The Effect of School Closure During the 2020 COVID-19 Pandemic on Student Reading and Mathematics Growth in Grades 3-6

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Abstract

Leaders closed brick-and-mortar buildings during Spring 2020 to help mitigate the spread of COVID-19. Although instruction was to continue, the impact on student achievement growth in reading and mathematics was unknown. The purpose of this current quasi-experimental design and quantitative study was to determine the differences in students' reading and mathematics achievement growth from fall to spring between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021). An additional purpose was to identify the effects of student socioeconomic status (SES), race, and gender on the differences in student achievement growth. Participants included students enrolled in Grades 3-6 during the 2018-2019 school year and students enrolled in Grades 3-6 during the 2020-2021 school year in a suburban Kansas district. The independent variables included the enrollment year, before the 2020 pandemic (2018-2019), after the 2020 pandemic disruption 2020-2021), student SES (free or reduced, full pay), race (minority, non-minority), and gender (female, male). Dependent variables included the reading and mathematics achievement fall to spring growth scores, as measured by AimswebPlus. Results yielded mixed results when analyzing students' reading and mathematics achievement growth. For reading and mathematics, enrollment year yielded a statistically significant difference in students' achievement growth, especially in Grades 4 and 6. Students enrolled in Grades 4 and 6 before the pandemic disruption (2018-2019) had a higher average achievement growth in reading and mathematics. In contrast, students enrolled in Grade 5 after the pandemic disruption (2020-2021) had a higher average achievement growth in mathematics. Although the

results were mixed at most grade levels, the differences were not affected by SES, race, and gender. The results yielded have implications for district administrators in allocating funds to meet the needs of students resulting from the prolonged school closures. The allocation of funds could include curriculum, professional learning, or possible summer opportunities for students. Recommendations for future research include the addition of multi-year data, district location, and assessment choice. Finally, future researchers might also consider a longitudinal study of students to identify the long-term effects of prolonged school closures and the changes in the delivery of teaching and learning.

Dedication

This dissertation is dedicated to my husband, Aaron, and our amazing daughters, Glenna and Emily. You are my inspiration, my heart, and my biggest supporters. To say that I am proud to be your wife and mom is an understatement. Without you, this journey would not have been possible. Thank you for walking beside me and sometimes pushing me through this journey. Remember, never let anyone dictate your future; it is yours to create and once you think that you have accomplished your goals, dream higher, dream bigger! I love you all tons and tons!

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Chapter 1

Introduction

Time out of school, such as summer break, has continued to be an area of research that has been debated regarding the effects on student achievement growth. As a result of one of the largest meta-analyses conducted, Hattie (2012) stated that summer breaks have a 0.08 effect size on student achievement compared to an average effect size of 0.40 of other variables' influence on students' achievement. Hattie (2009) indicated that a 0.40 effect size would suggest a medium effect for educational outcomes; therefore, a 0.08 effect size would suggest a small effect. The differences in opportunities for learning in home environments result in inequities and can impact the effect size of summer breaks related to student achievement. However, Hattie (2020) stated, "a benefit of schooling is to reduce these inequities in home resources, skills, and opportunities" (para. 16).

Additional researchers have found that summer break can have harmful effects on some students' learning (Baker, 2018; Mazjanis, 2015; Sandberg Patton & Reschly, 2013). However, the intensity of the harmful effects differs based on the variable that is analyzed. For example, the students' age can be a factor in summer learning loss. Researchers have found that the younger the students, the higher the rate of learning loss that occurs during a summer break (Baker, 2018; Mazjanis, 2015; Sandberg Patton & Reschly, 2013). One study, Baker (2018), found that students in second grade and below tended to have a higher rate of learning loss than those in third grade and above.

Natural disasters have disrupted schools and, in some cases, caused school closures for short or extended times. Fuller (2013) found that the North Carolina hurricanes had a statistically significant impact, although small, on student achievement.

This impact was concentrated mainly among middle school students and in the area of reading. According to Serrant (2013), schools in the Commonwealth of Dominica were disrupted and severely affected by Hurricane Dean in 2007 and Hurricane Ophelia in 2011. These hurricanes caused damage to the brick-and-mortar buildings, which resulted in time out of school and loss of instructional materials (Serrant, 2013).

The COVID-19 pandemic of 2020 brought a new phenomenon to the U.S. education system. Schools were forced to close in the spring of 2020. Due to the 2020 pandemic, school closures forced three months of school disruption prior to the summer break. The possible implication for student achievement growth should be explored to prepare districts for students' possible learning loss. Further research is needed to identify the effect of time out of school and the replacement of face-to-face instruction with virtual instruction, which for some students carried into the 2020-2021 school year.

Background

District S is a suburban district in Kansas that, according to the 2019-2020 Kansas Building Report Card, served approximately 6,300 students enrolled in Preschool through Grade 12 (see Table 1 for demographic details). Beginning in the 2019-2020 school year, all schools involved in this study had implemented the Comprehensive Integrated Three-Tiered Model of Prevention (Ci3T). The Ci3T model is a comprehensive approach to meet the academic, social emotional, and behavioral needs of students. In March 2020, District S and schools across Kansas were forced to close the brick-and-mortar buildings and provide a remote learning option for students to comply with the Stay-at-Home Order issued by the Kansas governor (Exec. Order No. 20-07, 2020). The school closure

executive order was extended through the end of the 2019-2020 school year (Exec. Order No. 20-28, 2020).

Table 1

District S Demographic Percentages for 2018-2019, 2019-2020, and 2020-2021

Demographic	School Year		
	2018-2019	2019-2020	2020-2021
Gender			
Male	51.6	51.9	52.4
Female	48.4	48.1	47.6
Race			
Minority[a]	25.4	25.6	25.9
Non-minority[b]	74.6	74.4	74.1
Socioeconomic status			
Economically disadvantaged[c]	31.2	30.7	30.4
Full pay	68.8	69.3	69.6

Note. Adapted from *Kansas Building Report Card*, by Kansas State Department of Education, 2021. Retrieved from https://ksreportcard.ksde.org/demographics.aspx?org_no=D0437&rptType=2

[a]Minority = African American, Asian, Native American, Hawaiian/Pacific Islander, Hispanic, and Multi-Racial; [b]Non-minority = White; [c]Economically Disadvantaged = Free and Reduced Lunches.

To comply with the COVID-19 safety protocols mandated through the governor's Exec. Order No. 20-59 (2020), District S entered the 2020-2021 school year in a Phase 2, or hybrid mode of instruction for all PK-12 students (superintendent, personal communication, July 24, 2020). A Phase 2, or hybrid mode of instruction, refers to students attending face-to-face instruction two days a week and remote learning the

remaining three days during the week. In October 2020, District S leaders made the decision for students enrolled in Preschool through Grade 6 to transition to an on-site and in-person mode of instruction. During this time, students enrolled in Grades 7-12 remained in a hybrid mode of instruction due to the district's inability to enforce six-foot social distancing (superintendent, personal communication, October 9, 2020). However, in March 2021, the District S Board of Education decided that students enrolled in Grades 7-12 would return to an on-site and in-person mode of instruction (superintendent, personal communication, March 4, 2021).

Statement of the Problem

As schools across the nation closed brick and mortar buildings due to the COVID-19 pandemic, prolonged disruption to student learning created a new phenomenon in the education system. Dorn, Hancock, Sarakatsannis, and Viruleg (2020) said, "The U.S. education system was not built to deal with extended shutdowns like those imposed by the COVID-19 pandemic" (p. 2). In 2020, experts began to project student learning loss due to the prolonged school disruption caused by COVID-19 (Kuhfeld, Soland, et al., 2020; Kuhfeld & Tarasawa, 2020).

Kuhfeld, Soland, et al. (2020) projected that students would not return to school in fall 2020 with the same learning gains as in previous years due to the pandemic disruption. The researchers predicted that "Under these projections, students are likely to return in fall 2020 with approximately 63-68% of the learning gains in reading relative to a typical school year and with 37-50% of the learning gains in math" (Kuhfeld, Soland, et al., 2020, p. 2). The prolonged school disruption experienced during the pandemic was a new phenomenon for educators and students. Research on the actual difference in

student achievement in reading and mathematics before and after a prolonged disruption due to a pandemic could not be found in 2020, as fall assessments had not been administered.

Purpose of the Study

Due to the lack of research on the prolonged disruption of schools in 2020 and the effects on student achievement, this research had two purposes. The first purpose was to determine the differences in students' reading and mathematics achievement growth from fall to spring between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021). The second purpose was to determine the extent the differences in students' reading and mathematics achievement growth from fall to spring between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021) were affected by student SES, race, and gender.

Significance of the Study

Before 2020, research had been conducted on the relationship between school closures due to natural disasters and student achievement. However, the study of school closures was limited to a specific area or region (Fuller, 2013; Serrant, 2013). The results of the 2020 COVID-19 pandemic forced schools across the United States to close for a prolonged period (Dorn et al., 2020; Kuhfeld, Soland, et al., 2020). The current research was intended to extend the knowledge on the effect of closing brick-and-mortar school buildings for a significant amount of time on student achievement. The results of this study might provide districts and educators with information on the extent of difference

in reading and mathematics achievement growth for students before and after the 2020 COIVD-19 pandemic to guide instructional and funding allocations. Also, the research results could help districts make systemic decisions to address the differences and prepare for future school disruptions.

Delimitations

Lunenburg and Irby (2008) defined delimitations as "self-imposed boundaries set by the researcher on the purpose and scope of the study" (p. 134). For this study, the participants included students enrolled in the same district in Grades 3-6 during the 2018-2019 school year or the 2020-2021 school year. Another included delimitation was the use of AimswebPlus reading and mathematics assessment. The differences between fall and spring scores were analyzed for the 2018-2019 and 2020-2021 school years to compare student growth from fall to spring in reading and mathematics.

Assumptions

According to Lunenburg & Irby (2008), "Assumptions are postulates, premises, and propositions that are accepted as operational for purposes of the research" (p. 135). The researcher made the following assumptions for this study.

- All students did their best when taking the AimswebPlus reading and mathematics assessments.
- All in-person test administrations followed testing protocols with fidelity.
- A staff member proctored all virtual test administrations to ensure proper fidelity.
- The collected student demographic data were entered correctly in Infinite Campus.

- AimswebPlus scores were accurately recorded.

Research Questions

The purpose of research questions is to "shape and specifically focus the purpose of the study" (Creswell & Creswell, 2018, p. 136). The following 16 research questions were posed to determine the extent of differences in reading and mathematics achievement growth from fall to spring before and after the 2020 pandemic disruption and the effects of demographics on those differences.

RQ1. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021)?

RQ2. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

RQ3. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021)?

RQ4. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

RQ5. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021)?

RQ6. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

RQ7. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021)?

RQ8. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

RQ9. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021)?

RQ10. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before

the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

RQ11. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021)?

RQ12. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

RQ13. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021)?

RQ14. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) affected by SES, race, and gender?

RQ15. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021)?

RQ16. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) affected by SES, race, and gender?

Definition of Terms

To provide clarity and a common understanding throughout a study, Lunenburg and Irby (2008) stated, "You should define all key terms central to your study" (p. 118). For this study, the following key terms were identified and defined.

Pandemic disruption. A pandemic is a disease outbreak that spreads across countries or continents, affects more people, and takes more lives than an epidemic (WebMD, 2021). Therefore, a pandemic disruption refers to a break in normal activities due to a disease outbreak that spreads across countries and affects more lives than an epidemic.

Race. Information regarding a student's race is reported at the time of enrollment. Race choices include Asian, African-American, American Indian, Hispanic, White, Hawaiian/Pacific Islander, and Multi-Racial (District S, 2021). The current study involved the variables minority (Asian, African-American, American Indian, Hispanic, Hawaiian/Pacific Islander, and Multi-Racial) and non-minority (White).

Socioeconomic status. A student's SES is based on the identification of free and reduced lunch status. This status is determined by the family income guidelines established by the National School Lunch Program (District S, 2021).

Student achievement. Pearson (2018) indicated that student achievement can be measured by student growth (reading and mathematics) from fall to spring as measured by the

AimswebPlus universal screener. In this study, growth scores were calculated as the difference between the fall and spring scores.

Organization of the Study

This study is organized into five chapters. Chapter 1 included the background, statement of the problem, the purpose of the study, the significance, delimitations, assumptions, research questions, the definition of terms, and the study's organization. Presented in Chapter 2 is a comprehensive literature review that addresses factors of learning loss due to school closures (summer vacation and natural disasters and school closures), perceptions of pandemic learning loss, and initial findings about pandemic learning loss. Chapter 3 includes the research design, selection of participants, measurement, data collection procedures, data analysis and hypothesis testing, and limitations. In Chapter 4, the results of the hypothesis testing are presented. Finally, a study summary, findings related to the literature, and the conclusions are included in Chapter 5.

Chapter 2

Review of the Literature

During the spring of 2020, public and private schools were forced to close to mitigate the spread of COVID-19. Although the brick-and-mortar buildings were closed, learning was still expected for students. The forced closures created an unexpected and immediate shift in the education system that tested educators' abilities to provide remote learning and left educators and parents concerned about the potential learning loss of students. The first purpose of this study was to determine the difference in students' reading and mathematics achievement growth from fall to spring between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021). The second purpose was to determine if the differences in students' reading and mathematics achievement growth from fall to spring between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021) were affected by SES, race, and gender.

Chapter 2 is divided into three sections. In the first section, past and current research regarding factors of learning loss related to school closures are presented. The reason for the school closures included summer vacations and natural disasters, such as hurricanes. The second section includes an overview of the perceptions and predictions of pandemic learning loss made during the spring and summer of 2020. Finally, a synthesis of initial research conducted during the 2020-2021 school year identifying learning loss related to the pandemic is provided.

Factors of Learning Loss Due to School Closures

To determine the effect of time out of school on learning loss, Hattie (2020) found the importance of distinguishing between the effects of school holidays, including summer breaks and school closures. Literature has been reviewed and synthesized into two primary areas to distinguish between the school holidays and school closures and the effects on learning loss. These areas include the effects of learning loss based on summer vacation and school closures due to natural disasters.

Summer vacation. Many educators and researchers have found summer learning loss an area of interest and debate. Research on summer learning loss or "summer slide" began in the early 1900s. Although most researchers agree that students suffer a learning loss in the summer, the extent and cause of that learning loss have been debated (Alexander, Entwisle, & Olson, 2007; Atteberry & McEachin, 2020; Cooper, Nye, Charlton, Linsdsay, & Greathouse, 1996; Kuhfeld, 2019; Sandberg Patton & Reschly, 2013; von Hippel & Hamrock, 2018).

Cooper et al. (1996) conducted a meta-analysis of 39 studies about summer learning loss dated from 1906 to1994. To provide relevant findings for students of the late 1900s, Cooper et al. (1996) divided the review into two groups. First, the researchers described the 26 studies conducted prior to 1975 and synthesized the studies using a vote-count method. Additionally, due to the imbalanced quality of the early studies, Cooper et al. (1996) conducted a meta-analysis of the 13 studies conducted after 1975 to confirm the imbalanced quality of the early studies. Findings of the studies conducted before 1975 provided evidence that summer vacation influenced learning loss in math computation and spelling for students enrolled in middle grades. The loss in mathematics

achievement was confirmed by the meta-analyses of the studies conducted after 1975, which indicated that students lost about one month of grade level equivalent; this loss was greater in math computation than in reading. The more recent studies also noted that the negative effect on math skills does not differ based on SES. However, SES had a greater negative effect on reading, as lower SES students had more learning loss than higher SES students. Gender and race did not influence learning loss, but learning loss increased with the grade level of students (Cooper et al., 1996).

In contrast, researchers have indicated that studies on summer learning loss need to be revisited, and the findings are not conclusive for two reasons. First, Cooper et al. (1996) relied on data collected mostly before 1990 and may not reflect current educational contexts (Kuhfeld, 2019). Also, von Hippel and Hamrock (2019) suggested that earlier research included flaws in testing procedures, such as administering tests that increased in difficulty in the fall compared to the prior spring. Kuhfeld (2019) concluded that 22-38% of students gained over the summer. Finally, Kuhfeld (2019) said, "The strongest predictor of whether a student experienced summer gains or losses was the size of gain the student had during previous year" (p. 27). Kuhfeld (2019) concluded that the larger the gain during the school year, the larger the potential for summer learning loss. To further summer learning loss research, Kuhfeld (2020) analyzed fall and spring NWEA MAP Growth reading and mathematics assessments for 2016-2017 and 2017-2018 for students enrolled in kindergarten through eighth grade. This sample included 3.4 million students in all 50 states. The results did show a summer learning loss, with 78% of students exhibiting a learning loss in mathematics and 62-73% in reading. The largest learning loss (84%) surfaced in the summer between Grades 5 and 6.

Alexander et al. (2007) further researched the effects of socioeconomic status and summer learning loss. To examine long-term effects, these researchers conducted a longitudinal study of Baltimore students enrolled in Grade 1 in 1982 to the age of 22. Findings from this study showed that students' gains made during elementary and middle school are attributed to their time in school (Alexander et al., 2007). These researchers also concluded that the achievement gap between students with high SES and low SES is more attributed to the learning loss during the summer and differences in learning opportunities of students based on SES status. Additionally, the summer learning differences directly affected high school graduation and enrollment at a four-year college.

To focus on the reading learning loss of students during summer break, Sandberg Patton and Reschly (2013) conducted a study of 317 students from a Title I school in northeast Georgia. These students were enrolled in Grades 2-5 and were administered the Dynamic Indicators of Basic Early Literacy Skills Oral Reading Fluency (DIBELS ORF). Other factors analyzed included grade, SES, race, English Language Learner (ELL) status, and special education status. Researchers found that summer loss was statistically significant, but small, for students enrolled in Grades 2 and 3 when administered a DIBELS ORF with the same level of difficulty in the spring and then in the fall the following year. However, students enrolled in Grades 4 and 5 showed no summer learning loss in reading. Factors contributing to a greater learning loss were SES, those students from lower-income families, and students receiving special education services (Sandberg Patton & Reschly, 2013).

Mazjanis (2015) also found that summer learning loss is not uniform across grade levels. In his study, Mazjanis (2015) sought to identify the magnitude of summer

learning loss in reading and mathematics for students in Maine enrolled in Grades 3-8 during the summer of 2009. Additionally, Mazjanis (2015) pursued the effects of gender and economic status on summer learning loss. Utilizing the Maine Educational Assessment (MEA) administered during the spring of 2009 and the New England Common Assessment Program (NECAP) administered during fall 2009. Although different assessments were used, both assessed reading and mathematics standards.

Results of this study indicated that during the summer of 2009, students showed a combined learning loss in mathematics of 11% of a deviation (Mazjanis, 2015). However, the learning loss was not consistent across grade levels. Students in younger grades exhibited an increased learning loss of 40% of a standard deviation. Of the demographic variables, socioeconomic status did show a statistically significant effect on student mathematics achievement during the summer of 2009 (Mazjanis, 2015).

Overall, students showed a slight increase in reading achievement during the summer of 2009 of about 2% of a standard deviation. Similar to mathematics, this was not consistent across grade levels (Mazjanis, 2015). The gain in reading achievement during the summer of 2009 was prevalent in the younger grades. In contrast, the oldest students exhibited a summer learning loss of 32% of a standard deviation (Mazjanis, 2015). Finally, the results of Mazjanis' (2015) study indicated that gender and socioeconomic status showed a statistically significant impact on student learning loss. "High-SES children gained nearly 25 percent of a performance level over their low-SES classmates, while female students gained nearly 40 percent of an achievement level over their male classmates" (Mazjanis, 2015, p. vi).

Baker (2018) conducted two studies to determine the effects of summer learning loss in reading for elementary students and if demographic variables and summer activities contributed to the learning loss. Participants in this study included 649 students enrolled in Kindergarten-Grade 5 during the 2015-2016 school year in 37 classrooms located in three Midwestern suburban schools. Participants were screened utilizing FastBridge Learning curriculum-based measures in oral reading (CBM-R) and letter sounds (LS) during the last two weeks of the 2015-2016 school year and again during the first two weeks of the 2016-2017 school year (Baker, 2018).

Baker (2018) found a significant effect of summer learning loss in reading among elementary students who participated in the study. However, it was not consistent among grade levels. The findings of Baker's (2018) study provided evidence that the most significant effect of summer learning loss was with students enrolled in Grade 5 (d = 1.37) and Grade 4 (d = 1.18). Students enrolled in Kindergarten (d = .52) and Grade 2 (d = .62) showed a moderate effect of summer learning loss in reading. Finally, Grade 3 showed a minor impact of summer learning loss (d = .17) (Baker, 2018).

Additionally, Baker (2018) found that the demographic variables, ELL, special education (SPED), SES, race, and grade, had a small effect on the summer learning loss and varied among grade levels. Due to the smaller sample size, ELL students only showed a significant impact when students enrolled in Grades 1-5 were combined. ELL students were predicted to lose 5.47 words read correctly per minute (WRCM) compared to English-speaking peers. The summer learning loss of students with disabilities (SPED) was only significant in Grade 4. Additionally, Baker (2018) found that the negative impact of summer learning loss for students who qualified for free and reduced

lunch only applied to students enrolled in Kindergarten and Grades 2, 4, and 5. A significant impact of race was present at kindergarten only, and a substantial increase of summer learning loss was presented in students after first grade.

Hattie (2020) found that school holidays or summer breaks have a minimal effect size on students and learning loss. Hattie concluded that the effect size of summer school length is .08, and summer school effect is .19. These small effect sizes provide evidence of an opportunity for learning loss due to summer breaks.

Finally, Atteberry and McEachin (2020) sought to further current research on summer learning loss and focus on additional contributing factors, not just race or ethnicity and a student's SES. Atteberry and McEachin (2020) used NWEA MAP data, including almost 18 million students across 7,500 school districts from 2008 to 2016. Reading and mathematics scores (fall and spring) were collected and analyzed for students enrolled in Grades 1-8.

Atteberry and McEachin (2020) found that average loss differed among grade levels. In reading, students lost on average 6.6 test score points the summer after first grade, 3.9 test score points during the summer after second grade, 3.4 test scores points during the summer after third grade, and it decreases to a loss of 0.9 test scores after seventh grade. On average, students exhibited a loss of 17-28% of the acquired school year gains during the following summer. Students lost, on average, 25-34% of the acquired school year mathematics gains during the following summer (Atteberry & McEachin, 2020).

Additionally, Atteberry and McEachin (2020) sought to answer how the summer experiences for students lead to student achievement over time. To achieve this,

Atteberry and McEachin (2020) employed a "multilevel model to characterize three plausible student experiences during the summers following each grade: the typical gain among students in the top, middle, and bottom thirds of a given summer's gain/loss distribution" (p. 267). The results of this study provided evidence that when the inequality of school experiences was eliminated, disparities in achievement still occurred due to summer break (Atteberry &McEachin, 2020).

Natural disasters and school closures. Although school districts plan for summer breaks, school closures due to natural disasters are typically unplanned and disrupt learning environments. Hurricanes Frances and Jeanne in 2004 forced students at 25 Palm Beach County schools to miss school for 21 days (Baggerly & Ferretti, 2008). Additionally, in 2005, Hurricane Katrina created a wide-scale disruption to schools and students. The effects of Hurricane Katrina forced many schools to temporarily or permanently close, which displaced as many as 196,000 public school students (Kousky, 2016; Sacerdote, 2008). Bush fires in Australia also caused an interruption of educational opportunities for students (Gibbs et al., 2019). From August to December 2011, a flood in Thailand caused schools to close for weeks (Thamtanajit, 2017). The impact of natural disaster disruptions on student learning is mixed based on the severity of destruction (Baggerly & Ferretti, 2008; Gibbs et al., 2019; Kousky, 2016; Sacerdote, 2008).

After Hurricane Francis and Jeanne in Florida caused students in 25 Palm Beach County schools to miss 21 days of school, educators and parents were concerned about the potential impact on student learning and achievement on the Florida Comprehensive Assessment (FCAT). Baggerly and Ferretti (2008) analyzed a purposeful sampling of

students enrolled in Grades 4-10 who took the FCAT in 2005. From severely-damaged schools located in areas within seven of the highest hurricane-impacted school districts and schools that were not damaged within seven low-hurricane-impacted school districts, 55,681 students were included in the study (Baggerly & Ferretti, 2008). Comparing the standard deviation of gains between 2004 and 2005 in reading and mathematics, Baggerly and Ferretti (2008) found that students from high-hurricane impacted areas showed less gains than those from low-hurricane impact areas. Results indicated that there were significant but not practical differences in the gains of students from 2004 to 2005. Baggerly and Ferretti (2008) stated, "The difference indicates that less than 1% of the variance in Developmental Scale Score (DSS) can be attributed to hurricane impact level" (p. 4).

Sacerdote (2008) said, "Hurricane Katrina was one of the worst natural disasters in United States history" (p. 109). In 2005, parts of Louisiana were destroyed, including the education system in schools and school districts across the area. Kousky (2016) explained that the areas that were hit the hardest by the storm were the lowest-performing schools and school districts in the state. However, some students from the lowest-achieving schools were displaced into higher-achieving schools. To find the impact on student achievement, studies were conducted to identify the initial and lasting effects of this natural disaster.

Sacerdote (2008) used a data set from the Louisiana Educational Assessment of Program (LEAP) for students enrolled in Grades 4 and 8 during the 2004-2007 school years. LEAP assessed students in reading and mathematics. Also, during the spring of 2006, the Integrated Louisiana Educational Assessment of Progress (ILEAP) was added

for students enrolled in Grades 3, 5, 6, and 7. Sacerdote observed both students pre-Katrina (2004 or 2005) and post-Katrina (2006-2008). Results indicated that in the first year after Hurricane Katrina, mathematics scores dropped .10 to .25 standard deviation for evacuated students compared to other Louisiana students (Sacerdote, 2008). However, students who were evacuated began to experience gains at a quicker pace than was expected. By 2007, evacuee students were achieving at the same rate as in 2004 and 2005, and by 2008, test scores showed a .10 standard deviation ahead of predicted achievement in 2004 test scores (Sacerdote, 2008).

Similarly, Pane, McCaffrey, Kalra, and Zhou (2008) found that the 196,000 students displaced due to Hurricane Katrina exhibited the same results. Pane et al. (2008) identified that the time out of school for the displaced students varied, but the average time out of school was five weeks before re-enrollment. Displaced students were also more likely to enroll in multiple schools, which increased the amount of time out of school. Pane et al. (2008) found that the negative effects of displacement and time out of school were present but minimal. However, the negative effects increased with the number of schools and the higher number of days out of school.

Fuller (2013) conducted a study to further the research on the effects of natural disasters on children in school. Fuller (2013) analyzed longitudinal administrative data from 1996 to 2011 provided by the North Carolina Education Research Data Center. The data set included over 10 million individual test records for over 2.9 million students enrolled in Grades 3-8 during those school years. The longitudinal data allowed for comparing achievement scores before and after the natural disaster (Fuller, 2013).

Fuller (2013) found that a student's exposure to hurricanes and time away from school negatively affected reading, especially for students enrolled in middle school. This negative effect was minimal (a little more than 1% of a standard deviation). The effect on mathematics was not statistically significant but did show a minimal negative effect. However, the effect sizes for reading and mathematics were not significant and close to zero the year following the hurricanes (Fuller, 2013).

From August 2011 to December 2011, floods in Thailand caused schools to close temporarily for weeks. Thamtanajit (2017) examined a combination of school-level O-net examination scores from the National Institute of Education Test Service (NIETS) and school-specific data from the Ministry of Education for the academic years 2006-2013. Students included in this study were enrolled in Grades 6, 9, and 12.

For students enrolled in Grade 6, Thamtanajit (2017) found a statistically significant effect of the Thailand floods and school closures and test scores. The result showed a relationship between the flood of 2011 and a decrease in scores in both mathematics and English. Thamtanajit (2017) indicated a drop-in mathematics test scores of 0.624 points or 0.049 standard deviation and a drop of 0.406 points or 0.031 standard deviation in English. The largest drop in test scores for students enrolled in Grade 6 was in science. Thamtanajit (2017) found that the drop was 1.024 points or 0.100 standard deviation.

Gibbs et al. (2019) examined academic data of students exposed to the Australian bush fires to show a delayed impact on academic performance. In 2009, Black Saturday bushfires caused widespread destruction and disruption to educational opportunities. Gibbs et al. analyzed the scores of more than 16,000 students in Victoria, Australia, up to

four years after the bushfires as it related to different levels of bushfire impact. Gibbs et al. (2019) found that students in the higher level of destruction level of impact showed smaller gains in reading and math than expected. In writing, spelling, and grammar, no significant trends were found.

Natural disasters are unexpected sources of disruptions for students in educational opportunities. The higher level of destructive impacts indicated a higher level of learning loss in students. Also, a reduction in student achievement gains has shown to be slight in some areas affected by natural disasters (Baggerly & Ferretti, 2008; Gibbs et al., 2019).

Perceptions of Pandemic Learning Loss

School closures due to COVID-19 are a new phenomenon that has affected students worldwide during the spring of 2020. At that time, the actual impact of school closures on student achievement was unknown. Researchers used current and past research on summer learning loss and other school closures to predict the impact on students returning during fall 2020. Most researchers predicted that students would suffer a learning loss, some more than others. The projection was based on existing literature on summer learning loss, weather-related school closures, and absenteeism (Azevedo, Hasen, Goldemberg, Aroob Iqbal, & Geven, 2020; Kuhfeld, Soland, et al., 2020; Lafortune, 2020; Van Lancker & Parolin, 2020; von Hippel, 2021). Although there are similarities to these planned and unplanned school closures, the difference was that instruction was expected to continue virtually through the spring 2020 semester (Kuhfeld, Soland, et al., 2020). However, the quality of distance learning full-time might not make up for the face-to-face time lost due to the closing of brick-and-mortar buildings (Lafortune, 2020).

Kuhfeld, Soland, et al. (2020) predicted the projected learning loss for students during the 2020-2021 school year after school closure during the spring of 2020. The data for five million students enrolled in Grades 3-7 in schools across the United States were analyzed from the NWEA's MAP Growth assessment. Kuhfeld, Soland, et al. (2020) focused on the 2017-2018 and 2018-2019 school years, and demographic data were also included. To estimate the potential learning loss, Kuhfeld, Soland, et al. (2020) utilized existing research on summer learning loss, weather-related school closures, and student absenteeism. Also, a comparison was conducted of typical student growth during a standard school year to learning projections that consider school closures for at least three months.

Kuhfeld, Soland, et al. (2020) estimated that the learning loss of students would not be consistent, and some students may make gains in reading for the 2020-2021 school year. Based on the study findings, students "will return in fall 2020 with approximately 63-68% of the learning gains in reading relative to a typical school year and 37-50% of the learning gains in math" (p. 23). The authors also found that the learning loss of students due to summer break is not consistent, so they projected that students' academic achievement would have more variety than that of a typical school year. Kuhfeld, Soland, et al. (2020) concluded that a prolonged disruption in school could significantly impact student achievement, and students would arrive at school in fall 2020 with a greater variety of levels in academic skills, especially in reading.

In predicting the amount of pandemic learning loss, Calefati (2021) relied on long-term trend data from the National Assessment of Education Progress (NAEP). The NAEP trend data indicated a concerning trend that was not due to COVID-19 but might

likely have a direct effect on predicting learning loss related to the pandemic. The results included nearly 9,000 thirteen-year-olds across the United States in over 450 schools. The test was administered before the pandemic disruption between October and December 2019. The results showed that the scores for students who were 13-years old decreased on average five points in math and three points in reading. Data for nine-year-old students were also presented but showed no significant changes (Calefati, 2021).

Additionally, the data indicated the continued widening of the achievement gap between White and African American students (Calefati, 2021). With the decline in scores before the pandemic disruption, researchers feared that learning loss might be intensified. Updated NAEP long-term trend assessment data should be presented to the public in 2022 and include the learning loss due to the pandemic (Calefati, 2021).

Another study provided simulations to predict the potential impacts of the school closures due to COVID-19 worldwide on learning outcomes (Azevedo et al., 2020). To identify the potential impact on learning outcomes and those effects on economic outcomes, Azevedo et al. utilized the Learning Adjusted Years of Schooling (LAYS) database and the Organization for Economic Cooperation and Development's Programme for International Student Assessment. The LAYS database looks at the education life of students ages 4-17 and covers 157 countries. The simulations were also based on the amount of time schools were closed (three, five, and seven months) and the effectiveness of remote learning possibilities. Three scenarios were presented for the simulation study. The first was an optimistic scenario where schools were only closed for three months and were highly effective at mitigation measures such as remote learning. The second was an intermediate scenario where schools were closed for five months and had a moderate

level of effectiveness for mitigation measures. Finally, there was a pessimistic scenario that closed schools for seven months, and schools showed a low level of effectiveness for mitigation measures (Azevedo et al., 2020).

Results of the simulation study indicated initial findings of learning outcomes of students varying with the amount of time out of school and level of effectiveness of mitigation measures. Across the globe, the learning and level of schooling were predicted to decrease due to school closures. Azevedo et al. (2020) found that the loss can result in somewhere between 0.3 and 0.6 years of schooling. As the level of effectiveness of mitigation measures, such as remote learning, decreased in low- and middle-income countries, Azevedo et al. predicted the greater the loss of learning, especially affected girls, ethnic minorities, and persons with disabilities.

In November 2020, Bailey, Duncan, Murnane, and Au Yeung surveyed educational researchers to forecast both short- and longer-term changes in achievement gaps between low- and high-income students as a result of the pandemic disruption. The purpose of this study was to answer whether achievement gaps between low- and high-income students increased during the pandemic disruption and the effectiveness of system responses (Bailey et al., 2021). The forecasts involved the predictions of learning gaps between SES groups before and the year after the pandemic and the gains or improvements the following year (2021-2022). Responses to the survey were collected from educational researchers between November 18 and 27, 2020, and 221 responses were received.

Bailey et al. (2021) found that educational researchers forecasted a median increase of 1.00 to 1.30 standard deviations in the achievement gap before the pandemic

to spring 2021 in mathematics. Educational researchers indicated a minor increase from 1.00 to 1.25 standard deviations for the reading achievement gap between low- and high-income students (Bailey et al., 2021). Additionally, some of the survey results forecasted the ability of school systems to catch students up during the 2020-2021 school year. Of the survey responses collected, Bailey et al. (2021) found that educational researchers forecasted that the achievement gaps would decrease modestly by 1.30 to 1.25 standard deviations in mathematics and 1.25 to 1.20 standard deviations in reading by the spring of 2022. Some respondents even predicted that the achievement gap between low- and high-income students would increase by the spring of 2022 compared to the spring of 2021.

Van Lancker and Parolin (2020) and von Hippel (2021) agreed that students from low-income families are more likely to have a greater loss of learning due to school closures. Van Lancker and Parolin (2020) stated, "While learning might continue unimpeded for children from higher income households, children from lower income households are likely to struggle to complete homework because of precarious housing situations" (p. 243). Another factor is the accessibility of technology to provide effective remote learning. Von Hippel (2021) identified that one in seven children lacks internet access. The lack of internet access is doubled in families in low-income households. Researchers believe these situations provide an opportunity for the achievement gap to widen and could have a lasting effect.

Initial Findings about Pandemic Learning Loss

During fall 2020, students returned to school either in-person or remote learning. Educators were eager to identify the impact of the pandemic disruption on students'

learning. Assessments administered during the fall of 2020 as students returned provided an insight into the magnitude of learning loss for students (Domingue, Hough, Lang, & Yeatman, 2021; Engzell, Frey, & Verhagen, 2021; Johnson & Kuhfeld, 2020; Kuhfeld, Tarasawa, et al., 2020).

In May 2020, NWEA projected the potential impact of the pandemic disruption on student learning and growth (Kuhfeld, Soland, et al., 2020). With students returning to school for the 2020-2021 school year, fall 2020 data provided an opportunity to analyze actual learning loss. In November, Kuhfeld, Tarasawa, et al. (2020) published initial findings comparing fall 2019 to fall 2020 MAP Growth assessments of 4.4 million students enrolled in Grades 3-8. Kuhfeld, Tarasawa, et al. (2020) found that the projections made during the spring of 2020 were consistent or slightly lower than the actual fall 2020 data results. Although the assessments were administered both remotely and in person, Kuhfeld, Tarasawa, et al. (2020) found that the assessment results were consistent regardless of the delivery.

Kuhfeld, Tarasawa, et al. (2020) found that in fall 2020, students achieved similar results in reading compared to students in the same grade during the fall 2019 testing window. In mathematics, students performed 5 to 10 percentile points lower in fall 2020 when compared to students in the same grade during the fall 2019 testing window. Additionally, students showed some growth in both reading and mathematics since the beginning of COVID-19. However, the growth in reading tended to be higher on average than in mathematics (Kuhfeld, Tarasawa, et al., 2020).

Although the data indicated an optimistic picture of student growth during and after the pandemic disruption, it was not without caution and might have produced an

underestimated learning loss (Johnson & Kuhfeld, 2020; Kuhfeld, Tarasawa, et al., 2020). According to an attrition analysis published by Johnson and Kuhfeld in November 2020, a significant portion of students was not assessed in fall 2020. The findings of the study indicated that students who were assessed in fall 2020 achieved a higher average achievement baseline. Additionally, students tested had a smaller percentage of racial diversity and attended more affluent schools than students not tested during fall 2020 (Johnson & Kuhfeld, 2020). The result of attrition patterns could underestimate the impact of the pandemic disruption on the learning loss of students.

Engzell et al. (2021) conducted a study in the Netherlands to identify student learning loss after an eight-week lockdown of schools (March 16-May 11) due to COVID-19. To identify the learning loss accrued during that time, Engzell et al. (2021) analyzed data from primary schools during the years 2017 through 2020. Participants included students ages eight to eleven years old and enrolled in Grades 4-7 in the Netherlands. Subjects assessed included math, spelling, and reading. Data were also analyzed by subgroups (prior performance, gender, and parental education level). Engzell et al. (2021) reported that students showed a learning loss of 3 percentile points as a result of the eight-week school closures compared to other years. The 3-percentile point learning loss was consistent across grade levels, subjects, and prior performance levels. The results indicated that students from parents with the low and lowest parental education groups suffered the greatest learning loss. Students in these subgroups exhibited a learning loss of 4 to 4.5 percentile points compared to a 3-percentile point learning loss of students with parents with high education (Engzell et al., 2021). The

findings of this study confirmed predictions of widening the achievement gap between students from low-income and affluent families.

Turner (2021) conducted a study to compare the beginning of the year readiness in reading of North Carolina students. Students enrolled in Grade 3 during the 2019-2020 school year (114 students) were compared to students enrolled in Grade 3 during the 2020-2021 school year (111 students) in North Carolina. Students enrolled in Grade 3 during the fall of 2019 had not experienced school closures, while the students enrolled in Grade 3 during the fall of 2020 had. To compare the beginning of year readiness, Turner (2021) used a local diagnostic, i-Ready reading assessment, and the North Carolina Beginning of Grade (NC BOG) assessment.

Turner (2021) found that the differences in the mean Lexile Levels were not statistically significant between students enrolled in Grade 3 during the fall of 2019 and students enrolled in Grade 3 during the fall of 2020 on both the i-Ready and NC BOG3 reading assessments. The results of the comparison of the i-Ready reading assessment indicated a slightly higher mean for students enrolled in Grade 3 that did not experience the school closures during the fall of 2019 (M = 576.62, SD = 225.67) compared to students that experienced the school closures (M = 521.40, SD = 216.47). However, it was still not statically significant due to the p value (.7) being greater than the alpha level of .5 (Turner, 2021). Additionally, Turner (2021) found that the results of the NC BOG3 reading assessment showed that students enrolled in Grade 3 during the fall of 2020 that did experience the school closures had a higher mean Lexile Level (M = 521.31, SD = 242.85) compared to the students enrolled in Grade 3 that did not experience the school closures (M = 513.30, SD = 242.85). Again, this was not statistically significant

as the *p* value (.81) was greater than the alpha level of .5. The Lexile Level means of both sets of students were within the range of where students should be when finishing second grade.

Schweitzer (2021) investigated the short-term impact of the school closures due to the pandemic disruption on selected students in a mid-size suburban school district in Virginia and focused on the student academic performance from the fall of fifth grade to the fall of sixth grade. Participants of the study included students enrolled in Grade 5 and attending the selected schools in the falls of 2016 (cohort 1), 2017 (cohort 2), 2018 (cohort 3), and 2019 (cohort 4). All cohorts contained between 850 and 900 students. Demographic information was also utilized for each cohort (Schweitzer, 2021). Individual test scores were collected from the NWEA MAP growth assessment for reading and mathematics (Schweitzer, 2021).

Schweitzer (2021) found that the reading NWEA MAP RIT score in all four cohorts grew from the fall of fifth grade to the fall of sixth grade. Cohort 4, which included fifth-grade students during the pandemic disruption, showed a similar gain in reading from the fall of 2019 as fifth graders to the fall of 2020 as sixth graders to all other cohorts before the pandemic disruption (Schweitzer, 2021). Although economically disadvantaged students indicated lower NWEA MAP RIT scores, the growth patterns were consistent among all cohorts 1-4 (Schweitzer, 2021).

For mathematics, Schweitzer (2021) found that all cohorts1-4 grew from the fall of fifth grade to the fall of sixth grade, but the growth was not consistent. Students in cohort 4, those experiencing the pandemic disruption, indicated a slower growth rate than

those in cohorts 1-3 (Schweitzer, 2021). A similar pattern was found with students in cohorts 1-4 that were also economically disadvantaged.

Milhorn (2021) explored the relationship of reading performance of students enrolled in Grade 3 during remote learning as a result of school closures in a Tennessee district that was 1:1 or one student device per one student. To explore this relationship, Milhorn (2021) compared the fall 2020 STAR Reading universal screener Normal Curve Equivalent Scores (NCEs) of students enrolled in Grade 3 in 2020-2021 to their fall 2018 Grade 1 STAR Reading universal screener NCEs. The findings of this study were significant ($t(304) = 2.829$, $p = .005$). Milhorn (2021) found that the cohort of students enrolled in Grade 3 during the 2020-2021 school year scored significantly lower on the third-grade fall 2020 STAR Reading universal screener NCEs ($M = 51.97$, $SD = 19.84$) than on the first grade 2018 STAR Reading universal screener NCEs before the pandemic ($M = 54.59$, SD = 18.17). Students in this Grade 3 cohort also tended to score lower on the fall 2020 STAR Reading universal screener NCEs when compared to their Grade 2 fall 2019 STAR Reading universal screener NCEs (Milhorn, 2021).

Additionally, Milhorn (2021) compared the fall STAR Reading universal NCEs for students enrolled in Grade 3 during the 2020-2021 school year with students enrolled in Grade 3 during the 2018 school year. Students enrolled in Grade 3 during the fall of 2020 ($M = 51.97$, $SD = 19.84$) tended to score similar to students enrolled in Grade 3 during the fall of 2018 ($M = 54.62$, $SD = 19.88$). Therefore, Milhorn (2021) found that the results of this analysis were not significant.

Finally, Domingue et al. (2021) focused on the growth of Oral Reading Fluency (ORF) in primary students during the COVID-19 pandemic of close to 100,000 students

in more than 100 school districts across the United States. Domingue et al. (2021) found that the pandemic disruption affected growth based on the ORF and tracking students for multiple years. Students enrolled in Grades 2 and 3 indicated a consistent growth pattern prior to the pandemic. However, the growth pattern flattened during the pandemic (Domingue et al., 2021). Although the oral reading fluency growth flattened during the 2019-2020 school year, some reassuring evidence emerged regarding learning gains. Domingue et al. (2021) stated that "learning gains are occurring at a rate similar to that observed in earlier years in fall 2020" (p. 16). Gains were not consistent across districts, the selection of districts was not random, and the districts were typically high-achieving. A continued focus on the impact of the pandemic disruption on all students is still an area of need within the research.

Summary

Chapter 2 included a synthesis of past and current research related to learning loss. The effects of summer vacation and school closures due to natural disasters provided an initial base of research to predict the impact of the pandemic disruption on student achievement growth and the potential learning loss. As more data were collected during the 2020-2021 school year, researchers and school districts have begun determining the actual impact of the pandemic on learning loss. In Chapter 3, the methodology utilized in this study is described in detail.

Chapter 3

Methods

The purpose of this study was to determine the differences in reading and mathematics achievement growth from fall to spring for students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and after the 2020 pandemic disruption (2020-2021). An additional purpose was to determine if the differences in students' reading and mathematics achievement growth from fall to spring between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 during and after the 2020 pandemic disruption (2020-2021) were affected by SES, race, and gender. This chapter includes a detailed description of the research design, selection of participants, measurement, data collection procedures, data analysis and hypotheses testing, and the limitations.

Research Design

A quasi-experimental design was utilized in this study to compare two groups that were not randomly assigned. The growth of students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021) was compared. According to Creswell and Creswell (2018), "the design may have partial or total lack of random assignment to groups" (p. 166). Independent variables were enrollment years before the 2020 pandemic disruption (2018-2019) and after the 2020 pandemic disruption (2020-2021), SES, race, and gender. The dependent variables were the AimswebPlus reading achievement growth from fall to spring and AimswebPlus mathematics achievement growth from fall to spring for students enrolled in Grades 3-6. Additional analyses were conducted to identify if the

independent demographic variables (SES, race, and gender) affected the differences in growth between the 2018-2019 and 2020-2021 school years for students enrolled in Grades 3-6.

Selection of Participants

The populations for this study were District S students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021). Lunenburg and Irby (2008) stated a "purposive sampling involves selecting a sample based on the researcher's experience or knowledge of the group to be sampled" (p. 175). Purposive sampling was used for this study since the students were selected based on enrollment criteria. The sample also was limited to those students with both fall and spring AimswebPlus reading and mathematics composite scores.

Measurement

In District S, AimswebPlus is used as a screening tool and a measurement of growth in reading and mathematics content for students enrolled in kindergarten through sixth grade. AimswebPlus includes measures to assess skills in early literacy; early numeracy; reading, including vocabulary and comprehension; silent reading fluency; math computation; and math concepts and application. AimswebPlus is administered three times a year (fall, winter, and spring). Growth scores were calculated as the difference between the fall and spring scores.

During the 2013-2014 school year, Pearson completed a standardized study that involved 31,000 students who were administered the assessment in the fall, winter, and spring. To represent an accurate sample, demographic characteristics (gender, race,

English language learner [ELL] status, and SES) were reported utilizing a resampling method to match the U.S Census Bureau Community Survey in 2013. According to Pearson (2017), "The resampling algorithm used a target sample size by grade and subject, resulting in target counts for each demographic based on U.S. census percentages" (p. 3).

For the current study, the AimswebPlus reading composite scores were used to calculate the growth scores. In Grade 3, the composite score is calculated on scores of three subtests, Vocabulary (VO), Reading Comprehension (RC), and Oral Reading Fluency (ORF). The subtests, VO (22 questions) and RC (24 questions), are untimed and are scored by one point for each question answered correctly. The ORF is administered individually, and students read two passages for one minute per passage. The ORF score is calculated by the mean score of the number of words read correctly in both passages. In Grades 4-6, composite scores are calculated from scores on the subtests, VO, RC, and Silent Reading Fluency (SRF). VO and RC are administered and scored the same as in Grade 3. The SRF is untimed and scored by the mean of the scores of three passages and corresponding questions. For Grade 3, the formula to calculate the composite reading score is the sum of one-half of the ORF, VO, and RC. In Grades 4-6, the formula to calculate the composite score is the sum of one-half of the SRF, VO, and RC.

Also, AimswebPlus mathematics composite scores were used to calculate the growth scores for the current study. In Grades 3-6, the composite score is calculated from scores on the three subtests. The first subtest, a three-minute timed test, is Number Comparison Fluency-Triads (NCF-T) and includes 40 possible items. Second, students complete a four-minute timed test, Mental Computation Fluency (MCF) with 42 possible

items. In both subtests, students earn one point for each question answered correctly, and adjustments are made to total scores for student guesses. The final subtest is Concepts and Applications (CA). This untimed subtest includes 29-31 questions, depending on grade level, and students earn one point for each question answered correctly (Pearson, 2017). The mathematics composite score is calculated by adding the NCF-T, MCF, and CA.

Lunenburg and Irby (2008) defined reliability as "the degree to which an instrument consistently measures whatever it is measuring" (p. 182). According to Pearson (2017), two types of reliability were reported for both the reading and mathematics tests, internal consistency reliability (all untimed measures) and alternate form reliability (all timed measures). Internal consistency, as indexed by Coefficient *M*, of the reading and mathematics composite scores is presented in Table 2 below. Based on the results of the reliability analysis presented in the table, the AimswebPlus reading and mathematics assessments are considered reliable measures of student growth.

Table 2

Internal Consistency of Reading and Mathematics Composites Scores for Grades 3-6

	Reading			Mathematics		
Grade	*M*[a]	Range	SEM	*M*[a]	Range	SEM
3	.92	.92-.93	16.40	.92	.92-.93	9.93
4	.88	.87-.89	18.98	.90	.89-.91	9.97
5	.88	.87-.89	18.76	.91	.91	9.83
6	.87	.86-.88	20.33	.90	.88-.91	10.90

Note. Adapted from *AimswebPlus Technical Manual*, by Pearson, 2017, p. 21. Retrieved from https://www.marshfieldschools.org/cms/lib/WI01919828/Centricity/Domain/82/Plus%20Technical%20Manual.pdf

[a]*M* = Coefficient *M*.

Lunenburg and Irby (2008) defined validity as "the degree to which an instrument measures what it purports to measure" (p. 181). Pearson measured concurrent and predictive validity for Grades 1-8. "Concurrent validity represents the correlation of AimswebPlus composite scores and criterion measure scores, both from the Spring testing season. Predictive validity represents the correlation of Fall AimswebPlus composite scores and Spring scores from the criterion measures." (Pearson, 2017, p. 45). Since the spring and fall scores were used in the current study, this researcher focused on the predictive validity results. Validity tables include unadjusted and adjusted validity coefficients and weighted mean adjusted coefficients by each grade level. Pearson (2017) identified the adjusted validity coefficient as a more reliable estimate of the actual population as it considers the population characteristics' effects on scores. The weighted

mean adjusted validity coefficient is the average of the adjusted validity coefficient weighted by sample size (Pearson, 2017).

According to the National Center on Intensive Intervention (NCII), to maintain the strong evidence of validity of screeners' predictive validity, a correlation of .70 or higher is required (Pearson, 2017). It is also critical to test the predictive validity with a number of different criterion measures. To evaluate the validity of the reading assessment in Grades 3-6, the following criterion measures were used: (a) Illinois Standards Achievement Test (ISAT), (b) Missouri Assessment Program Grade-Level Assessment (MAP-GLA), (c) Northwest Evaluation Measures of Academic Progress (NWEA-MAP), and (d) State of Texas Academic Assessment of Readiness (STAAR). The reading AimswebPlus predictive validity unadjusted and adjusted coefficients with each criterion measure are shown in Table 3. Additionally, a weighted mean validity coefficient for Grades 3-6 is shown, which "provides an estimate of the overall predictive validity" (Pearson, 2017, p. 49). For Grades 3-6, the weighted mean of the adjusted coefficients was above .70, except the Grade 4 mean, which was .69. These results indicated moderately strong predictive validity for AimswebPlus reading compared to the criterion measures. The results of the analysis are presented in Table 3. Based on the results presented in the table, the AimswebPlus reading assessments are considered a valid measure of student growth.

Table 3

Reading Composite Score Predictive Validity Coefficients by Grade and Criterion Measure for Grades 3-6

		Correlation			
Criterion	Grade	*n*	Unadjusted	Adjusted	Mean
ISAT[a]	3	113	.80	.84	.77
MAP-GLA[b]	3	317	.71	.69	
NWEA-MAP[c]	3	150	.78	.79	
STAAR[d]	3	208	.70	.74	
ISAT[a]	4	230	.77	.79	.69
MAP-GLA[b]	4	292	.62	.58	
NWEA-MAP[c]	4	125	.76	.77	
STAAR[d]	4	277	.60	.61	
ISAT[a]	5	250	.73	.75	.73
MAP-GLA[b]	5	222	.65	.65	
NWEA-MAP[c]	5	141	.81	.79	
STAAR[d]	5	157	.66	.71	
ISAT[a]	6	332	.74	.77	.75
NWEA-MAP[c]	6	124	.67	.73	

Note. Adapted from *AimswebPlus Technical Manual*, by Pearson, 2017, p. 50. Retrieved from https://www.marshfieldschools.org/cms/lib/WI01919828/ Centricity/ Domain/82/Plus%20Technical%20Manual.pdf

[a]ISAT = Illinois Standards Achievement Test; [b]MAP-GLA = Missouri Assessment Program Grade-Level Assessment; [c]NWEA-MAP = Northwest Evaluation Measures of Academic Progress; [d]STAAR = State of Texas Academic Assessment of Readiness.

To evaluate the validity of the mathematics assessment, the following criterion measures were used: (a) Iowa Tests of Basic Skills (IBTS), (b) (ISAT), (c) New Mexico Standards-Based Assessment (NMSBA), (d) NWEA-MAP, and (e) STAAR. The mathematics AimswebPlus predictive validity unadjusted and adjusted coefficients with each criterion measure are shown in Table 4. Additionally, a weighted mean validity coefficient for Grades 3-6 is shown which "provides an estimate of the overall predictive validity" (Pearson, 2017, p. 48. For Grades 3-6, the weighted mean of the adjusted coefficients was above .70. These results indicated a moderately strong predictive validity for AimswebPlus mathematics when the test results were compared to the criterion measures. The coefficients from the analysis of the mathematics composite score predictive validity are presented in Table 4 below. Based on the results of the analysis presented in the table, the AimswebPlus mathematics assessments are considered a valid measure of student growth.

Table 4

Mathematic Composite Score Predictive Validity Coefficients by Grade and Criterion Measure for Grades 3-6

		Correlation			
Criterion	Grade	*n*	Unadjusted	Adjusted	Mean
ISAT[a]	3	69	.85	.81	
NWEA-MAP[b]	3	101	.83	.79	.79
STAAR[c]	3	146	.74	.77	
ISAT[a]	4	175	.80	.79	
NWEA-MAP[b]	4	95	.76	.75	.76
STAAR[c]	4	207	.75	.73	
ISAT[a]	5	189	.86	.84	
NWEA-MAP[b]	5	81	.89	.86	.83
STAAR[c]	5	91	.70	.79	
ISAT[a]	6	273	.84	.89	
NMSBA[d]	6	210	.75	.80	.85
NWEA-MAP[b]	6	86	.79	.83	
STAAR[c]	6	61	.63	.75	

Note. Adapted from *AimswebPlus Technical Manual*, by Pearson, 2017, p. 48. Retrieved from https://www.marshfieldschools.org/cms/lib/WI01919828/Centricity/Domain/82/Plus%20Technical%20Manual.pdf

[a]ISAT = Illinois Standards Achievement Test; [b]NWEA-MAP = Northwest Evaluation Measures of Academic Progress; [c]STAAR = State of Texas Academic Assessment of Readiness; [d]NMSBA = New Mexico Standards-Based Assessment.

The demographic variables in the current study included student SES designation, race, and gender. According to USDA (2017), for children to qualify for free meals, the family's income must be "below 130 percent of the Federal poverty level" (p. 2). Also, to be eligible for reduced price meals, the family income must be "between 130 and 185 percent of the Federal poverty level". Children who do not meet the stated requirements are considered full pay. For this study, the SES status was recoded into two categories, free or reduced and full pay. SES information was obtained from Infinite Campus, the SIS of District S.

During District S enrollment, parents enter the students' race and gender into the student information system (SIS) Infinite Campus. Options for race include White, African American, American Indian, Asian, Hawaiian/Pacific Islander, Hispanic, or Multi-Racial. For the current study, race designations were recoded into two categories, non-minority (White) and minority (African American, American Indian, Asian, Hawaiian/ Pacific Islander, Hispanic, and Multi-Racial). For gender, parents have the choice of identifying their child as female or male.

Data Collection Procedures

Before data collection, District S gave written consent for the study to be conducted on September 20, 2021, and to collect archival, de-identified AimswebPlus test score data and student demographic information (see Appendix A). On October 25, 2021, an institutional review board form was submitted to Baker University, and approval was granted on October 27, 2021 (see Appendix B). The District S data warehouse manager provided the researcher with Excel worksheets containing the data to the researcher on November 1, 2021. To protect the anonymity of students, the data were de-

identified by the data warehouse manager prior to the transfer. Each student's name was removed and replaced with an assigned random number. Excel spreadsheets were compiled into one document and uploaded to SPSS Statistics Faculty Pack 27 for PC to analyze the data.

Data Analysis and Hypothesis Testing

Hypothesis tests were conducted to compare the difference in both reading and mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3-6 after the 2020 pandemic disruption (2020-2021). Also, hypothesis testing was conducted to identify whether the differences were affected by the three subgroup variables: SES, race, and gender. Each research question is listed below with the corresponding hypothesis (or hypotheses) and data analysis.

RQ1. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021)?

***H1*.** There is a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021).

A two-factor analysis of variance (ANOVA) was conducted to test H1 and H2. The two categorical variables used to group the dependent variables, AimswebPlus reading achievement growth, were Grade 3 enrollment year (before the 2020 pandemic

disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 3 Enrollment Year x SES). The main effect for Grade 3 enrollment year was used to test H1. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ2. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

***H2*.** The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the first two-factor ANOVA was used to test H2. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

***H3*.** The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student race.

A second two-factor ANOVA was conducted to test H3. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for race, and a two-way interaction effect (Grade 3 Enrollment Year x Race). The interaction effect for Grade 3 enrollment year by race was used to test H3. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

H4. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

A third two-factor ANOVA was conducted to test H4. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]), and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 3 Enrollment Year x Gender). The interaction effect for Grade 3 enrollment year by gender was used to test

H4. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ3. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021)?

H5. There is a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021).

A fourth two-factor ANOVA was conducted to test H5 and H6. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]), and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 4 Enrollment Year x SES). The main effect for Grade 4 enrollment year was used to test H5. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ4. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the

2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) affected by SES, race, and gender?

H6. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the fourth two-factor ANOVA was used to test H6. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared,* is reported.

H7. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by race.

A fifth two-factor ANOVA was conducted to test H7. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]), and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, and main effect for race, and a two-way interaction effect (Grade 4 Enrollment Year x Race). The interaction effect for Grade 4 enrollment year by race was used to test H7. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared,* is reported.

***H8*.** The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

A sixth two-factor ANOVA was conducted to test H8. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 4 Enrollment Year x Gender). The interaction effect for Grade 4 enrollment year by gender was used to test H8. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ5. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021)?

***H9*.** There is a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021).

A seventh-two-factor ANOVA was conducted to test H9 and H10. The two categorical variables used to group the dependent variable, AimswebPlus reading

achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 5 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 5 Enrollment Year x SES). The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ6. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

***H10*.** The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the seventh two-factor ANOVA was conducted to test H10. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

***H11*.** The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by student race.

An eighth two-factor ANOVA was conducted to test H11. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]), and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for the difference of a numerical of three or more groups, including a main effect from Grade 5 enrollment year, a main effect for race, and a two-way interaction effect (Grade 5 Enrollment Year x Race). The interaction effect from Grade 5 enrollment year by race was used to test H11. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

***H12*.** The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by gender.

A ninth two-factor ANOVA was conducted to test H12. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]), and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 5 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 5 Enrollment Year x Gender). The interaction effect for Grade 5 enrollment year by race was used to test

H12. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ7. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021)?

***H13*.** There is a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021).

A tenth two-factor ANOVA was conducted to test H13 and H14. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021], and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 6 Enrollment Year x SES). The main effect for Grade 6 enrollment year was used to test H13. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ8. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the

2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H14. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the tenth two-factor ANOVA was used to test H14. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared,* is reported.

H15. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by student race.

An eleventh two-factor ANOVA was conducted to test H15. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for race, and a two-way interaction effect (Grade 6 Enrollment Year x Race). The interaction effect for Grade 6 enrollment year by race was used to test H15. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared,* is reported.

H16. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

A twelfth two-factor ANOVA was conducted to test H16. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 6 Enrollment Year x Gender). The interaction effect for Grade 6 enrollment year by gender was used to test H16. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ9. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021)?

H17. There is a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021).

A thirteenth two-factor ANOVA was conducted to test H17 and H18. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]), and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 3 Enrollment Year x SES). The main effect for Grade 3 enrollment year was used to test H17. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ10. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H18. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the thirteenth two-factor ANOVA was used to test H18. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

H19. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020

pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student race.

A fourteenth two-factor ANOVA was conducted to test H19. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for race, and a two-way interaction effect (Grade 3 Enrollment Year x Race). The interaction effect for Grade 3 enrollment year by race was used to test H19. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

***H20*.** The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

A fifteenth two-factor ANOVA was conducted to test H20. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]), and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 3 Enrollment Year

x Gender). The interaction effect for Grade 3 enrollment year by gender was used to test H20. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ11. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021)?

***H21*.** There is a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021).

A sixteenth two-factor ANOVA was conducted to test H21 and H22. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 4 Enrollment Year x SES). The main effect for Grade 4 enrollment year was used to test H21. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ12. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before

the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H22. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the sixteenth two-factor ANOVA was used to test H22. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

H23. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student race.

A seventeenth two-factor ANOVA was conducted to test H23. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for race, and a two-way interaction effect (Grade 4 Enrollment Year x Race). The interaction effect for Grade 4 enrollment year by race was used to test H23. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

***H24*.** The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

An eighteenth two-factor ANOVA was conducted to test H24. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 4 Enrollment Year x Gender). The interaction effect for Grade 4 enrollment year by gender was used to test H24. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ13. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021)?

***H25*.** There is a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021).

A nineteenth two-factor ANOVA was conducted to test H25 and H26. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 5 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 5 Enrollment Year x SES). The main effect for Grade 5 enrollment year was used to test H25. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ14. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H26. The difference in mathematics achievement growth, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the nineteenth two-factor ANOVA was used to test H26. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

H27. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020

pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by student race.

A twentieth two-factor ANOVA was conducted to test H27. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]), and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 5 enrollment year, a main effect for race, and a two-way interaction effect (Grade 5 Enrollment Year x Race). The interaction effect for Grade 5 enrollment year by race was used to test H27. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

H28. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

A twenty-first two-factor ANOVA was conducted to test H28. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]), and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 5 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 5

Enrollment Year x Gender). The interaction effect for Grade 5 enrollment year by gender was used to test H28. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ15. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021)?

***H29*.** There is a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021).

A twenty-second two-factor ANOVA was conducted to test H29 and H30. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]), and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 6 Enrollment Year x SES). The main effect for Grade 6 enrollment year was used to test H29. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

RQ16. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before

the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H30. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the twenty-second two-factor ANOVA was used to test H30. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

H31. The difference in mathematics achievement growth, from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by student race.

A twenty-third two-factor ANOVA was conducted to test H31. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for race, and a two-way interaction effect (Grade 6 Enrollment Year x Race). The interaction effect for Grade 6 enrollment year by race was used to test H31. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

H32. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

A twenty-fourth two-factor ANOVA was conducted to test H32. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021] and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 6 Enrollment Year x Gender). The interaction effect for Grade 6 enrollment year by gender was used to test H32. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

Limitations

Lunenburg and Irby (2008) defined limitations of a study as factors "not under the control of the researcher [and] factors that may have an effect on the interpretation of the findings or on the generalizability of the results" (p. 133). For this study, the following limitations were acknowledged or potentially affected the interpretation of the results.

1. Students may have experienced a different quality of teaching and learning depending on the classrooms or building the student was enrolled.
2. During the 2020-2021 school year, students experienced different modes of instruction, in-person, hybrid, and remote.

3. Attendance and internal motivation of students may have varied.
4. Testing conditions and locations (remote or in-person) for the fall and spring of 2020-2021 may have varied.

Summary

Discussed in this chapter were the methods used in this study. The topics included the research design, selection of participants, measurement, data collection procedures, data analysis and hypotheses testing, and the limitations of the study. Chapter 4 includes the results of the data analysis associated with the hypothesis testing.

Chapter 4

Results

The first purpose of this quantitative study was to determine the differences in students' reading and mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021). The second purpose was to determine if the differences in students' reading and mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021) were affected by SES, race, and gender. The results of the hypothesis testing are included in this chapter.

Hypothesis Testing

The results of the hypothesis testing to address the 16 research questions presented in the study are discussed in this section. Each research question is followed by the corresponding hypotheses. Following each hypothesis, the corresponding analysis is reviewed. Finally, the result of each data analysis is explained after each hypothesis and analysis.

RQ1. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in grade 3 after the 2020 pandemic disruption (2020-2021)?

H1. There is a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021).

A two-factor ANOVA was conducted to test H1 and H2. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 3 Enrollment Year x SES). The main effect for Grade 3 enrollment year was used to test H1. The level of significance was set at .05. When appropriate, an effect size as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two of the means, $F(1, 712) = 0.288$, $p = .592$. See Table 5 for the means and standard deviations for this analysis. H1 was not supported. There was not a significant difference in reading achievement growth from fall to spring between students enrolled in Grade 3 before the 2020 pandemic disruption and students enrolled in Grade 3 after the 2020 pandemic disruption.

Table 5

Descriptive Statistics for the Results of the Test for H1

Enrollment Year	*M*	*SD*	*N*
2018-2019	42.99	28.23	357
2020-2021	46.14	32.95	359

RQ2. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H2. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by SES.

The interaction effect from the first two-factor ANOVA was used to test H2. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two of the means, $F(1,712) = 2.440$, $p = .119$. See Table 6 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H2 was not supported. The difference in reading achievement growth from fall to spring between students enrolled in Grade 3 before the 2020 pandemic disruption and students enrolled in Grade 3 after the 2020 pandemic disruption was not affected by student SES.

Table 6

Descriptive Statistics for the Results of the Test for H2

Enrollment Year	SES	*M*	*SD*	*N*
2018-2019	Free or Reduced	42.89	30.41	87
	Full Pay	43.03	27.55	270
2020-2021	Free or Reduced	40.22	32.13	102
	Full Pay	48.49	33.04	257

H3. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student race.

A second two-factor ANOVA was conducted to test H3. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for race, and a two-way interaction effect (Grade 3 Enrollment Year x Race). The interaction effect for Grade 3 enrollment year by race was used to test H3. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two of the means, $F(1, 712) = 0.201$, $p = .654$. See Table 7

for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H3 was not supported. The difference in reading achievement growth from fall to spring between students enrolled in Grade 3 before the 2020 pandemic disruption and students enrolled in Grade 3 after the 2020 pandemic disruption was not affected by student race.

Table 7

Descriptive Statistics for the Results of the Test for H3

Enrollment Year	Race	*M*	*SD*	*N*
2018-2019	Minority	36.69	29.21	85
	Non-minority	44.96	27.67	272
2020-2021	Minority	41.57	32.70	77
	Non-minority	47.39	32.97	282

H4. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

A third two-factor ANOVA was conducted to test H4. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019] and after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 3 Enrollment Year

x Gender). The interaction effect for Grade 3 enrollment year by gender was used to test H4. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two of the means, $F(1, 712) = 1.379$, $p = .241$. See Table 8 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H4 was not supported. The difference in reading achievement growth from fall to spring between students enrolled in Grade 3 before the 2020 pandemic disruption and students enrolled in Grade 3 after the 2020 pandemic disruption was not affected by student gender.

Table 8

Descriptive Statistics for the Results of the Test for H4

Enrollment Year	Gender	*M*	*SD*	*N*
2018-2019	Female	45.48	29.31	172
	Male	40.69	27.06	185
2020-2021	Female	45.85	30.71	185
	Male	46.45	35.27	174

RQ3. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021)?

H5. There is a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020

pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021).

A fourth two-factor ANOVA was conducted to test H5 and H6. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 4 Enrollment Year x SES). The main effect for Grade 4 enrollment year was used to test H5. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated a statistically significant difference between the two means, $F(1, 816) = 14.419$, $p = .000$, $\eta^2 = .017$. See Table 9 for the means and standard deviations for this analysis. H5 was supported. Reading achievement growth from fall to spring ($M = 32.30$) for students enrolled in Grade 4 before the 2020 pandemic disruption was higher than reading achievement growth from fall to spring ($M = 24.89$) for students enrolled in Grade 4 after the 2020 pandemic disruption. The effect size indicated a small effect.

Table 9

Descriptive Statistics for the Results of the Test for H5

Enrollment Year	*M*	*SD*	*N*
2018-2019	32.30	36.84	377
2020-2021	24.89	36.20	443

RQ4. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H6. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the fourth two-factor ANOVA was used to test H6. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated a statistically significant difference between at least two of the means, $F(1, 816) = 6.605$, $p = .010$, $\eta^2 = .008$. See Table 10 for the means and standard deviations for this analysis. A follow-up post hoc was conducted to determine which pairs of means were different. The Tukey's Honestly Significant Difference (HSD) post hoc was conducted at $\alpha = .05$. Two of the differences were significant. H6 was supported. Reading achievement growth ($M = 36.10$) before the 2020 pandemic disruption for Grade 4 students who qualified for free or reduced lunch

and reading achievement growth (M = 30.83) before the 2020 pandemic disruption for Grade 4 students who qualified for full pay lunch were higher than reading achievement growth (M = 17.71) after the 2020 pandemic disruption for Grade 4 students who qualified for free or reduced lunch. The effect size indicated a small effect.

Table 10

Descriptive Statistics for the Results of the Test for H6

Enrollment Year	SES	*M*	*SD*	*N*
2018-2019	Free or Reduced	36.10	36.44	105
	Full Pay	30.83	36.96	272
2020-2021	Free or Reduced	17.71	39.56	111
	Full Pay	27.29	34.74	332

H7. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student race.

A fifth two-factor ANOVA was conducted to test H7. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for race, and a two-way interaction effect (Grade 4 Enrollment Year x Race). The interaction effect for Grade 4 enrollment year by race was

used to test H7. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two of the means, $F(1, 816) = 0.022$, $p = .882$. See Table 11 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H7 was not supported. The difference in reading achievement growth from fall to spring between students enrolled in Grade 4 before the 2020 pandemic disruption and students enrolled in Grade 4 after the 2020 pandemic disruption was not affected by student race.

Table 11

Descriptive Statistics for the Results of the Test for H7

Enrollment Year	Race	*M*	*SD*	*N*
2018-2019	Minority	33.68	38.49	93
	Non-minority	31.85	36.35	284
2020-2021	Minority	25.59	42.55	117
	Non-minority	24.64	33.70	326

H8. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

A sixth two-factor ANOVA was conducted to test H8. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-

2019], after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 4 Enrollment Year x Gender). The interaction effect for Grade 4 enrollment year by gender was used to test H8. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two of the means, $F(1, 816) = 0.130$, $p = .718$. See Table 12 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H8 was not supported. The difference in reading achievement growth from fall to spring between students enrolled in Grade 4 before the 2020 pandemic disruption and students enrolled in Grade 4 after the 2020 pandemic disruption was not affected by student gender.

Table 12

Descriptive Statistics for the Results of the Test for H8

Enrollment Year	Gender	*M*	*SD*	*N*
2018-2019	Female	34.83	37.09	177
	Male	30.06	36.57	200
2020-2021	Female	26.42	38.22	211
	Male	23.50	34.29	232

RQ5. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before

the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021)?

H9. There is a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021).

A seventh two-factor ANOVA was conducted to test H9 and H10. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 5 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 5 Enrollment Year x SES). The main effect for Grade 5 enrollment year was used to test H9. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two of the means, $F(1, 788) = 1.994$, $p = .158$. See Table 13 for the means and standard deviations for this analysis. H9 was not supported. There was not a significant difference in reading achievement growth from fall to spring for students enrolled in Grade 5 before the 2020 pandemic disruption and students enrolled in Grade 5 after the 2020 pandemic disruption.

Table 13

Descriptive Statistics for the Results of the Test for H9

Enrollment Year	*M*	*SD*	*N*
2018-2019	25.87	32.34	391
2020-2021	23.51	32.97	401

RQ6. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H10. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the seventh two-factor ANOVA was used to test H10. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two means, $F(1, 788) = 1.069$, $p = .301$. See Table 14 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H10 was not supported. The difference in reading achievement growth from fall to spring between students enrolled in Grade 5 before the 2020 pandemic disruption and students enrolled in Grade 5 after the 2020 pandemic disruption was not affected by student SES.

Table 14

Descriptive Statistics for the Results of the Test for H10

Enrollment Year	SES	*M*	*SD*	*N*
2018-2019	Free or Reduced	27.78	38.78	96
	Full Pay	25.25	29.99	295
2020-2021	Free or Reduced	21.08	35.12	90
	Full Pay	24.22	32.34	311

H11. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by race.

An eighth two-factor ANOVA was conducted to test H11. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 5 enrollment year, a main effect for race, and a two-way interaction effect (Grade 5 Enrollment Year x Race). The interaction effect for Grade 5 enrollment year by race was used to test H11. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two means, $F(1, 788) = 0.175$, $p = .676$. See Table 15 for the

means and standard deviations for this analysis. No follow-up post hoc was warranted. H11 was not supported. The difference in reading achievement from fall to spring between students enrolled in Grade 5 before the 2020 pandemic disruption and students enrolled in Grade 5 after the 2020 pandemic disruption was not affected by race.

Table 15

Descriptive Statistics for the Results of the Test for H11

Enrollment Year	Race	*M*	*SD*	*N*
2018-2019	Minority	19.89	35.14	85
	Non-minority	27.54	31.38	306
2020-2021	Minority	19.55	32.20	105
	Non-minority	24.92	33.17	296

H12. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by gender.

A ninth two-factor ANOVA was conducted to test H12. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 5 enrollment years (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade5 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 5 Enrollment Year x Gender). The interaction effect for Grade 5 enrollment year by race was used to test

H12. The level of significance was set at .05. When appropriate, and effect size, as indexed by *eta squared,* is reported.

The results of this analysis indicated a statistically significant difference between at least two of the means, $F(1, 788) = 6.124$, $p = .014$, $\eta^2 = .008$. See Table 12 for the means and standard deviations for this analysis. A follow up post hoc was conducted to determine which pairs of means were different. The Tukey's HSD post hoc was conducted at $\alpha = .05$. One difference was significant. H12 was supported. Reading achievement growth ($M = 27.79$) after the 2020 pandemic disruption for Grade 5 male students was higher than reading achievement growth ($M = 19.13$) after the 2020 pandemic disruption for Grade 5 female students. The effect size indicated a small effect.

Table 16

Descriptive Statistics for the Results of the Test for H12

Enrollment Year	Gender	*M*	*SD*	*N*
2018-2019	Female	27.31	33.37	189
	Male	24.53	31.37	202
2020-2021	Female	19.13	33.59	198
	Male	27.79	31.84	203

RQ7. To what extent is there a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021)?

H13. There is a difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020

pandemic (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021).

A tenth two-factor ANOVA was conducted to test H13 and H14. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 6 Enrollment Year x SES). The main effect for Grade 6 enrollment year was used to test H13. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of the analysis indicated a statistically significant difference between the two means, $F(1, 805) = 7.213$, $p = .007$, $\eta^2 = .009$. See Table 17 for the means and standard deviations for this analysis. H13 was supported. Reading achievement growth from fall to spring ($M = 22.83$) for students enrolled in Grade 6 before the 2020 pandemic disruption was higher than reading achievement growth from fall to spring ($M = 17.07$) for students enrolled in Grade 6 after the 2020 pandemic disruption The effect size indicated a small effect.

Table 17

Descriptive Statistics for the Results of the Test for H13

Enrollment Year	*M*	*SD*	*N*
2018-2019	22.83	33.01	390
2020-2021	17.07	30.93	419

RQ8. To what extent is the difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H14. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the tenth two-factor ANOVA was used to test H14. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two means, $F(1, 805) = 0.903$, $p = .342$. See Table 18 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H14 was not supported. The difference in reading achievement growth from fall to spring between students enrolled in Grade 6 before the 2020 pandemic disruption and students enrolled in Grade 6 after the 2020 pandemic disruption was not affected by student SES.

Table 18

Descriptive Statistics for the Results of the Test for H14

Enrollment Year	SES	*M*	*SD*	*N*
2018-2019	Free or Reduced	24.67	34.18	93
	Full Pay	22.26	32.68	297
2020-2021	Free or Reduced	15.16	36.24	106
	Full Pay	17.72	28.95	313

H15. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by student race.

An eleventh two-factor ANOVA was conducted to test H15. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for race, and a two-way interaction effect (Grade 6 Enrollment Year x Race). The interaction effect for Grade 6 by race was used to test H15. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is listed.

The results of this analysis indicated there was not a statistically significant difference between at least two means, $F(1, 805) = 0.029$, $p = .864$. See Table 19 for the

means and standard deviations for this analysis. No follow-up post hoc was warranted. H15 was not supported. The difference in reading achievement growth from fall to spring between students enrolled in Grade 6 before the 2020 pandemic disruption and students enrolled in Grade 6 after the 2020 pandemic disruption was not affected by race.

Table 19

Descriptive Statistics for the Results of the Test for H15

Enrollment Year	Race	*M*	*SD*	*N*
2018-2019	Minority	21.95	34.88	102
	Non-minority	23.15	32.38	288
2020-2021	Minority	16.84	30.50	113
	Non-minority	17.16	31.14	306

H16. The difference in reading achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

A twelfth two-factor ANOVA was conducted to test H16. The two categorical variables used to group the dependent variable, AimswebPlus reading achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 6 Enrollment Year x Gender). The interaction effect for Grade 6 enrollment year by gender was used to test

H16. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared,* is reported.

The results of this analysis indicated there was not a statistically significant difference in at least two means, $F(1, 805) = 0.440$, $p = .507$. See Table 20 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H16 was not supported. The difference in reading achievement growth from fall to spring between students enrolled in Grade 6 before the 2020 pandemic disruption and students enrolled in Grade 6 after the 2020 pandemic disruption was not affected by gender.

Table 20

Descriptive Statistics for the Results of the Test for H16

Enrollment Year	Gender	*M*	*SD*	*N*
2018-2019	Female	23.62	30.47	198
	Male	22.02	35.51	192
2020-2021	Female	19.54	26.32	194
	Male	14.95	34.33	225

RQ9. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021)?

H17. There is a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021).

A thirteenth two-factor ANOVA was conducted to test H17 and H18. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 3 Enrollment Year x SES). The main effect for Grade 3 enrollment year was used to test H17. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two means, $F(1, 723) = 0.002$, $p = .968$. See Table 21 for the means and standard deviations. No follow-up post hoc was warranted. H17 was not supported. There was not a significant difference in mathematics achievement growth from fall to spring for students enrolled in Grade 3 before the 2020 pandemic disruption and students enrolled in Grade 3 after the 2020 pandemic disruption.

Table 21

Descriptive Statistics for the Results of the Test for H17

Enrollment Year	*M*	*SD*	*N*
2018-2019	37.61	20.01	357
2020-2021	37.74	25.71	370

RQ10. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before

the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H18. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the thirteenth two-factor ANOVA was used to test H18. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference in at least two of the means, $F(1, 723) = 0.369$, $p = .544$. See Table 22 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H18 was not supported. The difference in mathematics achievement growth from fall to spring between students enrolled in Grade 3 before the 2020 pandemic disruption and students enrolled in Grade 3 after the 2020 pandemic disruption was not affected by student SES.

Table 22

Descriptive Statistics for the Results of the Test for H18

Enrollment Year	SES	*M*	*SD*	*N*
2018-2019	Free or Reduced	31.93	21.40	87
	Full Pay	39.44	19.23	270
2020-2021	Free or Reduced	30.69	27.91	105
	Full Pay	40.53	24.28	265

H19. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student race.

A fourteenth two-factor ANOVA was conducted to test H19. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for race, and a two-way interaction effect (Grade 3 Enrollment Year x Race). The interaction effect for Grade 3 enrollment year by race was used to test H19. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two means, $F(1, 723) = 0.170$, $p = .681$. See Table 23 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H19 was not supported. The difference in mathematic achievement growth from fall to spring between students enrolled in Grade 3 before the 2020 pandemic disruption and student enrolled in Grade 3 after the 2020 pandemic disruption was not affected by student race.

Table 23

Descriptive Statistics for the Results of the Test for H19

Enrollment Year	Race	*M*	*SD*	*N*
2018-2019	Minority	35.69	18.40	85
	Non-minority	38.21	20.48	272
2020-2021	Minority	34.48	25.77	82
	Non-minority	38.66	25.66	288

H20. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 3 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 3 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

A fifteenth two-factor ANOVA was conducted to test H20. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 3 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 3 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 3 Enrollment Year x Gender). The interaction effect for Grade 3 enrollment year by gender was used to test H20. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated that there was not a statistically significant difference in at least two of the means, $F(1, 723) = 1.357$, $p = .244$. See Table 24 for the

means and standard deviations for this analysis. No follow-up post hoc was warranted. H20 was not supported. The difference in mathematics achievement growth from fall to spring between students enrolled in Grade 3 before the 2020 pandemic disruption and students enrolled in Grade 3 after the 2020 pandemic disruption was not affected by student gender.

Table 24

Descriptive Statistics for the Results of the Test for H20

Enrollment Year	Gender	*M*	*SD*	*N*
2018-2019	Female	35.28	18.23	172
	Male	39.77	21.36	185
2020-2021	Female	37.49	24.86	190
	Male	37.99	26.65	180

RQ11. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021)?

H21. There is a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021).

A sixteenth two-factor ANOVA was conducted to test H21 and H22. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption

[2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 4 Enrollment Year x SES). The main effect for Grade 4 enrollment year was used to test H21. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of the analysis indicated a statistically significant difference between the two means, $F(1, 819) = 26.450$, $p = .000$, $\eta^2 = .031$. See Table 25 for the means and standard deviations for this analysis. H21 was supported. Mathematics achievement growth from fall to spring ($M = 41.72$) for students enrolled in Grade 4 before the 2020 pandemic disruption was higher than mathematics achievement growth from fall to spring ($M = 33.77$) for students enrolled in Grade 4 after the 2020 pandemic disruption. The effect size indicated a small effect.

Table 25

Descriptive Statistics for the Results of the Test for H21

Enrollment Year	*M*	*SD*	*N*
2018-2019	41.72	20.44	377
2020-2021	33.77	22.92	446

RQ12. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender.

H22. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student SES.

The interaction effect from the sixteenth two-factor ANOVA was used to test H22. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference in at least two of the means, $F(1, 819) = 0.832$, $p = .362$. See Table 26 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H22 was not supported. The difference in mathematics achievement growth from fall to spring between students enrolled in Grade 4 before the 2020 pandemic disruption and students enrolled in Grade 4 after the 2020 pandemic disruption was not affected by student SES.

Table 26

Descriptive Statistics for the Results of the Test for H22

Enrollment Year	SES	*M*	*SD*	*N*
2018-2019	Free or Reduced	38.35	21.22	105
	Full Pay	43.01	20.02	272
2020-2021	Free or Reduced	28.02	22.83	116
	Full Pay	35.79	22.64	330

H23. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020

pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student race.

A seventeenth two-factor ANOVA was conducted to test H23. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for race, and a two-way interaction effect (Grade 4 Enrollment Year x Race). The interaction effect for Grade 4 enrollment year by race was used to test H23. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference between at least two of the means, $F(1, 819) = 1.306$, $p = .254$. See Table 27 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H23 was not supported. The difference in mathematics achievement growth from fall to spring between students enrolled in Grade 4 before the 2020 pandemic disruption and students enrolled in Grade 4 after the 2020 pandemic was not affected by student race.

Table 27

Descriptive Statistics for the Results of the Test for H23

Enrollment Year	Race	*M*	*SD*	*N*
2018-2019	Minority	42.81	19.77	93
	Non-minority	41.36	20.68	284
2020-2021	Minority	31.89	22.70	118
	Non-minority	34.45	22.99	328

H24. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 4 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 4 after the 2020 pandemic disruption (2020-2021) is affected by student gender.

An eighteenth two-factor ANOVA was conducted to test H24. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 4 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 4 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 4 Enrollment Year x Gender). The interaction effect for Grade 4 enrollment year by gender was used to test H24. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of the analysis indicated a statistically significant difference between at least two of the means, $F(1, 819) = 5.875$, $p = .016$, $\eta^2 = .007$. See Table 28 for the

means and standard deviations for this analysis. A follow up post hoc was conducted to determine which pairs of means were different. The Tukey's HSD post hoc was conducted at $\alpha = .05$. Three of the differences were significant. H24 was supported. Mathematics achievement growth ($M = 44.05$) before the 2020 pandemic disruption for Grade 4 female students was higher than mathematics achievement growth ($M = 32.22$) after the 2020 pandemic disruption for Grade 4 female students and mathematics achievement growth ($M = 35.21$) after the 2020 pandemic disruption for Grade 4 male students. Additionally, mathematics achievement growth ($M = 39.65$) before the 2020 pandemic disruption for Grade 4 male students was higher than mathematics achievement growth ($M = 32.22$) after the 2020 pandemic disruption for Grade 4 female students. The effect size indicated a small effect.

Table 28

Descriptive Statistics for the Results of the Test for H24

Enrollment Year	Gender	*M*	*SD*	*N*
2018-2019	Female	44.05	20.40	177
	Male	39.65	20.30	200
2020-2021	Female	32.22	22.48	214
	Male	35.21	23.27	232

RQ13. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021)?

H25. There is a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021).

A nineteenth two-factor ANOVA was conducted to test H25 and H26. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 5 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 5 Enrollment Year x SES). The main effect for grade 5 enrollment year was used to test H25. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of the analysis indicated a statistically significant difference between the two means, $F(1, 792) = 11.513$, $p = .001$, $\eta^2 = .014$. See Table 29 for the means and standard deviations for this analysis. H25 was supported. Mathematics achievement growth from fall to spring ($M = 21.60$) for students enrolled in Grade 5 before the 2020 pandemic disruption was lower than mathematics achievement growth from fall to spring ($M = 26.36$) for students enrolled in Grade 5 after the 2020 pandemic disruption. The effect size indicated a small effect.

Table 29

Descriptive Statistics for the Results of the Test for H25

Enrollment Year	*M*	*SD*	*N*
2018-2019	21.60	18.51	392
2020-2021	26.36	20.14	404

RQ14. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) affected by student SES, race, and gender?

H26. The difference in mathematics achievement growth, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by SES.

The interaction effect from the nineteenth two-factor ANOVA was used to test H26. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference in at least two of the means, $F(1, 792) = 0.727$, $p = .394$. See Table 30 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H26 was not supported. The difference in mathematics achievement growth from fall to spring for students enrolled in Grade 5 before the 2020 pandemic and students enrolled in Grade 5 after the 2020 pandemic was not affected by student SES.

Table 30

Descriptive Statistics for the Results of the Test for H26

Enrollment Year	SES	*M*	*SD*	*N*
2018-2019	Free or Reduced	19.47	19.03	97
	Full Pay	22.30	18.32	295
2020-2021	Free or Reduced	26.30	22.47	94
	Full Pay	26.38	19.41	310

H27. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by race.

A twentieth two-factor ANOVA was conducted to test H27. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 5 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 5 Enrollment Year x Race). The interaction effect for Grade 5 enrollment year by race was used to test H27. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference in at least two of the means, $F(1, 792) = 2.218$, $p = .137$. See Table 31 for the

means and standard deviations for this analysis. No follow-up post hoc was warranted. H27 was not supported. The difference in mathematics achievement growth from fall to spring between students enrolled in Grade 5 before the 2020 pandemic and students enrolled in Grade 5 after the 2020 pandemic disruption was not affected by student race.

Table 31

Descriptive Statistics for the Results of the Test for H27

Enrollment Year	Race	*M*	*SD*	*N*
2018-2019	Minority	21.38	18.39	86
	Non-minority	21.66	18.58	306
2020-2021	Minority	22.61	20.48	105
	Non-minority	27.68	19.88	299

H28. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 5 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 5 after the 2020 pandemic disruption (2020-2021) is affected by gender.

A twenty-first two-factor ANOVA was conducted to test H28. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 5 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 5 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 5 Enrollment Year x Gender). The interaction effect for Grade 5 enrollment year by gender

was used to test H28. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference in at least two of the means, $F(1, 792) = 0.832$, $p = .362$. See Table 32 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H28 was not supported. The difference in mathematics achievement growth from fall to spring between students enrolled in Grade 5 before the 2020 pandemic disruption and students enrolled in Grade 5 after the 2020 pandemic disruption was not affected by student gender.

Table 32

Descriptive Statistics for the Results of the Test for H28

Enrollment Year	Gender	*M*	*SD*	*N*
2018-2019	Female	22.57	18.12	190
	Male	20.69	18.87	202
2020-2021	Female	26.04	19.51	197
	Male	26.67	20.76	207

RQ15. To what extent is there a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021)?

H29. There is a difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the

2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021).

A twenty-second two-factor ANOVA was conducted to test H29 and H30. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and SES (free or reduced, full pay). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for SES, and a two-way interaction effect (Grade 6 Enrollment Year x SES). The main effect for Grade 6 enrollment year was used to test H29. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of the analysis indicated a statistically significant difference between the two means, $F(1, 802) = 4.788$, $p = .029$, $\eta^2 = .006$. See Table 33 for the means and standard deviations for this analysis. H29 was supported. Mathematics achievement growth from fall to spring ($M = 31.87$) for students enrolled in Grade 6 before the 2020 pandemic disruption was higher than mathematics achievement growth from fall to spring ($M = 29.50$) for students enrolled in Grade 6 after the 2020 pandemic disruption. The effect size indicated a small effect.

Table 33

Descriptive Statistics for the Results of the Test for H29

Enrollment Year	*M*	*SD*	*N*
2018-2019	31.87	21.14	389
2020-2021	29.50	24.07	417

RQ16. To what extent is the difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) affected by SES, race, and gender?

H30. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by SES.

The interaction effect from the twenty-second two-factor ANOVA was used to test H30. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The result of this analysis indicated there was not a statistically significant difference in at least two of the means, $F(1, 802) = 3.673$, $p = 0.056$. See Table 34 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H30 was not supported. The difference in mathematics achievement growth from fall to spring between students enrolled in Grade 6 before the 2020 pandemic and students enrolled in Grade 6 after the 2020 pandemic disruption was not affected by student SES.

Table 34

Descriptive Statistics for the Results of the Test for H30

Enrollment Year	SES	*M*	*SD*	*N*
2018-2019	Free or Reduced	30.35	23.59	93
	Full Pay	32.34	20.33	296
2020-2021	Free or Reduced	22.81	22.27	108
	Full Pay	31.84	24.27	309

H31. The difference in mathematics achievement growth, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by race.

A twenty-third two-factor ANOVA was conducted to test H31. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and race (minority, non-minority). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for race, and a two-way interaction effect (Grade 6 Enrollment Year x Race). The interaction effect for Grade 6 enrollment year by race was used to test H31. The level of significance was set to .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference in at least two of the means, $F(1, 802) = 0.067$, $p = .795$. See Table 35 for the

means and standard deviations for this analysis. No follow-up post hoc was warranted. H31 was not supported. The difference in mathematics achievement growth from fall to spring between students enrolled in Grade 6 before the 2020 pandemic and students enrolled in Grade 6 after the 2020 pandemic disruption was not affected by student race.

Table 35

Descriptive Statistics for the Results of the Test for H31

Enrollment Year	Race	*M*	*SD*	*N*
2018-2019	Minority	30.79	22.13	102
	Non-minority	32.25	20.80	287
2020-2021	Minority	27.72	25.94	108
	Non-minority	30.13	23.39	309

H32. The difference in mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grade 6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grade 6 after the 2020 pandemic disruption (2020-2021) is affected by gender.

A twenty-fourth two-factor ANOVA was conducted to test H32. The two categorical variables used to group the dependent variable, AimswebPlus mathematics achievement growth, were Grade 6 enrollment year (before the 2020 pandemic disruption [2018-2019], after the 2020 pandemic disruption [2020-2021]) and gender (female, male). The results of the two-factor ANOVA can be used to test for differences in the means of a numerical among three or more groups, including a main effect for Grade 6 enrollment year, a main effect for gender, and a two-way interaction effect (Grade 6 Enrollment Year x Gender). The interaction effect for Grade 6 enrollment year by gender

was used to test H32. The level of significance was set at .05. When appropriate, an effect size, as indexed by *eta squared*, is reported.

The results of this analysis indicated there was not a statistically significant difference in at least two of the means, $F(1, 802) = 0.406$, $p = .524$. See Table 36 for the means and standard deviations for this analysis. No follow-up post hoc was warranted. H32 was not supported. The difference in mathematics achievement growth from fall to spring between students enrolled in Grade 6 before the 2020 pandemic disruption and students enrolled in Grade 6 after the 2020 pandemic disruption was not affected by student gender.

Table 36

Descriptive Statistics for the Results of the Test for H32

Enrollment Year	Gender	*M*	*SD*	*N*
2018-2019	Female	32.20	20.07	198
	Male	31.53	22.24	191
2020-2021	Female	30.95	24.11	194
	Male	28.24	24.01	223

Summary

The methods of statistical analyses used to address each of the 16 research questions by testing the associated hypotheses were presented in Chapter 4. Additionally, the results of the two-factor ANOVAs were presented. Chapter 5 includes a summary of the study, the findings related to the literature, and the conclusions.

Chapter 5

Interpretation and Recommendations

The focus of this study was on whether there was a difference of student achievement growth for students in reading and mathematics before and after the 2020 pandemic disruption. Additionally, this study focused on the effects of student SES, race, and gender on these differences. Chapter 5 is divided into three main sections: study summary, findings related to the literature, and the conclusion.

Study Summary

A summary of the current study is presented in this section that includes an overview of the problem and exploration of the differences in reading and mathematics achievement growth before and after the 2020 pandemic. Additionally, the purpose of the study and research questions are included. The summary concludes with a review of the methodology and the current study's major findings.

Overview of the problem. School closures due to summer break, weather-related, or natural disasters are not new phenomena. Typically, unplanned school closures due to natural disasters are limited to a specific area or region (Fuller, 2013; Serrant, 2013). However, brick-and-mortar school buildings were forced to close globally during spring 2020 to help mitigate the spread of COVID-19 (Dorn et al., 2020; Kuhfeld, Soland, et al., 2020). In contrast to summer vacations and some natural disasters or weather-related school closures, learning was expected to continue during spring 2020. School districts were forced to provide remote learning opportunities to students during an extended shut-down and create systems to provide these opportunities in an education system that was not created to support them (Dorn et al., 2020).

Additionally, researchers and school districts began to predict the magnitude of impact this prolonged school closure would have on student achievement (Azevedo et al., 2020; Calefati, 2021; Kuhfeld, Soland, et al.,2020; Lafortune, 2020; Van Lancker & Parolin, 2020; von Hippel, 2021). Kuhfeld, Soland, et al. (2020) predicted that students would return to school in fall 2019 with "63-68% of the learning gains in reading relative to a typical school year and with 36-50% of the learning gains in math" (p. 2). Research on the impact of the COVID-19 pandemic disruption on student achievement growth was limited due to this new phenomenon of prolonged school closures. This researcher sought to extend the limited research and identify the differences in reading and achievement growth and the effects of student SES, race, and gender on those differences.

Purpose statement and research questions. Due to the lack of research on the prolonged disruption of schools and the effects on student achievement growth, two purposes were the basis for this research study. The first purpose was to determine the differences in students' reading and mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021). The second purpose was to determine if the differences in students' reading and mathematics achievement growth from fall to spring, as measured by AimswebPlus, between students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021) were affected by SES, race, and gender. To address the

two purposes of this study, 16 research questions were posed, and 32 hypotheses were tested.

Review of the methodology. A quasi-experimental design was used in this quantitative study to compare the reading and mathematics achievement growth of students before and after the 2020 pandemic disruption. Participants included students from a suburban district who were enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021). The independent variables included the enrollment years (before the 2020 pandemic [2018-2019], after the 2020 pandemic disruption [2020-2021]). Dependent variables include the reading and mathematics achievement growth scores from fall to spring, as measured by AimswebPlus, for students enrolled in Grades 3-6. Other independent variables also included student SES (free or reduced, full pay), race (minority, non-minority), and gender (female, male). To test the 32 hypotheses, 24 two-factor ANOVAs were conducted.

Major findings. The researcher of the current study investigated the extent to which there was a difference in students' reading and mathematics achievement growth between students enrolled in Grades 3-6 before the 2020 pandemic disruption and those enrolled in Grades 3-6 after the pandemic disruption. As was hypothesized, the results of the current study indicated a difference in reading and mathematics achievement growth; however, it was not consistent across grade levels. For both reading and mathematics, students enrolled in Grades 4 and 6 had lower achievement growth after the 2020 pandemic disruption as compared to students enrolled in Grades 4 and 6 before the 2020 pandemic disruption. In contrast, students enrolled in Grade 5 after the 2020 pandemic

had higher achievement growth in mathematics than students enrolled in Grade 5 before the 2020 pandemic disruption.

Additionally, the current study investigated the effect of students' SES, race, and gender on the difference in reading and mathematics achievement growth for students enrolled in Grades 3-6 before the 2020 pandemic disruption and students enrolled in Grades 3-6 after the pandemic disruption. The analysis of the data revealed mixed results. Students qualifying for free or reduced and full pay lunches enrolled in Grade 4 before the 2020 pandemic disruption had higher reading achievement growth than students qualifying for free or reduced lunches enrolled in Grade 4 after the 2020 pandemic disruption. Additionally, in reading, male students enrolled in Grade 5 after the 2020 pandemic disruption had a higher achievement growth than female students enrolled in Grade 5 after the 2020 pandemic disruption. Gender also affected the differences in mathematics student growth for students enrolled in Grade 4. Female and male students enrolled before the 2020 pandemic disruption had higher mathematics achievement growth than female students enrolled after the 2020 pandemic disruption. Female students before the 2020 pandemic also had higher mathematics achievement growth than males after the 2020 pandemic disruption. Finally, the results yielded that race did not have an effect on differences in reading or mathematics achievement growth.

Findings Related to the Literature

Findings from this study related to the literature on the extent of differences in reading and mathematics achievement growth for students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021) are discussed in this section. Additionally, the

current study focused on the effects of student SES, race, and gender on the differences in reading and mathematics achievement growth between students enrolled in Grades 3-6 before the 2020 pandemic disruption and students enrolled in Grades 3-6 after the 2020 pandemic disruption. The findings support some and are in contrast to some of the research studies discussed in the literature review. However, the amount of research available to compare with the findings of this study regarding achievement growth for students was limited.

The results from the analysis conducted to address the research questions in the current study showed mixed results for differences in students' reading and mathematics achievement growth. The findings from the current study both support and are in contrast to the findings of Schweitzer (2021). NWEA MAP RIT scores for students enrolled in Grade 5 during the school years 2016-2017 (cohort 1), 2017-2018 (cohort 2), 2018-2019 (cohort 3), and 2019-2020 (cohort 4) were analyzed to find the difference in reading growth from the fall of fifth grade to the fall of sixth grade. Schweitzer (2021) found that all four student cohorts grew at a similar rate before the 2020 pandemic and after the 2020 pandemic in reading. This finding was supported by the results of the current study for students enrolled in Grades 3 and 5. Schweitzer (2021) found that students after the 2020 pandemic indicated a slower growth rate in mathematics than the cohorts before the 2020 pandemic, which is supported by the current findings for students enrolled in Grades 4 and 6. However, the results yielded for Grade 5 are in contrast to Schweitzer's (2021) findings.

The current study's findings supported the findings of Domingue et al. (2021). In analyzing the growth of ORF in students enrolled in Grades 2-3, Domingue et al. (2021)

found that growth patterns prior to the 2020 pandemic had a consistent pattern. However, during the 2019-2020 school year, the growth pattern flattened. Domingue et al. (2021) said that when analyzing the fall 2020 data, "learning gains are occurring at a rate similar to that observed in earlier years" (p. 16). The findings were supported by the current study's findings. There was not a statistically significant difference in reading achievement growth between students enrolled in Grade 3 before the 2020 pandemic and students enrolled in Grade 3 after the 2020 pandemic.

In the current study, the effects of student SES, race, and gender on the difference in students' reading and mathematics achievement growth before and after the 2020 pandemic disruption were also analyzed. The only statistically significant effect of student SES was on differences in Grade 4 reading achievement growth. Students qualifying for free or reduced and full pay lunches enrolled in Grade 4 during the 2018-2019 school year had a statistically significant higher achievement growth mean than students qualifying for free or reduced lunches in 2020-2021. The findings of Mazjanis's (2015) summer learning loss study indicated that high SES children gained nearly 25% of a performance level of their low-SES classmates" in reading (p.vi). The results of the current study are in contrast to the findings related to the students enrolled in Grades 3, 5, and 6 in Mazjanis's study.

The current study findings were both supported and were in contrast to Engzell et al.'s (2020) findings. In a study conducted in the Netherlands after an eight-week lockdown due to COVID-19, Engzell et al. (2020) found that students from low-income families showed a higher learning loss after the eight-week shutdown. The findings for Grade 4 students in the current study supported Engzell et al.'s (2020) findings.

However, the results of the current study were in contrast to Engzell et al.'s (2020) consistent findings across Grades 4-7.

Additionally, the effects of race and gender on the difference in students' reading and mathematics achievement growth before and after the 2020 pandemic disruption were analyzed. The analyses in the current study did not show that race had a statistically significant effect on the differences in student achievement growth among students enrolled in Grades 3-6 in reading or math. However, gender did have a statistically significant effect on reading achievement growth for students enrolled in Grade 5 and mathematics achievement growth for students enrolled in Grade 4. Of the studies discussed in the literature review, there was no mention of race or gender in the analysis to compare with the current study's findings.

Conclusions

This final section provides conclusions for the current study on the impact of the 2020 pandemic disruption on students reading and mathematics achievement growth and the effects of student SES, race, and gender on those differences. Implications for action and recommendations for future research are also included. The section is finalized with closing remarks from the researcher.

Implications for action. The findings of this study and research conducted regarding the impact of the prolonged school closures due to the COVID-19 pandemic on student achievement growth have implications for school districts to continue to move learning forward. First, district administrators must be cognizant of the data analysis results, in conjunction with district data to identify the comparison of fall data to identify if students exhibited a learning loss compared to previous fall data. This awareness and

understanding could aid in the allocations of needed funds to purchase additional or new curriculum resources for staff to best meet the needs of students.

An added implication for district administrators might be to compare the students who received in-person instruction for the majority of the 2020-2021 school year and those who received virtual instructions. This comparison could provide an insight into the effectiveness of in-person or virtual instruction. This insight might warrant instructional decisions as students return in-person for the 2021-2022 school year.

Additionally, district and building administrators might consider analyzing the instructional strategies for students enrolled in Grade 5 mathematics during the 2020-2021 school year. A focus group of Grade 5 teachers might provide a deeper understanding of what instructional strategies were effective during the 2020-2021 school year. The results of the current study found that students enrolled in Grade 5 during the 2020-2021 school year had a higher achievement growth rate. An analysis of strategies and instructional choices of teachers could benefit other grade levels moving forward.

Allocating staff and resources, especially for Grades 4 and 6 in reading and mathematics, could be critical since these grades had lower achievement growth means during the 2020-2021 school year compared to the 2018-2019 school year. District administrators, along with building administration and teachers, may need to prioritize standards to identify what is critical that students master. This prioritization could directly correlate to what is taught to all students in the classrooms. Professional learning for teachers and staff may be needed once standards are identified. Additionally, a curriculum audit might be considered to identify the effectiveness of resources to teach

the prioritized standards and ensure that staff is supported in providing instruction to students.

District administrators must support building administrators by student growth progress monitoring within each building. This monitoring will help guide decisions for allocating time, staff, and support within the building. This support could allow coverage for collaboration time for teachers to discuss classroom and grade level data to help aid in informed instructional decisions.

Another implication for district administrators might be the increased need for students to receive an intervention. Due to gaps in learning, an increase of students that need intervention could occur. District and building administrators might consider creative ways to provide this support for students without overwhelming the intervention system. This support could include the continuation of intervention into summer. Also, the district could allocate funds to offer engagement opportunities for students in the summer or after school to provide support. Finally, district leaders might also consider analyzing data and instructional strategies in reading and mathematics based on gender to ensure equity, especially in Grade 4 mathematics and Grade 5 reading.

Recommendations for future research. The purpose of this study was to compare the differences of reading and mathematics achievement growth of students enrolled in Grades 3-6 before the 2020 pandemic disruption and students enrolled in Grades 3-6 after the 2020 pandemic disruption and the effect of SES, race, and gender on those differences. Due to the new phenomenon of a prolonged global closure of brick-and-mortar buildings due to the COVID-19 pandemic, a significant amount of research was not readily available on the impact on achievement growth for students. This

researcher sought to expand on the limited research. However, recommendations for future research are included in this section.

Regarding the location and demographics of the district studied, the first recommendation would be to conduct a study in an urban or rural district rather than a suburban district to truly identify the scope of the impact on student achievement growth due to the closure of brick-and-mortar buildings caused by the COVID-19 pandemic. District S serves a majority of non-minority students (74.1%) who receive full-pay lunches (69.6%) and is located in a suburban area (KSDE, 2021). A future study utilizing a sample of students from an urban area with differing demographics could provide a more in-depth analysis of the effect on student achievement growth.

Next, regarding the assessment tool and years analyzed, future researchers might consider utilizing the state assessments for reading and mathematics instead of AimswebPlus. The utilization of this data could provide a broader range of comparisons for students' achievement growth that were affected by school closures across the state. Additionally, future researchers might consider comparing more than two years of data. Due to the continuation of the pandemic into the 2021-2022 school year, adding an additional year might provide a more in-depth analysis of the students' achievement growth over time.

Finally, the current study focused on students enrolled in Grades 3-6 before the 2020 pandemic disruption (2018-2019) and students enrolled in Grades 3-6 after the 2020 pandemic disruption (2020-2021). The comparison of students' growth was based on year and not looking at a cohort of students to measure growth across the years to determine the long-term effect of the prolonged closures of brick-and-mortar buildings.

Future researchers might consider a longitudinal study of students enrolled in kindergarten during the 2019-2020 school year. Completing a longitudinal study could identify the long-term effects of the brick-and-mortar school closings on younger students. Additionally, future researchers might consider extending the current research to include other grade levels.

Concluding remarks. Spring 2020 brought a new phenomenon to the United States education system as schools were forced to close brick-and-mortar buildings to help mitigate the spread of COVID-19. Since school buildings were closed, school systems were forced to create new systems to continue student learning. This phenomenon caused a disruption to school districts as the traditional school system was not created to support prolonged school closures (Dorn et al., 2020). Due to the ongoing impact of COVID-19 on school districts, this phenomenon should continue to be monitored. School districts and policymakers need to continue to make informed decisions to move learning forward in a rapidly changing education system and identify strategies to meet the needs of all students.

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Appendices

Appendix A: Research Approval Letter from District S

[redacted]

9/20/2021

Attn: Heather Burris, Graduate Student with Baker University

On 9/20/2021, the Board of Education for [redacted] approved the request for access to district student data for the purpose of graduate research by Heather Burris. The Board of Education's approval included the following stipulations:

1) Student identifying information (i.e. Name, [redacted] assigned ID Number) will not be included in the analysis of data or verbal/printed communication of data.
2) [redacted] as identifying information, will not be included in the analysis of data or verbal/printed communication of data.

It is essential, in accordance with FERPA, that our student and district data is not identifiable and remains confidential throughout the entirety of this research project extending to any publications. [redacted] is pleased to support the research project as a service to the professional field and requests access to the conclusions of the research question.

Sincerely,

[redacted]

Appendix B: Institutional Review Board Approval

Baker University Institutional Review Board

October 27th, 2021

Dear Heather Burris and Susan Rogers,

The Baker University IRB has reviewed your project application and approved this project under Exempt Status Review. As described, the project complies with all the requirements and policies established by the University for protection of human subjects in research. Unless renewed, approval lapses one year after approval date.

Please be aware of the following:

1. Any significant change in the research protocol as described should be reviewed by this Committee prior to altering the project.
2. Notify the IRB about any new investigators not named in original application.
3. When signed consent documents are required, the primary investigator must retain the signed consent documents of the research activity.
4. If this is a funded project, keep a copy of this approval letter with your proposal/grant file.
5. If the results of the research are used to prepare papers for publication or oral presentation at professional conferences, manuscripts or abstracts are requested for IRB as part of the project record.
6. If this project is not completed within a year, you must renew IRB approval.

If you have any questions, please contact me at npoell@bakeru.edu or 785.594.4582.

Sincerely,

Nathan Poell, MLS
Chair, Baker University IRB

Baker University IRB Committee
Sara Crump, PhD
Nick Harris, MS
Christa Manton, PhD
Susan Rogers, PhD