Math Assessment
t-test of two independent means

Variable	Mean (M)	Standard Deviation (SD)	Degrees of Freedom (d.f.)	*t*-value	*p*-value (left tail)
At-Home	18.283	75.342	59	-0.203	0.5802
In-Person	20.93	67.153			

Null Hypothesis 3: There is no decrease in student growth in mathematics as measured by the STAR assessment for students with a 504 plan prior to and post adaptive learning, as a result of the COVID-19 pandemic. The researcher ran a *t*-test of two dependent means to see if there was no decrease in student growth in mathematics of students with a 504 plan prior to and post adaptive learning, as a result of the COVID-19 pandemic. The results showed that the decrease in scores (M = -25.02, SD = 92.64) were significant; $t(59) = -2.092$, $p = 0.0204$. The researcher rejected the null hypothesis and concluded that there was a decrease in growth in mathematics of students with a 504 plan that was statistically significant, when comparing student scores before and after adaptive instruction.

Table 3

Hypothesis 3: Students with 504 Plans Growth STAR Math Assessment
t-test of two-dependent means

Variable	Mean (M)	Standard Deviation (SD)	Degrees of Freedom (d.f.)	*t*-value	*p*-value (left tail)
Students with 504 Plans	-25.02	92.64	59	-2.092	0.0204

Null Hypothesis 4: There is no decrease in student growth in mathematics as measured by the STAR assessment for students with an Individualized Education Plan (IEP) prior to and post adaptive learning, as a result of the COVID-19 pandemic. The researcher ran a *t*-test of two dependent means to see if there was no decrease in student growth in mathematics of students with an IEP prior to and post adaptive learning, as a result of the COVID-19 pandemic. The results showed that the slight decrease in scores (M = -8.32, SD = 103.81) were not significant; $t(59) = -0.621$, $p = 0.2686$. The researcher failed to reject the null hypothesis and concluded that there was a slight decrease in growth in mathematics of students with IEPs, but not statistically significant when comparing student scores before and after adaptive instruction.

Table 4

Hypothesis 4: Students with IEP Plans Growth STAR Assessment
t-test of two-dependent means

Variable	Mean (M)	Standard Deviation (SD)	Degrees of Freedom (d.f.)	*t*-value	*p*-value (left tail)
Students with IEP Plans	-8.32	103.81	59	-0.621	0.2686

Null Hypothesis 5: There is no decrease in student growth in mathematics as measured by the STAR assessment for Asian students prior to and post adaptive learning, as a result of the COVID-19 pandemic. The researcher ran a *t*-test of two dependent means to see if there was no decrease in student growth in mathematics of students who identified as Asian prior to and post adaptive learning, as a result of the COVID-19 pandemic. The results showed that the slight increase in scores (M = 0.95, SD = 86.54) were not significant; $t(59) = -0.085$, $p = 0.5337$. The researcher failed to reject the null hypothesis and concluded that there was a slight increase in growth in mathematics of students who identify as Asian, but not statistically significant when comparing student scores before and after adaptive instruction.

Table 5

Hypothesis 5: Asian Student Growth STAR Assessment
t-test of two-dependent means

Variable	Mean (M)	Standard Deviation (SD)	Degrees of Freedom (d.f.)	*t*-value	*p*-value (left tail)
Asian Student Growth	0.95	86.54	59	-0.085	0.5337

Null Hypothesis 6: There is no decrease in student growth in mathematics as measured by the STAR assessment for Black students prior to and post adaptive learning, as a result of the COVID-19 pandemic. The researcher ran a *t*-test of two dependent means to see if there was no decrease in student growth in mathematics of students who identified as Black prior to and post adaptive learning, as a result of the COVID-19 pandemic. The results showed that the slight decrease in scores (M = -0.30, SD = 81.03) were not significant; *t*(59) = -0.029, *p* = 0.4886. The researcher failed to reject the null hypothesis and concluded that there was a slight decrease in growth in mathematics of students who identify as Black, but not statistically significant when comparing student scores before and after adaptive instruction.

Table 6

Hypothesis 6: Black Student Growth STAR Assessment
t-test of two-dependent means

Variable	Mean (M)	Standard Deviation (SD)	Degrees of Freedom (d.f.)	*t*-value	*p*-value (left tail)
Black Student Growth	-0.30	81.03	59	-0.029	0.4886

Null Hypothesis 7: There is no decrease in student growth in mathematics as measured by the STAR assessment for Hispanic students prior to and post adaptive learning, as a result of the COVID-19 pandemic. The researcher ran a *t*-test of two dependent means to see if there was no decrease in student growth in mathematics of students who identified as Hispanic prior to and post adaptive learning, as a result of the COVID-19 pandemic. The results showed that the slight decrease in scores (M = -5.52, SD = 108.11) were not significant; *t*(59) = -0.395, *p* = 0.347. The researcher failed to reject the null hypothesis and concluded that there was a slight decrease in growth in mathematics of students who identify as Hispanic, but not statistically significant when comparing student scores before and after adaptive instruction.

Table 7

Hypothesis 7: Hispanic Student Growth STAR Assessment
t-test of two-dependent means

Variable	Mean (M)	Standard Deviation (SD)	Degrees of Freedom (d.f.)	*t*-value	*p*-value (left tail)
Hispanic Student Growth	-5.52	108.11	59	-0.395	0.347

Null Hypothesis 8: There is no decrease in student growth in mathematics as measured by the STAR assessment for White students prior to and post adaptive learning, as a result of the COVID-19 pandemic. The researcher ran a *t*-test of two dependent means to see if there was no decrease in student growth in mathematics of students who identified as White prior to and post adaptive learning, as a result of the COVID-19 pandemic. The results showed that the increase in scores (M = 17.03, SD = 97.56) were not significant; $t(59) = -1.352$, $p = 0.9093$. The researcher failed to reject the null hypothesis and concluded that there was an increase in growth in mathematics of students who identify as White, but not statistically significant when comparing student scores before and after adaptive instruction.

Table 8

Hypothesis 8: White Student Growth STAR Assessment
t-test of two-dependent means

Variable	Mean (M)	Standard Deviation (SD)	Degrees of Freedom (d.f.)	*t*-value	*p*-value (left tail)
White Student Growth	17.03	97.56	59	-1.352	0.9093

Null Hypothesis *9*: There is no decrease in student growth in mathematics as measured by the STAR assessment for students who receive free or reduced meal plans prior to and post adaptive learning, as a result of the COVID-19 pandemic. The researcher ran a *t*-test of two dependent means to see if there was no decrease in student growth in mathematics of students who received free or reduced meal plans prior to and post-adaptive learning, as a result of the COVID-19 pandemic. The results showed that the slight increase in scores (M = 1.93, SD = 92.73) were not significant; *t*(59) = -0.161, *p* = 0.5639. The researcher failed to reject the null hypothesis and concluded that there was a slight increase in growth in mathematics of students who received free or reduced meal plans, but not statistically significant when comparing student scores before and after adaptive instruction.

Table 9

Hypothesis 9: Students Who Receive Free or Reduced Meal Plans Growth STAR Assessment
t-test of two-dependent means

Variable	Mean (M)	Standard Deviation (SD)	Degrees of Freedom (d.f.)	*t*-value	*p*-value (left tail)
Students that receive F/R Meal Plans Growth	1.93	92.73	59	-0.161	0.5639

The researcher reviewed the results of the study overall by comparing the growth in the various subgroups evaluated using either a *t*-test of dependent means or *t*-test of independent means. Table 10, *Summary of Significant Difference in Mathematical STAR Assessment Growth Scores*, summarizes the increase or decrease and whether or not the *t*-test used identified it to be statistically significant. The most significant takeaway was that the students with 504 plans were the only population that showed a statistically significant decrease in growth on the STAR mathematics assessment. Additional items to note were Asian and White students were the only student ethnicity subgroups that noted an increase in mean growth STAR assessments scores. The researcher found this to align with prior research that Asian and White students performed at a higher rate than Hispanic and Black students in the area of mathematics which is noted extensively in Chapter Two. The results of the study were an indication that COVID-19 and adaptive instruction could have expanded on the already existent achievement gap with these populations in the area of mathematics.

Table 10

Summary of Significant Difference in Mathematical STAR Assessment Growth Scores

<table>
<tr><th>Student Groups</th><th>Increase or Decrease of Mean Growth STAR Assessment Scores</th><th>Statistically Significant Decrease in Growth</th><th>p-value (left tail)</th></tr>
<tr><td>Overall Students</td><td>Decrease</td><td>No</td><td>0.1654</td></tr>
<tr><td>At-Home Students</td><td>Increase</td><td rowspan="2">No</td><td rowspan="2">0.5802</td></tr>
<tr><td>In-Person Students</td><td>Increase</td></tr>
<tr><td>Students with 504 Plans</td><td>Decrease</td><td>Yes</td><td>0.0204</td></tr>
<tr><td>Students with IEP Plans</td><td>Decrease</td><td>No</td><td>0.2686</td></tr>
<tr><td>Asian Students</td><td>Increase</td><td>No</td><td>0.5337</td></tr>
<tr><td>Black Students</td><td>Decrease</td><td>No</td><td>0.4886</td></tr>
<tr><td>Hispanic Students</td><td>Decrease</td><td>No</td><td>0.347</td></tr>
<tr><td>White Students</td><td>Increase</td><td>No</td><td>0.9093</td></tr>
<tr><td>Students who Qualify for Free or Reduced Meal Plans</td><td>Increase</td><td>No</td><td>0.5639</td></tr>
</table>

Summary

The researcher collected 4,982 students' secondary STAR math assessment data points from third grade through the students' current grade level from the district of study's administrative data team. The researcher broke down the secondary data to evaluate student growth pre-adaptive instruction, which is the window from Fall 2019 to Winter 2020 and post-adaptive instruction, as a result of COVID-19, which is the window from Fall 2020 to Winter 2021. Due to COVID-19, there was no testing performed or assessment data to evaluate for Spring 2020. The researcher used a *t*-test of dependent or independent means to evaluate student growth on the secondary STAR math assessment data.

The researcher evaluated Null Hypothesis 1 through analyzing the secondary student STAR assessment data from the overall population of the district of study using a random stratified sampling of 60 students' assessment data points. A *t*-test of dependent means was used to fail to reject the Null Hypothesis 1, that stated there is no decrease in student growth in mathematics as measured by the STAR assessment prior to and post adaptive learning, as a result of the COVID-19 pandemic. This means that there was no statistical decrease in growth, as a result of the COVID-19 pandemic.

The Null Hypothesis 2 stated there is no decrease in student growth in mathematics as measured by the STAR assessment between students who learned at-home compared to at-school learners post adaptive learning, as a result of the COVID-19 pandemic. A *t*-test of independent means was used to fail to reject the Null Hypothesis 2, which means there was no statistically significant decrease in growth when comparing students that learned at-home vs. students that learned in-person. This means that students that learned at home had similar learning outcomes to those that learned in person.

Null Hypotheses 3, 4, 5, 6, 7, 8, and 9 were tested using the secondary STAR math assessment data collected by the researcher, which was stratified using random sampling to 60 students for each of the subgroups assessed. The researcher used a *t*-test of dependent means on each of these null hypotheses, as the same population secondary data were used pre-and post-adaptive instruction.

The researcher rejected the Null Hypothesis 3 which stated, there is no decrease in student growth in mathematics as measured by the STAR assessment for students with a 504 plan prior to and post adaptive learning, as a result of the COVID-19 pandemic. This meant that there was a statistically significant decrease in growth for students who had a 504 Plan.

The researcher failed to reject Null Hypothesis 4 which stated, there is no decrease in student growth in mathematics as measured by the STAR assessment for students with an Individualized Education Plan (IEP) prior to and post adaptive learning, as a result of the COVID-19 pandemic. This meant that students with IEP plans did not see a statistically significant decrease in growth as a result of adaptive instruction, as a result of COVID-19.

The researcher failed to reject Null Hypothesis 5 which stated, there is no decrease in student growth in mathematics as measured by the STAR assessment for Asian students prior to and post adaptive learning, as a result of the COVID-19 pandemic. This meant that Asian students did not see a statistically significant decrease in growth as a result of adaptive instruction, as a result of COVID-19.

The researcher failed to reject Null Hypothesis 6 which stated, there is no decrease in student growth in mathematics as measured by the STAR assessment for Black students prior to and post adaptive learning, as a result of the COVID-19 pandemic. This meant that Black students did not see a statistically significant decrease in growth, as a result of adaptive instruction as a result of COVID-19.

The researcher failed to reject Null Hypothesis 7 which stated, there is no decrease in student growth in mathematics as measured by the STAR assessment for Hispanic students prior to and post adaptive learning, as a result of the COVID-19 pandemic. This meant that Hispanic students did not see a statistically significant decrease in growth as a result of adaptive instruction as a result of COVID-19.

The researcher failed to reject Null Hypothesis 8 which stated, there is no decrease in student growth in mathematics as measured by the STAR assessment for White students prior to and post adaptive learning, as a result of the COVID-19 pandemic. This meant that White students did not see a statistically significant decrease in growth as a result of adaptive instruction, as a result of COVID-19.

Finally, the researcher failed to reject Null Hypothesis 9 which stated, there is no decrease in student growth in mathematics as measured by the STAR assessment for students who receive free or reduced meal plans prior to and post adaptive learning, as a result of the COVID-19 pandemic. This meant that students who received free or reduced meal plans did not see a statistically significant decrease in growth, as a result of adaptive instruction as a result of COVID-19.

Chapter Five: Discussion

Overview

The goal of this case study was to identify the effects of adaptive instruction, due to the COVID-19 Pandemic, on middle school mathematics students in a Midwest Public School District. The researcher conducted a quantitative study on middle school mathematics students with a study population of 4,982 students across six middle schools within the district of study. In Chapter Four, the researcher summarized the findings of the nine hypotheses within the quantitative case study. Chapter Five discusses these findings in detail, states any implications found during the study, and provides recommendations for future research. Within the study, the researcher identified that students with a 504 plan statistically showed the greatest negative impact from adaptive instruction, due to COVID-19. Additionally, IEP students, Black students, and Hispanic students saw a slight mathematical decline, but were not identified as being statistically significant. Asian students, White students, and students with a free or reduced meal plan saw a slight increase in mathematical achievement through adaptive instruction but also was not statistically significant. The researcher also identified that there was no statistical significance between students who learned at-home compared to those who learned in-person.

The researcher used secondary data collected using the mathematics STAR Assessment from the district of study. The researcher then found the students' growth prior- and post-adaptive instruction and used a *t*-test to identify statistical significance. This study only began to evaluate the impact of adaptive instruction, due to the COVID-19 Pandemic, on students in mathematics. The researcher was fearful that the results of this study indicated that adaptive instruction has exacerbated the mathematical achievement gap of Asian and White students compared to Black, Hispanic, and students identified with a disability.

Implications

Null Hypothesis 1: There is no decrease in student growth in mathematics as measured by the STAR assessment prior to and post adaptive learning, as a result of the COVID-19 pandemic.

A *t*-test of two dependent means was used to determine whether there was a significant decrease in student growth when comparing student growth in mathematics post-adaptive instruction to pre-adaptive instruction, as a result of COVID-19. The researcher used a random stratified sample of 60 students from the total population of 3,212 students to test this hypothesis. The data showed a slight decrease in student growth, M = -10.75, but it was not statistically significant given the *p*-value = 0.1654, which was larger than the 0.05 *p*-value needed to show a significant decrease. The findings in Chapter Two detailed how teachers and school districts were left scrambling to put in place a plan for social distancing and adaptive instruction. Kamenetz (2020) described how teachers felt ill-prepared to instruct students virtually, concurrently, or implement blended and hybrid instructional methods. As a result of the investigations and personal experience as an educator, the researcher expected that there would be a statistically significant decrease, therefore this result contradicted the researcher's predictions. While this sample was taken from one district, the district of study, future investigation into school districts statewide may provide more indicative results of potential decreases in student growth, as a result of adaptive instruction. While there was not a statistically significant decrease, it should still be noted that there was a decrease which indicates for the district of study, and districts across the United States, educators should focus on identifying students' gaps in knowledge and be implementing intervention strategies.

Null Hypothesis 2: There is no decrease in student growth in mathematics as measured by the STAR assessment between students who learned at-home compared to at-school learners post adaptive learning, as a result of the COVID-19 pandemic.

A *t*-test of two independent means was used to determine whether there was a decrease in student growth when comparing students who learned at-home compared to students who learned in the classroom during the COVID-19 Pandemic. The data showed a slight increase for both student groups. Students who learned at-home during adaptive instruction show a growth of, M = 18.283, and students who learned in the classroom during adaptive instruction showed growth of, M = 20.93. The *p*-value found testing whether there was a decrease in student growth when comparing students who learned at-home compared to students who learned in the classroom was $p = 0.5802$, which was much larger than the 0.05 *p*-value needed to show a statistically significant decrease. Therefore, there was not a significant decrease when comparing students who learned at-home compared to students who learned in the classroom during the COVID-19 Pandemic. The researcher believed that students who learned at school would increase their scores at a statistically significant rate compared to those that learned at home and these results contradict that. The population sample used to test null hypothesis two were random stratified samples of 60 students dwindled from 2,743 students that learned in person, compared to 60 students dwindled from 469 students that learned at home. It should be noted that there was actually an increase in student growth for students from this study that learned at-home and in-person. Although this growth was not statistically significant, it indicates that students were still able to make achievement growth despite the challenges they faced during COVID-19 and adaptive instruction. The district of study conducted at-home learning using specific curriculum and instructional resources to instruct students. The researcher suggests a future study that compares the learning of at-home students in a variety of districts that utilized different curriculum and instructional resources to determine the effectiveness of the at-home learning model of the district of study.

Null Hypothesis 3: There is no decrease in student growth in mathematics as measured by the STAR assessment for students with a 504 plan prior to and post adaptive learning, as a result of the COVID-19 pandemic.

A *t*-test of two dependent means was used to determine whether there was a decrease in student growth when comparing students with a 504 plan post-adaptive instruction to pre-adaptive instruction. The data showed a statistically significant decrease in student growth, M = -25.02 and *p*-value = 0.0204. This was determined to be statistically significant given the *p*-value = 0.0204 was less than the 0.05 p-value needed to show statistical significance. The researcher tested the null hypothesis using a random stratified sample of 60 students dwindled from a total of 120 students with 504 plans. There could have been a variety of different factors that led to a significant decline in student growth in mathematics with a 504 plan. Students with 504 plans required many different strategies and accommodations to support their unique learning needs, many of which are optimal to provide during in-person instruction.

During adaptive instruction, the district of study primarily used a hybrid concurrent instructional model. Hybrid concurrent instruction was when the teacher was teaching one group of students in class while simultaneously teaching another group of students online (Tucker, 2021). In the classroom, teachers had to divide their attention between at-home students and in-person students, this could have reduced the amount of attention the teacher could give to accommodating the needs of students with a 504 plan. When teachers were focusing on students in two different locations, and implementing new technology resources, the needs of students with 504 plans could have been easily overlooked.

Lee (2020) stated that 2.3% of students in the United States have a 504 plan and the most common diagnoses were anxiety, food allergies, mild ADHD, asthma, or diabetes. The CDC (2021) reported that many adolescents' social, emotional, and mental well-being had been impacted by the pandemic in the areas of changed routines, break in the continuity of learning, break in the continuity of healthcare, missed significant life events, and loss of security and safety. Therefore, students with 504 plans may have overall been more negatively affected by the pandemic than students without 504 plans depending on their disability. The researcher suggests future research that breaks down specific 504 eligibility criteria to determine if students with specific disabilities were more impacted in student achievement in the area of mathematics than others, as a result of the adaptive instruction during the pandemic. The results derived from testing this null hypothesis indicated that the school district of study should provide students with 504 plans with targeted interventions to combat the decrease in student growth when comparing students with a 504 plan post-adaptive instruction to pre-adaptive instruction.

Null Hypothesis 4: There is no decrease in student growth in mathematics as measured by the STAR assessment for students with an Individualized Education Plan (IEP) prior to and post adaptive learning, as a result of the COVID-19 pandemic.

A *t*-test of two dependent means was used to determine whether there was a decrease in student growth when comparing students with an IEP post-adaptive instruction to pre-adaptive instruction. The researcher used a random stratified sample of 60 students from the total population of 484 students to test this hypothesis. The data showed a slight decrease in student growth, M = -8.32, but it was not statistically significant given the *p*-value = 0.2686, which was larger than the 0.05 p-value needed to show a significant decrease. The results of this study confirmed prior research that students with an IEP traditionally perform at a lower rate compared to other student subgroups. The researcher believes that teachers were unable to effectively meet the needs of students with an IEP, due to the demands of adaptive instruction.

Null Hypothesis 5: There is no decrease in student growth in mathematics as measured by the STAR assessment for Asian students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

A *t*-test of two dependent means was used to determine whether there was a decrease in student growth when comparing Asian students' growth post-adaptive instruction to pre-adaptive instruction. The researcher used a random stratified sample of 60 students from the total population of 253 students to test this hypothesis. The data showed a slight increase in student growth, M = 0.95, but it was not statistically significant given the *p*-value = 0.5337, which was larger than the 0.05 *p*-value needed to show a significant decrease. The slight positive growth of Asian students in mathematics aligns with the findings in Chapter Two, that Asian students are traditionally the highest performing student subgroup. Hsin and Xie (2014) conducted a study to understand why Asian Americans consistently outperformed other student subgroups. They found that Asian American students simply worked harder than other student subgroups, and this contributed to parent expectations. The researcher would recommend a study that identified how strong the correlation was between positive parent support, parental expectations, and positive growth achievement in mathematics during adaptive instruction.

Null Hypothesis 6: There is no decrease in student growth in mathematics as measured by the STAR assessment for Black students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

A *t*-test of two dependent means was used to determine whether there was a decrease in student growth when comparing Black students' growth post-adaptive instruction to pre-adaptive instruction. The researcher used a random stratified sample of 60 students from the total population of 232 students to test this hypothesis. The data showed a slight decrease in student growth, M = -0.30, but it was not statistically significant given the *p*-value = 0.4886, which was larger than the 0.05 p-value needed to show a significant decrease. Prior research in Chapter Two indicated that Black students traditionally were one of the lowest-performing student subgroups in mathematics. The researcher was encouraged that the data indicated that adaptive instruction had little to no impact on Black students. This could be attributed to the fact that the district of study has made it a priority to create a more equitable educational experience.

Null Hypothesis 7: There is no decrease in student growth in mathematics as measured by the STAR assessment for Hispanic students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

A *t*-test of two dependent means was used to determine whether there was a decrease in student growth when comparing Hispanic students' growth post-adaptive instruction to pre-adaptive instruction. The researcher used a random stratified sample of 60 students from the total population of 117 students to test this hypothesis. These data showed a slight decrease in student growth, M = -5.52, but it was not statistically significant given the *p*-value = 0.347, which was larger than the 0.05 *p*-value needed to show a significant decrease. Research has shown and was confirmed in this study that Hispanic students traditionally perform at a lower rate in mathematics compared to other student subgroups. The researcher found it important to note that Hispanic students were not broken down between English Language Learners and Non-English Language Learners. Chapter Two detailed a study from the National Assessment of Educational Progress (NAEP) in 2019 that described how grade 8 Hispanic students showed the least amount of growth in mathematics during their Kindergarten through 12th-grade journey. Further research should be conducted to seek understanding and clarification on why Hispanic students are struggling in middle school mathematics. Additionally, there could be value in a study that broke down the difference between English Language Learners and Non-English Language Learners during adaptive instruction.

Null Hypothesis 8: There is no decrease in student growth in mathematics as measured by the STAR assessment for White students prior to and post adaptive learning, as a result of the COVID-19 pandemic.

A *t*-test of two dependent means was used to determine whether there was a decrease in student growth when comparing White students' growth post-adaptive instruction to pre-adaptive instruction. The researcher used a random stratified sample of 60 students from the total population of 2,472 students to test this hypothesis. These data showed a slight increase in student growth, M = 17.73, but it was not statistically significant given the *p*-value = 0.9093, which was larger than the 0.05 *p*-value needed to show a significant decrease. Of the student subgroups within the study, White students benefited the most from adaptive instruction and saw the largest amount of growth in mathematics. This aligns with the research in Chapter Two indicating that Asian and White students traditionally outperform the other student subgroups in the area of mathematics. It was positive that White students benefited from adaptive instructions, but the researcher would like to see all student subgroups benefiting from adaptive instruction. Further research could be conducted to identify what factors led to White students benefiting from adaptive instruction. Once the positive factors were identified, educators should strive to develop those same positive factors in the other student subgroups.

Null Hypothesis 9: There is no decrease in student growth in mathematics as measured by the STAR assessment for students who receive free or reduced meal plans prior to and post adaptive learning, as a result of the COVID-19 pandemic.

A *t*-test of two dependent means was used to determine whether there was a decrease in student growth when comparing students with an IEP post-adaptive instruction to pre-adaptive instruction. The researcher used a random stratified sample of 60 students from the total population of 474 students to test this hypothesis. These data showed a slight increase in student growth, M = 1.93, but it was not statistically significant given the *p*-value = 0.5639, which was larger than the 0.05 *p*-value needed to show a significant decrease. The findings and research from Chapter Two indicated that students of a low socioeconomic status traditionally achieved at a lower rate in mathematics. The researcher was encouraged that the data indicated adaptive instruction had little to no impact on students who qualify for a free-or-reduced meal plan. The minimal-to-no impact of students who qualify for a free or reduced meal plan could have been contributed to the district of study providing all households with a Wi-Fi hotspot that did not have internet access in their house.

Recommendations

The researcher recommended further research on the success of students learning at-home compared to students learning in the classroom. The study should include, but not be limited to comparing student subgroups that learned at-home, factoring the support of parents relating to the success of students learning at-home, and at-home factors that can benefit or impede the at-home learning process. Additionally, the researcher saw value in research regarding how the COVID-19 Pandemic and adaptive instruction affected students with anxiety or any other mental illnesses. It was concerning that students with a 504 plan saw a statistically significant decline in mathematical growth. Further research should be conducted to identify how/if students with anxiety were negatively impacted across all content areas and grade levels during adaptive instruction.

Discussion

At the onset of this study, the researcher had a primary goal of identifying if students in mathematics could learn virtually at the same rate as students who learned in person. The findings from the study indicated that it was possible for students at-home to learn at a similar rate as those who learned in the classroom at the middle school level. The researcher believed that the biggest factor in the success of a student learning at-home lay in parental support rather than race or demographics. Additionally, this quantitative case study has fueled the motivation of the researcher to search for solutions to minimize the achievement gap in mathematics. The results of this study indicated that White students benefited the most from adaptive instruction. The researcher intends to identify what factors led to positive growth during adaptive and duplicate those factors in student subgroups who were underperforming.

Conclusions

The researcher was encouraged that the majority of students saw no statistical decrease in mathematical growth in grades six through eight during adaptive instruction. The researcher was also surprised to see that there was no statistical difference between students who learned at-home compared to those who learned in the classroom in mathematics during adaptive instruction. Further research could be conducted on parental support and the effects of the learning environment at home on student mathematical achievement. Finally, the researcher wanted to highlight that students with a 504 plan saw a statistically significant decrease in mathematical growth during adaptive instruction. Further research should be conducted to identify how students with Anxiety performed academically during adaptive instruction.

References

AJMC Staff. (2021). *A timeline of COVID-19 developments in 2020*. *American Journal of Managed Care*. https://www.ajmc.com/view/a-timeline-of-covid19-developments-in-2020

Albert Resources. (2021, August 10) *21 strategies for teaching online: The ultimate guide*. https://www.albert.io/blog/strategies-for-teaching-online/

AMLE. (2020, November 1). The successful middle school: This we believe. Association for Middle Level Education. https://www.amle.org/wp-content/uploads/2021/01/AMLE_SMS_Summary_Color.pdf

Anderson, K. (2020, August 4). *Missouri releases updated guidance for schools returning to in-person learning*. ksdk.com. https://www.ksdk.com/article/news/health/coronavirus/missouri-school-reopening-guidelines-update/63-5c08a74e-50a3-41a6-8f6b-dca8bb2afbaa

Anderson, M. D. (2017, April 25). How does race affect a student's math education? *The Atlantic*. https://www.theatlantic.com/education/archive/2017/04/racist-math-education/524199/

Anthony, D., & Thomas, M. (2020, October 1). Asynchronous learning or live lessons? Which one works better for me? *EdSurge*. https://www.edsurge.com/news/2020-10-01-asynchronous-learning-or-live-lessons-which-one-works-better-for-me

Asthma and Allergy Foundation of America. (n.d.). *AAFA*. https://www.aafa.org/asthma-facts/

Baker, C. (2013). *Study: Kids who are behind in math in first grade don't catch up*. University of Nebraska-Lincoln. https://newsroom.unl.edu/announce/primarilymath/2124/11904

Balfanz, R., & Byrnes, V. (2006). Closing the mathematics achievement gap in high-poverty middle schools: Enablers and constraints. *Journal of Education for Students Placed at Risk*. http://mathenrich.pbworks.com/w/file/fetch/52433692/Closing.pdf

Belsky, G. (2021). What is an IEP? Understood. https://www.understood.org/articles/en/what-is-an-iep

Bennett, L. (2020, September 3). 9 benefits of synchronous and asynchronous e-learning. *Kaltura*. https://corp.kaltura.com/blog/9-benefits-of-synchronous-and-asynchronous-e-learning/

Bhamani, S., Makhdoom, A. Z., Bharuchi, V., Ali, N., Kaleem, S., & Ahmed, D. (2020). Home learning in times of COVID: Experiences of parents. *Journal of Education and Educational Development*, *7*(1), 9–26.

Bjorklund-Young, A., & Plasman, J. S. (2020). Reducing the achievement gap: Middle grades mathematics performance and improvement. *Research in Middle Level Education, Online*, *43*(10), 25–45. https://doi.org/10.1080/19404476.2020.1836467

Boaler, J. & LaMar, T. (2019, February 28). A better way to teach students with learning disabilities. *Time*. https://time.com/5539300/learning-disabilities-special-education-math-teachers-parents-students/

Burns, M. (2007). Nine ways to catch kids up. *Educational Leadership.* Association for Supervision and Curriculum Development. https://www.ascd.org/publications/educational-leadership/nov07/vol65/num03/Nine-Ways-to-Catch-Kids-Up.aspx

Cai, J., Mayer, J., & Wang, N., (1999) Parental roles in students' learning of mathematics: An exploratory study. *Research in Middle Level Education; Quarterly.* https://www.tandfonline.com/doi/pdf/10.1080/10848959.1999.11670147

Calderon, V. J. (2021, August 16). *U.S. parents say COVID-19 harming child's mental health*. Gallup.com. https://news.gallup.com/poll/312605/parents-say-covid-harming-child-mental-health.aspx

Carnoy, M., García, E., & Economic Policy Institute. (2017). Five key trends in U.S. student performance: Progress by Blacks and Hispanics, the takeoff of Asians, the stall of Non-English speakers, the persistence of socioeconomic gaps, and the damaging effect of highly segregated schools. *Economic Policy Institute*.

Castro, M., Choi, L., Kudson, J., & O'Day, J. (2020). Grading policy in the time of Covid-19 considerations and implications for equity. *California Collaborative on District Reform*, 1–8. https://files.eric.ed.gov/fulltext/ED606474.pdf

Center for Disease Control and Prevention [CDC]. (2021, May 7). *Scientific brief: Sars-COV-2 transmission*. Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/sars-cov-2-transmission.html

Center on Reinventing Public Education [CRPE]. (2020). Chicago schools grind into action: Lessons from Chicago Public Schools' COVID-19 response. Spring 2020. In *Center on Reinventing Public Education*. Center on Reinventing Public Education.

Chen, G. (2020, September 17). *10 characteristics of a successful student (and what parents can do to nurture them!).* Public School Review. https://www.publicschoolreview.com/blog/10-characteristics-of-a-successful-student-and-what-parents-can-do-to-nurture-them

Colorado Department of Education. (2019). *Instructional models for math*. Colorado Department of Education. https://www.cde.state.co.us/comath/math-instructional-models

Crawford, K. (2018, November 2). *When teachers think differently about themselves as math learners, students benefit*. Stanford Graduate School of Education. https://ed.stanford.edu/news/study-when-teachers-think-differently-about-themselves-math-learners-students-benefit

Crosby, S. D., Howell, P. B., & Thomas, S. (2020). Teaching through collective trauma in the era of COVID-19: Trauma-informed practices for middle level learners. *Middle Grades Review*, *6*(2), Article 5.

Data Quality Campaign, Alliance for Excellent Education, & Collaborative for Student Success. (2020). *Measuring growth in 2021: What state leaders need to know*. https://files.eric.ed.gov/fulltext/ED607220.pdf

Davenport, G. C., & Slate, J. R. (2019). Poverty and mathematics performance of Texas grade 3 students: A Cause for Concern. *Bulletin of Education and Research*, *41*(3), 167–176.

Dorn, E., Hancock, B., Sarakatsannis, J., & Viruleg, E. (2020, June). *COVID-19 and student learning in the United States.* McKinsey & Company. https://www.mckinsey.com/~/media/McKinsey/Industries/Public%20and%20Social%20Sector/Our%20Insights/COVID-19%20and%20student%20learning%20in%20the%20United%20States%20The%20hurt%20could%20last%20a%20lifetime/COVID-19-and-student-learning-in-the-United-States-FINAL.pdf

Downey, K. (2021). *Long covid in children: Less frequent and 'much more poorly understood'*. Healio. https://www.healio.com/news/primary-care/20210723/long-covid-in-children-less-frequent-and-much-more-poorly-understood

Education Week. (2021, February 8). The Coronavirus spring: The Historic closing of U.S. schools (a Timeline). *Education Week*. https://www.edweek.org/leadership/the-coronavirus-spring-the-historic-closing-of-u-s-schools-a-timeline/2020/07

Educational Reform. (2013, August 29). Learning loss definition. The Glossary of Education Reform. https://www.edglossary.org/learning-loss/

EdSource Staff. (2021, March 11). Teachers speak out on students' social and emotional well-being. *EdSource*. https://edsource.org/2021/spotlight-2-students-social-and-emotional-wellbeing/649021

Engelmann, S. (2015). *Basic philosophy of direct instruction (DI)*. National Institute For Direct Instruction. https://www.nifdi.org/15/index.php?option=com_content&view=article&id=52&Itemid=27

Flores, A. (2007). Examining disparities in mathematics education: Achievement gap or opportunity gap? *The High School Journal*, *91*(1), 29–42. https://doi.org/10.1353/hsj.2007.0022

García, E., & Economic Policy Institute. (2020). Schools are still segregated, and black children are paying a price. *Economic Policy Institute*.

Gervasoni. A. & Lindenskov, L. (2011). Students with ‘special rights” for mathematics education. In B. Atweh, M. Graven W. Secadda, P. (Eds.), *Mapping equity and quality in mathematics education* (pp. 307-323). Netherlands: Springer.

Gonzalez, L., Chapman, S., & Battle, J. (2020). Mathematics identity and achievement among Black students. *School Science and Mathematics*, *120*(8), 456–466.

Hattie, J. (2018). *Hattie effect size list - 256 influences related to achievement*. Visible Learning. https://visible-learning.org/hattie-ranking-influences-effect-sizes-learning-achievement/

Hsin, A., & Xie, Y. (2014, June 10). *Explaining Asian Americans' academic advantage over Whites*. PNAS. https://www.pnas.org/content/111/23/8416

Huntington, R. (2021, January 5). The pros and cons of remote learning. Huntington Learning Center. https://huntingtonhelps.com/resources/blog/the-pros-and-cons-of-remote-learning-2021

Johns Hopkins Coronavirus Resource Center. (n.d.). *Mortality analyses*. https://coronavirus.jhu.edu/data/mortality

Jones, E., Bhojwani, S., & Wilson, R. (1997). *Mathematics instruction for secondary students with learning disabilities*. Mathematics Instruction for Secondary Students with Learning Disabilities. http://www.ldonline.org/article/5934/

Kamenetz, A. (2020, December 4). *5 things we've learned about virtual school in 2020*. NPR. https://www.npr.org/2020/12/04/938050723/5-things-weve-learned-about-virtual-school-in-2020

Kelly, S. (2009). The black-white gap in mathematics course taking. *Sociology of Education*, *82*(1), 47–69. https://doi.org/10.1177/003804070908200103

Learning & Teaching Overview. (2020). / STAR Assessments. https://www.isd742.org/Page/6501#:~:text=STAR%20assessments%20are%20locally%20determined,goals%20for%20the%20following%20benchmark

Lee, A. (2020, October 22). *Thousands of public schools aren't using 504 plans, new analysis suggests*. Understood. https://www.understood.org/articles/en/thousands-of-public-schools-arent-using-504-plans-new-analysis-suggest

Leon, J., Medina-Garrido, E., & Núñez, J. L. (2017). Teaching quality in math class: The development of a scale and the analysis of its relationship with engagement and achievement. *Frontiers in psychology*, *8*, 895. https://doi.org/10.3389/fpsyg.2017.00895

Maragakis, L. (2020, June 23). *Coronavirus and COVID-19: Who is at higher risk?* Johns Hopkins Medicine. https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/coronavirus-and-covid19-who-is-at-higher-risk

Marshall, W. F. (2021, May 21). *Can COVID-19 (Coronavirus) spread through food and water?* Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/coronavirus/expert-answers/can-coronavirus-spread-food-water/faq-20485479

Meier, K. (2016, September 29). Qualities of effective middle schools. https://education.seattlepi.com/qualities-effective-middle-schools-2733.html

Merriam-Webster. (n.d.). *Pandemic*. Merriam-Webster. https://www.merriam-webster.com/dictionary/pandemic

Minero, E. (2020, August 21). *8 strategies to improve participation in your virtual classroom*. Edutopia. https://www.edutopia.org/article/8-strategies-improve-participation-your-virtual-classroom

National Center for Education Statistics. (2021). *The NCES fast facts tool provides quick answers to many education questions*. National Center for Education Statistics (NCES) Home Page, a part of the U.S. Department of Education. https://nces.ed.gov/fastfacts/display.asp?id=372

Olneck-Brown, B. (2021). *Public education's response to the coronavirus (COVID-19) pandemic*. National Conference of State Legislators.

https://www.ncsl.org/research/education/public-education-response-to-coronavirus-covid-19.aspx

Organization for Economic Co-operation and Development. (2020, September 24). *Strengthening online learning when schools are closed: The role of families and teachers in supporting students during the COVID-19 crisis*. OECD. https://www.oecd.org/coronavirus/policy-responses/strengthening-online-learning-when-schools-are-closed-the-role-of-families-and-teachers-in-supporting-students-during-the-covid-19-crisis-c4ecba6c/

Parke, C. S. (2016). Differences in math performance indicators within an ethnicity subgroup: an investigation of an urban district's high schools. *American Secondary Education*, *45*(1), 5–21.

Pediatric Care Group. (2020, September 7). Online vs. in-person learning. Pediatric Care Group, P.C.
https://pcgkids.com/online-vs-in-person-learning/

Porter, A. (2021). *Rethinking the achievement gap*. Penn Graduate School of Education. https://www.gse.upenn.edu/news/rethinking-achievement-gap

Protheroe, N. (2007). "What does good math instruction look like?" *Principal*, *7*(1), 51 – 54.

Quinn, D. M., & Polikoff, M. (2017, September 14). *Summer learning loss: What is it, and what can we do about it?* Brookings. https://www.brookings.edu/research/summer-learning-loss-what-is-it-and-what-can-we-do-about-it/

Ralph, M. (2020, April 17). *Teaching strategies of award-winning online instructors*. Edutopia. https://www.edutopia.org/article/teaching-strategies-award-winning-online-instructors

Renaissance. (2019, July 29). *Math milestones: The critical role of math achievement in student success*. https://www.renaissance.com/2018/03/22/blog-math-milestones-critical-role-math-achievement-student-success/

Renaissance Place. (2020). *Parent's guide to star assessment*. https://www.isd742.org/cms/lib/MN01909691/Centricity/domain/591/assessment/Guide_to_STAR_Assess.pdf

Robinson, P. D. (2017, November 21). *How accurate is the star math assessment?* Classroom Synonym. https://classroom.synonym.com/accurate-star-math-assessment-41062.html

Scafidi, T., & Bui, K. (2010). Gender similarities in math performance from middle school through High School. *Journal of Instructional Psychology*, *37*(3), 252–255.

Schwartz, S. (2021, September 10). How can schools keep quarantined students learning? *Education Week*. https://www.edweek.org/technology/how-can-schools-keep-quarantined-students-learning/2021/08

Sheldon, S. B., Epstein, J. L., & Galindo, C. L. (2010). Not just numbers: Creating a partnership climate to improve math proficiency in schools. *Leadership and Policy in Schools*, *9*(1), 27–48. https://doi.org/10.1080/15700760802702548

Stanford Health Care [SHC]. (2021). *COVID-19 basics*. Stanford Health Care. https://stanfordhealthcare.org/discover/covid-19-resource-center/covid-19-basics.html#fa

Steele, C. (2021, June 5). *Hybrid vs blended learning: The difference and why it matters*. Leading Learning. https://www.leadinglearning.com/hybrid-vs-blended-learning/

TeachThought Staff. (2021, July 17). *The definition of the flipped classroom*. TeachThought. https://www.teachthought.com/learning/the-definition-of-the-flipped-classroom/

Testing Technology. (2021, July 29). SmarterBalanced. https://smarterbalanced.org/our-system/assessments/testing-technology/

Tine, M., & Gotlieb, R. (2013). Gender-, race-, and income-based stereotype threat: The effects of multiple stigmatized aspects of identity on math performance and working memory function. *Social Psychology of Education: An International Journal*, *16*(3), 353–376.

Tucker, C. (2021, February). *Tips for navigating a concurrent classroom*. Study Sync. https://www.studysync.com/blog/tips-for-navigating-a-concurrent-classroom

Turan, S., & Matteson, S. (2021). Middle school mathematics classrooms practice based on 5E instructional model. *International Journal of Education in Mathematics, Science, and Technology (IJEMST), 9*(1), 22-39. https://files.eric.ed.gov/fulltext/EJ1282262.pdf

Thompson, J. (2015, August 4). Authors discuss reasoning behind high levels of Asian American achievement. https://www.insidehighered.com/news/2015/08/04/authors-discuss-reasoning-behind-high-levels-asian-american-achievement

U.S. Department of Education. (2019, February). *Status and trends in the education of racial and ethnic groups*. National Center for Education Statistics. https://nces.ed.gov/programs/raceindicators/indicator_rcb.asp

U.S. Legal, I. (2019). Find a legal form in minutes. 504 Plan [Education], Law and Legal Definition | U.S. Legal, Inc. https://definitions.uslegal.com/5/504-plan-education/

Waldman, A., & Groeger, L. (2018, October 16). *Miseducation*. ProPublica. https://projects.propublica.org/miseducation/district/2926850

Weissinger, K. (2020, August 19). *Back to school: What is concurrent teaching?* MAYA. https://www.mayaconsultingllc.com/blog/2020/8/19/back-to-school-what-is-concurrent-teaching

Weitzel, A. (2021, July 7). *7 advantages of blended learning programs*. CourseKey. https://coursekey.com/7-advantages-of-blended-learning-programs/

World Health Organization [WHO]. (2020). *Listings of who's response to COVID-19*. World Health Organization. https://www.who.int/news/item/29-06-2020-covidtimeline

Appendices

Appendix A
Application to Perform Research

ROCKWOOD SCHOOL DISTRICT	APPLICATION TO PERFORM RESEARCH

PROCEDURES FOR PROCESSING REQUESTS TO PERFORM RESEARCH

Applications to perform research are accepted from (a) individuals of institutions conducting studies of interest to the academic community, or (b) students pursuing advanced degrees for which research is a major part or requirement of their academic studies. Requests for data from state, federal, or other agencies which school systems are legally required to cooperate are exempted from this criteria.

Steps to secure approval to perform research in our school district:

Step 1: Researcher submits completed application, Form No. 1003, to the office of the Director of Research, Evaluation and Assessment, 500 North Central, Eureka, MO 63025.

Step 2: Application is reviewed by the Director of Research, Evaluation and Assessment and/or other district administrators, as appropriate.

Evaluation of all research requests will be based upon:

1. Assessing the purpose of the study.
2. Methodology to be employed.
3. Analysis to be conducted.
4. Survey to be given and other research factors.
5. Potential benefits of the research to the Rockwood Schools.
6. Potential value of the study to the general field of research.
7. Whether the research is part of a national study or major project requiring Board participation for validity.
8. If request is received from a major organization or agency with whom the district would particularly like to maintain cooperative relations.
9. Adherence to FERPA and other guidelines to protect the privacy of the individuals (staff, students, parents, and school(s) participating in the project.)
10. Clarity of the project procedures and processes.

In addition to these considerations, attention will be given to practical aspects of the research including:

a. Time requirements of staff and/or students,
b. Impact on other school activities (e.g., study occurring during testing or near the end of the year),
c. Sensitivity of the data to be collected and how it will be used, and
d. Administrative demands on the school system.

Step 3: The researcher will be notified of the decision.

A research request can be (1) accepted, (2) accepted subject to certain modifications in the study's design, or (3) rejected. Upon approval, the researcher will be provided contact information of the person(s) at the approved location(s) for performing the research.

All persons whose research is approved should note the following:

1. Any modifications from the original approved proposal must be approved by the Director of Research, Evaluation and Assessment before implementation of research.
2. Any research project is subject to termination if the procedures described in the proposal are not adhered to or if the research is conducted in such a way that the administration judges it to unduly disrupt the flow of work in the schools.

ROCKWOOD SCHOOL DISTRICT	**APPLICATION TO PERFORM RESEARCH**

Date of Request: 2/9/2021

I. Researcher Information

Name of Researcher: Matthew Buschman

Institutional Affiliation: 7th Grade Math Teacher at Crestview Middle School

Office Address: Crestview Middle School Room 419

Home Address: 212 Twin Birch Court Lake St. Louis, MO. 63367

Office Phone: ext. 24419 Home Phone: 636-221-4135

If your research will be in partial fulfillment of a degree requirement, what degree is sought?
Doctorate in Education Administration from Lindenwood University

II. Project Information

Project Title:(Dissertation) A Quantitative Study on the Impact of Adapted School Instruction as a Result of COVID-19 Pandemic (or COVID-19) on Student Standardized Math Scores in a Midwest Public Middle School

Description: I want to identify the impact of adaptive learning during the COVID-19 pandemic on student growth in the area of mathematics for CMS/Rockwood 7th grade students. To do this, I want to analyze annual student STAR Assessment scores from grades 3-7 to find the average student growth prior to the COVID-19 pandemic and compare that data to student growth during adaptive instruction and the COVID-19 pandemic. I am going to look at the data as a whole group, compare at-home and at-school learners, and break down the data by subgroups(Race, F/R Lunch, IEP, 504). I would not use student names in my study as all data would be de-identified and coded using a number system.

Proposed Starting Date: March 2021 Proposed Completion Date: Summer 2022

III. Participant Information : Number of Subjects Required Form of Participation
(Include treatments, tests, observations, etc.)

Students: Approximately 406 student test results would be analyzed. However, the STAR test is already administered to the student population that the results would be reviewed from Crestview; therefore, there would be no additional tests, surveys, etc. that would be required of students as a result of this study.

Administrators: 0

Teachers: 0

Parents: 0

Student Time Required(per class / per student): No additional time would be required for students as a result of this study given the STAR math assessment is already a part of the curriculum and required to be given to all students by the district.

Time Required of Others: 0

Form No. 1003 Date: December 2013 Policy: 1440 Page 2 of 3

ROCKWOOD SCHOOL DISTRICT	**APPLICATION TO PERFORM RESEARCH**

III. Participant Information (cont'd.)

If particular schools are being requested, please list: Crestview Middle School

Cite the publication references one or two major studies that have been published or reported in your chosen area of research:

Further Consequences of COVID. (2021). *Principal, 100*(3), 8.
https://www.edweek.org/policy-politics/coronavirus-learning-loss-risk-index-reveals-big-equity-problems/2020/09

COVID Slide or COVID Slowdown? (2020). *Principal, 100*(1), 7.
Collaborative-Brief_Covid19-Slide-APR20.pdf (nwea.org)

Attach a brief proposal of your research study explaining the important methodological features of the study (e.g., sampling methods, assessment tools, how confidential information will be handled, data analysis procedures, etc.). If you will be using a survey instrument, please enclose a complete copy.

IV. Results Information

What is the anticipated value of this research? To identify the impact of adaptive instruction on student growth in mathematics due to COVID-19. This could impact future studies, inform educators on the impact of adaptive learning, and potentially inform educators if there is a need to review essential outcomes within the curriculum because of a lack of student retention due to adaptive learning.

V. Confidentiality Information

If you have extended confidentiality, names may be omitted from this item.

Have you conducted research in other school systems? No

If yes, please name:

Are other school systems involved in this research? No, but I am conducting the research for completion of my Doctoral Degree at Lindenwood.

If yes, please name: Lindenwood

VI. Completion of Research Requirements

Upon completion of the research, you are required to submit two copies of the report or summary to the Director of Research, Evaluation and Assessment, 500 N. Central Avenue, Eureka, MO 63025. We welcome you to include a memorandum indicating procedural issues, unusual experiences, recommendations, comments, and observations.
These documents can be expected by (date): August 2022

Signature of Applicant: Matthew Buschman Date: 2/9/2021
Print Name of Institutional Advisor, Professor, or Supervisor: Dr. Robert Steffes Institution: Lindenwood

Signature of Advisor, Professor, or Supervisor: Bob Steffes Office Phone: 639-949-4744

Vitae

Matthew Walker Buschman earned a bachelor's degree in education from the University of Missouri, Columbia, Missouri, in 2013. He received his master's degree in educational administration from Southeast Missouri State University, Cape Girardeau, Missouri, in 2017. Matthew completed his specialist degree in educational administration from Lindenwood University, St. Charles, Missouri in 2019. He anticipates earning his doctorate in educational administration from Lindenwood University in 2022.

Matthew currently holds certification in Administration K-8, Math 5-9, and Social Studies 5-9 in the state of Missouri. He currently serves as a seventh grade math teacher and extracurricular activities coordinator at Crestview Middle School in the Rockwood School District. He has also worked as a math teacher at Meramec Valley Middle School and an American History teacher at Pacific High School.