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An Investigation of Standardized Assessment Performance for Middle School Students Before and During the COVID-19 Pandemic

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AN INVESTIGATION OF STANDARDIZED ASSESSMENT PERFORMANCE FOR MIDDLE SCHOOL STUDENTS BEFORE AND DURING THE COVID-19 PANDEMIC

A Dissertation

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ABSTRACT

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The purpose of this study is to examine how the COVID-19 pandemic has affected the learning of students in public education through the analysis of standardized assessment performance before and during COVID-19. The study also compares virtual learning and face-to-face students' change in performance on the standardized assessments. To answer the research questions, the quantitative research uses 5th and 7th grade math and reading STAAR data from 2019 and 2021 for the same cohort of students at a suburban ISD in Texas. The casual-comparative research study suggests that there is a significant drop in students' performance on standardized assessments in both math and reading. The results also suggest there is not a significant difference between student learning environment groups in change in standardized assessment performance in the math STAAR assessments, however, there is a significant difference between student learning environment groups in the reading STAAR assessments, with the virtual students outperforming the face-to-face students. The results of this study may inform educational decisions during and after the COVID-19 pandemic.

Keywords: COVID-19, Covid slide, learning, standardized assessments, STAAR, face-to-face, virtual learning, Texas

DEDICATION

This dissertation is dedicated to my wife and children for their unwavering love, support, and understanding during my studies. Starting my first graduate degree in 2013 until the completion of my doctorate degree in 2023 has been a journey where they have continually supported me despite the countless hours I have spent working and learning in the evenings and on the weekends. To my parents, for their unconditional love and for instilling in me the values of hard work and the value of education. My gratitude for all that my family has done for me and supported me through cannot be measured.

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CHAPTER I

INTRODUCTION

There is an issue with the impact of COVID-19 on learning by students in public education during the global pandemic (National Center for Educational Statistics, 2022). Learning can be measured in numerous ways, but an important measurement of learning from year to year in public education is by the performance on state standardized assessments. Students have had their education disrupted and altered due to COVID-19 and went two years between standardized assessments with little formal benchmarking of their learning in-between. Comparing the performance on standardized assessments before and during COVID-19 has the potential to help understand any effect the COVID-19 global pandemic has had on student learning. The null hypothesis is that there is not a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19. The alternative hypothesis is that there is a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19. Comparing face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19 also has the potential to help understand the effect learning environment has on student learning. The null hypothesis is that there is not a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19.

The alternative hypothesis is that there is a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19.

The analysis of standardized assessment performance before and during COVID-19 will occur at a suburban public independent school district in Texas (from here on referred to as "the district"). The district participated in state standardized assessments the year before COVID-19, in 2019, and again near the end of the first full school year after the onset of the COVID-19 pandemic, in 2021. In the first full school year during COVID-19, the district offered both fully face-to-face and fully virtual learning options for students. The data on the standardized assessment performance before and during COVID-19 and by learning environment will be collected. The data and analysis may lead to some conclusions or further discussion on the impact of COVID-19 on learning in public education and the effect learning environment has on student learning.

The Research Problem

The impact of COVID-19 on learning by students in public education is a problem that is worth addressing. The impact of COVID-19 on education can be displayed in numerous areas, all of which may play factors in students being successful in their learning, grades, and overall academic performance. Learning can be measured through assessments and observations; however, state assessments are used to standardize assessment and measure student learning year over year. COVID-19 has had an impact on the education system since the beginning of the pandemic and may be affecting student learning. This effect on student learning in public education is a problem that needs further examination.

In early 2020, the COVID-19 pandemic swept through the world and forced schools around the United States and the rest of the world to alter the way they operate. COVID-19 is a novel coronavirus outbreak that the World Health Organization (WHO) declared a global health emergency on January 30, 2020 (Velavan & Meyer, 2020). The outbreak resulted in a worldwide pandemic (from here on referred to as "COVID-19") that impacted almost every single country and industry in the world. Educational institutions were forced to create plans to return to school mostly or entirely online through virtual learning. Teachers and students were thrust into a new mode of learning that many had not experienced before (Middleton, 2020). This remote form of virtual learning started as a few-week measure that turned into the rest of the school year experience for most schools. With the swift onset of the COVID-19 pandemic, educational institutions had very little time to prepare for virtual learning (Daniel, 2020). The last quarter of the 2019-2020 school year saw the start of a disruption to the education system that may be leading to significant learning loss for students.

The COVID-19 pandemic worsened in the summer and fall of 2020 and educational institutions had to make decisions on returning to school for the 2020-2021 school year. In the United States, some states continued to solely offer virtual learning, and other states, including Texas, started the first few weeks online and then offered families a choice of remaining fully virtual or returning to face-to-face instruction with safety precautions in place. The COVID-19 pandemic had become the largest disruption to education in modern history and affected 95% of the world's student population (Engzell et al., 2021). COVID-19 has been described as the greatest challenge that the national education system has ever faced (Daniel, 2020).

The disruption of the education system by the COVID-19 pandemic led to many issues related to instruction, learning, and assessment (Jiao & Lissitz, 2020). Educators were presented

with the biggest challenge of their careers and teachers have consistently indicated they were not prepared to teach online (Middleton, 2020). Online learning pedagogy and instructional strategies differ from traditional face-to-face instructional strategies. Students were also not prepared for this change and teachers reported a significant percentage of students did not even log in to complete assignments (Middleton, 2020). These factors are causing concerns about learning loss during the COVID-19 pandemic. To measure potential learning loss, effective assessment also must occur. Assessment in online education has issues of validity, reliability, and dishonesty related to assessment that does not exist in traditional learning environments (Perera-Diltz & Moe, 2014). Accurate assessment of student learning during the COVID-19 pandemic may not have been taking place.

Concern for learning loss during the COVID-19 pandemic is such a prevalent concern among the educational community there is even a term for it, "COVID slide". The suspension of face-to-face instruction and lost school time during the COVID-19 pandemic have led to serious concerns for student learning. Data and research on this issue have been limited and slow to emerge. However, some initial data and studies are suggesting that students are spending considerably less time on schoolwork and learning less than in a typical school year (Engzell et al., 2021). Performance on standardized assessments from before COVID-19 and during COVID-19 may indicate COVID slide in learning over a longer period.

Loss of learning due to COVID-19 may be taking place at all levels and schools, of interest is in public schools subject to state standardized assessments. Standardized assessments can measure learning during a school year and measure growth from year to year. Because of the great concern for the learning of public-school students, the population of this study is a public independent school district in a suburban community. In this study, the students have the

potential for learning loss during the COVID-19 pandemic, but also meet the criteria of participating in face-to-face and virtual learning environments. The study will look at students' performance on standardized assessments from before COVID-19 and during COVID-19 and in different learning environments.

Purpose of the Study and Research Questions

The purpose of this research study is to examine how the COVID-19 pandemic has affected the learning of students in public education. The impact of COVID-19 on education problem can be studied in numerous areas, this study will examine if learning during COVID-19 affected standardized assessment performance. The study will also look at the comparison of face-to-face and virtual learning students' change in performance on standardized assessments. The before COVID-19 and during COVID-19 standardized assessment performance of students in a public suburban independent school district will be measured.

Students at the district were forced to virtual learning for the final quarter of the 2019-2020 school year. Some findings have suggested that students have made little or no progress while learning from home during the COVID-19 pandemic (Engzell et al., 2021). After the first three weeks of the 2020-2021 school year, students of the district had the choice of fully virtual or fully face-to-face learning. Learning over a typical school year is measured by the state using standardized assessments. In Texas, these assessments are in specific subjects depending on the grade level and are referred to as the STAAR (State of Texas Assessments of Academic Readiness) assessments. State standardized assessments were canceled for the 2019-2020 school year, creating a gap of two full years between the administration of the assessments and assessment results. Students resumed taking the STAAR assessments in the 2020-2021 school year.

The 2021 STAAR assessments were the first state standardized assessments students had taken since the onset of the COVID-19 pandemic. The COVID-19 pandemic has put a lot of pressure on instruction, learning, and assessment (Jiao & Lissitz, 2020). Real concerns are being raised about the potential learning loss during the COVID-19 pandemic. The comparison of performance on the STAAR assessments before COVID-19 and during COVID-19 will provide data on how performance has changed and potential learning loss. This study will provide data on a minimum of one full year of learning during COVID-19 and related standardized assessment performance.

Students and families of the district were given a choice in September 2020 to continue with fully virtual learning or to return to campuses for face-to-face learning with safety precautions in place. Virtual learning has had varying levels of success for different groups (Engzell et al., 2021). The option to return to face-to-face learning was taken by some students and others chose to remain in a fully virtual environment. The term virtual learning has been used to represent various forms of online and remote learning during the COVID-19 pandemic. Many schools simply moved their face-to-face instruction to an online environment which would normally be referred to as remote learning. Some schools were more prepared for virtual learning with pedagogical strategies for instruction and assessment designed for a virtual environment and would be referred to as virtual learning. Virtual learning through the district in this research study was provided through Canvas LMS and using Zoom to host live sessions with a selection of available digital tools. The virtual learning followed the regular bell schedule with students expected to attend classes online where they received live instruction and then were directed to complete synchronous or asynchronous learning activities.

Questions about the effectiveness of virtual learning have arisen and there have not been any standardized assessments to measure performance during the time that virtual learning was thrust upon students during the COVID-19 pandemic. The 2021 STAAR assessments offer a chance for the performance change since the last STAAR assessment to be compared between face-to-face and virtual learning environment students. This study will provide data on the learning and the related change in standardized assessment performance before and during COVID-19 for face-to-face and virtual learning students.

The research questions are:

1. Is there a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19? The null hypothesis is that there is not a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19. The alternative hypothesis is that there is a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19.
2. Is there a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19? The null hypothesis is that there is not a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19. The alternative hypothesis is that there is a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19.

Objectives

The main objective of the study is to compare students' performance on standardized assessments from before COVID-19 and during COVID-19. The secondary objective of the study is to compare face-to-face students and virtual learning students' change in performance on standardized assessments from before COVID-19 and during COVID-19.

Significance of the Study

The study of the impact of COVID-19 on learning by students in public education during the global pandemic has the potential to examine student learning at a time when the education system is facing one of its greatest challenges ever. Further research is needed to assess the fall-out of the COVID-19 pandemic on student learning (Engzell et al., 2021). As all stakeholders in education desire to gain insight into the effect of the pandemic on education and student learning, this study could provide some data and conclusions that could help gain an understanding of this effect and be used to help develop policies and practices moving forward.

The results of this study may give insight into student learning during the COVID-19 pandemic which has limited published research on it. Over the past couple of years, education has been disrupted and altered and there is little assessment of the impact on learning in public education, particularly in performance on state standardized assessments. This research study will add to the literature on COVID slide in standardized assessment performance in public education in Texas.

This study may also produce statistical data on differences in learning between face-to-face and virtual learning students measured by change in performance on standardized assessments. The study's primary objective is to determine if there is a statistically significant drop in performance on standardized assessments from before and during COVID-19, although,

a secondary objective is to compare if there is a statistically significant difference between face-to-face students and virtual learning students in change in performance on standardized assessments from before and during COVID-19. The degree of learning of students in virtual learning is a top-level concern of almost all stakeholders in education. This is an area that also has limited research on it as the COVID-19 pandemic has only existed for a little over three years at this time.

The results of this study may be used by individual schools, school districts, school boards, and local or state agencies in developing recommendations for future learning during and after the COVID-19 pandemic. The results could provide valuable data, information, and conclusions that may help policymakers develop policies and practices in learning during crises and while implementing virtual learning.

The study could also justify further studies on learning loss during the COVID-19 pandemic. The study could show results that warrant further investigation into why some subjects or groups experienced different amounts of learning loss than others. The study may also provide results that warrant further investigations on face-to-face learning versus virtual learning and why they have different levels of learning loss. The impact of COVID-19 on student learning and state standardized assessment performance is an extremely important issue in public education, it has numerous areas and avenues of potential investigations.

Assumptions and Limitations

The study assumed that the students performed to the best of their ability to demonstrate their learning while taking the standardized STAAR assessments.

This study will be delimited to a public independent school district of approximately 66 000 students in kindergarten through twelfth grade in a suburban community in Texas. The

study will be conducted with data from the standardized assessment performance of students over two grade levels in math and reading. The issue of student grades will not be covered by the study, although student grades are related to learning during the COVID-19 pandemic.

One possible limitation of the study is the lack of ability of the STAAR assessments to determine enrichment in learning. The STAAR assessments are designed to measure academic readiness based on subject for a grade level and may not measure the level of enrichment in learning for students meeting this academic readiness level. This may make it more difficult to differentiate learning between students that had previously acquired this academic readiness level. Another possible limitation of the study is the generalization of the results as the study is taking place in an independent school district with only a 13% economically disadvantaged student population. The low percentage of economically disadvantaged students increases the likelihood of widespread access to technology for virtual learning and may make the results difficult to generalize to other demographic areas. A third limitation of the study is the limited grades and subjects of the performance on the STAAR assessments being analyzed. These only represent the STAAR results over two grades from two subject areas, math and reading. As grade levels and subject matters are different, the results may not necessarily generalize to all ages and subject matters.

Definitions of Terms

For this study, the below list of terms is defined as follows:

COVID-19: COVID-19 is a novel coronavirus outbreak that the World Health Organization declared a global health emergency on January 30, 2020 (Velavan & Meyer, 2020). COVID-19 caused shutdowns in many industries all over the world, including education. The COVID-19 pandemic originated in China and is still active throughout the world today.

COVID slide: COVID slide is the term given to the learning loss and lack of motivation due to the disruption in education during the COVID-19 pandemic. The term is known among educators and researchers in the education field. COVID slide is a phenomenon that will have a high demand for research and action as schools attempt to recover during and after the COVID-19 pandemic.

STAAR: The State of Texas Assessments of Academic Readiness (STAAR) is a program that annually assesses core subjects at specific grade levels. STAAR often refers to the state of Texas annual standardized assessments that have existed in their current form since the spring of 2012 (Texas Education Agency, 2022).

Scale Score: Conversion of a raw score to a scale that is common to all STAAR assessment forms that allows for direct comparison of student performance across different assessment administrations. Scale score quantifies student performance relative to passing standards or proficiency levels (Texas Education Agency, 2022).

Percentile Score: A 100-point scale that allows for the comparison of student performance with the performance of other students who took the same assessment. The percentile represents the percentage of students that took the assessment and received a scale score less than the score of interest (Texas Education Agency, 2022).

Face-to-face: The learning environment where students attend their campus and are face-to-face with a teacher in a classroom. This can also be referred to as in-person or traditional learning. Face-to-face learning allows for live, in-person interaction between a learner, instructor, and peers.

Virtual learning: The learning environment where students learn online either asynchronously or synchronously. Virtual learning may or may not allow for live interaction between learner, instructor, and peers. Virtual learning is the term for the environment that almost all students were moved to at the emergence of the COVID-19 pandemic, although it varied in forms.

Performance: Student performance is the learning demonstrated by the amount of mastery of the learning objectives prescribed by a curriculum and measured through an aligned assessment. For this study, student performance is shown through how well students score and demonstrate learning on yearly state standardized assessments.

Summary

Chapter I presented an introduction to the study, an overview of the need for the study, the research questions, the significance, and limitations of the study. Chapter II reviews the literature related to the concepts discussed in this study. Chapter III details the study's methodology, including the research design, population, sample and selection, data collection, instrumentation, and analysis of data. Chapter IV includes the research findings, and Chapter V presents the summary and conclusions of the study.

CHAPTER II

LITERATURE REVIEW

The literature review explores the current research on COVID-19's effect on education, including school closure impacts, potential learning loss, and effectiveness of virtual learning. It also discusses the theoretical framework of effective instruction and effective assessment.

There is an issue with the impact of COVID-19 on learning by students in public education during the global pandemic (National Center for Educational Statistics, 2022). Learning can be measured in numerous ways, but an important measurement of learning from year to year in public education is by the performance on state standardized assessments. COVID-19 has had an impact on the education system since the beginning of the pandemic and may be affecting student learning. Future educational policies and decisions are dependent on knowing the effect COVID-19 had and is having on learning. Studies on learning loss during COVID-19 were slow to emerge, but three years into the pandemic studies are starting to address any potential learning loss taking place, also referred to as "COVID slide". During the COVID-19 pandemic, many students have spent some or all of their time learning virtually. The comparison of face-to-face learning and virtual learning is also an area with limited research from the learning during COVID-19.

School Closure Impacts

In early 2020, the COVID-19 pandemic spread rapidly around the world and forced educational institutions to take similar actions to all other industries and close their buildings to

help stop the spread of COVID-19. Initially, these closures were to last a few weeks, but they became prolonged school closures that impacted over 55 million students in at least 124 thousand schools in the United States (Hoffman & Miller, 2020). Worldwide, it impacted nearly 1.6 billion learners in more than 200 countries, which was more than 94% of the world's student population (Pokhrel & Chhetri, 2021). The effects of learning loss due to these extended closures are of great concern to the educational community and its stakeholders. Data on possible learning loss has been slow to emerge as the education sector does not post data at the frequency of other sectors like health care or the economy (Engzell, Frey, & Verhagen, 2021). With the ability of learning gaps to compound over time, this data is vital for the educational system and possible interventions. At the onset of the COVID-19 pandemic and the initial start of school closures, educational institutions rushed to move to virtual learning with little data on how the school closures may impact learning (Kuhfeld et al., 2020). Some of the earliest data on learning during school closures suggest an increased dispersion of assessment scores and a decrease in the amount of coursework being completed by students (Engzell et al., 2021). The very short timeframe to prepare and move learning to a virtual environment created a unique set of challenges and a limited time to fully prepare for the system-wide change. Educators used their current knowledge to move remotely with either synchronous learning, asynchronous learning, or a combination of the two. The method and rigor of virtual learning varied widely by state and school district (Bansak & Starr, 2021). Throughout the school closures, the majority of parents are concerned that their K-12 children have fallen behind academically (Kuhfeld et al., 2020).

COVID-19 caused the first large-scale school closures due to a pandemic in a century. The COVID-19 pandemic presents unique challenges that make it unclear how to use the lessons

of the past (Engzell et al., 2021). One study found that educational disruptions in World War II significantly affected the earnings of younger learners some 40 years later (Bansak & Starr, 2021). Most recent unplanned school closures were due to weather and natural disasters which made the COVID-19 pandemic closures unique without plans to transition to virtual learning in this type of emergency (Francom et al., 2021). The lack of plans for this type of emergency highlights the importance of current research on school closures due to the COVID-19 pandemic. This will help schools reflect and adjust to the current situation and develop plans for future similar situations. Educational institutions benefit greatly from plans to support learning through emergencies (Francom et al., 2021).

The potential learning loss through COVID-19 school closures presents current and future challenges for educational institutions across the country. To support students, curriculum and instruction teams will need data to guide them, especially for the groups most impacted by COVID-19 school closures (Kuhfeld & Tarasawa, 2020). Unfortunately, the uniqueness of the COVID-19 pandemic has limited studies on how teachers transitioned to virtual learning (Francom et al., 2021). This lack of research presents additional problems moving forward and recovering from the effects of the pandemic on learning. Teachers and schools have a need for knowing the amount of learning loss and the variations of learning loss (Kuhfeld et al., 2020). The initial lack of research and data provides a gap in preparing for the recovery of the COVID-19 school closures. Kuhfeld and Tarasawa (2020) state that collaborative and timely research will allow for the generalization of identified learning loss which will help define potential policies for recovery throughout the United States. Data and interpretation of the data from Texas STAAR assessments may also help identify learning loss for policy and pedagogical

decisions. The 2021 STAAR assessments were the first to take place in a two-year span, which includes the COVID-19 school closures and the implementation of virtual learning.

Potential Learning Loss

The potential learning loss from the initial and extended school closures was slow to emerge, but currently, some studies are being released that examine the issue and provide data. The short-term effects of the school closures on learning are starting to be determined, however, longer-term effects on learning may not be known for years. The findings of a study by Engzell et al. (2021) imply that students made little to no progress while in virtual learning. Another study projects students who returned from the school closures in the fall of 2020 had approximately 63 to 68% of learning gains in reading and 37 to 50% of learning gains in math when compared to a typical school year (Kuhfeld et al., 2020). Middleton (2020) suggests that the impact of school closures on educational measurements will be realized long after children return to school. The 2018-19 to 2019-2020 and 2019-20 to 2020-21 growth will be difficult to be calculated (Middleton, 2020) and those potential missing measurements will make learning loss less clear to educators. This also aligns with the concerns of teachers during this time. Many teachers fear most students fell behind during the school closures and will need help in catching up on their learning (Midcalf & Boatwright, 2020).

Current predictions and measurements of learning loss are coming from early studies or comparisons to other school closures. Literature on school closures due to weather and natural disasters, absenteeism, and summer vacation indicate negative effects on learning, with larger learning losses in mathematics (Kuhfeld et al., 2020). The extent of learning loss also increases in the upper grades (Kuhfeld & Tarasawa, 2020). Literature indicates that with the switch to virtual learning, student learning was impacted by various factors including stress, anxiety,

illness, and being forced to learn in a different method than previously experienced (Middleton, 2020). A conducive learning environment at home has also not been uniform for all students (Pokhrel & Chhetri, 2021). Some early studies have already found evidence of learning loss. A study out of the Netherlands could be described as a "best-case scenario" as they had a short lockdown and have world-leading rates of broadband internet access (Engzell et al., 2021). The Engzell et al. study (2021) states "there is clear evidence that students are learning less during the lockdown than in a typical year". Other projections are suggesting major learning impacts from COVID-19 school closures (Kuhfeld & Tarasawa, 2020). Measurements of learning loss may be worse than indicated as prior studies have reported incidences of academic dishonesty and cheating in virtual learning up to 12 times higher compared to face-to-face learning (el Refae et al., 2021).

In 2022, the National Center for Education Statistics conducted a special administration of the National Assessment of Educational Progress (NAEP) long-term trend reading and mathematics assessments for 9-year-old students to examine student achievement during the COVID-19 pandemic. The average scores showed a 5-point decline in reading, the largest average score decline since 1990, and a 7-point decline in mathematics, the first decline in mathematics ever (National Center for Educational Statistics, 2022). The results also show a widening of the score gap between white and black students in this time, from 25 points to 33 points (National Center for Educational Statistics, 2022). The discrepancy in performance between the groups justifies further examination of the COVID-19 pandemic's effect on learning by ethnicity groups. The lack of comparison between gender groups in many studies also justifies the examination of the COVID-19 pandemic's effect on learning by gender groups. In 2023, a report summarizing all their results for 9-year-old and 13-year-old students dating back

to 1970 is scheduled to be released. The return of state standardized assessments should assist in providing a more complete picture of levels of learning loss. Some school districts were also proactive in preparing for learning loss by having students attend summer school to make up for lost learning (Middleton, 2020).

Regionally, despite serious declines across the country, Texas had mostly positive results on the NAEP. Texas improved its rank in fourth and eighth grade reading and in eighth grade mathematics (National Center for Educational Statistics, 2022). Texas also had numerous other areas of success on the NAEP, including the following: in fourth grade mathematics, Texas students scored four points higher than the national average, in fourth grade reading Texas student subgroups performed well compared to their peers, in eighth grade mathematics several Texas student subgroups improved their rankings, and in eighth grade reading Texas student subgroups made very large gains in the national rankings (National Center for Educational Statistics, 2022). The NAEP provides a good measure of comparison with other states in reading and mathematics learning improvement. These gains in Texas are relative to other states, however, and may still reflect an overall decline in learning.

Effectiveness of Virtual Learning

One of the greatest factors in the amount of learning loss during school closures could be the effectiveness of the virtual learning that most of the students around the United States were forced to start in March 2020. The length of time in virtual learning varied by state, some states resumed in-person in September of 2020 and some states remained solely in virtual learning for the next full school year. Numerous issues with the effectiveness of virtual learning have been raised. Many K-12 students and teachers had little or no experience with online learning before this movement to virtual learning in March 2020 (Kuhfeld et al., 2020). Teachers found it

difficult to find resources and to set up online learning courses (Francom et al., 2021). The inexperience in virtual learning may contribute to student learning loss as it requires different pedagogy and learning design. Virtual learning is not the same as face-to-face learning and effective pedagogical approaches differ (Yates et al., 2021). Teachers need to use pedagogies that are effective in virtual learning. These approaches are required not only to increase learning but also to increase student motivation in virtual learning (Yates et al., 2021). Students that were missing proper structure in the lessons would experience a decline in understanding and enjoyment in all subjects (Lauret & Bayram-Jacobs, 2021). Teachers also found it difficult to measure the learning that was taking place in virtual learning (Hamaidi et al., 2021). A crucial part of online learning is assessment and providing timely feedback (Pokhrel & Chhetri, 2021).

Another significant reported issue with virtual learning is the contact that teachers had with students. Kuhfeld et al. (2020) reported that there were concerning signs that many teachers had no contact at all with a large number of their students. Teachers not only found it difficult to communicate with students, but they also found it difficult to have them participate and keep them engaged and motivated. Along with this lack of motivation and engagement, teachers noticed the lack of parent involvement and support in virtual learning (Francom et al., 2021). All these factors also could have contributed to the amount of work students were completing. During the virtual learning of COVID-19, many teachers reported students not completing the work associated with virtual learning (Midcalf & Boatwright, 2020). Another negative aspect of virtual learning was a lack of peer-to-peer interaction and the lack of communication among students (Lee et al., 2021). This lack of social interaction may cause additional learning loss during the virtual learning of the COVID-19 pandemic.

Technology issues were also of major concern during virtual learning. There were large gaps in technology and access and many students lacked the means to access the virtual learning and materials from home (Kuhfeld et al., 2020). The lack of technology and access disproportionately impacted vulnerable children, including students with limited resources and support from home (Hoffman & Miller, 2020). The National Assessment of Educational Progress long-term trend assessment found of the 9-year-old students who performed at or above the 75th percentile in the assessment had greater access than the students who performed below the 25th percentile (National Center for Educational Statistics, 2022). The discrepancy in performance justifies further examination of the COVID-19 pandemic's effect on learning by economic status groups. Teachers not only lacked experience in virtual learning but also in the technical aspects of virtual learning. Teachers found it challenging to support computer and internet access during virtual learning (Francom et al., 2021).

While virtual learning did have many challenges, it also presented some opportunities in learning. The COVID-19 pandemic has provided the opportunity to pave the way to introducing digital learning (Pokhrel & Chhetri, 2021). Virtual learning has the ability to present content in multiple ways and has methods to personalize learning for students (Midcalf & Boatwright, 2020). Previous research on student academic performance in face-to-face learning versus virtual learning shows mixed results, but some of them favor virtual learning (el Refae et al., 2021). However, there were other reported results during the initial virtual learning that bring into question its' effectiveness and it may have impacted learning. Teachers did not feel that they had a clear understanding of how the virtual learning classes were to be run and some schools did not allow teachers to have sessions to teach new content (Francom et al., 2021). There were also cases of a lack of standardization of virtual learning and less new material was

taught, especially in low-SES schools (Middleton, 2020). Virtual learning was also more difficult for teachers to obtain accurate assessments due to their lack of experience in the environment and the significantly higher cheating rate in virtual learning (el Refae et al., 2021). The effectiveness of virtual learning has many components to consider and a number of them may have and may continue to impact the amount of learning taking place in the virtual learning environment.

Theoretical Framework

The theoretical framework considered throughout this research is based on the aspects of effective instruction and effective assessment. Effective instruction results in learning and learning is accurately measured by aligned effective assessments are acknowledged by this research, and both concepts are being considered. Planning and delivering research-based, effective instructional strategies provides the best opportunity for students to learn and master learning objectives (Dean et al., 2012). The COVID-19 pandemic forced schools to shift from face-to-face instruction to virtual learning instruction. As a result, the characteristics of effective instruction changed (Yates et al., 2021) and included, but are not limited to, the following changes. Student engagement and interaction can be different for virtual learning. Virtual learning can be isolating and disengaging for students, so effective instruction during the pandemic required teachers to find new ways to keep students engaged and connected (Lee et al., 2021). Virtual learning is also dependent upon and facilitated around technology integration. Effective instruction during the pandemic required technology to be integrated effectively into learning and synchronous interactions occurred through videoconferencing tools. Clear communication and expectations and structure had become more integral during virtual learning. Educators were required to provide clear instructions, expectations, and feedback during

effective virtual learning instruction (Lauret & Bayram-Jacobs, 2021). Finally, accessibility and equity issues were required to be addressed for effective instruction (Kuhfeld et al., 2020). Disparities in access required educators to be mindful of inequalities in the planning and delivery of educational resources and opportunities. The characteristics of effective instruction have shifted during the pandemic to reflect the unique challenges and opportunities of virtual learning models. Educators had to address the changing needs of students, while also maintaining standards for academic achievement and student engagement.

Effective assessments provide evidence about learning and can be used for the purpose of student mastery or instructional effectiveness (Chappuis, 2015). The shift from face-to-face instruction to virtual learning instruction also changed the characteristics of effective assessment. As with instruction, virtual learning assessment is also dependent upon and facilitated around technology integration. Both formative and summative assessments had to be through digital assessment tools to assess student learning. Digital assessment tools often provided real-time data; however, assessment integrity was more challenging to ensure (el Refae et al., 2021). The real-time data was necessary to gauge student learning as there was not the same presence as in the face-to-face classroom (Pokhrel & Chhetri, 2021). The difficulty in proctoring assessments also required educators to use alternative assessments, such as performance tasks or projects. Alternative assessments are different from traditional tests and quizzes and often involved more application of learning. This style of assessment was less utilized by educators, and less common to students, before the pandemic. Finally, the same accessibility and equity issues that affected instruction were present during assessment. Disparities in access required instructors to be mindful of inequalities in the planning and delivery of student learning assessments. The characteristics of effective assessment also shifted during the pandemic to reflect the unique

challenges and opportunities of virtual learning models. The items of effective instruction and effective assessment provide a well-suited framework for investigating how the COVID-19 pandemic has affected the learning of students in public education and is presented in Figure 1.

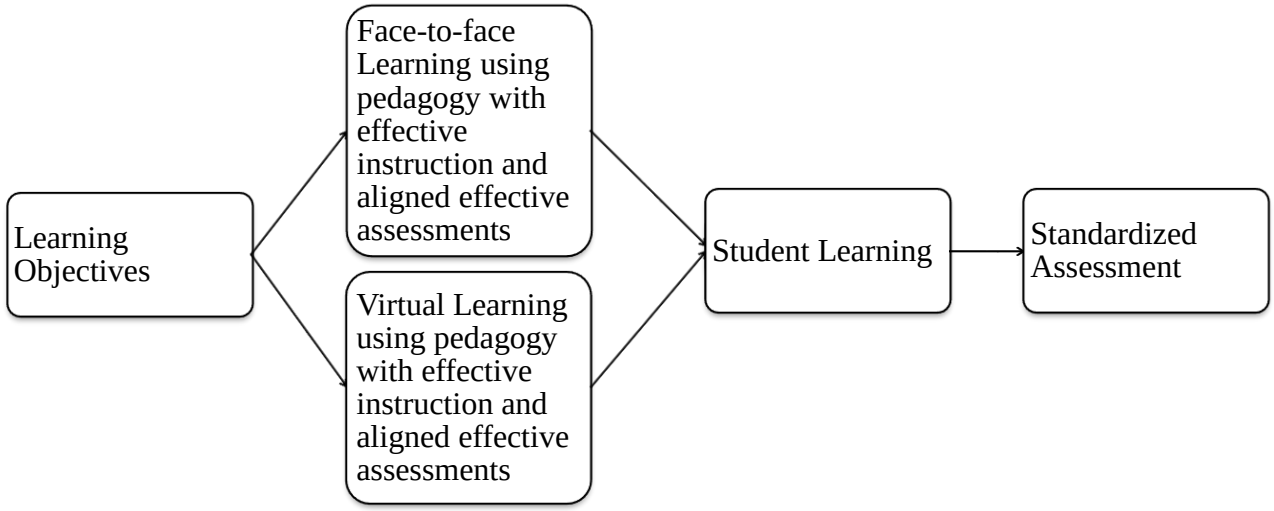

Figure 1. *Theoretical Framework Visualization*

Summary

This chapter presented the current literature on COVID-19's effect on education, including school closure impacts, potential learning loss, and effectiveness of virtual learning. It also explained the theoretical framework of effective instruction and effective assessment that the study is designed around. There is limited research on the COVID-19 pandemic's effect on the learning of students in public education and very limited research on the long-term effects of COVID-19 on student learning. This study focuses on how the COVID-19 pandemic has affected the learning of students in public education. The next chapter presents the methodology used in this study to explore the performance of students on state standardized assessments

before COVID-19 and during COVID-19 and comparing performance between face-to-face students and virtual learning students.

CHAPTER III

METHODOLOGY

There is an issue with the impact of COVID-19 on learning by students in public education during the global pandemic (National Center for Educational Statistics, 2022). Learning can be measured in numerous ways, but an important measurement of learning from year to year in public education is by the performance on state standardized assessments. Comparing the performance on standardized assessments before COVID-19 and during COVID-19 has the potential to help understand any effect the COVID-19 global pandemic has had on student learning. Comparing face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19 also has the potential to help understand the effect learning environment has on student learning. The purpose of this research study is to examine how the COVID-19 pandemic has affected the learning of students in public education.

This chapter describes the methodology that was selected for this research study, including the research method and design appropriateness, the participants of the study, data collection, the instrumentation, and the data analysis procedures. In addition, it provides the rationale for how this study examines the problem of the impact of COVID-19 on learning by students in public education.

Research Method and Design Appropriateness

An observational study design was chosen because the effect of a variable is being observed without affecting who is being exposed to the variable. The study is a causal-comparative study using archival data provided by the district and data available in public records. This type of study is appropriate and most suitable to determine the effect the COVID-19 global pandemic has had on student learning and the effect learning environment has on student learning as measured by standardized assessments.

The causal-comparative study will involve before COVID-19 and during COVID-19 conditions and the effect this change in condition has on student learning measured by state standardized assessment scores. The second part of the study will involve an independent variable of face-to-face or virtual learning and a dependent variable of student learning measured by the change in state standardized assessment scores. Comparison of state standardized assessment scores in math and reading for the same group of students will occur from the first year of assessments during COVID-19 to the last year of assessments before COVID-19. The change in standardized assessment scores will be compared for students that spent the first full year of school during COVID-19 in face-to-face learning environment with students that spent the first full year of school during COVID-19 in virtual learning environment.

The study will use Texas STAAR standardized assessment data from the spring of 2019 and the spring of 2021. The 2019 STAAR assessment data will be based on learning before COVID-19 and before separation of students into face-to-face and virtual learning environments and the 2021 STAAR assessment data will be based on learning during COVID-19 and during separation of students into face-to-face and virtual learning environments. The difference in the results of the STAAR assessment data will be used to determine the effect the COVID-19 global

pandemic has had on student learning and the effect learning environment has on student learning.

The causal-comparative study design with the use of archival state standardized assessments data will provide the data necessary to examine the effect the COVID-19 global pandemic has had on student learning and the effect learning environment has on student learning. This style of study is the best choice to obtain data from a large sample size and tabulate and analyze the data of the chosen state STAAR standardized assessments. It also provides an appropriate method to examine the differences in change in assessment scores for students in face-to-face learning with students in virtual learning. The observational study approach provides the best option for examining the effect of a variable that was not controlled.

Research Questions

The research question is there a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19? The null hypothesis is that there is not a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19. The alternative hypothesis is that there is a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19. A second research question is there a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19? The null hypothesis is that there is not a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19. The alternative hypothesis is that there is a statistically

significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19.

Population

The population of this study is the students at a suburban public independent school district located in Texas. The population of the public school district consists of approximately 66 000 students in grades K – 12. The ethnic breakdown of the population is as follows: 36.8% Asian, 33.7% White, 12.9% Hispanic, 11.1% African American, 4.9% two or more races, and 0.6% other. Notable categories of the population include 13% economically disadvantaged, 9% emergent bilingual, and 10% students served by special education.

Sample

The sample consisted of the students of the district selected through criteria sampling as they met the following criteria: they had both 5th and 7th grade math/reading STAAR scores and were either fully face-to-face learning or fully virtual learning during the 2020-2021 school year (apart from the first three weeks where all students were learning virtually). The sample of students with 5th and 7th grade math STAAR scores totaled 3172 students from 17 different middle schools during the 2020-2021 school year. The sample of students with 5th and 7th grade reading STAAR scores totaled 3379 students from 17 different middle schools during the 2020-2021 school year.

Students that did not have scores for one or both 5th and 7th grade math STAAR or the 5th and 7th grade reading STAAR were excluded from the respective sample. The reason for their exclusion is the inability to compare their change in STAAR performance from before and during COVID-19. Students that changed their learning environment during the school year were also excluded from the sample. They were excluded because they could not be compared

by learning environment as they were not solely in one type of learning environment for the school year. Even with the exclusions, the sample was most of the potential students in the corresponding cohort and was sufficient to create a representative sample size.

Informed Consent and Confidentiality

Authorization to conduct the research was obtained from the district through the data analyst and the research review board of the independent school district. The data does not contain any student names or student ID numbers so they cannot be traced back to individual students. All students remained anonymous, and all student information remained confidential as students were not identified in the data in any manner.

Data Collection

This study used a single data collection method. A request was made for archival data from the district which included: 2021 7th grade math STAAR scores with corresponding student 2019 5th grade math STAAR scores, 2021 7th grade reading STAAR scores with corresponding 2019 5th grade reading STAAR scores, learning environment of each student for the 2020-21 school year with gender, ethnicity, and economically disadvantaged identifiers. The data were in the form of a spreadsheet that was able to be used to analyze the collected data.

The collected quantitative data were convenient for a large number of participants and provided a statistical comparison. The concept of learning can be measured in other ways, but a quantitative approach was most appropriate for this study. A qualitative or interview approach would have reduced the sample size and not provided the same statistical analysis of the data. Other measurements of learning would have changed the design of the study from the desired design used in this study. The state STAAR assessment scores were the most appropriate available data to measure yearly student learning.

Instrumentation

A standardized instrument for learning was used in this study. The instrument was the state of Texas STAAR (State of Texas Assessments of Academic Readiness) assessments for math and reading. As the STAAR assessments are designed for students across the state, it should be generalizable from the sample to a similar larger population. The STAAR assessments already have established reliability and validity. Independent evaluations of the reliability and validity of the STAAR assessments are conducted every year (Ivy & Szabo, 2019). The STAAR assessments evaluate the learning objectives of individual courses which made it an appropriate instrument for measuring learning for the study. The STAAR assessments convert the raw score to a scale score on each assessment that allows for tracking of expected performance improvement from year to year. The STAAR assessments also convert scale score to percentile score for the comparison of student performance with the performance of other students who took the same assessment.

Data Analysis

The data analysis consisted of analyzing two sets of data, the math STAAR scores and the reading STAAR scores. For each set of data, the corresponding individual student's 2021 percentile score, 2019 percentile score, and change in percentile score via the difference between the 2021 percentile score and the 2019 percentile score were calculated. Then several statistical assessments were conducted to examine the effect the COVID-19 pandemic has had on student learning and the effect learning environment has on student learning, and to answer the research questions. A summary of the data variables is presented in Table 1.

Table 1

Summary of Data Variables

Variable	Level of Measurement	Range of Possible Scores
Gender	Nominal	
Ethnicity	Nominal	
Economically Disadvantaged	Nominal	
Learning Environment	Nominal	
2019 Scale Score	Interval	864 to 2084
2021 Scale Score	Interval	946 to 2181
2019 Percentile Score	Ratio	0 to 100
2021 Percentile Score	Ratio	0 to 100
Change in Percentile Score	Interval	-100 to 100

For the first research question, using a data analysis software, a t-Test for dependent samples was conducted to compare percentile scores on the STAAR assessment during COVID-19 (2021) and before COVID-19 (2019). This test was completed for both the math and reading STAAR data. This test examined if there is a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19. A t-Test for dependent samples was an appropriate test to conduct as the pretest and post-test scores from the same group were being compared (Salkind, 2017). The use of a parametric test was justified as there was a large sample size. Next, a one-way ANOVA was conducted on the change in percentile scores for the math and reading STAAR assessments with the students divided into groups by ethnicity identifier. This test compared the difference in the effect the COVID-19 pandemic has had on student learning by ethnicity groups. A one-way ANOVA was an appropriate test to conduct as the change in percentile scores was being compared for more than two unrelated groups (Salkind, 2017). Finally, a t-Test for independent samples was

conducted on change in percentile scores for the math and reading STAAR assessments with the students divided into groups by gender and then again for students divided by economically disadvantaged status. These tests compared the difference in the effect the COVID-19 pandemic has had on student learning by gender and economic status groups. A t-Test for independent samples was an appropriate assessment to conduct as the change in percentile scores was being compared for two unrelated groups (Salkind, 2017).

For the second research question, using a data analysis software, a t-Test for independent samples was conducted on change in percentile scores for the STAAR assessments with the students divided into groups by learning environment. This test was completed for both the math and reading STAAR data. This test compared the difference in the effect the COVID-19 pandemic has had on student learning by learning environment. A t-Test for independent samples was an appropriate test to conduct as the change in percentile scores was being compared for two unrelated groups (Salkind, 2017). The use of a parametric test was justified as there was a large sample size that could have contained different spreads for the two groups.

The two types of t-Tests and the one-way ANOVA provided the desired results in differences in the STAAR assessment data to determine the effect the COVID-19 global pandemic has had on student learning and the effect learning environment has on student learning.

Summary

This chapter detailed the methodology applied to address the research questions. The study applies a causal-comparative study design through the use of archival data of state standardized assessment scores from middle school students selected by a criteria sampling method. Several t-Tests and ANOVA data analyses were conducted to examine the effect the

COVID-19 global pandemic has had on student learning and the effect learning environment has on student learning. Differences in these scores may help answer the research questions and provide insight into how the COVID-19 pandemic and learning environment may affect student learning.

CHAPTER IV

FINDINGS

The purpose of this quantitative research study was to examine how the COVID-19 pandemic has affected the learning of students in public education through standardized assessment performance. The study also compared learning environments of face-to-face and virtual learning students' change in performance on standardized assessments. Archival data from the district were collected which included: 2021 7th grade math STAAR scores with corresponding student 2019 5th grade math STAAR scores, 2021 7th grade reading STAAR scores with corresponding 2019 5th grade reading STAAR scores, learning environment of each student for the 2020-21 school year with gender, ethnicity, and economically disadvantaged identifiers.

The first section of the findings includes the demographic information of the sample for the math STAAR data and reading STAAR data. The second section of the findings reiterates the research questions. The third section presents the data analysis of the findings based on the research questions.

Demographic Information

The sample for this study consisted of the students of the district selected through criteria sampling. A total of 3172 students had both 5th and 7th grade math STAAR scores and were either fully face-to-face learning or fully virtual learning during the 2020-2021 school year (apart from the first three weeks where all students were learning virtually). A total of 3379 students

had both 5th and 7th grade reading STAAR scores and were either fully face-to-face learning or fully virtual learning during the 2020-2021 school year (apart from the first three weeks where all students were learning virtually).

Math STAAR Demographics

The sample of students that had both 5th and 7th grade math STAAR scores (*N* = 3172) represented the ethnicities of White (1388, 43.8%), Asian (948, 29.9%), Hispanic (377, 11.9%), African American (282, 8.9%), two or more races (150, 4.7%), and other (27, 0.8%). The math STAAR score sample was 49.5% (*N* = 1570) female and 50.5% (*N* = 1602) male. The economically disadvantaged breakdown of the sample was 87.3% (*N* = 2770) no and 12.7% (*N* = 402) yes. The sample representativeness of the population was within 0.5% for economically disadvantaged status and within 10.1% for all ethnicity groups, within 2.2% for four of the six ethnicity groups. In terms of learning environment, the sample consisted of 62.6% (*N* = 1987) of students in face-to-face learning and 37.4% (*N* = 1185) of students in virtual learning. This demographic information is presented in Figures 2, 3, 4, and 5.

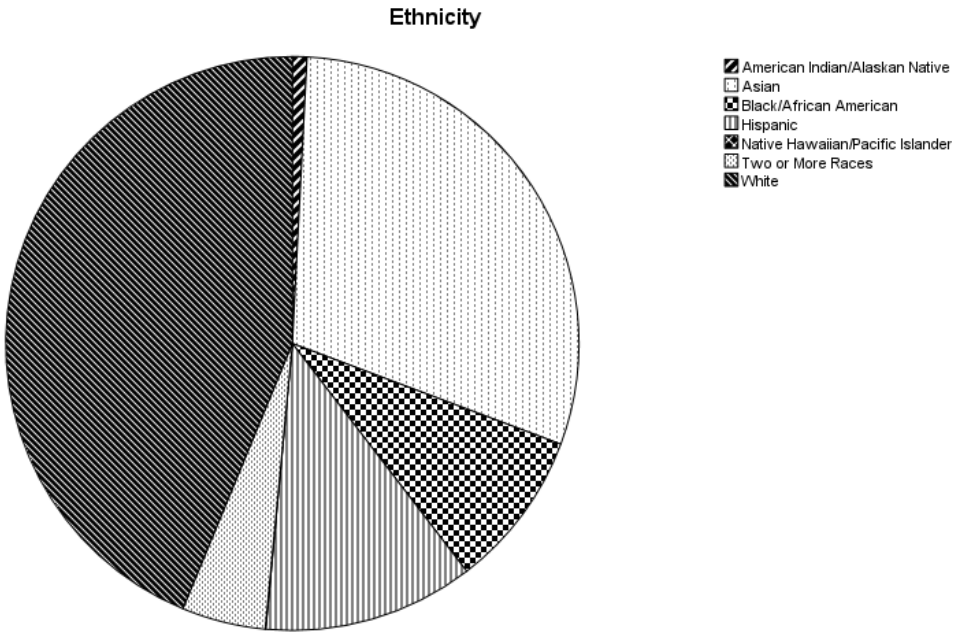

Figure 2. *Distribution of Ethnicity in Math STAAR Data*

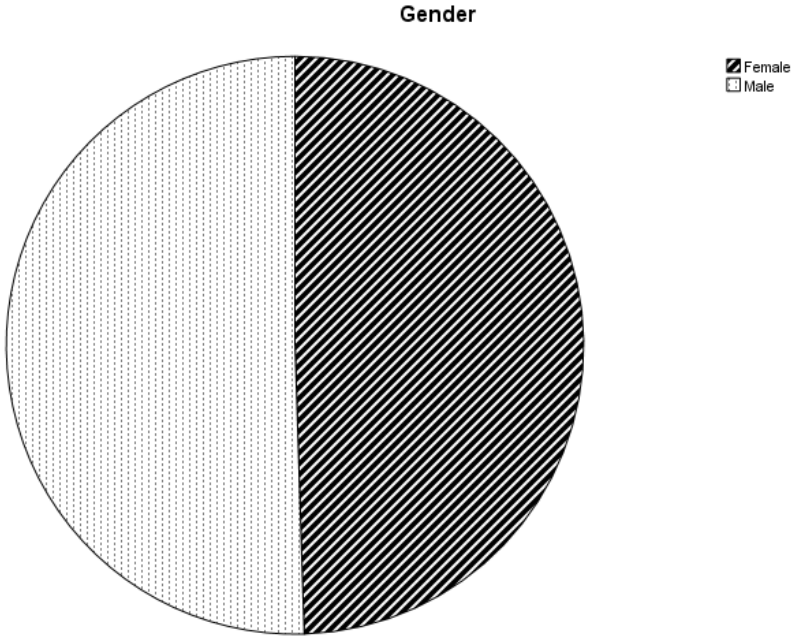

Figure 3. *Distribution of Gender in Math STAAR Data*

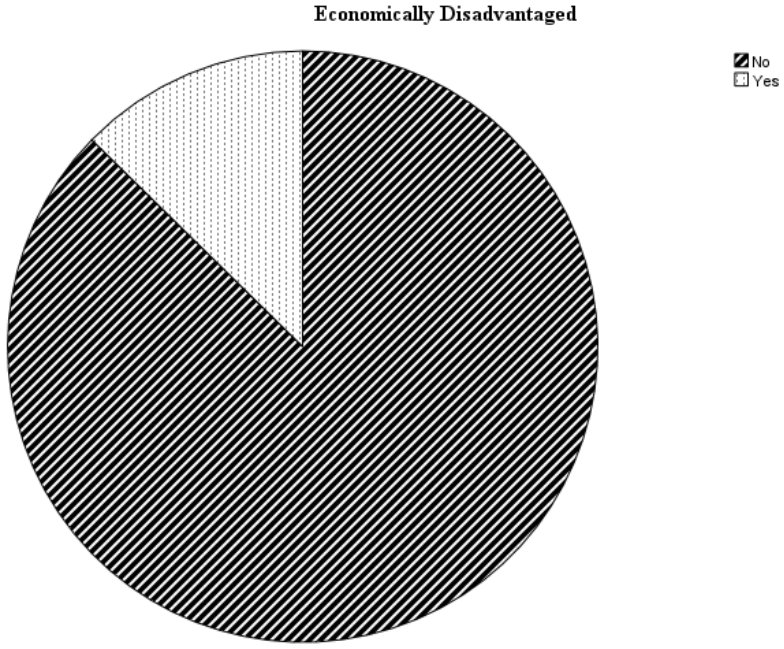

Figure 4. *Distribution of Economically Disadvantaged in Math STAAR Data*

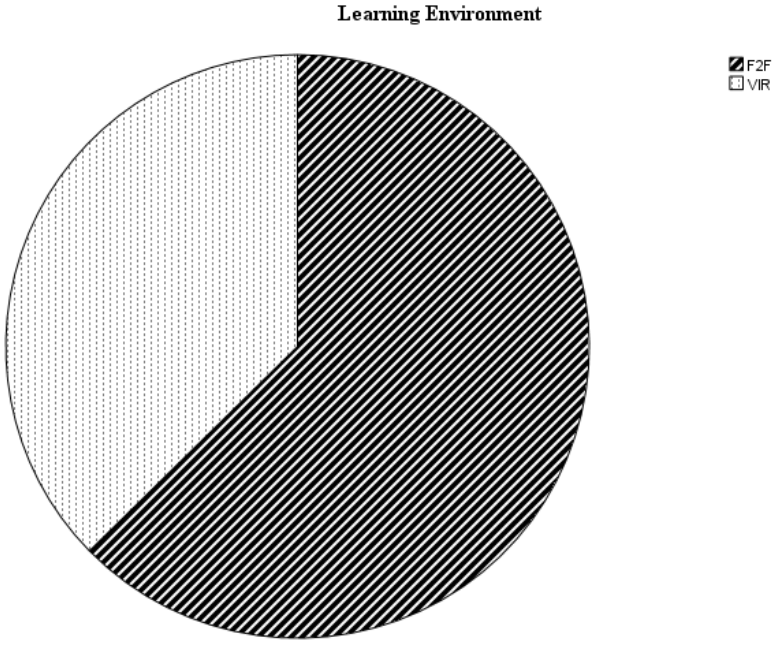

Figure 5. *Distribution of Learning Environment in Math STAAR Data*

Reading STAAR Demographics

The sample of students that had both 5th and 7th grade reading STAAR scores (*N* = 3379) represented the ethnicities of White (1402, 41.5%), Asian (1146, 33.9%), Hispanic (380, 11.2%), African American (273, 8.1%), two or more races (147, 4.4%), and other (31, 0.9%). The reading STAAR score sample was 48.2% (*N* = 1628) female and 51.8% (*N* = 1751) male. The economically disadvantaged breakdown of the sample was 88.0% (*N* = 2974) no and 12.0% (*N* = 405) yes. The sample representativeness of the population was within 1% for economically disadvantaged status and within 7.8% for all ethnicity groups, within 3% for five of the six ethnicity groups. In terms of learning environment, the sample consisted of 59.2% (*N* = 2002) of students in face-to-face learning and 40.8% (*N* = 1377) of students in virtual learning. This demographic information is presented in Figures 6, 7, 8, and 9.

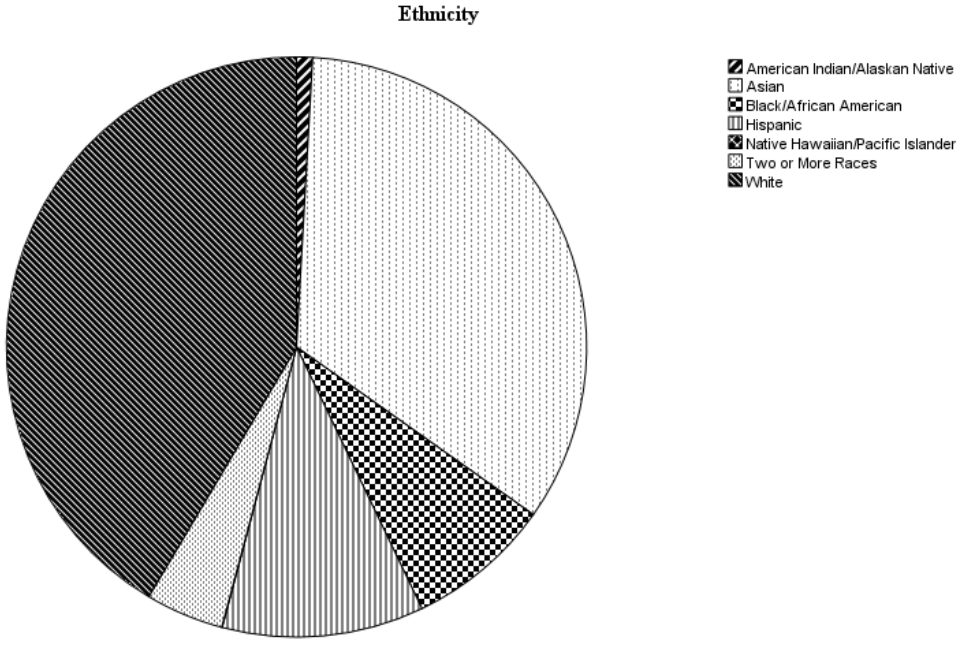

Figure 6. *Distribution of Ethnicity in Reading STAAR Data*

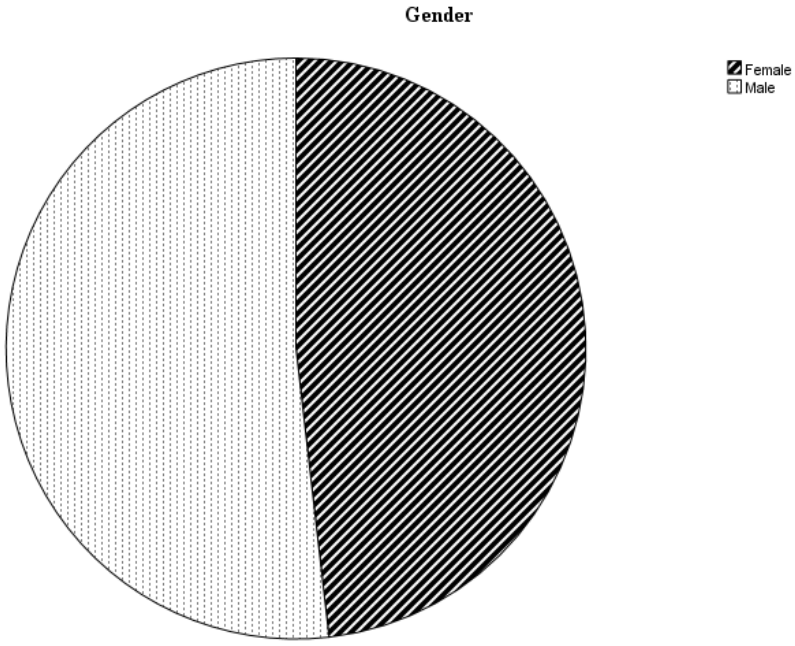

Figure 7. *Distribution of Gender in Reading STAAR Data*

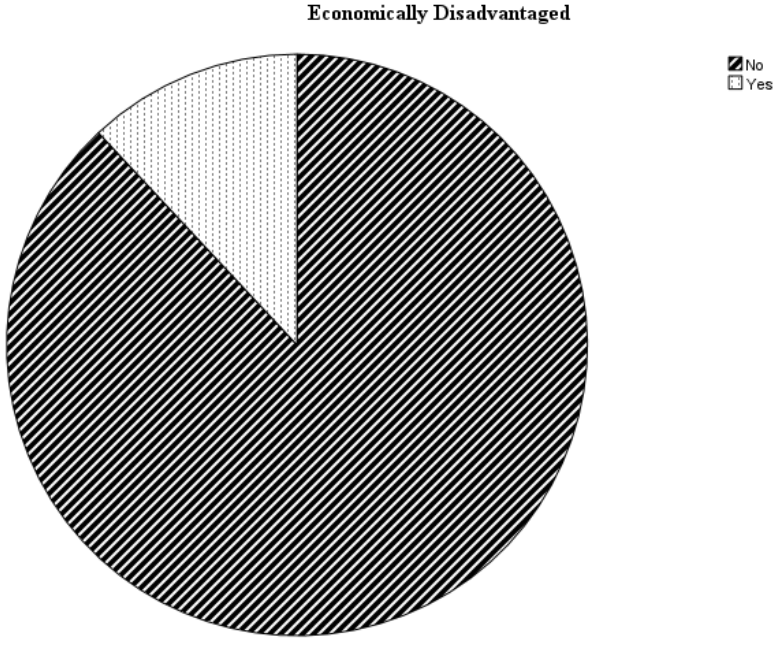

Figure 8. *Distribution of Economically Disadvantaged in Reading STAAR Data*

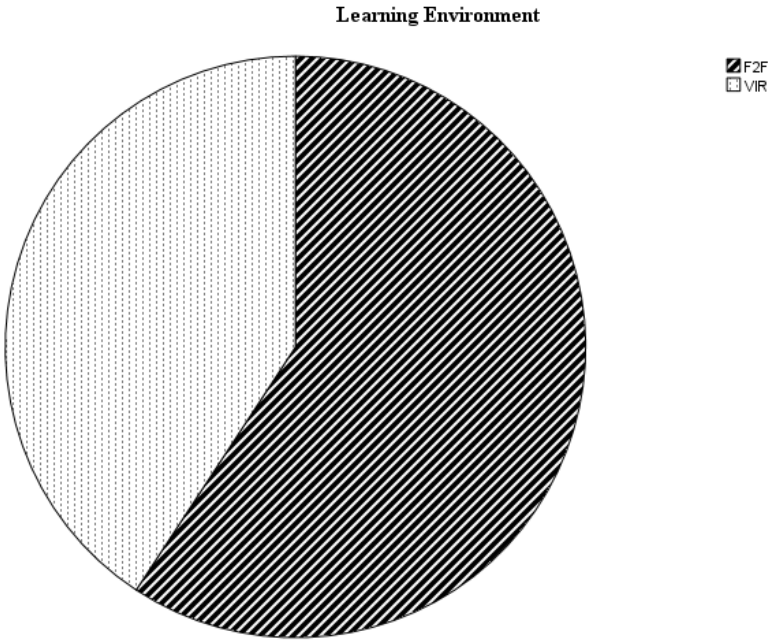

Figure 9. *Distribution of Learning Environment in Reading STAAR Data*

Research Questions

The two research questions presented in Chapter I were used as the parameters for this study. The research questions were as follows:

1. Is there a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19?
2. Is there a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19?

Overall District STAAR Passing Performance

The passing rate (Approaches, Meets, or Masters expectations) on the 2021 7th grade math STAAR assessment for the district was 85% of all students and on the 2019 5th grade math

STAAR assessment for the district was 94% of all students. This represents a decrease of 9% in the passing rate for the math STAAR assessment for the cohort. The passing rate (Approaches, Meets, or Masters expectations) on the 2021 7th grade reading STAAR assessment for the district was 90% of all students and on the 2019 5th grade reading STAAR assessment for the district was 91% of all students. This represents a decrease of 1% in the passing rate for the reading STAAR assessment for the cohort. These passing rates, and the passing rates of all other STAAR assessments for the district in 2019 and 2021, are presented in Figure 10.

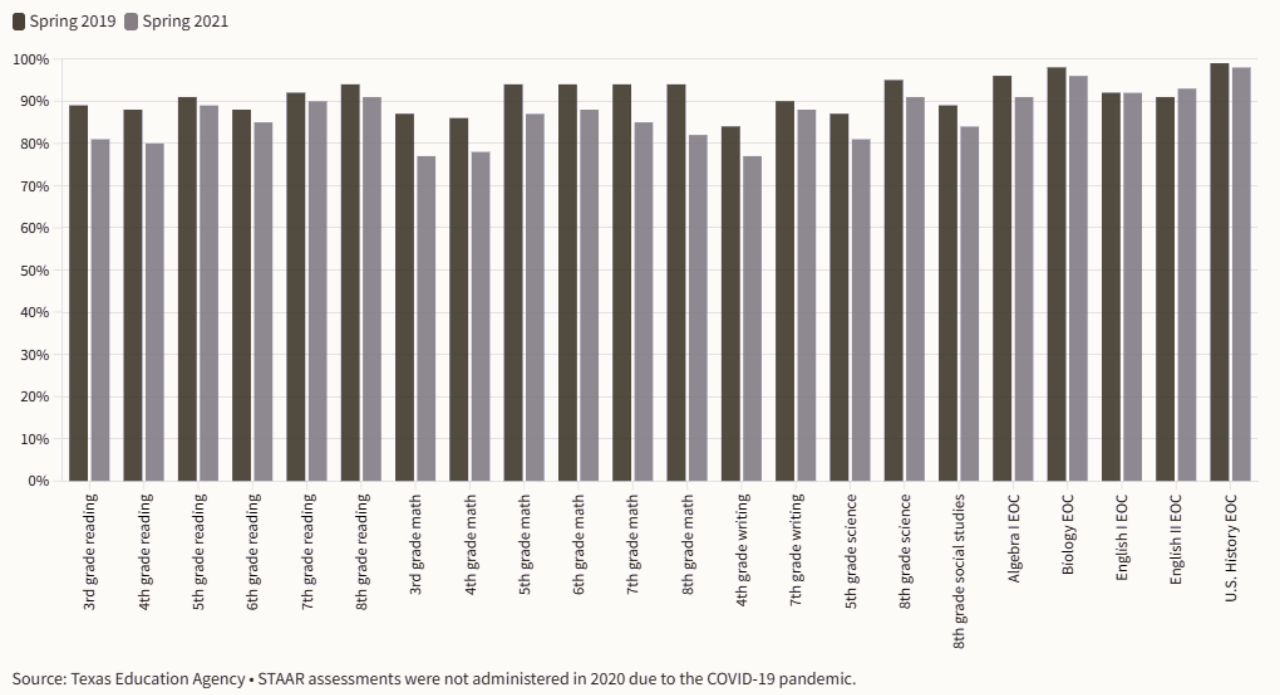

Figure 10. *The District STAAR Passing Rates for 2019 and 2021*. Used with permission from "STAAR results show the district high schools scored better than students statewide," by B. Cooper, 2021, *Community Impact*, Copyright 2021 by Community Impact Newspaper Co. Charts compiled by Community Impact Newspaper staff.

Research Question 1 Results

The first research question proposed is there a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19. The null hypothesis is that there is not a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19. The alternative hypothesis is that there is a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19.

Math STAAR Percentile Scores

The 2021 7^{th} grade math percentile scores and 2019 5^{th} grade math percentile scores both have a sample size of 3172. The 2021 percentile scores have a mean of 68.515 and a standard deviation of 27.755 with a standard mean error of 0.493. The 2019 percentile scores have a mean of 71.567 and a standard deviation of 28.020 with a standard mean error of 0.498. The full descriptive analysis data is found in Table 2.

A t-Test for dependent samples was conducted on the 2021 and 2019 math STAAR percentile scores. The math STAAR assessment was given to the same group at the end of the 2021 and 2019 school years. With a sample of 3172 participants, a dependent samples t-Test was conducted to compare the math STAAR percentile scores before and during COVID-19. There was a significant difference in the 2021 scores (M = 68.515, SD = 27.755) and the 2019 scores (M = 71.567, SD = 28.020); $t(3171) = -9.846$, $p < .001$. These results suggest a decrease in math STAAR percentile scores by 3.052 percentile points. Table 3 displays the data from the analysis.

Table 2

Math STAAR Percentile Scores 2019 and 2021 Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	2021 Percentile	68.5148	3172	27.75453	.49280
	2019 Percentile	71.5668	3172	28.02018	.49751

Table 3

Paired Samples Test Statistics for 2019 and 2021 Math STAAR Percentile Scores

		Paired Differences							Significance	
					95% Confidence Interval of the Difference					
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	One-Sided p	Two-Sided p
Pair 1	2021 Percentile - 2019 Percentile	-3.05202	17.45754	.30997	-3.65978	-2.44426	-9.846	3171	<.001	<.001

From the data analysis, we can reject the null hypothesis that there is not a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19 when analyzing the math STAAR assessments.

Reading STAAR Percentile Scores

The 2021 7th grade reading percentile scores and 2019 5th grade reading percentile scores both have a sample size of 3379. The 2021 percentile scores have a mean of 68.641 and a standard deviation of 26.324 with a standard mean error of 0.453. The 2019 percentile scores have a mean of 70.194 and a standard deviation of 26.527 with a standard mean error of 0.456. The full descriptive analysis data is found in Table 4.

A t-Test for dependent samples was conducted on the 2021 and 2019 reading STAAR percentile scores. The reading STAAR assessment was given to the same group at the end of the

2021 and 2019 school years. With a sample of 3379 participants, a dependent samples t-Test was conducted to compare the reading STAAR percentile scores before and during COVID-19. There was a significant difference in the 2021 scores (M = 68.641, SD = 26.324) and the 2019 scores (M = 70.194, SD = 26.527); $t(3378) = -4.860$, $p < .001$. These results suggest a decrease in reading STAAR percentile scores by 1.553 percentile points. Table 5 displays the data from the analysis.

Table 4

Reading STAAR Percentile Scores 2019 and 2021 Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	2021 Percentile	68.6407	3379	26.32435	.45286
	2019 Percentile	70.1941	3379	26.52714	.45635

Table 5

Paired Samples Test Statistics for 2019 and 2021 Reading STAAR Percentile Scores

		Paired Differences							Significance	
					95% Confidence Interval of the Difference					
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	One-Sided p	Two-Sided p
Pair 1	2021 Percentile - 2019 Percentile	-1.55342	18.57979	.31963	-2.18010	-.92673	-4.860	3378	<.001	<.001

From the data analysis, we can reject the null hypothesis that there is not a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19 when analyzing the reading STAAR assessments.

Math Change in STAAR Percentile Score by Ethnicity

The White group has a sample size of 1388 with a mean of -4.517, a standard deviation of 18.417, and a range of 150. The Asian group has a sample size of 948 with a mean of -0.016,

a standard deviation of 14.278, and a range of 136. The Hispanic group has a sample size of 377 with a mean of -3.019, a standard deviation of 18.851, and a range of 117. The African American group has a sample size of 282 with a mean of -5.606, a standard deviation of 17.620, and a range of 107. The two or more races group has a sample size of 150 with a mean of -4.213, a standard deviation of 19.757, and a range of 123. The other group has a sample size of 27 with a mean of -1.704, a standard deviation of 19.711, and a range of 82. The full descriptive analysis data is found in Table 6.

A one-way analysis of variance was conducted on the change in percentile score on the 2021 7th grade math STAAR assessment from the 2019 5th grade math STAAR assessment. With a sample of 3172 data points, a one-way analysis of variance was conducted to compare the change in percentile score in White (N = 1388), Asian (N = 948), Hispanic (N = 377), African American (N = 282), two or more races (N = 150), and other (N = 277) groups. The means of the six ethnicity groups were unequal according to a one-way ANOVA; $F(5,3166) = 9.178$, $p < .001$. The change in percentile score for groups were White (M = -4.517, SD = 18.417), Asian (M = -0.016, SD = 14.278), Hispanic (M = -3.019, SD = 18.851), African American (M = -5.606, SD = 17.620), two or more races (M = -4.213, SD = 19.757), and other (M = -1.704, SD = 19.711). Pairwise comparisons of the means using Tukey's Honestly Significant Difference procedure indicated two significant comparisons: the African American group scored significantly ($p < .001$) lower than the Asian group by -5.591 percentile points and the White group scored significantly ($p < .001$) lower than the Asian group by -4.501 percentile points in change in percentile score in math. The other comparisons were not significant (p = n.s.). The data from the analysis is displayed in Tables 7 and 8.

Table 6

Descriptives for Math STAAR Change in Percentile Score by Ethnicity

Change in Percentile Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
White	1388	-4.5166	18.41653	.49433	-5.4863	-3.5469	-76.00	74.00
Asian	948	-.0158	14.27793	.46373	-.9259	.8942	-59.00	77.00
Hispanic	377	-3.0186	18.85096	.97087	-4.9276	-1.1095	-62.00	55.00
African Am.	282	-5.6064	17.62028	1.04927	-7.6718	-3.5410	-64.00	43.00
Two or more	150	-4.2133	19.75745	1.61319	-7.4010	-1.0257	-79.00	44.00
Other	27	-1.7037	19.71102	3.79339	-9.5011	6.0937	-41.00	41.00
Total	3172	-3.0520	17.45754	.30997	-3.6598	-2.4443	-79.00	77.00

Table 7

ANOVA of Math STAAR Change in Percentile Score by Ethnicity

Change in Percentile Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13808.054	5	2761.611	9.178	<.001
Within Groups	952604.363	3166	300.886		
Total	966412.417	3171			

Table 8

Multiple Comparisons of Math STAAR Change in Percentile Score by Ethnicity

Dependent Variable: Change in Percentile Score

Tukey HSD

					95% Confidence Interval	
(I) Ethnicity	(J) Ethnicity	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
White	Asian	-4.50075*	.73087	<.001	-6.5848	-2.4167
	Hispanic	-1.49800	1.00741	.673	-4.3706	1.3746
	African Am.	1.08981	1.13303	.930	-2.1410	4.3206
	Two or more	-.30324	1.49087	1.000	-4.5544	3.9479
	Other	-2.81287	3.37056	.961	-12.4239	6.7981
Asian	White	4.50075*	.73087	<.001	2.4167	6.5848
	Hispanic	3.00274	1.05617	.051	-.0089	6.0144
	African Am.	5.59056*	1.17659	<.001	2.2356	8.9456
	Two or more	4.19751	1.52424	.065	-.1488	8.5438
	Other	1.68788	3.38546	.996	-7.9656	11.3414
Hispanic	White	1.49800	1.00741	.673	-1.3746	4.3706
	Asian	-3.00274	1.05617	.051	-6.0144	.0089
	African Am.	2.58782	1.36568	.405	-1.3064	6.4820
	Two or more	1.19477	1.67452	.980	-3.5800	5.9696
	Other	-1.31486	3.45572	.999	-11.1687	8.5390
African American	White	-1.08981	1.13303	.930	-4.3206	2.1410
	Asian	-5.59056*	1.17659	<.001	-8.9456	-2.2356
	Hispanic	-2.58782	1.36568	.405	-6.4820	1.3064
	Two or more	-1.39305	1.75296	.968	-6.3915	3.6054
	Other	-3.90268	3.49441	.875	-13.8668	6.0615
Two or more races	White	.30324	1.49087	1.000	-3.9479	4.5544
	Asian	-4.19751	1.52424	.065	-8.5438	.1488
	Hispanic	-1.19477	1.67452	.980	-5.9696	3.5800
	African Am.	1.39305	1.75296	.968	-3.6054	6.3915
	Other	-2.50963	3.62627	.983	-12.8498	7.8305
Other	White	2.81287	3.37056	.961	-6.7981	12.4239
	Asian	-1.68788	3.38546	.996	-11.3414	7.9656
	Hispanic	1.31486	3.45572	.999	-8.5390	11.1687
	African Am.	3.90268	3.49441	.875	-6.0615	13.8668
	Two or more	2.50963	3.62627	.983	-7.8305	12.8498

*. The mean difference is significant at the 0.05 level.

Reading Change in STAAR Percentile Score by Ethnicity

The White group has a sample size of 1402 with a mean of -3.652, a standard deviation of 19.507, and a range of 151. The Asian group has a sample size of 1146 with a mean of 0.439, a standard deviation of 16.160, and a range of 116. The Hispanic group has a sample size of 380 with a mean of -0.176, a standard deviation of 18.909, and a range of 126. The African American group has a sample size of 273 with a mean of -1.256, a standard deviation of 21.078, and a range of 133. The two or more races group has a sample size of 147 with a mean of -0.415, a standard deviation of 20.190, and a range of 116. The other group has a sample size of 31 with a mean of -5.194, a standard deviation of 14.237, and a range of 59. The full descriptive analysis data is found in Table 9.

A one-way analysis of variance was conducted on the change in percentile score on the 2021 7th grade reading STAAR assessment from the 2019 5th grade reading STAAR assessment. With a sample of 3379 data points, a one-way analysis of variance was conducted to compare the change in percentile score in White (N = 1402), Asian (N = 1146), Hispanic (N = 380), African American (N = 273), two or more races (N = 147), and other (N = 31) groups. The means of the six ethnicity groups were unequal according to a one-way ANOVA; $F(5,3373) = 7.055$, $p < .001$. The change in percentile score for groups were White (M = -3.652, SD = 19.507), Asian (M = 0.439, SD = 16.160), Hispanic (M = -0.176, SD = 18.909), African American (M = -1.256, SD = 21.078), two or more races (M = -0.415, SD = 20.190), and other (M = -5.194, SD = 14.237). Pairwise comparisons of the means using Tukey's Honestly Significant Difference procedure indicated two significant comparisons: the White group scored significantly ($p < .001$) lower than the Asian group by -4.091 percentile points and the White group scored significantly ($p = .015$) lower than the Hispanic group by -3.476 percentile points in change in

percentile score in reading. The other comparisons were not significant (p = n.s.). The data from the analysis is displayed in Tables 10 and 11.

Table 9

Descriptives for Reading STAAR Change in Percentile Score by Ethnicity

Change in Percentile Score

					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
White	1402	-3.6519	19.50666	.52097	-4.6739	-2.6300	-88.00	63.00
Asian	1146	.4389	16.15969	.47735	-.4977	1.3755	-59.00	57.00
Hispanic	380	-.1763	18.90925	.97002	-2.0836	1.7310	-68.00	58.00
African Am.	273	-1.2564	21.07777	1.27568	-3.7679	1.2551	-68.00	65.00
Two or more	147	-.4150	20.18980	1.66523	-3.7060	2.8761	-70.00	46.00
Other	31	-5.1935	14.23709	2.55706	-10.4158	.0287	-38.00	21.00
Total	3379	-1.5534	18.57979	.31963	-2.1801	-.9267	-88.00	65.00

Table 10

ANOVA of Reading STAAR Change in Percentile Score by Ethnicity

Change in Percentile Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12068.980	5	2413.796	7.055	<.001
Within Groups	1154046.128	3373	342.142		
Total	1166115.108	3378			

Table 11

Multiple Comparisons of Reading STAAR Change in Percentile Score by Ethnicity

Dependent Variable: Change in Percentile Score

Tukey HSD

		Mean Difference			95% Confidence Interval	
(I) Ethnicity	(J) Ethnicity	(I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
White	Asian	-4.09084*	.73661	<.001	-6.1912	-1.9905
	Hispanic	-3.47561*	1.06977	.015	-6.5259	-.4253
	African Am.	-2.39552	1.22365	.367	-5.8846	1.0935
	Two or more	-3.23696	1.60360	.332	-7.8094	1.3355
	Other	1.54162	3.35870	.997	-8.0352	11.1185
Asian	White	4.09084*	.73661	<.001	1.9905	6.1912
	Hispanic	.61523	1.09496	.993	-2.5069	3.7373
	African Am.	1.69533	1.24572	.750	-1.8567	5.2473
	Two or more	.85388	1.62051	.995	-3.7668	5.4745
	Other	5.63247	3.36681	.550	-3.9675	15.2324
Hispanic	White	3.47561*	1.06977	.015	.4253	6.5259
	Asian	-.61523	1.09496	.993	-3.7373	2.5069
	African Am.	1.08009	1.46753	.977	-3.1043	5.2645
	Two or more	.23865	1.79663	1.000	-4.8842	5.3615
	Other	5.01723	3.45503	.695	-4.8343	14.8687
African American	White	2.39552	1.22365	.367	-1.0935	5.8846
	Asian	-1.69533	1.24572	.750	-5.2473	1.8567
	Hispanic	-1.08009	1.46753	.977	-5.2645	3.1043
	Two or more	-.84144	1.89229	.998	-6.2370	4.5541
	Other	3.93714	3.50573	.872	-6.0589	13.9332
Two or more races	White	3.23696	1.60360	.332	-1.3355	7.8094
	Asian	-.85388	1.62051	.995	-5.4745	3.7668
	Hispanic	-.23865	1.79663	1.000	-5.3615	4.8842
	African Am.	.84144	1.89229	.998	-4.5541	6.2370
	Other	4.77858	3.65573	.781	-5.6452	15.2023
Other	White	-1.54162	3.35870	.997	-11.1185	8.0352
	Asian	-5.63247	3.36681	.550	-15.2324	3.9675
	Hispanic	-5.01723	3.45503	.695	-14.8687	4.8343
	African Am.	-3.93714	3.50573	.872	-13.9332	6.0589
	Two or more	-4.77858	3.65573	.781	-15.2023	5.6452

*. The mean difference is significant at the 0.05 level.

Math Change in STAAR Percentile Score by Gender

The female group has a sample size of 1570 with a mean of -2.343, and a standard deviation of 17.520 with a standard mean error of 0.442. The male group has a sample size of 1602 with a mean of -3.747, and a standard deviation of 17.374 with a standard mean error of 0.434. The full descriptive analysis data is found in Table 12.

A t-Test for independent samples was conducted on the change in percentile score on the 2021 7th grade math STAAR assessment from the 2019 5th grade math STAAR assessment. The female and male groups were considered to be independent groups with no relation. With a sample of 3172 participants, an independent samples t-Test was conducted to compare the change in percentile score in female (N = 1570) and male (N = 1602) groups. There was a significant difference in the change in percentile score for female (M = -2.343, SD = 17.520) and male (M = -3.747, SD = 17.374); $t(3170) = 2.267$, $p < .03$. These results suggest that male students have a greater decrease in percentile score than their female student counterparts by 1.405 percentile points. The data from the analysis is displayed in Table 13.

Table 12

Descriptives for Math STAAR Change in Percentile Score by Gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Change in Percentile Score	Female	1570	-2.3427	17.51983	.44216
	Male	1602	-3.7472	17.37366	.43407

Table 13

Independent Samples Test of Math STAAR Change in Percentile Score by Gender

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean	Std. Error	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Difference	Difference	Lower	Upper
Change in Percentile Score	Equal variances assumed	.350	.554	2.267	3170	.012	.023	1.40452	.61956	.18973	2.61930
	Equal variances not assumed			2.267	3167.416	.012	.023	1.40452	.61962	.18963	2.61940

Reading Change in STAAR Percentile Score by Gender

The female group has a sample size of 1628 with a mean of -0.610, and a standard deviation of 18.276 with a standard mean error of 0.453. The male group has a sample size of 1751 with a mean of -2.431, and a standard deviation of 18.821 with a standard mean error of 0.450. The full descriptive analysis data is found in Table 14.

A t-Test for independent samples was conducted on the change in percentile score on the 2021 7th grade reading STAAR assessment from on the 2019 5th grade reading STAAR assessment. The female and male groups were considered to be independent groups with no relation. With a sample of 3379 participants, an independent samples t-Test was conducted to compare the change in percentile score in female (N = 1628) and male (N = 1751) groups. There was a significant difference in the change in percentile score for female (M = -0.610, SD = 18.276) and male (M = -2.431, SD = 18.821); $t(3377) = 2.849$, $p < .005$. These results suggest

that male students have a greater decrease in percentile score than their female student counterparts by 1.821 percentile points. The data from the analysis is displayed in Table 15.

Table 14

Descriptives for Reading STAAR Change in Percentile score by Gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Change in Percentile Score	Female	1628	-.6100	18.27555	.45294
	Male	1751	-2.4306	18.82107	.44978

Table 15

Independent Samples Test of Reading STAAR Change in Percentile Score by Gender

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Change in Percentile Score	Equal variances assumed	.470	.493	2.849	3377	.002	.004	1.82066	.63901	.56777	3.07355
	Equal variances not assumed			2.852	3370.635	.002	.004	1.82066	.63833	.56911	3.07221

Math Change in STAAR Percentile Score by Economically Disadvantaged Status

The yes (economically disadvantaged) group has a sample size of 402 with a mean of -2.415, and a standard deviation of 19.145 with a standard mean error of 0.955. The no (not economically disadvantaged) group has a sample size of 2770 with a mean of -3.144, and a

standard deviation of 17.201 with a standard mean error of 0.327. The full descriptive analysis data is found in Table 16.

A t-Test for independent samples was conducted on the change in percentile score on the 2021 7th grade math STAAR assessment from on the 2019 5th grade math STAAR assessment. The yes and no groups were considered to be independent groups with no relation. With a sample of 3172 participants, an independent samples t-Test was conducted to compare the change in percentile score in yes (N = 402) and no (N = 2770) groups. There was not a significant difference in the change in percentile score for yes (M = -2.415, SD = 19.145) and no (M = -3.144, SD = 17.201); $t(499.458) = 0.722$, p = n.s. The data from the analysis is displayed in Table 17.

Table 16

Descriptives for Math STAAR Change in Percentile score by Econ. Dis. Status

	Econ.Dis	N	Mean	Std. Deviation	Std. Error Mean
Change in Percentile Score	Yes	402	-2.4154	19.14531	.95488
	No	2770	-3.1444	17.20064	.32682

Table 17

Independent Samples Test of Math STAAR Change in Percentile score by Econ. Dis. Status

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean	Std. Error	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Difference	Difference	Lower	Upper
Change in Percentile Score	Equal variances assumed	10.254	.001	.782	3170	.217	.434	.72898	.93180	-1.09801	2.55598
	Equal variances not assumed			.722	499.458	.235	.470	.72898	1.00926	-1.25394	2.71190

Reading Change in STAAR Percentile Score by Economically Disadvantaged Status

The yes (economically disadvantaged) group has a sample size of 405 with a mean of -0.104, and a standard deviation of 20.317 with a standard mean error of 1.010. The no (not economically disadvantaged) group has a sample size of 2974 with a mean of -1.751, and a standard deviation of 18.325 with a standard mean error of 0.336. The full descriptive analysis data is found in Table 18.

A t-Test for independent samples was conducted on the change in percentile score on the 2021 7th grade reading STAAR assessment from on the 2019 5th grade reading STAAR assessment. The yes and no groups were considered to be independent groups with no relation. With a sample of 3379 participants, an independent samples t-Test was conducted to compare the change in percentile score in yes (N = 405) and no (N = 2974) groups. There was not a significant difference in the change in percentile score for yes (M = -0.104, SD = 20.317) and no

(*M* = -1.751, *SD* = 18.325); *t*(497.648) = 1.548, *p* = n.s. The data from the analysis is displayed in Table 19.

Table 18

Descriptives for Reading STAAR Change in Percentile score by Econ. Dis. Status

	Econ.Dis	N	Mean	Std. Deviation	Std. Error Mean
Change in Percentile Score	Yes	405	-.1037	20.31690	1.00955
	No	2974	-1.7508	18.32533	.33603

Table 19

Independent Samples Test of Reading STAAR Change in Percentile score by Econ. Dis. Status

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Change in Percentile Score	Equal variances assumed	7.917	.005	1.674	3377	.047	.094	1.64714	.98383	-.28183	3.57610
	Equal variances not assumed			1.548	497.648	.061	.122	1.64714	1.06401	-.44337	3.73764

Research Question 2 Results

The second research question proposed is there a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19. The null hypothesis is that there is not a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19. The alternative hypothesis is that there is a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19.

Math Change in STAAR Percentile Score by Learning Environment

The virtual learning group has a sample size of 1185 with a mean of -2.417, and a standard deviation of 16.431 with a standard mean error of 0.477. The face-to-face learning group has a sample size of 1987 with a mean of -3.431, and a standard deviation of 18.035 with a standard mean error of 0.405. The full descriptive analysis data is found in Table 20.

A t-Test for independent samples was conducted on the change in percentile score on the 2021 7th grade math STAAR assessment from on the 2019 5th grade math STAAR assessment. The virtual learning and face-to-face learning groups were considered to be independent groups with no relation. With a sample of 3172 participants, an independent samples t-Test was conducted to compare the change in percentile score in virtual learning (N = 1185) and face-to-face learning (N = 1987) groups. There was not a significant difference in the change in percentile score for virtual learning (M = -2.417, SD = 16.431) and face-to-face learning (M = -3.431, SD = 18.035); t(2673.767) = 1.620, p = n.s. The data from the analysis is displayed in Table 21.

Table 20

Descriptives for Math STAAR Change in Percentile score by Learning Environment

	Learning Environment	N	Mean	Std. Deviation	Std. Error Mean
Change in Percentile Score	VIR	1185	-2.4169	16.43106	.47732
	F2F	1987	-3.4308	18.03534	.40460

Table 21

Independent Samples Test of Math STAAR Change in Percentile score by Learning Environment

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean	Std. Error	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Difference	Difference	Lower	Upper
Change in Percentile Score	Equal variances assumed	26.105	<.001	1.583	3170	.057	.114	1.01392	.64060	-.24211	2.26996
	Equal variances not assumed			1.620	2673.767	.053	.105	1.01392	.62573	-.21303	2.24088

From the data analysis, we cannot reject the null hypothesis that there is not a statistically significant difference between student learning environment groups in change in standardized assessment performance from before COVID-19 and during COVID-19 when analyzing the math STAAR assessments.

Reading Change in STAAR Percentile Score by Learning Environment

The virtual learning group has a sample size of 1377 with a mean of 0.288, and a standard deviation of 16.569 with a standard mean error of 0.447. The face-to-face learning

group has a sample size of 2002 with a mean of -2.820, and a standard deviation of 19.749 with a standard mean error of 0.441. The full descriptive analysis data is found in Table 22.

A t-Test for independent samples was conducted on the change in percentile score on the 2021 7th grade reading STAAR assessment from on the 2019 5th grade reading STAAR assessment. The virtual learning and face-to-face learning groups were considered to be independent groups with no relation. With a sample of 3379 participants, an independent samples t-Test was conducted to compare the change in percentile score in virtual learning (N = 1377) and face-to-face learning (N = 2002) groups. There was a significant difference in the change in percentile score for virtual learning (M = 0.288, SD = 16.569) and face-to-face learning (M = -2.820, SD = 19.749); $t(3247.024) = 4.951$, $p < .001$. These results suggest that virtual learning students have an increase in percentile score while their face-to-face learning student counterparts have a decrease in percentile score, with a difference between them of 3.108 percentile points. The data from the analysis is displayed in Table 23.

Table 22

Descriptives for Reading STAAR Change in Percentile score by Learning Environment

	Learning Environment	N	Mean	Std. Deviation	Std. Error Mean
Change in Percentile Score	VIR	1377	.2883	16.56919	.44651
	F2F	2002	-2.8202	19.74940	.44139

Table 23

Independent Samples Test of Reading STAAR Change in Percentile score by Learning Environment

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean	Std. Error	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Difference	Difference	Lower	Upper
Change in Percentile Score	Equal variances assumed	38.332	<.001	4.794	3377	<.001	<.001	3.10849	.64838	1.83724	4.37974
	Equal variances not assumed			4.951	3247.024	<.001	<.001	3.10849	.62785	1.87746	4.33951

From the data analysis, we can reject the null hypothesis that there is not a statistically significant difference between student learning environment groups in change in standardized assessment performance from before COVID-19 and during COVID-19 when analyzing the reading STAAR assessments.

Summary

The purpose of this quantitative research study was to examine how the COVID-19 pandemic has affected the learning of students in public education. The study also compared learning environments of face-to-face and virtual learning students' change in performance on standardized assessments. The data collected included the 2021 7th grade math STAAR scores with corresponding student 2019 5th grade math STAAR scores, 2021 7th grade reading STAAR scores with corresponding 2019 5th grade reading STAAR scores, learning environment of each student for the 2020-21 school year with gender, ethnicity, and economically disadvantaged

identifiers. A t-Test for dependent samples was conducted on each of the math and reading STAAR data to compare the percentile score on the STAAR assessment during COVID-19 (2021) and before COVID-19 (2019). Next, a one-way ANOVA test was conducted on each of the math and reading STAAR data to compare the change in percentile score on ethnicity groups. Then an independent samples t-Test was conducted on each of the math and reading STAAR data to compare the change in percentile score on gender and economically disadvantaged status groups. Finally, an independent samples t-Test was conducted on each of the math and reading STAAR data to compare the change in percentile score on learning environment groups.

After analyzing the data, the null hypothesis was rejected for three of the statistical tests and not rejected for one of the tests. For the first research question, there was a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19 for both math and reading. There was also a statistically significant difference between some ethnicity groups and gender groups in change in standardized assessment performance from before COVID-19 and during COVID-19. However, there was not a statistically significant difference between economically disadvantaged groups in change in standardized assessment performance from before COVID-19 and during COVID-19. For the second research question, there was not a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19 in math. Although, there was a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19 in reading, with the virtual learning students outperforming the face-to-face students. The implications of this research study will be examined in the next chapter.

CHAPTER V

SUMMARY AND CONCLUSION

This chapter presents the summary and conclusion that resulted from the study investigating how the COVID-19 pandemic has affected the learning of students in public education and the comparison of face-to-face and virtual learning students' change in performance on standardized assessments at a suburban public independent school district in Texas.

To present the study, Chapter I detailed the research problem and the purpose of the study, the research questions, and the significance of the study. Chapter II focused on the literature review and conceptual framework on which this study was grounded. Chapter III presented the methodology and research design of the study, along with information about the research population and sample, and the data collection and analysis. Chapter IV detailed the sample demographic information and the results of the data analysis. Subsequently, this chapter presents the summary and conclusion of the study.

The summary and conclusion chapter begins with a summary of the study and a summary of the findings. If follows with the discussion, implications, limitations, and recommendations for future research. The final section offers a conclusion to the study.

Summary of the Study

The purpose of this quantitative research study was to examine how the COVID-19 pandemic has affected the learning of students in public education through standardized assessment performance. The study also compared learning environments of face-to-face and virtual learning students' change in performance on standardized assessments. The analysis of standardized assessment performance before and during COVID-19 occurred at a suburban public independent school district in Texas. The district participated in state standardized assessments the year before COVID-19, in 2019, and again at the end of the first full school year after the onset of the COVID-19 pandemic, in 2021. In the first full school year during COVID-19, the district offered both fully face-to-face and fully virtual learning options for students. Data on the standardized assessment performance before and during COVID-19 and by learning environment was collected and analyzed to study the impact of COVID-19 on learning in public education and the effect learning environment has on student learning.

Loss of learning due to COVID-19 may be taking place at all levels and schools, of interest is in public schools subject to state standardized assessments. Standardized assessments can measure learning during a school year and measure growth from year to year. In Texas, state standardized assessments were canceled for the 2019-2020 school year, creating a gap of two full years between the administration of the assessments and assessment results. Students resumed taking the STAAR assessments in the 2020-2021 school year. The 2021 STAAR assessments were the first state standardized assessments students had taken since the onset of the COVID-19 pandemic. The COVID-19 pandemic has put a lot of pressure on instruction, learning, and assessment (Jiao & Lissitz, 2020). The comparison of performance on the STAAR assessments before COVID-19 and during COVID-19 provided data on how performance has changed and

potential learning loss. The theoretical framework considered throughout this research is based on the aspects of effective instruction and assessment. The COVID-19 pandemic forced schools to shift from face-to-face instruction to virtual learning instruction, and the characteristics of effective instruction and effective assessment changed with this shift in learning environment.

In the study, the district provided archival data which included: 2021 7th grade math STAAR scores with corresponding student 2019 5th grade math STAAR scores, 2021 7th grade reading STAAR scores with corresponding 2019 5th grade reading STAAR scores, learning environment of each student for the 2020-21 school year with gender, ethnicity, and economically disadvantaged identifiers. In each of the math and reading STAAR data sets, the following variables were calculated: 2019 percentile score, 2021 percentile score, and change in percentile score from 2019 to 2021. To analyze the data and answer the research questions, numerous statistical tests were performed on each of the math and reading STAAR data sets. For the first research question, using a data analysis software, a t-Test for dependent samples was conducted to compare percentile scores on the STAAR assessment during COVID-19 (2021) and before COVID-19 (2019). Next, a one-way ANOVA was conducted on change in percentile scores for the STAAR assessments with the students divided into groups by ethnicity identifier. Then, a t-Test for independent samples was conducted on change in percentile scores for the STAAR assessments with the students divided into groups by gender and then again for students divided by economically disadvantaged status. For the second research question, a t-Test for independent samples was conducted on change in percentile scores for the STAAR assessments with the students divided into groups by learning environment.

The dependent samples t-Tests, independent samples t-Tests, and one-way ANOVA tests provided the desired results in differences in the STAAR assessment data to determine the effect

the COVID-19 global pandemic has had on student learning and the effect learning environment has on student learning.

Summary of Findings

The causal-comparative study involved before COVID-19 and during COVID-19 conditions and the effect this change in condition has on student learning measured by state standardized assessment scores. The second part of the study involved an independent variable of face-to-face or virtual learning and a dependent variable of student learning measured by state standardized assessment scores. Comparison of state standardized assessment scores in math and reading for the same group of students occurred from the first year of assessments during COVID-19 to the last year of assessments before COVID-19. The change in assessment scores were compared for students that spent the first full year of school during COVID-19 in face-to-face learning environment with students that spent the first full year of school during COVID-19 in virtual learning environment. This section includes a summary of the findings from the previous chapter.

The criteria-based sample of students with 5^{th} and 7^{th} grade math STAAR scores totaled 3172 students from 17 different middle schools during the 2020-2021 school year and students with 5^{th} and 7^{th} grade reading STAAR scores totaled 3379 students from 17 different middle schools during the 2020-2021 school year. Using the collected STAAR assessment data, we have found that the overall district STAAR passing performance decreased for both math and reading from before COVID-19 (2019) to during COVID-19 (2021) for the sample. The passing rate for math decreased by 9%, from 94% of all students to 85% of all students. The passing rate for reading decreased by 1%, from 91% of all students to 90% of all students.

The first research question proposed is there a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19. The null hypothesis is that there is not a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19. The alternative hypothesis is that there is a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19.

After conducting a t-Test for dependent samples, we have found that there is a significant difference in the 2021 STAAR percentile scores and the 2019 STAAR percentile scores for both math and reading. Math STAAR percentile scores decreased by 3.052 percentile points in 2021 from 2019 and reading STAAR percentile scores decreased by 1.553 percentile points in 2021 from 2019. Based on the results of the data analysis, we can reject the null hypothesis that there is not a statistically significant drop in students' performance on standardized assessments from before COVID-19 and during COVID-19 when analyzing the math and reading STAAR assessments.

Further data analyses were conducted to compare the students' performance on standardized assessments from before COVID-19 and during COVID-19 by ethnicity, gender, and economically disadvantaged groups. After conducting a one-way analysis of variance on the change in percentile score on the 2021 7^{th} grade STAAR assessment from on the 2019 5^{th} grade STAAR assessment, we have found that the means of the six ethnicity groups were unequal for both math and reading. Math STAAR change in percentile score points are as follows: African American (-5.606), White (-4.517), two or more races (-4.213), Hispanic (-3.019), other (-1.704), and Asian (-0.016). Reading STAAR change in percentile score points are as follows: other (-5.194), White (-3.652), African American (-1.256), Hispanic (-0.176), and two or more races

(-0.415). The reading STAAR scores have one ethnicity group with an increase in percentile score points: Asian (0.439).

After conducting a t-Test for independent samples on the change in percentile score on the 2021 7th grade STAAR assessment from on the 2019 5th grade STAAR assessment, we have found that there is a significant difference in the change in percentile score by gender groups for both math and reading. Math STAAR change in percentile score has male students with a greater decrease in percentile score than their female student counterparts by 1.405 percentile points. Reading STAAR change in percentile score has male students with a greater decrease in percentile score than their female student counterparts by 1.821 percentile points.

After conducting a t-Test for independent samples on the change in percentile score on the 2021 7th grade STAAR assessment from on the 2019 5th grade STAAR assessment, we have found that there is not a significant difference in the change in percentile score by economically disadvantaged groups for both math and reading.

The second research question proposed is there a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19. The null hypothesis is that there is not a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19. The alternative hypothesis is that there is a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19.

After conducting a t-Test for independent samples on the change in percentile score on the 2021 7th grade STAAR assessment from on the 2019 5th grade STAAR assessment, we have

found that there is not a significant difference in the change in percentile score by learning environment groups for math. Based on the results of the data analysis, we cannot reject the null hypothesis that there is not a statistically significant difference between student learning environment groups in change in standardized assessment performance from before COVID-19 and during COVID-19 when analyzing the math STAAR assessments.

After conducting a t-Test for independent samples on the change in percentile score on the 2021 7th grade STAAR assessment from on the 2019 5th grade STAAR assessment, we have found that there is a significant difference in the change in percentile score by learning environment groups for reading. Reading STAAR change in percentile scores finds virtual learning students have an increase in percentile score of 0.288 percentile points while face-to-face learning students have a decrease in percentile score of -2.820 percentile points, a difference of 3.108 percentile points. Based on the results of the data analysis, we can reject the null hypothesis that there is not a statistically significant difference between student learning environment groups in change in standardized assessment performance from before COVID-19 and during COVID-19 when analyzing the reading STAAR assessments.

Discussion

This study investigated the issue of the impact of COVID-19 on learning by students in public education during the global pandemic by comparing the performance on standardized assessments before and during COVID-19, and comparing this change in performance by ethnicity, gender, and economically disadvantaged status groups. The study also compared the change in performance for face-to-face students with virtual learning students.

The findings of the study indicate that from before COVID-19 and during COVID-19 the overall passing rate for this district decreased for both math and reading STAAR assessments.

The decrease in math STAAR passing rate was larger than the decrease in reading STAAR passing rate. Math STAAR passing rate decreased by 9 percent in 2021 from 2019, while reading STAAR passing rate decreased by 1 percent in 2021 from 2019. For comparison to pre-COVID-19 pandemic conditions, we can reference the corresponding passing rates for the 5th to the 7th grade cohort from 2017 to 2019. The math STAAR passing rate decreased by 1 percent in 2019 (95%) from 2017 (96%). This shows an 8 percent decrease in math STAAR passing rate for a pandemic cohort when compared to a pre-pandemic cohort. The reading STAAR passing rate decreased by 2 percent in 2019 (92%) from 2017 (94%). This shows a 1 percent increase in reading STAAR passing rate for a pandemic cohort when compared to a pre-pandemic cohort. The overall decrease in passing rate for both math and reading STAAR assessments is consistent with current long-term trend assessments that show national declines in both math and reading performance (National Center for Educational Statistics, 2022). It also strengthens claims of earlier studies that found evidence of learning loss during the COVID-19 pandemic.

The findings also indicate, based on the results of the first research question, that there is a statistically significant drop in students' performance on standardized assessments for both math and reading. The decrease in math STAAR percentile scores was larger than the decrease in reading STAAR percentile scores. Math STAAR percentile scores decreased by 3.052 percentile points in 2021 from 2019, while reading STAAR percentile scores decreased by 1.553 percentile points in 2021 from 2019. These results confirmed findings on previous school closures which indicated negative effects on learning, with larger learning losses in math (Kuhfeld et al., 2020).

There are unequal changes in percentile scores by ethnicity groups for both math and reading. This suggests that the impact of the COVID-19 pandemic on students' academic

performance may have varied based on their ethnicity. For math, the African American group had the largest decrease in percentile score points (-5.606), followed by White (-4.517), two or more races (-4.213), Hispanic (-3.019), other (-1.704), and Asian (-0.016). This indicates that African American and White students experienced the largest decreases in math performance, while Asian students experienced the smallest decrease. For reading, the other group had the largest decrease in percentile score points (-5.194), followed by White (-3.652), African American (-1.256), Hispanic (-0.176), and two or more races (-0.415). However, the Asian group had a small increase in percentile score points (0.439). It is important to note that the other group was a relatively small sample compared to the ethnicity groups and the results may have been skewed by outliers. This suggests that the impact of the COVID-19 pandemic varied for ethnicity groups, with some groups experiencing larger decreases and one group experiencing a small increase. The results are consistent with previous findings that have shown a widening of score gaps between some ethnicity groups (National Center for Educational Statistics, 2022). The findings of this study provide additional evidence to support that certain ethnicity groups may have been disproportionately affected by the COVID-19 pandemic.

There is a significant difference in the change in percentile score by gender groups for both math and reading. This suggests that the impact of the COVID-19 pandemic on students' academic performance may have varied based on their gender. For math, male students had a greater decrease in percentile score than their female counterparts by 1.405 percentile points. For reading, male students had a greater decrease in percentile score than their female counterparts by 1.821 percentile points. This suggests that male students may have been more negatively impacted by the pandemic in both math and reading performance. The significant difference in the change in percentile score by ethnicity and gender groups is in line with

previous research that has found disparities in academic achievement among different student groups.

There is not a significant difference in the change in percentile score by economically disadvantaged groups for both math and reading. This suggests that the impact of the COVID-19 pandemic on students' academic performance may not have varied significantly based on their economically disadvantaged status. These findings are inconsistent with much of the current research on economically disadvantaged students and the impact the COVID-19 pandemic and school closures have had on them. A speculation is that economically disadvantaged students in suburban areas such as the one in this study had less of a gap in technology and greater access for virtual learning than economically disadvantaged students in other areas.

The findings of the study indicate, based on the results of the second research question, that there is not a significant difference between face-to-face students and virtual learning students in the change in standardized assessment performance from before COVID-19 and during COVID-19 for math. However, it also indicates there is a significant difference between face-to-face students and virtual learning students in the change in standardized assessment performance from before COVID-19 and during COVID-19 for reading. For reading, virtual learning students had an increase in percentile score of 0.288 percentile points, whereas face-to-face learning students had a decrease in percentile score of 2.820 percentile points. This suggests that the impact of the COVID-19 pandemic on students' academic performance may not have varied significantly based on their learning environment for math. Although, it also suggests virtual learning may have had a positive impact on reading performance. Previous research on student academic performance in face-to-face learning versus virtual learning shows mixed results (el Refae et al., 2021). Previous research on the early days of virtual learning

during the COVID-19 pandemic questioned its' effectiveness and the impact it was having on learning. The findings of this study on the impact of virtual learning on academic performance add to the mixed results of virtual learning in general, but it is inconsistent with most of the findings on virtual learning during the initial phases of the COVID-19 pandemic.

The theoretical framework considered throughout this research was based on the aspects of effective instruction and assessment. Effective instruction results in learning and learning is accurately measured by aligned effective assessment. The characteristics of effective instruction changed with the shift from face-to-face instruction to virtual learning instruction (Yates et al., 2021). The characteristics of effective instruction are underlying in the varied results of performance in reading in virtual learning relative to face-to-face learning. The shift from face-to-face learning to virtual learning also changed the characteristics of effective assessment. In virtual learning, alternative assessments were often different from traditional tests and quizzes and often involved more application of learning. Based on the study results, this shift in assessments may be more difficult to implement to measure learning in math compared to reading. The characteristics of both effective instruction and assessment shifted during the COVID-19 pandemic to reflect the unique challenges and opportunities of virtual learning.

Implications

The findings of this study have important implications for educators, policymakers, and families. They suggest that the COVID-19 pandemic has had a negative impact on students' academic performance, particularly in math. This may have long-term consequences for students' educational and career opportunities, as well as for the economy and society as a whole. As such, it's important for stakeholders to take steps to address these issues and support students in recovering from the effects of the COVID-19 pandemic. This could include targeted

interventions and support to help students recover academically. The findings also suggest that more targeted interventions may be needed to support students from certain ethnicity and gender groups who may have been disproportionately affected by the pandemic.

In terms of learning environment, the findings of this study suggest that virtual learning can provide a viable alternative to face-to-face learning. Additionally, the results suggest that virtual learning students need more support in math than in reading. Academic success in virtual learning may vary by subject and for individual students or groups. The results of this study may inform decisions for future learning during and after the COVID-19 pandemic. It could also help shape policies and practices for the continuation or expansion of virtual learning.

Limitations of the Study

This study was limited to one independent school district in a suburban community in Texas, which participated in state standardized assessments the year before COVID-19, in 2019, and again at the end of the first full school year after the onset of the COVID-19 pandemic, in 2021. The study was also limited to quantitative data in a causal-comparative study approach. The data represented only one cohort over a two-year span and consisted of 5^{th} and 7^{th} grade STAAR assessment scores for math and reading. Although the sample size for the study was large, $N = 3172$ for math STAAR and $N = 3379$ for reading STAAR, it would be hard to generalize the findings from the school district in this study to a larger population as the geographic location and demographics of the district may vary dramatically from other schools, districts, and states.

Recommendations for Future Research

Based on the findings of this study, there are several recommendations for future research. A similar study could be conducted with additional subject STAAR assessments and

also with direct comparison by grade level STAAR assessments, instead of by cohort. As this study was quantitative in design, a recommendation for future research would also be to collect qualitative data to describe the experiences of participants and to help identify specific factors that may have affected students' academic performance. Qualitative data may also provide insight into the characteristics of the implemented virtual learning and the differences from face-to-face learning.

A follow-up study recommendation is to analyze the data by the middle schools and identify pockets of success amongst the schools. The study could identify factors and characteristics that contributed to the success of the students at high-performing schools. Another follow-up study recommendation is to perform a similar study with statewide and national data sets. This study could be used to compare academic performance between different local school districts, regions within Texas, and states. A national study would also be able to compare the performance between states that responded to COVID-19 differently and how it may have affected academic outcomes.

Conclusion

The results of this study suggest that there is a drop in students' performance on standardized assessments from before COVID-19 and during COVID-19 when analyzing the math and reading STAAR assessments. This drop is reflected in a decrease in passing rate in math and reading and in a statistically significant drop in students' performance from before COVID-19 and during COVID-19 when analyzing the math and reading STAAR assessments percentile scores. Further analyses on the change in percentile score on the 2021 7^{th} grade STAAR assessment from the 2019 5^{th} grade STAAR assessment suggest that there is a significant difference in the change in percentile score by ethnicity and gender groups for both

math and reading. However, there is not a significant difference in the change in percentile score by economically disadvantaged groups for both math and reading.

The study also set out to answer if there is a statistically significant difference between face-to-face students and virtual learning students in change in standardized assessment performance from before COVID-19 and during COVID-19. The results of this study suggest there is not a statistically significant difference between student learning environment groups in change in standardized assessment performance in the math STAAR assessments. The study did find that there is a significant difference between student learning environment groups in change in standardized assessment performance in the reading STAAR assessments, with the virtual learning students outperforming the face-to-face students.

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BIOGRAPHICAL SKETCH

Michael Norman Voth was born in Manitoba, Canada, where he was raised and lived until departing for college. He is the youngest of the two children of Mr. John H. Voth and Mrs. Constance E. Voth. He attended elementary and secondary school in rural southern Manitoba and then attended the University of Manitoba in Winnipeg, Canada. There he earned two degrees, a Bachelor of Science (1995), with a double major in physics and mathematics, and a Bachelor of Education (1997). Upon graduation, Michael worked as a high school teacher in Canada for the next ten years.

In 2007, Michael moved with his wife to Texas where he continued as a high school physics teacher while he furthered his education by earning a graduate degree, Master of Education in Educational Technology (2015) at the University of Texas at Brownsville. He used this degree and his experience to work as an instructional technology coordinator and then joined a team that launched an online learning program for a public school district. In May of 2023, Michael earned a doctoral degree in Curriculum and Instruction with a specialization in Educational Technology at the University of Texas Rio Grande Valley. He continues to work in education and will also look to start teaching at the post-secondary level. Michael resides in Texas with his wife and two children. He can be contacted at mnvoth@gmail.com.