5-7-2024

Effect of Virtual Learning on Middle School English and Mathematics Scores

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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Walden University
2024

Abstract

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MA, University of Charleston, 2005

MA, The Citadel, 2010

BS, South Carolina State University, 2000

Doctoral Study Submitted in Partial Fulfillment

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Abstract

State assessment test scores in English language arts (ELA) and mathematics had continued to decline in a southern state in the United States over the last few years. The purpose of this quantitative study was to examine the difference in middle school ELA and mathematics test scores between students receiving instruction in virtual and face-to-face environments for 5 years. The study, grounded in the theoretical framework of opportunity to learn, investigated the difference in middle school ELA and mathematics test scores between students receiving instruction virtually and students receiving instruction in face-to-face (FTF) environments for one year. This quantitative, ex post facto causal-comparative study used *t* tests to analyze test scaled score data from a sample of approximately 300 middle school students. Large effect sizes definitively showed FTF learners outperformed virtual learners from 46.23 to 113.09 points depending on subject and year. The *t* tests revealed consistent advantages for FTF learning environments on ELA in all 5 years. Similar gaps exceeded 75 points for FTF students on math SCReady scaled scores for all 5 years. The results could inform policies on virtual versus FTF instruction to promote positive social change through improved student learning outcomes.

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Dedication

To God, I offer my deepest gratitude for the strength, guidance, and wisdom You have bestowed upon me. Your grace has sustained me through the trials and tribulations of this endeavor, and I am humbled by Your unwavering presence in my life. I am thankful for the countless blessings You have provided me, and I pray that my work may be a testament to Your glory.

I dedicate this dissertation to my treasured daughter, Addis, who has been my constant source of inspiration and motivation throughout this challenging journey. Your unwavering love, support, and understanding have given me the strength to persevere and reach for my dreams. I am forever grateful for the joy and purpose you bring to my life.

To my friends and family, I am grateful for your continuous encouragement, understanding, and the laughter we have shared along the way. Your presence in my life has brought me immense joy and has made this journey more bearable. Thank you for being my support system and for always believing in me.

Finally, I devote this work to all the educators and researchers who have come before me, paving the way for future generations. Your tireless efforts and contributions to the field of education have inspired me to pursue this path and make a difference in the lives of students.

Acknowledgments

I would like to express my deepest gratitude to the many individuals who have supported me throughout my doctoral journey and made the completion of this dissertation possible.

I would like to express my sincere gratitude to my committee chair, Dr. Ross, for your invaluable guidance, feedback, and unwavering support throughout my dissertation journey. Your expertise and mentorship have been instrumental in shaping my research and helping me navigate the complexities of the dissertation process. I am grateful to my content expert committee member, Dr. Johnson, for sharing your extensive knowledge and insights. Your valuable feedback and constructive critiques have helped me refine my research and elevate the quality of my work.

I extend my appreciation to my advisor, Chue Vang, whose constant check-ins, guidance, and encouragement have been a beacon of light throughout my doctoral program. Your genuine care for my progress and well-being has made a profound impact on my journey.

Thank you all for being an integral part of my doctoral journey and for contributing to the successful completion of this dissertation.

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Chapter 1: Introduction to the Study

State assessment test scores in English language arts (ELA) and mathematics have continued to decline in the southern parts of the United States. A 2022 report by the Southern Education Foundation found that, on average, students in the South scored 10 points lower on the National Assessment of Educational Progress (NAEP) in mathematics and 8 points lower in ELA than students in the rest of the country. The report also found that the achievement gap in the South is wider than in any other region of the country.

Virtual instruction and face-to-face instruction are two different approaches to teaching and learning. Virtual instruction is delivered online, while face-to-face instruction takes place in a traditional classroom setting. Virtual learning has become increasingly popular in recent years, as more students and teachers have incorporated the flexibility and convenience of virtual learning. A 2020 report by the Babson Survey Research Group found that the number of students enrolled in virtual classes in the United States has increased by 60%. Asynchronous learning and synchronous learning are two different approaches to virtual learning (Johnson et al., 2023). In asynchronous learning, students learn at their own pace and in their own time, without real-time interaction with the teacher or classmates Synchronous learning occurs when students learn at the same time and interact with the teacher and classmates in real time, usually through video conferencing or a live chat (Zhang et al., 2021).

This quantitative study will focus on examining the difference in middle school ELA and mathematics test scores from the state assessment, SC Ready, between students who received virtual instruction and students who receive instruction face-to-face. The goal of the study is to compare the effectiveness of the two instructional methods, specifically looking at the students' academic performance on state assessments in ELA and mathematics.

This research is critical due to the growing trend of virtual learning environments (Johnson et al., 2023). Despite the increasing use of virtual instruction, there is a lack of evidence about effectiveness compared to face-to-face instruction (Graham & Halverson, 2022). The knowledge gained from this study will fill a gap in practice with regards to current educational practice surrounding the choice of instruction formats in middle schools.

The study's relevance is highlighted as it directly impacts the core subject of ELA and mathematics for middle school students. This population of students is typically transitioning from basic to specialized subject learning (Basham et al., 2018). The study's findings could influence educational policies and decisions at the school, district, state, or even national level. If virtual learning is found to be just as effective or more effective than face-to-face instruction, it could lead to more widespread acceptance and implementation of virtual learning strategies, contributing to greater flexibility in learning environments for students.

Chapter 1 includes the background information for the study, the problem statement, purpose of the quantitative study, and both research questions and hypothesis. Next, the theoretical framework, Opportunity to Learn, will be used to guide the study (Schmidt et al., 2021). The chapter concludes with the final sections explaining the nature of the study, definitions, assumptions, limitations, significance of the study and a summary with the potential contributions to social change.

Background

The use of technology in teaching and learning has experienced significant changes in recent years. New technologies are changing the way that students learn and teachers teach (Flavell et al., 2019). These technologies offer students new opportunities to access educational resources, collaborate with other students, and create their own learning materials. As technology continues to evolve, teachers need to be able to use it effectively. This means being able to integrate technology into teaching, using technology to communicate with students, and using technology to evaluate student learning (Baca, 2020).

The use of different instructional methods, such as face-to-face and virtual learning, has created a gap in understanding student learning outcomes. One gap in practice is the limited research on the impact of virtual instruction on middle school students (Purnama et al., 2023). The lack of research on how the method of instruction affects academic performance is critical because more schools are embracing technology and virtual learning environments to offer flexibility and personalized learning opportunities. Most of the research on virtual instruction has been conducted in higher education, not in K12 education (Baca, 2020).

Problem Statement

The problem that will be addressed through this quantitative study is that ELA and mathematics scores continue to decline for middle school students in a rural U.S. southern state school district. There is a lack of systematic comparison between face-to-face versus virtual instruction of student performance in middle school ELA and mathematics. This comparison is necessary given the contrasting nature of the instructional environments (Fitzpatrick & Mustillo, 2020). Understanding the effect of learning environments on the different types of knowledge can provide insights into how to improve instruction. By studying this gap in practice, teachers can develop more effective instructional strategies and policies that address the unique needs of students in different learning environments, while improving student outcomes.

Purpose of the Study

The purpose of the quantitative study is to examine the difference in middle school ELA and mathematics test scores between students receiving instruction in virtual and students receiving instruction in face-to-face environments for 5 years. The allocation of students into each group was based on either a voluntary selection or the current circumstances of a shortage of certified educators with in the school.

Research Question(s) and Hypotheses

Research Question 1: What is the difference in middle school ELA test scores between students receiving instruction virtual and students receiving instruction face-to-face environments for one year?

$H_0$1: There is no significant difference between virtual versus face-to-face instructional formats for ELA test scores among middle school students.

$H_1$1: There is a significant difference between virtual versus face-to-face instructional formats for ELA test scores among middle school students.

Research Question 2: What is the difference in middle school math test scores between students receiving instruction virtual and students receiving instruction face-to-face environments for one year?

$H_0$2: There is no significant difference between virtual versus face-to-face instructional formats for mathematics test scores among middle school students.

$H_1$2: There is a significant difference between virtual versus face-to-face instructional formats for mathematics test scores among middle school students.

Theoretical Foundation

The theoretical framework that will be used is the "opportunity to learn" (OTL). The OTL framework proposes that learning is influenced not only by individual differences in student ability, but the extent to which students are exposed to high-quality learning experiences (Schmidt et al., 2021). The OTL framework is grounded in the belief that conducive and supporting learning environments are essential for students to learn effectively. The OTL framework enables the analysis of the factors that lead to learning loss and the assessment of the effectiveness of various instructional methods (Schmidt et al.,2021). OTL takes information processing into account based on the learning environment by considering the availability and quality of learning resources and the match between students' prior knowledge and the demands of the task. This means that the OTL framework not only focuses on the quantity of instruction but also on the quality of instruction provided to students. By using the opportunity to learn framework, researchers can investigate the factors contributing to the continued decline of test scores. The framework can help evaluate equitable access to high-quality learning experiences and opportunities to learn. By understanding the factors that contribute to the continued decline of test scores, educators and policymakers can take steps to provide targeted support to students and mitigate the effects of disruptions to the learning.

Nature of the Study

A quantitative study can be a justified approach in comparing virtual versus in-person instruction over the last 5 years. Quantitative research involves collecting and analyzing numerical data, which can provide objective insights into the impact of virtual versus face-to-face instruction on learning outcomes. An ex post facto design is a type of research design where the independent variable is not manipulated by the researcher but is simply observed. In this type of design, the researcher looks at the effect of an independent variable that has already occurred. The one-way analysis of variance

(ANOVA) is a statistical technique used to identify differences among the means of two or more independent groups (Strunk & Mwavita, 2021).

Data collection for the study involves two primary methods: Analysis of student performance through SC Ready state standardized test scores in ELA and mathematics and collection of data related to the duration of different instructional formats. An a priori power analysis was conducted to determine an effective sample size for the study. This was achieved by assuming a medium effect size (d = .25), an alpha (Type I) error rate of .05, and a statistical power (1-β) set at .80. The calculations yielded a sample size of 128 participants per group. The allocation of students in each group was based on either voluntary selection or current circumstance of a shortage of certified educators within the school. The students' test scores will be aggregated based on either face-to-face or virtual learning environments.

Definitions

Blended learning: A hybrid learning model that combines traditional face-to-face instruction with online learning (Singh et al., 2021).

Computer assisted instruction: A method of instruction that uses computers to deliver instructional context and activities to students (Lai & Bower 2020).

Educational technology: The use of technology to improve teaching and learning, with the goal of making education more accessible, effective, and engaging for all learners (Alpizar et al., 2020)

Face-To-Face instruction: The traditional method of teaching where the instructor and students are physically present in the same location (Allen & Seamen, 2020).

Information and communication technology (ICT): The application of digital technologies such as computers, software, networks, and the internet, to facilitate teaching and learning processes

Instructional technology: The use of various technological tools, including hardware, software, and processes, to create, deliver, and manage instructional content (Baca, 2020).

One-to-one: Each student is provided with a personal electronic device, laptop or table, to use for learning.

Virtual learning: A type of education that takes place online or through other electronic means (Barbour et al., 2020).

Assumptions

In order to accurately compare the difference in ELA and mathematics test scores between virtual and face-to-face instruction, certain assumptions must be established for the study. The assumption that all participants have equal access to technology is due to the school district being a one-to-one device school district. The assumption was made to eliminate the unequal device resources for each student. Based on the ability to make a voluntary choice of being a virtual learning, an assumption was made that all student was motivated to learn in a virtual setting. These assumptions were made to ensure that the only difference between the two groups is the type of instruction received.

Scope and Delimitations

The topic of this quantitative research study and location for the study were chosen based on the relevance and significance with the local school district. The continued use of teaching virtually and face-to-face at the school district has created an interest in how to understand the factors that are contributing to the decline of test scores in ELA and mathematics. By conducting this study, the data analysis could identify the factors that could inform policy decisions that could contribute to student success.

Limitations

There are several methodical limitations and constraints that deserve consideration when conducting this study. The dependence on standardized test scores presents a limitation. SC Ready only captures a specific, measurable set of skills not testing a student’s full range of abilities.

The second limitation is the study cannot account for uncontrolled variables such as technological proficiency, home learning environment, and student motivation. These factors can impact the learning outcomes of students.

The rural setting of the study may introduce additional limitations. The rural setting may limit the number of available schools and consequently the population size available for sampling. This limitation could challenge the study’s external validity and the generalizability of its findings.

Significance

This study is significant in researching learning loss in ELA and mathematics test scores between virtual versus in-person instruction as the results of the study could contribute to the broader field of education by providing new insights and knowledge. A better understanding of achievement gains or losses based on instructional formats can be achieved from the results of the study. While there has been significant research on the effectiveness of various format of instruction, such as lectures, online modules, and group discussions, more investigation is required in order to evaluate the effectiveness of instruction formats for ELA and mathematics for students. For example, online modules may effectively convey information, but they may provide a different level of engagement and interaction than an in-person discussion or group activity. Face-to-face discussions may promote engagement and interaction; but they may not be as effective at conveying complex information as a well-designed online module. As the use of different formats of instruction continues to expand in educational settings, there is a need for further research and understanding about how to integrate these formats to optimize learning outcomes effectively. By developing a better understanding of different formats of instruction, educators can create more engaging and effective learning experiences for students to minimize learning loss.

Studying different formats of instruction can contribute to positive social change by raising awareness of learning loss between virtual versus in-person instruction and the impact that disruptions to learning can have on middle school students. The research results can bring attention to the issue of learning loss and format of instruction to make a case for policy reforms and allocation of resources increasing benefits for both students and teachers.

Summary

Middle school students in a rural area of the southern United States are experiencing a decline in state assessment test scores in ELA and mathematics, as highlighted in a 2022 report by the Southern Education Foundation. As technology continues to be integrated into education, virtual instruction has become increasingly popular, as documented by a 60% increase in virtual class enrollment in a 2020 Babson Survey Research Group report. Despite the growth of virtual instruction, experimental evidence comparing its effectiveness with face-to-face instruction is limited. This quantitative study aims to understand the gap by comparing SC Ready scores in ELA and mathematics among middle school students receiving either virtual or face-to-face instruction. The findings could potentially influence educational policies around implementation of virtual learning strategies. As more schools adopt technology and virtual learning environments for personalized education, understanding their impact on learning outcomes is crucial.

Chapter 2 includes an introduction and literature review including the strategies used to conduct the review of literature. The literature review will include several sections that summarize the major topics identified from the literature, more on the OTL framework, and the need for this particular study.

Chapter 2: Literature Review

The rapid growth and adoption of virtual education technologies has led to increased interest in understanding their effectiveness for student learning. Middle school represents a critical developmental stage between elementary and high school where academics become more rigorous and grading more stringent (Johnson & Howley, 2020). Students also undergo social-emotional, physical, and cognitive changes that can impact their educational experiences (Peng and Kievit, 2020). Thus, it is important to closely examine the impacts that virtual learning environments have on diverse outcomes for middle school populations. A review of recent literature reveals mixed findings regarding the effects of virtual learning environments.

While some studies demonstrate comparable or even improved outcomes for students in virtual compared to face-to-face learning environments, others show clear negative impacts of virtual learning on achievement and student attitudes (Keebler & Huffman, 2020). Approaches studied include fully online schools, blended models combining virtual and face-to-face elements, and technology integration in brick-and-mortar classrooms. This review synthesizes and critically evaluates current research on the implementation and effectiveness of virtual learning for middle school students. Outcomes examined span standardized test results, subject matter comprehension, student perceptions of their learning experiences, and knowledge retention. By appraising the strengths and weaknesses suggested by existing literature, this review aims to inform best practices in order to maximize benefits and minimize disadvantages for middle school learners.

The problem that will be addressed through this quantitative study is that ELA and mathematics scores continue to decline for middle school students in a rural US southern state school district. The purpose of the quantitative study is to examine the difference in middle school ELA and mathematics test scores between students receiving instruction in virtual and students receiving instruction in face-to-face environments for 1 year.

Literature Search Strategy

A systematic search strategy was essential to identifying relevant studies for this literature review on virtual learning in middle school. The search utilized educational research databases including ERIC, Education Research Complete, google scholar, and JSTOR to find studies published in peer-reviewed journals and reports. Combinations of key search terms were used such as "virtual learning," "online learning," "remote learning," "blended learning," "hybrid learning, " "learning loss, " "knowledge retention" paired with "middle school," "junior high," "adolescent," "rural, " and "teen." Results were limited to studies from the last 5 years to focus on current research.

Initial searches were too broad to compile a comprehensive collection of potentially relevant literature. Then titles, abstracts, and keywords were screened to determine inclusion based on focus on virtual learning, middle school student population, and examination of academic, or other student outcomes. Full texts were retrieved and further screened for final selection of studies providing evidence specifically related to the effects of virtual instruction on middle grades learners. Reference lists of selected articles will be mined for additional relevant sources. Careful record-keeping of search strategies, screening criteria, and ultimate selections helped ensure a rigorous, reproducible process for identifying the best evidence to review.

Theoretical Foundation

The OTL framework centers on the idea that academic outcomes depend on students actually having adequate chances to engage with and learn material, often influenced by instructional variables. As Handa (2020) and others explained, “opportunity to learn standards seek to measure whether students have had the opportunity to learn material essential to attain high standards” (p. 22). The OTL model is highly applicable to investigating potential reasons behind declining academic performance in middle school ELA and mathematics. Examining rural middle students’ opportunities for quality instruction, curriculum access, technology resources, and differentiated support could reveal gaps limiting ELA and math achievement. OTL analysis can delineate if decreases stem from curriculum deficiencies, lack of supplemental learning resources, or other process factors. An equity-focused OTL framework may show disparities impeding rural students’ academic progress. Rural education often suffers from funding and staffing challenges that could constrain opportunities, especially with the pivot to more virtual learning environments (Johnson &

Howley 2020). Applying an OTL framework allows the ability to diagnose specific areas where rural middle students lack opportunities that negatively impact learning.

OTL has been applied in various educational research contexts to examine how curriculum, teaching practices, resource access and other factors impact student achievement. This framework is highly relevant for evaluating the difference between virtual and face-to-face learning environments in middle school ELA and mathematics test scores. OTL has indicators like exposure to high quality instruction, access to necessary technology resources, learning time allocation, differentiated support as needed, and active engagement with content that could be compared to determine. factors along with ultimate student performance data could provide insights on reasons for achievement differences between online and face-to-face learning environments. OTL provides a useful lens for moving beyond just outcome data to understand the educational processes that drive student performance results.

Literature Review Related to Key Concepts and Variable

The rapid increase in virtual learning over the past decade has profoundly impacted K-12 education. As virtual instruction becomes increasingly common there is a demanding need to evaluate its effectiveness compared to traditional FTF instruction. This literature review synthesizes current research on differences in knowledge retention, teaching strategies, and student outcomes between virtual and FTF learning environments. Additionally, the review of literature explores the factors influencing declines in state assessment scores and analyzes formative and summative assessments in virtual settings.

The review begins by providing historical background, tracing the evolution of virtual education. It then compares FTF and virtual environments, examining how medium impacts teaching methods, student engagement, and knowledge retention. Research on blended learning models is assessed, along with studies analyzing specific virtual learning platform tools and designs. Literature evaluating summative assessments in virtual environments as well as debates around high-stakes testing is explored.

This review aims to provide a comprehensive overview of the uses and limitations of virtual learning based on key areas of literature. Findings on best practices for transitioning between instructional methods are synthesized. The review concludes by identifying gaps in current literature and proposing future guidelines for research as virtual education continues to expand. The purpose is to discover meaningful knowledge to guide administrators, teachers, and policymakers in implementing effective virtual and FTF learning environments.

Face-to-Face Learning Environments

FTF instruction has long been an integral part of education, valued for the productivity of in-person interpersonal interaction. However, as virtual and blended modalities rise, understanding the unique possibilities of FTF learning environments has become increasingly relevant. Research points to key potential benefits of FTF instruction, including opportunities for collaborative learning, personalized teacher-student rapport, and enriched verbal/nonverbal communication (Louis-Jean & Cenat, 2020). While characterizing precisely how physical co-presence enhances engagement, motivation, and other learning processes remains an area of research, as does determining effective practice of FTF learning. This literature review examines current literature focused on clarifying the impacts, both positive and negative, of FTF educational settings. It synthesizes studies comparing FTF and virtual outcomes as well participant experiences and behaviors in FTF settings. By providing a comprehensive overview of FTF learning, this literature review explains where consensus exists regarding best practices and also reveals continuing discussions and unanswered questions to demonstrate the need for future research.

FTF learning has long been considered the tradition in education. Tracing back to ancient philosophers like Socrates and Plato. FTF learning, often considered the traditional model of instruction, has long been the base of education (Gherhes et al., 2021), providing in-person interaction between teachers and students.

FTF learning has historically been valued as an impactful instructional approach due to its capacity to support social interaction, prompt feedback, and individualized instruction (Aperapar & Anthonysamy, 2023). Research conducted on FTF collaborative learning environments explains the advantages in promoting student engagement, fostering critical thinking, and enabling deep learning. FTF instruction is viewed as one of the most effective means of delivering responsive, adaptive instruction, largely due to the inherent capabilities for timely formative assessment and tailoring to specific student needs in-the-moment (Yates et al., 2021).

FTF learning is not without challenges. Some scholars have critiqued the approach for limitations in scalability and uniformity of implementation (Anthony, 2019). The flexibility to accommodate diverse individual learner needs in a FTF environment has been questioned (Kang, 2023). This has prompted efforts to supplement FTF learning with technology-enabled tools to create more personalized blended learning experiences (Elliott et al., 2020; Means et al., 2013).

While collaborative and adaptive learning represent key components of FTF environments, additional benefits have also been highlighted. FTF learning enables the building of instructor-student rapport, which can increase student motivation and engagement (Ashraf et al., 2021). Through in-person interactions and non-verbal cues, students often feel connected with instructors in FTF settings compared to distance formats (Dumford & Miller, 2018). This sense of relatedness promotes positive learning orientations and activities.

FTF learning accommodates experiential instructional approaches that are difficult to replicate by way of virtual formats. Hands-on activities, simulations, and interactive demos allow students to actively apply their developing knowledge and skills (Anderson & Hira, 2020). The shared physical classroom space also enables efficient collaborative projects, discussions, and peer learning. Through these immersive FTF activities, students can construct deeper understandings.

Adopting active and experiential methods in FTF environments does not guarantee meaningful learning. The success of these approaches depends on well-designed activities and adept facilitation (Martin et al., 2020). There are also inherent trade-offs regarding time and resources. But when thoughtfully implemented, experiential FTF activities provide engaging, embodied learning experiences that benefit students.

Beyond adaptive and collaborative affordances, FTF learning offers additional advantages related to instructor rapport, experiential methods, and peer interactions. Capitalizing on these benefits requires purposeful, quality design and delivery of FTF instruction (Chachage & Walls, 2019).

FTF learning has historically been valued for its ability to enable impactful instructional strategies including social interaction, prompt feedback, and individualized support. As collaborative environments, FTF settings promote heightened engagement, critical thinking, and deep learning. The responsive nature of FTF instruction also allows for effective formative assessment and adaptation. However, concerns exist regarding scalability, flexibility, and integration of technology. While the number of virtual and blended modalities are increasing, FTF retains unique components related to building instructor rapport, facilitating experiential activities, and leveraging peer interactions. Research on blended learning continues to clarify how to maximize the benefits of purposefully designed FTF learning. Ultimately, quality implementation, activity design, and adept facilitation remain essential to capitalizing on the advantages of FTF instruction.

History of Virtual Learning

Virtual learning, in which instruction is delivered through online channels and digital media, has become an essential part of education at all levels. Understanding the origins and evolution of technology-enabled learning can provide meaningful perspective into current practices, models, and issues surrounding virtual education. Tracing the development of virtual learning over time reveals its roots in distance education as well as the influence of emerging technologies in shaping and expanding new instructional possibilities (Archambault et al., 2022). From early correspondence courses to present-day blended classrooms sophisticated learning management systems, the history of virtual education is one of increasing access, engagement, and capability. This review synthesizes the key developments in virtual learning, identifying critical pioneers, technologies, and educational institutions that drove innovation. It analyzes how theories and best practices of online learning evolved along with new technological affordances. By tracing the course of virtual learning through its formative events and phases, this historical review clarifies foundational principles, continuing challenges, and the future possibilities of this continually evolving field.

The origins of virtual learning can be traced back to the 1920s, with the introduction of distance education by correspondence. This allowed students in remote areas to receive their course materials and assignments by mail (De Nito, 2023). The next major development came in the 1960s and 1970s with the creation of closed-circuit television systems and early computer-assisted instruction models, enabling some interaction and feedback (Gu, 2022).

In the 1980s and 1990s, virtual learning expanded with the rise of electronic learning (e-learning) and adoption of learning management systems. This allowed for virtual course delivery through select campus platforms (Dumford & Miller, 2018). The internet opening access to education outside of traditional brick-and-mortar classrooms. However, early online learning retention and completion rates were poor due to static, text-heavy courses (Martin et al., 2020).

Steady refinement of virtual learning was experienced between 2000 - 2010, with an emphasis on multimedia, collaboration, and interactive elements (Leatherdale, 2019). Virtual schools at the K-12 level also grew, providing new educational options for students. Advancements in learning analytics, mobile compatibility, video technology and simulations have enhanced the virtual experience and improved learning outcomes (Archambault, 2022).

While early forms of distance learning date back over a century, modern virtual education leveraging internet and digital affordances have rapidly evolved over the past 20-30 years. Looking forward, virtual learning will likely continue to expand its reach and capabilities through ongoing innovation and technological improvements (Villanueva, 2021). Ensuring equitable access and support for all learners remains an issue needing attention.

Formative and Summative Assessment in Virtual Learning

As virtual and blended courses become more prevalent across educational settings, determining effective assessment strategies in digital environments is crucial (Borup et al., 2020). Formative and summative assessments are fundamental tools educators use to measure student learning and progress. Translating the use of formative and summative assessments from traditional FTF classrooms to virtual settings poses unique challenges and opportunities. This review synthesizes current literature examining the implementation of formative and summative assessments in virtual learning environments. The review presents emerging techniques and technologies that uses digital media to enhance assessment capabilities for virtual learners. It also identifies continuing issues surrounding designing, administering, and providing feedback on assessments in virtual platforms. It analyzes best practices and principles for integrating formative and summative assessments within online courses and programs. By conducting research on formative and summative assessment strategies for virtual learning, this review clarifies key considerations and frameworks while also revealing areas in need of further research as virtual education continues to grow.

Assessment is an essential component of effective instruction and learning, allowing educators to measure student progress and provide feedback. With the growth of virtual education, determining how to best evaluate formative and summative assessment strategies in digital environments has become increasingly important. Research into digital assessment tools and the implementation is a crucial area of focus for improving online learning outcomes. More research needs to occur to understand how assessments can be designed specifically for online contexts, rather than simply transferred from FTF classrooms.

Formative assessment involves frequent, interactive checking of student understanding during the learning process so that teachers can identify misconceptions and make pedagogical adjustments (Opdecam & Everaert, 2022). Studies of virtual learning indicate that well-designed formative activities integrated throughout virtual modules and courses positively impact student motivation, metacognition, and achievement (Archambault et al., 2022). However, developing impactful virtual formative assessment requires attention to providing substantive feedback, facilitating student self-assessment, and incorporating flexible opportunities for revision (Falkner et al., 2020).

In contrast, summative assessments evaluate cumulative student learning and mastery at the conclusion of instruction. While sometimes standardized, summative assessments in virtual contexts should align to targeted learning outcomes and allow students to demonstrate meaningful application of knowledge (Falkner et al., 2020). Integrating multimedia options and simulations into virtual summative assessments can enhance authenticity and engagement (Falkner and Vivian, 2020). Ensuring high-quality questions and effective test security procedures are also important considerations.

A key benefit of virtual learning is the ability to implement adaptive formative and summative assessments informed by analytics. Sophisticated learning management systems can generate customized assessments based on areas of student need and tailor the testing experience (Turnbull et al., 2020). While adaptive online assessments demonstrate potential, careful attention must be paid to sustaining assessment validity and providing reasonable accommodations to ensure ethical, equitable, and meaningful implementations. Assessment validity involves confirming that the assessment aligns with the learning objectives, the questions accurately measure the intended skills, the format allows all students to properly demonstrate their abilities, and scores are interpreted correctly.

Best practice recommends balanced use of both formative and summative virtual assessments. Well-designed formative activities allow for identification of developing student needs, while quality summative tasks measure culminating competencies (Alexander et al., 2020). When thoughtfully combined, they provide a comprehensive representation of student progress in virtual environments. However, issues about providing timely, individualized feedback, ensuring question quality, and maintaining test security remain (McBean, 2023). Virtual learning necessitates strategic integration of formative and summative assessments. Both play important complementary roles in measuring student learning needs and achievements.

Impact of Virtual Learning on ELA and Mathematics achievement

Virtual learning has become increasingly prevalent across K-12 and other education settings over the past decade. This rise of virtual and blended models supports research regarding the potential impacts on key subject areas ELA and mathematics. An increasing amount of research has investigated student learning outcomes in virtual versus FTF ELA and math courses and analyzed the challenges and opportunities unique to virtual learning in these core subjects. While preliminary findings are mixed, this demonstrates the need for a better understanding of how best to use technology-enabled instruction to enhance ELA and mathematics achievement. This review synthesizes current literature comparing traditional FTF and virtual approaches to teaching and learning ELA and math. It identifies areas of potential in virtual environments as well as continuing challenges. By clarifying what the existing research evidence reveals about virtual ELA and mathematics instruction, this review establishes an outline for practice and future study aimed at developing the potential for technology-enhanced learning in these core subjects.

Some research indicates potential benefits of virtual learning for ELA and math achievement. Johnson et al. (2023) found small positive effects for online learning in ELA and math at the K-12 level, provided online curriculum and pedagogy are well-designed. However, other studies reveal challenges of virtual learning in ELA and mathematics. Topping et al. (2020) found lower student engagement in self-paced K-12 online ELA and math learning environments. Instructors emphasize the need for interactive online tools to provide math support and feedback (Ali et al., 2023). This emphasizes the importance of deliberate community building and personalized design in virtual contexts.

Subject-specific difficulties have been cited concerning virtual learning of ELA and mathematics. Translating in-depth textual analysis to virtual ELA courses can be problematic (Barbour et al., 2020). Visualization and manipulation required in upper-level math is also often not available in virtual formats (Alemdag & Yildrim, 2022).

While virtual models are rapidly expanding, their impact on subjects like ELA and mathematics remains complex. Outcomes are mixed, pointing to the need for careful design and implementation to subject-specific considerations if benefits are to be maximized (Molnar et al., 2019). Further research is justified to provide evidence-based guidance on effective virtual learning practices in these core subject areas.

Influencing Factors for Declining ELA and Mathematics achievement

The decline in test scores in ELA and mathematics among K-12 students has been a concerning trend in recent years. Researchers have examined various factors that may be contributing to this decline, in order to develop strategies for improvement. This literature review will examine research on influencing factors including time spent on devices and social media, teacher quality and experience, curriculum changes, poverty and inequity, and student mindset and motivation.

One factor that has received significant consideration is the amount of time students spend on devices and social media, and its impact on learning. Excessive technology use has been found to negatively affect comprehension, critical thinking skills focus, and retention of information, and (Allred & Cena, 2020). Students who multitask between devices while studying or in class tend to have lower assessment performance

(Jamet et al., 2020). Researchers recommend regulating device time and using technology purposefully to support learning.

Another fundamental factor is teacher quality and experience. Studies show that ineffective or inexperienced teachers contribute to declining achievement (Podolsky et al., 2019). High teacher turnover, crowded classrooms, and lack of professional development opportunities are concerning trends (Gibbons et al., 2021, 2011; York, 2021). Mentoring programs, ongoing training in effective instructional strategies, and measures to retain experienced teachers are suggested to address these issues according to the research (Vagi et al., 2019).

Curriculum changes have also impacted achievement levels. The transition from a traditional curriculum focus towards STEM and technical skills has been critiqued by some researchers (Dell'Erba, 2019). Declining instruction time for certain core subject areas is concerning, as these subjects play an important role in developing critical thinking (Masters, 2023). Outdated curriculums that do not engage students or reflect the realities of the modern world are also problematic (Killcoglu, 2020).

Persistent issues of poverty and inequity negatively impact learning outcomes. Students facing socioeconomic disadvantages, food and housing insecurity, lack of healthcare, and similar challenges demonstrate lower achievement (McIntosh, 2019). These systemic issues continue to go unresolved. Addressing these root causes through policy reform is critical for increasing learning outcomes.

Student mindset and motivation influence achievement. Researchers find that students with fixed mindsets, who believe intelligence cannot be changed, are less resilient when facing challenges (Cho et al., 2021; Yeager & Dweck, 2020). Low motivation and engagement also adversely impact learning and achievement (Johnson et al., 2020). Promoting growth mindsets and implementing engaging instructional approaches can positively influence student effort, learning, and achievement.

This literature review has researched factors such as technology overuse, teacher quality, curriculum changes, socioeconomic barriers, and student mindsets. Understanding these influences is key for policymakers and educators looking to reverse declining achievement trends and implement impactful reforms.

Knowledge Retention

Knowledge retention is a critical aspect of learning, allowing students to recall and apply information over time. Research shows that students tend to forget much of what they learn within a short period after initial instruction (Huang et al., 2020). This decrease of retaining newly acquired knowledge presents a significant barrier to effective learning and academic performance. Understanding the factors that influence knowledge retention and developing techniques to promote long-term retention have become goals for educational researchers (Yang & Chen, 2021). This literature review synthesizes key findings from studies examining different approaches to improving retention, including distributed practice techniques, relating new material to prior knowledge, active retrieval practice, dual coding, and techniques to optimize cognitive load. Taken together, these studies highlight evidence-based strategies educators can use to enhance knowledge retention and student academic success. This review provides an integrated overview of current research in various educational settings.

Findings across numerous studies is that using distributed or spaced practice techniques enhances long-term retention compared to massed practice or cramming (Lyle et al., 2020). Distributing learning across multiple sessions over time provides opportunities for consolidation and connections, while massing learning into a single lengthy session typically produces less long-lasting memories. Both the timing between practice sessions and overall span of time influence retention. Optimal schedules balance spacing and efficiency.

Relating new information to prior knowledge and experiences is another established method to improve retention (Lou & Jaeggi, 2020). Linking concepts to existing mental frameworks and schemas facilitates assimilation (Ruixue, 2021; Dorko, 2019). Piaget believed that children construct knowledge by actively integrating new information into existing cognitive schemas. This process of assimilation allows children to expand their understanding by relating novel concepts to familiar mental representation (Piaget, 1952). Using analogies, creating concept maps, and explicitly showing how ideas connect enables building these meaningful associations. Success depends on correct knowledge foundations, showing the importance of determining students' preconceptions.

Retrieval practice through exercises like flashcards, low-stakes quizzing, and writing summaries increase retention compared to simply rereading material (Syed et al., 2020) Active recall strengthens and recreates memory traces, while passive review of material often produces illusions of competence. Repeated, spaced retrieval practice maximizes benefits. Educators should incorporate more opportunities for effortful retrieval, while being mindful of learner motivation.

Dual coding theory suggests that processing information verbally and visually enhances retention by creating multiple mental representations (Plass & Kalyuga, 2019). Techniques like diagramming key concepts, using mnemonic images, and combining visual aids with lectures influence this effect. Multimedia instructional design must avoid overloading fixed working memory.

Cognitive load theory provides key insights on optimizing retention (Plass & Kalyuga, 2019; Sweller, 2020). Cognitive load theory proposes that working memory is limited in its capacity to process information. According to cognitive load theory, if too much information is presented at once or the information is too complex, it can overwhelm working memory and hinder learning (Sweller, 2020). Extraneous load from unclear instruction should be minimized, while germane load focused on essential concepts is productive. Balancing intrinsic load from material complexity with learner expertise promotes retention. Educators can practice these principles of cognitive load to design instruction and assignments that effectively manage working memory demands.

Blended learning approaches aim to show the strengths of both FTF and virtual modalities (Graham et al., 2019). Flipped classroom models blend active in-person problem-solving with virtual content delivery. Such hybrid designs allow for peer collaboration and instructor guidance during knowledge application, while providing flexibility of recorded lectures and virtual materials. Studies of blended learning report improved retention and achievement compared to FTF or virtual formats, suggesting integrative approaches may support knowledge consolidation (Macumber, 2021; Kazakoff et al., 2018). Further research of optimal blending strategies appears a promising direction for enhancing durable learning.

The shift to more virtual learning has raised questions about how virtual instruction impacts knowledge retention compared to traditional FTF classrooms. Several studies have found decreased retention and academic performance in virtual contexts (Lines et al., 2019). Lack of interactions with others and increased distractions have contribute to lower processing during virtual lessons. Outcomes depend significantly on course design elements like inclusion of active learning techniques. Well-structured virtual learning environments can have equivalent or greater gains versus FTF environments (Raes et al., 2020). More research is needed to identify best practices for optimizing retention in virtual environments.

This literature review synthesizes research on various methods for improving knowledge retention, an essential component of learning and student achievement. Techniques such as distributed practice, linking new material to prior knowledge, active retrieval practice, dual coding, and optimizing cognitive load show consistent evidence for enhancing retention across many studies. Comparisons of FTF and virtual learning indicate virtual settings may impair retention, but course design significantly impacts outcomes. While further studies are needed, the literature provides a foundation of practical approaches educators can use to promote learning. Encouraging retention provides students the knowledge needed for academic achievement.

State Assessments

State standardized assessments have become common in American K-12 education due to policies like No Child Left Behind and Every Student Succeeds Act which mandated annual testing. Research reveal ongoing debates around the validity and reliability, of these large-scale assessments (Emler et al., 2019; Zhao, 2020). Opponents argue that high-stakes testing narrows curriculum, causes undue stress, and fails to account for inequities (Cawthon & Shyyan, 2022). Supporters believe that standardized data are critical for accountability and tracking achievement gaps, between groups (Renzulli, 2022).

South Carolina requires students to take the SC Ready assessment each spring, beginning in third grade. SC Ready's objective is to assess mastery of state standards in ELA and mathematics using a combination of multiple choice and constructed response items (SC Department of Education, 2021). Studies analyzing 5 years of SC Ready data found significant score gaps correlated to poverty, race, disability status and English proficiency (McMillan, 2022; Pickett, 2023). Researchers note concerns around relying on once-a-year standardized testing for high-stakes decisions.

Recent studies reveal concerning trends of declining ELA and mathematics scores on state tests across the Southern United States. Analysis of National Assessment of Educational Progress (NAEP) results indicates math scores decreased by 8% and reading by 6% for fourth and eighth graders in Southern states between 2009 and 2019 (National Center for Education Statistics, n.d.) These drops exceed nationwide declines. Researchers have suggested possible factors the decline that include high rates poverty, inadequate funding and resources, and difficulties staffing all classrooms with certified teachers. These inequalities highlight needs to target interventions and supports. Continued research is required to identify specific policies and practices that can decrease declines and increase achievement for all students.

Formative assessments are proposed to supplement summative standardized tests. Brandmo et al. (2020) established formative assessment's positive impact on learning outcomes. Districts utilize MAP and other benchmark tests to monitor growth and adjust instruction between state assessments. Researchers debate over-testing students does not equate to improved teaching and learning (Bondie et al., 2019). Continuing research is needed on balancing standardized assessments with other measures of student achievement.

The majority of states waived summative testing requirements during the spring of 2020, making comparisons and tracking achievement gaps complex (Will, 2021).

Studies found students experienced learning loss associated with virtual instruction, widening equity divides (Dorn et al., 2020). The disruptions and continued use of virtual instruction require careful analysis of assessments and accountability policies moving forward. Scholarly discussion on standardized testing continues to advance. Assessments must be analyzed for bias and combined with universal evaluation of student needs.

Teaching Strategies for Virtual Verses Face-to-face

The shift towards more virtual and blended learning in recent years has led to questions about how teaching strategies and pedagogies may need to adapt for these new environments. While the Covid-19 pandemic necessitated a sudden large-scale shift to virtual instruction, there are broader trends towards more blended and virtual learning models even outside of emergency situations. Comparing effective strategies for virtual and FTF instruction can provide important understandings for the design of high-quality learning experiences in both modalities.

A key difference between virtual and FTF instruction is the natural physical separation between instructors and students in a virtual environment. This can present challenges in building instructor-student relationships, assessing student engagement and comprehension, and facilitating active learning (Lin & Gronseth, 2020). Virtual instructors must be more intentional in building community, designing interactive elements to engage students, and gathering feedback. FTF instructors can rely more on in-person indications.

Virtual instruction also presents unique opportunities, such as the flexibility of anytime, anywhere access which can promote increased participation for some students (Chhetri, 2022). Thoughtfully designed virtual learning utilizes multimedia, discussions, and remote collaboration tools to create active learning experiences comparable to those in physical classrooms (Dumford & Miller, 2018). Well-trained virtual instructors can use these advantages through strong course organization, clear expectations, and virtual community building.

Different subject matter and learning objectives may also suit some learning environments better than others. Highly interactive disciplines like foreign language learning or lab sciences can be more difficult to adapt to virtual environments, while theoretical disciplines like mathematics may transform easily (Andrade, 2021). Hybrid models blending both virtual and FTF elements can balance advantages, especially for typically hands-on fields.

Assessment requires adjustment in virtual environments. Best practices point to expanding assessment strategies and designing more low-stakes assessments to standardize the online testing experience for students (Whitelock et al., 2021). Academic integrity requires rethinking testing protocols, developing assignments with real-world applications, and designing diverse assessments evaluating higher-order skills. Finding ways to incorporate peer and self-assessment engages students actively in virtual contexts.

While debates continue regarding online versus FTF instruction, the most effective strategy involves finding the right balance between environments based on the learning goals, student population, and subject matter. Instructors prepared with pedagogical tools designed for both virtual and FTF environments will be best equipped to maximize student learning experiences. Additional research on optimal uses of each learning environment will provide deeper insights for all areas of education.

Virtual Learning Environment Modules

The rapid advancement of technology over the past few decades has led to significant changes in how education is delivered. Virtual learning environments, sometimes referred to as learning management systems, have become increasingly used in schools and universities to facilitate virtual and blended learning environments. This literature review synthesizes key research related to the use of virtual learning environments and the impacts on various aspects of teaching and learning. The review encompasses research on virtual learning environments tools and features, implementation challenges, student engagement, knowledge retention, student-instructor interaction, collaborative learning, and overall learning outcomes associated with virtual based instruction.

A large body of literature has focused on evaluating the types of tools and features commonly incorporated into virtual learning platforms. Standard capabilities include content delivery features like video lectures, online texts, and podcasts; assessment tools like quizzes, exams, and automated grading; communication channels like email, forums, chat; as well as administrative features for managing courses and student data (Walker et al., 2016). Researchers have compared different virtual learning environment platforms based on available capabilities and the alignment to pedagogical needs across different disciplines (Liu & Yu, 2023). Studies emphasize the need for continued advancement of virtual learning tools to provide adaptive, interactive, and collaborative experiences.

Virtual learning environment research has examined instructor and institution challenges with effective implementation. A constant finding is that just adding technology is not sufficient, virtual learning success depends on faculty development and changing pedagogical approaches (Elliott et al., 2020). Faculty report facing challenges in learning new systems, redesigning curriculum materials, and supporting student technical issues (Talsma et al., 2018). Institutional barriers include costs, technical support, and reward systems that do not adequately encourage online teaching excellence (Horvitz et al., 2019). Studies emphasize the need for comprehensive training programs, communities of practice, and course development support teams to help instructors gain confidence with virtual learning tools while rethinking teaching methods (Lucas et al., 2019).

The ways in which virtual learning environments facilitate or hinder student-instructor interaction has also been a research area. Findings suggest virtual learning environments often lack capabilities to encourage regular, high-quality student-instructor interactions compared to FTF environments (Martin et al., 2019). Active instructor engagement in discussion forums, prompt feedback on assignments, and integrating multimedia like video messages can help promote instructor presence and accessibility (Kim & Gurvitch, 2020). Studies advocate that virtual learning environments should allow relationship-centered course designs where instructors act as guides rather than provider of content. This empowers students as active participants, which is linked to improved satisfaction, motivation and learning (Martin et al., 2020).

Some studies have specifically analyzed the potential of virtual learning environments to enhance collaborative learning through forums, wikis, group assignments, and other built-in tools. Results indicate that simply providing such capabilities does not ensure meaningful collaboration, activities must be intentionally designed and facilitated (Zheng & Warschauer, 2015). Successful strategies include providing clear project guidelines, designing complex problems necessitating collaboration, and having instructors model constructive feedback practices (Barreto et al., 2022). Strategies to avoid include artificial discussion threads without synthesis or application of ideas (Hursen, 2021). Realizing virtual learning requires a supportive community and pedagogical approaches that promote productive peer engagement.

A number of studies have investigated the influence of virtual learning on student learning outcomes and performance. Meta-analyses indicate that on average, virtual learning based instruction produces learning outcomes equivalent to traditional FTF classrooms (Albeta et al., 2023). Findings emphasize that outcomes depend greatly on the quality of curriculum design, teaching presence, and appropriate use of multimedia tools aligned to learning objectives (Wang et al., 2021). Studies advocate focusing less on replication of physical classrooms and more on using virtual learning advantages like gamification, simulations, and adaptive content to increase knowledge retention, higher-order application, and motivational outcomes that enhance learning (Gunness et al., 2023).

Research of the literature examining virtual learning environments is enormous and multidisciplinary. While findings emphasize the potential benefits of thoughtfully implemented virtual learning tools and practices, researchers also point to the need for continued innovation and research of how these platforms impact the student experience. Ongoing research should inform the design of personalized, socially-engaging, adaptable virtual learning environments that support diverse learning needs across varying educational settings.

Summary and Conclusions

The increase in virtual learning over the past decade has greatly impacted K-12 education. As virtual instruction becomes increasingly common there is a demanding need to evaluate its effectiveness compared to traditional FTF instruction. This literature review synthesized current research on differences in knowledge retention, teaching strategies, and student outcomes between virtual and FTF learning environments. Additionally, factors influencing declines in state assessment scores and formative and summative assessments in virtual settings were analyzed.

The review provided historical background on the evolution of virtual education then compared FTF and virtual environments, examining how environments impact teaching methods, student engagement, and knowledge retention. Research on blended learning models was assessed, along with studies of specific virtual learning platform tools and designs. Literature evaluating summative assessments in virtual environments and debates around high-stakes testing were explored.

In conclusion, this review aimed to provide a comprehensive overview of the uses and limitations of virtual learning based on key areas of literature. Findings pointed to the need for more personalized and interactive instructional approaches in virtual settings to increase student engagement and achievement. Blended learning models demonstrate potential, but must be thoughtfully designed and implemented. More research is needed on best practices for transitioning between instructional methods and optimizing assessments.

As virtual education continues expanding, further guidelines and research is needed for administrators, teachers, and policymakers seeking to implement effective virtual and FTF learning environments. Key gaps persist in understanding how specific content areas and student populations are impacted. Further exploration through classroom-based research could provide meaningful insights to guide blended learning innovations and virtual education policies. By continuing to build knowledge, virtual and FTF instruction can support one another in helping students increase achievement.

Chapter 3: Research Method

The purpose of this quantitative study is to examine the difference in middle school ELA and mathematics test scores between students receiving instruction in virtual and students receiving instruction in FTF environments for 1 year. Chapter 3 defines the approach and procedures used in conducting the quantitative study. The research setting is described, providing relevant details about the location, population, and context for the research. The research design and rationale are presented, justifying the chosen design and explaining why it is appropriate for addressing the research questions and purpose of the study. The methodology section provides a detailed account of the methods used for data collection and analysis. This includes specifics about the sample, instruments, procedures, and analysis techniques. Threats to validity are identified and strategies used to increase the credibility and trustworthiness of the findings are described. Ethical procedures and considerations are outlined, including how confidentiality, informed consent, and potential risks to participants were handled. Discussion of these key elements provides the reader with a comprehensive understanding of the research approach and evidence that the study was conducted in a thoughtful and responsible manner

Research Design and Rationale

The key variables in this quantitative study include the instructional environment (virtual or FTF), the academic subject (ELA and mathematics), and the middle school students' test scores. The independent variable is the type of instructional environment, categorized into two groups: virtual instruction or FTF instruction. The dependent variables are the middle school students' ELA and mathematics SCReady test scores, measured at the end of the school year. The test scores will be continuous numerical data. Examining group differences in test scores between the virtual and FTF instructional groups will allow for comparison and analysis between instructional environment and student achievement in both ELA and mathematics.

This study will utilize an ex post facto, causal-comparative research design to examine differences in middle school ELA and mathematics test scores between students receiving virtual versus FTF instruction. Specifically, the study will examine test score data retroactively, looking at results from assessments already administered to students after experiencing 1 year of either virtual or FTF instructional environment.

An ex post facto design was chosen because the independent variable of instructional environment cannot be manipulated or randomized. Students have already been learning through virtual or FTF instructional formats; the researcher cannot control or change how participants were assigned to these groups. However, an ex post facto design can still compare the virtual and FTF groups on the dependent variables of ELA and mathematics SCReady test scores. The first research question will analyze differences in ELA scores between virtual and FTF students. The second question will examine differences in math scores using the same grouping variable and test results. The ex post facto approach allows for retrospective analysis of group differences in the key variables.

Research Question 1: What is the difference in middle school ELA test scores between students receiving instruction virtual and students receiving instruction face-to-face environments for one year?

$H_0$1: There is no significant difference between virtual versus face-to-face instructional formats for ELA test scores among middle school students.

$H_1$1: There is a significant difference between virtual versus face-to-face instructional formats for ELA test scores among middle school students.

Research Question 2: What is the difference in middle school math test scores between students receiving instruction virtual and students receiving instruction face-to-face environments for one year?

$H_0$2: There is no significant difference between virtual versus face-to-face instructional formats for mathematics test scores among middle school students.

$H_1$2: There is a significant difference between virtual versus face-to-face instructional formats for mathematics test scores among middle school students.

Methodology

Population Selection

The target population for this study will be rural middle school students from various socioeconomic backgrounds. To determine an appropriate sample size, an a priori power analysis was conducted based on the study's intended statistical analyses. With an assumed medium effect size (d = .25), alpha level of .05, and desired statistical power of

.80, the analysis indicated a minimum sample size of 128 participants per group would be needed to detect significant effects, however more than the minimum number of scores will be available for data analyses. Given these parameters, the targeted sample size for this study was set at 300 total participants. Thus, this sample size is selected to order to meet or exceed the necessary assumptions for a valid statistical outcome.

Procedures for Recruitment, Participation, and Data Collection

The data for this study will comprise of 5 years of existing SCReady assessment data to compare student achievement in FTF and virtual instructional settings. SCReady is a standardized assessment administered annually to students in grades 3-8 in English language arts and mathematics. The data set will include SCReady scaled scores in ELA and math for all students in the selected grades 6^{th} – 8^{th}, over a 5-year period from 2018 to 2022. Students' instructional setting (FTF or virtual) will be matched to their assessment results for each year.

The quantitative study will use an ex post facto design with the instructional setting as the independent variable. To analyze differences in achievement between FTF and virtual instruction, a *t* test will be conducted using the SCReady scaled scores for both ELA and math as the dependent variables. The *t* test is a statistical technique that evaluates a potential significant difference between means of one independent variable against one dependent variable (Strunk & Mwavita, 2021). Mean scaled scores for FTF and virtual groups will be compared to determine if significant differences in achievement exist. Results will provide insight into differences in student achievement between FTF and virtual schooling models over the 5-year period based on standardized assessment performance. The SCReady data provides an appropriate source to empirically evaluate the impact of instructional format on student learning outcomes using this ex post facto design.

Archival Data

I plan to collect and analyze archival student data from the SCReady standardized tests administered over the past 5 years. As an instructional technology coach at the local school district, I have been granted permission to access the data. The goal is to compare SCReady score trends between students receiving FTF instruction and virtual instruction.

I will collect SCReady test score data in math and ELA for students in grades 6-8 from the 2018-2019 school year through 2022-2023. These data sets are accessible through the district's central offices, both in paper archives and digital formats. With approval, I can obtain the paper records, scan them, and securely store the digital copies. For recent years with digital data storage, I will be able to access the files directly using an administrator account.

In collecting this 5-year span of data, I will compile overall mean scaled scores in math and ELA for each grade level. Scores will be categorized and compared between students who received FTF versus virtual instruction each year. This will allow me to document any differences in achievement trends between the two settings.

Throughout data collection and analysis, I will protect student privacy by removing identifiers. Data will only be reported in aggregate. All digital files will be securely stored per research requirements. By examining achievement data between instructional formats, I aim to provide insights to inform best practices.

Instrumentation and Operationalization of Constructs

The study will utilize existing archival data from the SCReady standardized assessments in math and ELA to analyze academic achievement data. The SCReady assessments are administered each spring to students in grades 3-8 in public schools across South Carolina.

SCReady is a reliable and valid instrument that aligns to the state standards for each grade level and subject area. The assessments go through rigorous design, testing, and review processes to ensure they accurately measure the constructs of interest - math achievement and ELA achievement (South Carolina Department of Education, 2018). Reports indicate strong internal consistency reliability with Cronbach’s alpha coefficients above .90 for all test forms. Confirmatory factor analysis also demonstrates SCReady’s construct validity with math and ELA as distinct constructs (SCDE, 2020).

Math achievement will be operationally defined in this study as a student’s scaled score and performance level on the SCReady math assessment. ELA achievement will be defined as the scaled score and performance level on the SCReady ELA test. Scaled scores quantify a student’s overall performance, while performance levels categorize scores into domains of Does Not Meet Expectations, Approaches Expectations, Meets Expectations, and Exceeds Expectations. These scores provide standardized, norm-referenced data on student academic proficiency each year.

By analyzing existing SCReady data, the study will utilize instrumentation with proven reliability and validity to quantify the constructs of math and ELA achievement. Examining scaled scores and proficiency levels will enable a detailed investigation of student academic achievement data.

Data Analysis Plan

The statistical software package SPSS will be used to conduct data analysis to address the research questions and hypotheses. Laerd Statistics resources will also inform analysis procedures and interpretation. Before uploading the data into SPSS, I will screen for any incorrectly coded values and ensure the data is compatible with the software's requirements. I will inspect the archived SCReady data for any inconsistencies, errors, or missing values that may need to be addressed before analysis. I will create a codebook to define all variables and assign numeric codes for data entry. Descriptive statistics and frequency distributions will be run on all variables to provide information about the sample and study measures. Descriptive statistics and visual plots will be run to screen the data for any outliers that could skew results. Assumption testing for normality, linearity, and homoscedasticity will also be conducted. If any assumptions are violated, appropriate data transformations or nonparametric tests will be utilized.

To address Research Question 1, an independent samples *t*-test will be conducted to compare mean ELA SCReady scaled scores between middle school students receiving virtual instruction versus FTF instruction. The independent variable will be instructional format with two levels: virtual and FTF. The dependent variable will be the interval/ratio SCReady ELA scaled scores.

The *t*-test results, including the *t*-value, degrees of freedom, and *p*-value, will be used to determine whether to reject the null hypothesis of no significant difference in mean ELA scores between instructional formats. An alpha value of .05 will be used. Effect size will also be calculated using Cohen's d.

Research Question 2 will be addressed using the same analysis procedures. An independent *t* test will compare mean math SCReady scaled scores between virtual and FTF students. The t-test results will indicate whether the null hypothesis of no difference in math scores should be rejected using the .05 alpha value. Effect size will also be examined.

For both research questions, necessary statistical adjustments like Bonferroni corrections will be made for multiple *t* test comparisons to reduce Type I error. Results will be presented in APA format including tables summarizing descriptive, inferential, and effect size statistics. Findings will be discussed regarding the research hypotheses and interpreted based on theories from the literature review. Limitations and future research needs will also be addressed.

Threats to Validity

Threats to external validity impact the generalizability of results to other settings or populations. A main threat is interaction of setting and treatment - the specific virtual and FTF instructional formats utilized may limit generalizing findings to other formats.

Selection bias also threatens generalizability if the accessible archived data represents a non-equivalent sample.

History and maturation effects could impact results if major educational policies or student development factors occurred during the 5-year span of data. I will document any major changes over the time period. Testing effects may also be a factor if students performed differently on the later test occurrences.

These threats impact how well the variables and measures represent the constructs. The SCReady assessments have undergone extensive validation testing to ensure it measure math and ELA achievement. I will report reliability statistics to demonstrate this. Using scale scores will enhance construct representation.

Ethical Procedures

Several ethical considerations will guide the handling and use of the archival SCReady data for this study. The data contains sensitive student information that must remain confidential. I will remove all personal identifiers from the data files and store the data securely on a password-protected computer to protect privacy. Only aggregate data will be reported with no individual students' identifiable information.

The school district granted permission to access and utilize the archived SCReady data for this study under the stipulation that student confidentiality is maintained. I will follow FERPA and school district policies on data usage. The study procedures will also submit for IRB approval (11-30-23-0370096) to formally assess protections for human subjects.

While the data will be anonymized by the district before release, I still have an ethical obligation to treat the score data mindfully. The quantitative test results represent actual students at a school where I hold an instructional technology coach role. There are potential biases I must be aware of when examining and interpreting achievement results. Objectivity will be maintained when reporting and discussing the data.

The data must be accurately analyzed using the proposed methods to avoid misrepresentation of student performance. Limitations of the data and methodology will be disclosed. The results will aim to provide an authentic picture of academic achievement that can guide constructive improvement efforts. With thoughtful protections and procedures, this study intends to ethically leverage existing data to advance knowledge on instructional formats.

Summary

This quantitative study aims to analyze differences in student achievement on the SCReady assessments between FTF and virtual instructional formats. The study will utilize an ex post facto causal-comparative design. Archival data will be collected from the SCReady math and ELA tests administered to students in grades 6-8 over the past 5 years in a rural South Carolina school district. As an instructional technology coach in the district, I have been granted access to the data.

SCReady scaled scores and proficiency levels will be compared between students receiving FTF versus virtual instruction each year using *t* tests for statistical significance. Potential covariates such as prior performance will be controlled if significantly related to outcomes. Data will be analyzed using SPSS software. Descriptive, inferential, and effect size statistics will be calculated to address research questions regarding differences in ELA and math achievement between learning formats.

Threats to validity will be addressed by describing instructional approaches used, documenting any historical effects over the 5-year span, controlling for prior scores, and checking statistical assumptions. Ethical procedures include removing identifiers from the dataset, securely storing data, reporting aggregate results, and objectively analyzing and discussing findings.

Chapter 4 will present the results of the study, including details on data collection, data analysis, and key findings. The chapter will begin with an overview of the data collection process, describing the methodology used to gather the. The chapter will provide details on the study participants, measures utilized, and procedures followed to collect the data. The chapter describes the techniques used to analyze the collected data to answer the research questions from Chapter 1. The remainder of the chapter is dedicated to reporting the results of the data analyses. The key findings will be highlighted and presented logically, with the aid of tables and graphs to help summarize the results. The chapter will conclude with a summary of the major findings that emerged from the data. The findings will be briefly discussed in relation to past literature and the implications, setting the stage for the in-depth discussion that will follow in Chapter 5.

Chapter 4: Results

The purpose of this quantitative study is to examine the difference in middle school ELA and mathematics test scores between students receiving instruction in virtual environments and students receiving instruction in face-to-face environments for 1 year. The research aims to address two key questions related to comparing academic achievement for these two instructional modalities. The first research question is: “What is the difference in middle school ELA test scores between students receiving instruction virtually and students receiving instruction in face-to-face environments for one year?” This question centers on analyzing ELA test scores as the dependent variable and determining if there are significant differences based on whether students received virtual or FTF instruction. The second research question is, “What is the difference in middle school math test scores between students receiving instruction virtually and students receiving instruction in face-to-face environments for one year?” This second question mirrors the first but substitutes mathematics test scores as the key dependent variable. These two targeted research questions will support an analysis of academic achievement in two core subject areas to determine if virtual vs. FTF instruction if it results in a significant difference in middle school students' ELA and mathematics SCReady scaled scores over 1 academic year.

The purpose is to quantify if there is a significant difference in academic scores in ELA and math for middle school students differ across virtual and FTF learning environments. The two aligned research questions specifically allow for side-by-side comparisons of ELA and math achievement scores as related to the instructional model students experienced for one year.

Chapter 4 presents the results utilized to collect and analyze the quantitative data for this study. First, an introduction revisits the purpose of comparing virtual versus FTF learning modalities over 5 academic years. The next section explains how archived test scores were accessed and which inclusion criteria were used to extract a final sample and dataset appropriate for the planned analyses. The data preparation process transforms the raw data into an analysis-ready format. The data analysis portion describes the results of the mean score differences on both the ELA and mathematics assessments based on type of instruction (virtual or FTF). The results presentation systematically addresses each research question with tables and graphs condensing the outputs from the comparisons; findings are summarized in terms of how they relate to the stated hypotheses.

Data Collection

SCReady scaled scores were collected using a database maintained by the school district. Specifically, 150 scaled scores were collected for each subject (ELA and mathematics) and each learning modality (virtual and FTF instruction) from the middle schools across the district, yielding a total sample of 750 test scores for each year. These scores represented the final performance indicators used to assess academic achievement and learning outcomes from the academic year. The specific selection criteria included collecting the 5 prior year scores, regardless of the students' current year grade level, as long as they were enrolled in either 6th, 7th, or 8th grade for the entirety of the previous year. Inclusion criteria stipulated that only students who completed the full academic year leading up to testing in either virtual or FTF classrooms could be included. This ensured students experienced continuity in their mode of instruction prior to taking the SCReady test. The scores for the 5 years, which ranged from 300 to 900, were compiled into separate datasets sorted by subject and learning modality type. This method of data collection focused on collecting the appropriate achievement scaled scores directly related to the study's research questions comparing ELA and mathematics academic performance between students receiving virtual versus FTF instruction.

Results

The data analysis was conducted using the IBM SPSS statistical software version 28 (IBM, 2021). This widely used software was selected for the ability to run a variety of statistical tests and provide flexibility in analyzing variables. The two continuous dependent variables were the SCReady scaled scores in ELA and mathematics. The categorical independent variable was the learning environment, virtual or FTF. The two learning environments represented the subgroups compared through sample *t*-test analysis for differences in mean SCReady scaled scores. The *t* test determines if the difference in means is statistically significant.

Preliminary analysis was conducted to describe performance on SCReady scaled scores prior to testing group differences statistically. As displayed in Table 1, descriptive statistics including mean and standard deviations summarize the distribution of the scaled scores for the overall sample by learning environment and year. These descriptive statistics allows an initial quantitative interpretation of the different learning environments. The average scaled score for math in a FTF learning environment was 540.29 and in a virtual learning environment was 444.53. The average scaled score for ELA in a FTF learning environment was 555.49 and in a virtual learning environment was 479.73.

Table 1

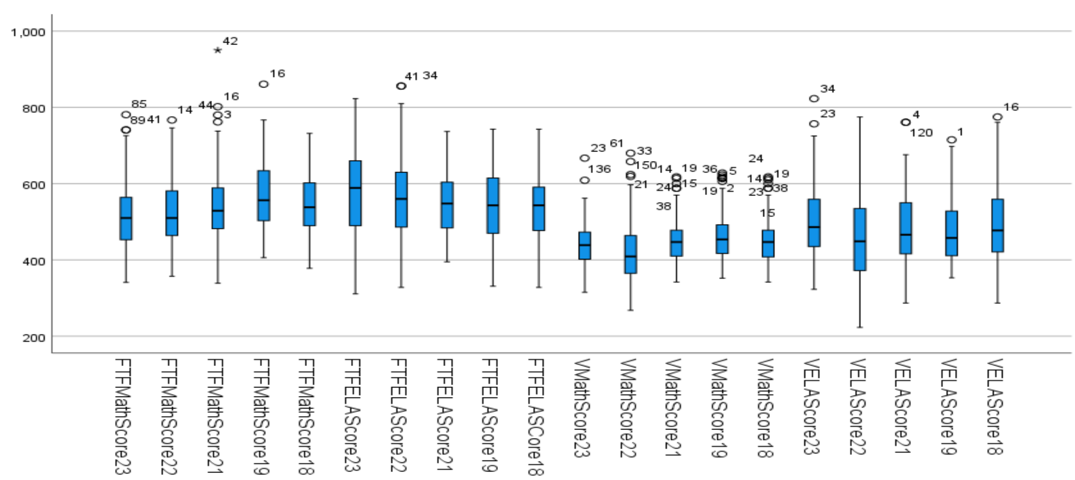
Descriptive Statistics for SCReady Scores Across 5 Years of Testing

	N				
	Valid	Mean	Std. Deviation	Minimum	Maximum
FTFMathScore23	150	519.31	85.209	341	781
FTFMathScore22	150	522.97	84.876	357	767
FTFMathScore21	150	543.23	92.112	339	950
FTFMathScore19	150	569.71	83.524	406	861
FTFMathScore18	150	546.22	74.938	378	732
FTFELAScore23	150	576.88	111.267	311	823
FTFELAScore22	150	567.63	101.720	328	856
FTFELAScore21	150	550.80	82.122	395	737
FTFELAScore19	150	544.84	97.859	331	743
FTFELASCore18	150	537.30	79.771	328	743
VMathScore23	150	444.25	54.359	315	667
VMathScore22	150	418.80	80.791	268	680
VMathScore21	150	448.91	56.145	342	618
VMathScore19	150	461.22	63.741	352	628
VMathScore18	150	449.48	57.599	342	618
VELAScore23	150	499.86	95.657	323	823
VELAScore22	150	454.54	114.392	223	775
VELAScore21	150	477.71	89.448	287	761
VELAScore19	150	475.45	80.268	353	715
VELAScore18	150	491.07	99.889	287	775

Prior to conducting the independent sample *t*-test comparisons, the data were evaluated for assumptions to ensure valid interpretation of the results. Six key assumptions must be tested. The dependent variable must be measured at the continuous level, which was met through the SCReady scaled scores. The independent variable must comprise of two categorical independent groups, satisfied by the FTF and virtual learning environments. Scores are independent between groups, therefore allowing for independence of observations. The fourth assumption specifies no significant outliers among the dependent variables, evaluated through boxplots (see Figure 1).

Figure 1

Boxplots Showing No Significant Outliers for Scale Scores by Learning Environment



Fifth is normality, determined using the Shapiro-Wilk test (see Figure 2) of normality to ensure the dependent variable, while not necessarily normally distributed, does not significantly deviate within the groups. The independent *t* test can still be considered robust even when the non-normality assumption is violated, as non- normality does not impact type 1 errors. Homogeneity of variance is valid due to the sample size being the same. Meeting necessary assumptions provides the basis for valid statistical inferences using the independent samples *t* test.

Figure 2

Test of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
FTFMathScore23	.081	150	.017	.962	150	<.001
FTFMathScore22	.080	150	.020	.971	150	.003
FTFMathScore21	.104	150	<.001	.954	150	<.001
FTFMathScore19	.099	150	.001	.972	150	.003
FTFMathScore18	.110	150	<.001	.974	150	.006
FTFELAScore23	.077	150	.028	.984	150	.074
FTFELAScore22	.071	150	.064	.989	150	.265
FTFELAScore21	.058	150	.200*	.982	150	.050
FTFELAScore19	.054	150	.200*	.984	150	.078
FTFELASCore18	.050	150	.200*	.995	150	.857
VMathScore23	.058	150	.200*	.973	150	.004
VMathScore22	.092	150	.004	.967	150	.001
VMathScore21	.075	150	.039	.965	150	<.001
VMathScore19	.076	150	.035	.963	150	<.001
VMathScore18	.081	150	.018	.959	150	<.001
VELAScore23	.073	150	.048	.976	150	.009
VELAScore22	.052	150	.200*	.988	150	.220
VELAScore21	.092	150	.003	.977	150	.014
VELAScore19	.096	150	.002	.955	150	<.001
VELAScore18	.100	150	<.001	.975	150	.008

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

An independent *t* test was conducted to compare the mean differences between two dependent variables, FTF and virtual learning environments for 5 years. Effect size using Cohen's d, Hedges' g, Glass's delta were calculated to estimate the standardized magnitude of group differences (see Figure 3). Effect size was interpreted based on benchmarks of .2, .5, and .8 representing small, medium, and large effects. Ninety-five percent confidence intervals were analyzed to determine precision and variability around the point estimates. Statistical significance was determined using an alpha value of 0.05.

Figure 3

Effect Sizes

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
M23	Cohen's d	71.46854	1.050	.808	1.291
	Hedges' correction	71.64904	1.048	.806	1.288
	Glass's delta	54.35947	1.381	1.104	1.655
M22	Cohen's d	82.85904	1.257	1.008	1.504
	Hedges' correction	83.06831	1.254	1.006	1.500
	Glass's delta	80.79122	1.289	1.018	1.557
M21	Cohen's d	76.27859	1.236	.988	1.483
	Hedges' correction	76.47124	1.233	.986	1.479
	Glass's delta	56.14482	1.680	1.382	1.974
M19	Cohen's d	74.29397	1.460	1.204	1.714
	Hedges' correction	74.48160	1.457	1.201	1.710
	Glass's delta	63.74149	1.702	1.403	1.998
M18	Cohen's d	66.83349	1.447	1.192	1.701
	Hedges' correction	67.00229	1.444	1.189	1.697
	Glass's delta	57.59925	1.680	1.382	1.974
ELA23	Cohen's d	103.75604	.742	.508	.976
	Hedges' correction	104.01808	.740	.506	.973
	Glass's delta	95.65690	.805	.560	1.048
ELA22	Cohen's d	108.24178	1.045	.803	1.285
	Hedges' correction	108.51516	1.042	.801	1.282
	Glass's delta	114.39198	.989	.735	1.240
ELA21	Cohen's d	85.86334	.851	.614	1.087
	Hedges' correction	86.08020	.849	.613	1.084
	Glass's delta	89.44824	.817	.571	1.061
ELA19	Cohen's d	89.49690	.775	.540	1.009
	Hedges' correction	89.72294	.773	.539	1.007
	Glass's delta	80.26839	.864	.617	1.110
ELA18	Cohen's d	90.39146	.511	.281	.741
	Hedges' correction	90.61976	.510	.280	.739
	Glass's delta	99.88907	.463	.230	.694

[a]. The denominator used in estimating the effect sizes.

Cohen's d uses the pooled standard deviation.

Hedges' correction uses the pooled standard deviation, plus a correction factor.

Glass's delta uses the sample standard deviation of the control group.

The effect sizes test indicated a large standardized difference between the means of the FTF and virtual learning environments. Cohen’s d using pooled standard deviation was 1.05(95% confidence interval [0.808, 1.29]), above the 0.80 large effect limit. Hedges' g correction controlling for small sample sizes calculated an almost identical point estimate of 1.048(95% confidence interval [0.806, 1.288]). Glass's delta based solely on the control group standard deviation was 1.381 (95% confidence interval [1.104, 1.655]) suggest a large effect. The 95% confidence intervals for Cohen's d and Hedges' g were narrow, ranging from 0.8 to 1.3 standard deviation units, indicating accuracy in the large effect size estimates. Glass's wider confidence interval may reflect lower certainty due to relying only on the standard deviation of one group rather than the pooled variances across samples.

Independent *t* tests conducted across the 10 key assessment variables uniformly determined significant differences for students in face-to-face learning environments versus students in virtual learning environments (see Figure 4). Mean differences ranged from 46 to 113 points—all statistically significant at $p < .001$, with 95% confidence intervals. The next section explains findings on each of the dependent variables individually.

Figure 4

Independent t test for ELA and Math Over 5 Years

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
M23	Equal variances assumed	27.633	<.001	9.096	298
	Equal variances not assumed			9.096	253.048
M22	Equal variances assumed	.983	.322	10.887	298
	Equal variances not assumed			10.887	297.278
M21	Equal variances assumed	22.652	<.001	10.708	298
	Equal variances not assumed			10.708	246.286
M19	Equal variances assumed	17.783	<.001	12.646	298
	Equal variances not assumed			12.646	278.598
M18	Equal variances assumed	11.186	<.001	12.536	298
	Equal variances not assumed			12.536	279.504
ELA23	Equal variances assumed	6.572	.011	6.429	298
	Equal variances not assumed			6.429	291.440
ELA22	Equal variances assumed	2.509	.114	9.048	298
	Equal variances not assumed			9.048	293.985
ELA21	Equal variances assumed	.266	.606	7.372	298
	Equal variances not assumed			7.372	295.850
ELA19	Equal variances assumed	5.743	.017	6.714	298
	Equal variances not assumed			6.714	287.019
ELA18	Equal variances assumed	6.000	.015	4.429	298
	Equal variances not assumed			4.429	284.101

The *t*-test analysis revealed statistically significant differences between the FTF versus virtual learning environments across all dependent variables examined, including M23, $t(298)=9.096$, $p<.001$; M22, $t(298)=10.887$, $p<.001$; M21, $t(298)=10.708$, $p<.001$; M19, $t(298)=12.646$, $p<.001$; M18, $t(298) = 12.536$, $p<.001$; ELA23, $t(298)=6.429$, $p<.001$; ELA22, $t(298)=9.048$, $p<.001$; ELA21, $t(298)=7.372$, $p<.001$; ELA19, $t(298)=6.714$, $p<.001$; and ELA18, $t(298)=4.429$, $p<.001$.

Summary

This study examined academic achievement differences in ELA and mathematics between middle school students receiving instruction FTF versus virtual over a five-year period. SCReady scaled scores representing standardized performance outcomes were compiled for 750 students each year. Scores met assumptions and were analyzed using independent *t* tests to compare means between the learning environments.

Statistically significant differences emerged across all years supporting FTF environments. Large effect sizes definitively showed FTF learners outperformed virtual learners from 46.23 to 113.09 points depending on subject and year, with confidence intervals supporting estimates. The analyses provide overwhelming evidence that FTF learning environments had higher academic proficiency in ELA and mathematics over the five-year time period.

Chapter 5 provides an in-depth discussion and interpretation of the key findings and results presented in Chapter 4, drawing meaningful conclusions that connect back to the original research purpose and questions. Grounded in the data and statistical analyses comparing academic achievement scores between FTF and virtual learning environments over time, evidence-based conclusions are made regarding the comparative pedagogical approaches. Theoretically-grounded explanations for the performance differences found are explored, along with relevant factors corroborated in existing literature that may account for FTF instructional environments presenting significant learning enhancements and loses. Actionable recommendations aligned to practice and policy are discussed based on the findings. Practical implications and future research directions are discussed focused on differentiated learning outcomes.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this quantitative study was to examine the difference in middle school ELA and mathematics SCReady scores between students receiving instruction in virtual environments and students receiving instruction in FTF environments over a 5-year period. An ex post facto design was utilized and independent samples *t* tests were used to analyze the data. The key findings that emerged were statistically significant differences across all years by FTF learners. Large effect sizes showed FTF students outperformed virtual students by 46.23 to 113.09 points depending on subject and year. The analysis showed evidence that FTF learning environments resulted in significantly higher academic test performance in both ELA and mathematics instruction over the 5-year study period compared to virtual environments. Further discussion of these definitive results and the implications are explained in this chapter.

Interpretation of the Findings

The independent samples *t* tests conducted on the 10 key student assessment variables showed significant differences across all measures between students in FTF versus virtual learning environments. Specifically, students in FTF classrooms substantially outperformed students in virtual learning environments on SCReady in both mathematics and ELA over the 5-year period examined.

The mean score differences between FTF and virtual groups ranged from 46 to 113 points on the various SCReady assessments. In all cases, these differences were statistically significant at the $p < .001$ level. FTF students significantly outscored virtual students on all mathematics exams, with mean contrasts of 46 points on the M18 up to 105 points on the M19. Differences between FTF and virtual learning environments ranged from approximately 50 points on the ELA18 to 85 points on the ELA22 in ELA.

The considerably higher performance by FTF learners persisted across both subjects and all 5 years examined in the study. This suggests FTF instruction leads to greater learning gains and content mastery compared to virtual instruction regardless of the specific academic domain or grade level. Several factors may explain the relative ineffectiveness of virtual learning environments. The absence of in-person teacher and peer interaction may hinder opportunities for valuable dialog, immediate feedback, and collaborative learning (Turk et al., 2021). In-person instruction facilitates face-to-face dialog between teachers and students, enabling immediate feedback and clarification of concepts. This format also promotes collaborative learning through group activities and peer interactions, fostering social skills and teamwork. FTF instruction may be less flexible in terms of scheduling and location, requiring students to be physically present at a specific time and place. It can be more resource-intensive, necessitating dedicated classroom spaces and materials.

Virtual instruction offers flexibility, allowing students to access course materials and participate in discussions at their own pace and from any location with an internet connection. This format can also be more cost-effective, as it eliminates the need for physical classroom spaces and can accommodate a larger number of students. The absence of in-person teacher and peer interaction in virtual instruction may hinder opportunities for valuable dialog, immediate feedback, and collaborative learning. Students may feel isolated or disconnected from classmates and instructors, which can impact motivation and engagement. Educators must carefully consider these pros and cons when designing and implementing instructional strategies to ensure that students receive a high-quality education regardless of the format. Lower accountability and increased distractions in virtual environments could negatively impact attentiveness and motivation (Ramailia & Molwele, 2022). Further research is needed to confirm which elements relative to virtual learning environments may be directly impairing student success.

The current analysis found no evidence of a narrowing achievement gap between FTF and virtual learners over time. The mean score differences slightly increased during the later years included in the study. This trend raises concerns that virtual learning environments may fail to provide adequate scaffolding and skills development compared to FTF environments.

This quantitative study overwhelmingly confirmed the advantage of FTF learning environments over virtual learning environments. The significant differences seen in this study emphasize limitations of the virtual learning instructional format. The opportunity to learn framework recognizes that academic achievement reflects not only individual effort, but the quality of instruction and tools supporting student growth (Rolfe et al., 2021). Students accessing well-designed learning that seem to be present in FTF learning environments are more likely to master content. Inadequate learning environments can impede mastery as evidenced in SCReady assessment scores.

The limited student-teacher relationship opportunities are available in virtual learning environments could be associated with decline in mathematical and ELA assessment scores. This relationship indicates that equivalency of content coverage does not necessarily confer equivalency of opportunity. Both FTF and virtual students access the identical curriculum. But, the virtual learning environment often reduces students' motivation and sense of accountability, leading to decreased engagement and participation, which creates behavioral divergence between FTF and virtual learners (Lazarides & Raufelder, 2021). Policymakers should apply opportunity to learn framework principles when evaluating academic outcomes, not just material inputs (Strietholt et al., 2021).

The results from this study align with decades of research highlighting the irreplaceable benefits of FTF teacher-student and peer interactions (Lonka et al., 2020). Despite the convenience and expanding role of virtual learning environments, it fails to offer the same degree of content mastery. Learning is an intrinsically social process (Richardson et al., 2021). Simply providing course materials virtually cannot replicate the scaffolding and motivational elements that arise organically from FTF learning environments. As districts weigh instructional approaches, they must consider both the empirical data and theoretical foundations underlying why FTF learning is more effective (Vale et al., 2020). This study contributes compelling quantitative evidence to inform these decisions. Still, further research can help delineate specific processes hindering virtual students. Such analysis may reveal modifications to improve virtual outcomes without sacrificing student achievement.

Limitations of the Study

While this study provides compelling evidence regarding significant differences in academic achievement between virtual and FTF learning environments, some limitations should be considered. The exclusive reliance on standardized state assessment scores restricts the skills and abilities that are measured. This test assesses only specific academic competencies, failing to evaluate students' complete range of knowledge, behaviors or higher-order thinking.

There are several uncontrolled variables between virtual and FTF learning environments which could impact student academic performance. These include discrepancies in technological access, home learning environment, parental support available, and individual student motivational or responsibility differences. While reasonable assumptions were made to limit some of these concerns, it remains difficult to control confounding variables in comparing instructional learning environments.

An additional limitation may be the rural geographic setting which constrained the population size available for study. The limited number of accessible schools likely decreased sample heterogeneity. This could hinder the broader generalizability of results to larger, more heterogeneous populations of students in suburban or urban educational contexts. Further research with larger, more diverse samples may strengthen external validity.

Dependencies on standardized testing instruments, inability to account for mitigating variables in home environments, and sample population restrictions stemming from the regional location may limit the conclusions drawn from this study. However, despite these constraints, the unambiguous findings strongly suggest significant differences in learning outcomes between virtual and FTF learning environments.

Recommendations

The significant findings over this 5-year span require attention from educational leaders before any major systemic transition towards a virtual learning model would take place. Students in FTF learning environments consistently outperformed the students in virtual learning environments across all academic outcome measures—a trend showing no signs of narrowing over time. Educational leaders should devote resources toward identifying best pedagogical practices uniquely supported through FTF learning environments before approving experimental alternative models under political or financial stress. Practical factors may necessitate virtual learning environment options as supplements. In such cases, enhancing virtual learning environment instruction requires addressing engagement, progress monitoring, and social inequalities.

Reinforcing learner connectivity and community should stay an instructional priority regardless of instructional learning environment. Districts should require professional development to help virtual teachers build personal connections with students. The professional development should demonstrate to virtual teachers how to use interactive collaborative tools to involve and motivate learners. Schools will need to outline clear expectations and accountability procedures intentionally written for virtual learners. Parents opting into virtual learning environments must recognize elevated self-direction requirements and lessen home distraction risks. Ongoing progress monitoring procedures should be included into virtual learning environment protocols, including interim online competency checks and remediation responses targeting skill discrepancies.

Gaps in social-emotional development created by virtual learning environments risk impeding cooperative efforts, dialog, and critical thinking development. Educational leaders should continue developing tools that reveal deficits in advanced social-emotional skills resulting from the lack of FTF learning environment interactions during virtual learning. This would allow community members to evaluate balance between student access, learning effectiveness, and budget impacts.

Blended and hybrid learning models combining virtual and FTF components could offer compromises, granting collaborative advantages with schedule flexibility. These learning approaches require purposeful coordination balancing project-based teamwork, whole group dialogue sessions, and targeted skill interventions. Simply transmitting lessons electronically without scaffolding student engagement could promote unrealistic expectations, resulting in inadequate outcomes due to reduced student to student and teacher to teacher interaction. Districts implementing hybrid learning models must fund extensive professional development in systematically combining appropriate learning activities with delivery environments. Random integration of virtual and FTF learning environment components risks misaligning, rather than optimizing, the distinctive attributes and limitations within both synchronous and asynchronous settings.

Implications

The definitive evidence of achievement gaps between virtual and FTF learning environments establishes restructuring of key learning supports to better scaffold developmental and achievement progress. Additional instructional time targeted specifically to reinforcing foundational competencies is required for virtual learners struggling to demonstrate proficiency benchmarks. Proactive monitoring through ongoing formative assessments would enable interventions addressing skill gaps earlier for students at risk of disengagement when removed from collaborative settings. Building in digital safeguards custom-fit to virtual learning environments would ensure equal access to essential individualized supports.

At the classroom level, formative assessment could enable responsive skill-building individualized lessons. With lower student densities, rural educators can strategically group students and tailor interventions addressing isolated competency deficits revealed through progress monitoring. The district can use assessment results to enhance training for parents and caregivers of virtual students. At the home level, modifications to expectations and home learning conditions could be made by parents providing a dedicated workspace more conducive to learner engagement. Regional leaders might fund training in best virtual facilitation practices to refine teacher videoconferencing, discussion moderation, and cooperative learning tactics for virtual learning environments.

Conclusion

Based on the comprehensive analysis of SCReady scores over a 5-year period, this study provides compelling evidence that FTF learning environments lead to significantly higher academic achievement in both ELA and mathematics compared to virtual learning environments. The persistent and substantial performance gaps between FTF and virtual learners, with effect sizes ranging from 46 to 113 points, underscore the need for educational leaders to carefully consider the limitations of virtual instruction and prioritize the development of strategies to enhance student engagement, progress monitoring, and social-emotional skills in virtual settings. While virtual learning offers flexibility and cost-effectiveness, the absence of in-person interactions and collaborative opportunities may hinder student motivation, accountability, and content mastery. To address these challenges, districts should invest in professional development for virtual teachers, establish clear expectations and progress monitoring procedures, and explore blended or hybrid learning models that combine the benefits of FTF and virtual instruction. The findings of this study may have social change significant implications for educational policy and practice, emphasizing the importance of providing students with high-quality learning environments that foster academic success and personal growth

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