The Academic Performance of Colorado Virtual Schools Operating With and Without Education Management Organizations

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Abstract

The enrollment growth across Kindergarten-12th (K-12) grade virtual public schools allows families and students more freedom with school choice but also brings a lack of research related to student success in virtual education to inform the choice (Barbour, 2016). To allow families, students, and policymakers the ability to make data-informed decisions regarding school options, the academic outcomes of Colorado virtual schools were analyzed. The purpose of this study was to determine if there is a difference in English language arts (ELA), reading, and math achievement, as demonstrated on the Colorado Measures of Academic Success (CMAS) assessment, between Colorado third through fifth-grade public virtual students who attend schools with an EMO and those who attend Colorado public virtual schools without an EMO. This dissertation was a quantitative causal-comparative analysis of the academic performance results of students enrolled in public virtual schools. State assessment results were collected from the Colorado Department of Education (CDE) for the 2021-2022 school year. The results of the study indicated no significant difference when comparing the academic outcomes of students who attended virtual schools with an EMO to those who attended a virtual school without an EMO. This result was true for all the means across ELA and math achievement for students in Grades 3-5. However, the study sample size was very small; thus, additional analyses were conducted using weighted means and weighted standard deviations. The results of the additional analyses provided evidence of a higher mean for Grades 3 and 5 ELA assessments for students who attended virtual schools with an EMO, while the Grade 4 comparison of ELA results indicated no significant difference. The additional analyses of math results indicated higher achievement of students who

attended a school with an EMO in Grades 3, 4, and 5. As the sample size was small and there was little prior research found on the topic, the research demonstrates a need for further research on the topic to occur.

Dedication

This dissertation is dedicated to my mother, Kim, who has always inspired me to pursue my passions, prayed with me through challenges, and taught me to value education from a young age. To my husband, Grant, and my son, Dominick, who have supported me through the writing journey with dedicated love and grace for missed family time, including practices, games, and events, I dedicate this to you. I dedicate this dissertation to my siblings, Megan, Miranda, Dana, Tom, and Tony, you each provide unique support to me. To Robert Nordyke who developed a passion for research and analysis in me with years of coaching me in debate, I dedicate this work to you. This work is dedicated to the countless other friends, family, and leaders who have lifted me up and walked a journey of education and career growth alongside me.

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Table of Contents

List of Tables

Chapter 1

Introduction

Virtual education is growing in popularity across the United States as families search for alternative forms of education. From 2016 to 2021, Kindergarten-12th grade (K-12) public virtual schools have rapidly increased enrollment (Molnar et al., 2021). The growing popularity of virtual education has brought concerns about the effectiveness of virtual public schools. Based on historical academic data, virtual school academic performance has not been as successful as brick-and-mortar schools (Molnar et al., 2021). Overall academic achievement is important to K-12 schools, but the two areas of greatest academic concern for virtual schools are mathematics and English Language Arts (ELA). Performance data for virtual schools has highlighted poor performance compared to K-12 grade brick-and-mortar schools (Adelstein & Barbour, 2017). Klein and Starkey (2017) noted that mathematics is foundational to early learning students. Thus, virtual schools must produce academic results for students in mathematics to meet learner needs. Additionally, evidence demonstrates that students who struggle to accomplish peer-level literacy skills in early elementary can develop a multitude of language acquisition deficits that, without intervention, hinder their education growth for life (Verhoeven et al., 2020). With the increased emphasis on early literacy skills, virtual education must provide students with adequate lessons and interventions to ensure academic success in literacy.

As virtual education has grown in popularity, the number of school choices in the virtual world has increased. The most significant identifiable difference in virtual schools is between those operating with an educational management organization (EMO) and those that do not. EMOs provide schools with curricula, a learning platform, and professional development for instructors (Bulkeley, 2003). The standardization of EMOs can provide end-to-end solutions for district-level administrators who authorize the implementation of virtual education without the need to piece together the elements of a successful school. Schools with EMOs offer standardized support to students and provide a model of education to families in need of a rapid pace (Bulkeley, 2003).

Virtual schools without an EMO have the flexibility to identify a curriculum, platform, and instructional support for staff that best fit the individual needs of the school but do not ensure alignment of the systems as an EMO does (Bulkeley, 2003). At the time of the current study, these differences had not been adequately explored. Studies have focused on the academic outcome differences between virtual and brick-and-mortar schools rather than comparing types of virtual schools.

Background

Public K-12 virtual schools first began in the United States in 1995 and have rapidly expanded throughout the first two decades of this century (Watson & Murin, 2014). Colorado is considered an early adopter of K-12 public education as the state is one of the few states that opted to launch a district-supported online school in the mid-1990s (Kennedy & Ferdig, 2018). Over the years, Colorado online schools have continued to grow. During the 2021-2022 school year, 55 online and blended learning education options were available for K-12 Colorado students**;** the schools served various grade levels and followed one of three authorization paths to offer online or blended learning education (CDE 2022). Although the number of schools has been growing, Colorado is one of many states where, as school options have expanded, the number of students in schools has continued to remain small or decline (Kennedy & Ferdig, 2018).

While online school enrollment grew during the COVID-19 crisis, during the 2021-2022 school year, Colorado online schools experienced declining enrollment post-pandemic (CDE, 2022).

Colorado has not only evolved by increasing the number of virtual schools in the state but has also added school oversight and options for authorization throughout the years. Colorado was one of the first states to create a policy framework for online schools (Kennedy & Ferdig, 2018). In 2006 the Legislative Audit Committee of Colorado determined the need for a task force to develop a framework of accountability; the State Board of Education formed the task force, and the first framework was passed as Senate Bill 215 in May of 2007 (Kennedy & Ferdig, 2018). Colorado legislators continued the evolution of online learning requirements as Colorado was one of three states to be the first to adopt required reporting and academic expectation standards in 2012 (Watson & Murin, 2014). One of the most recent evolutions of online education legislation occurred in 2018 when Colorado expanded the allowed authorizers for online, non-charter schools from only school districts to both districts and Boards of Cooperative Educational Services (Findlaw, 2019).

In 2022, there were three authorization structures for Colorado public online schools: single-district online schools, multi-district online schools, and education-collaborative online schools. A single-district online school is authorized by one school district, and students must reside in the school district that offers the school (CDE, 2022). Single-district online schools are often not partnered with an EMO as the district provides a school with a similar curriculum, platform, teachers, and student information system as the district brick-and-mortar schools. Multi-district online schools are authorized by multiple districts throughout the state and can serve students throughout the entire state (CDE, 2022). These schools are partnered with an EMO as the organization is needed to provide the learning platform, curriculum, teachers, and student information system across multiple districts. The final structure is similar to a multi-district online school authorized by a Boards of Cooperative Educational Services organization (CDE, 2022). As these schools also need a provider and are often a school that is also authorized by multiple districts, they are also partnered with EMOs.

At the time of this study, six non-EMO schools were provided by Colorado districts. These schools operated during the 2021-2022 school year and served at least Grades Kindergarten-eighth grades (CDE, 2022). Table 1 shows the number of students enrolled and the percentage of students tested in each school operated without an EMO.

Table 1

Number of Students Enrolled and Percentage of Students Tested in Colorado Virtual Schools in 2021-2022 Without an EMO Included in This Study

School	Number of Students Enrolled	Percentage of Students Tested*
A	954	19.0
B	522	26.2
C	374	34.1
D	587	72.0
E	532	54.8
F	25	83.3

Note: Adapted from "Office of online and blended learning," by CDE, 2022 (https://www.cde.state.co.us/onlinelearning).

At the time of this study, 10 EMO schools were provided with the multi-district online authorization allowance. These schools operated during the 2021-2022 school year and served at least Grades Kindergarten-eighth Grades (CDE, 2022). Table 2 shows the number of students enrolled and the percentage of students tested in each school for schools that operate with an EMO.

Table 2

Number of Students Enrolled and Percentage of Students Tested in Colorado Virtual Schools in 2021-2022 With an EMO Included in This Study

School	Number of Students Enrolled	Percentage of Students Tested*
AA	2,532	29.4
BB	94	71.4
CC	2,280	33.0
DD	805	6.9
EE	308	72.2
FF	653	93.5
GG	2,340	32.4
HH	204	91.4
II	107	31.2
JJ	15	Not Available

Note: Adapted from "Office of online and blended learning," by CDE, 2022 (https://www.cde.state.co.us/onlinelearning).

Statement of the Problem

Public virtual schools in Colorado are often criticized for underperforming academically compared to their brick-and-mortar counterparts. The CDE (2010) indicated that online students' scores in core achievement are significantly lower than brick-and-mortar students' and have been trending lower from 2019-2021. Concern exists that the last statement made by the Department of Education was in 2010; the length of time that has passed is indicative of a lack of regular review of virtual education by the state of

Colorado (CDE, 2010). However, more recent data do not show any further positive view regarding virtual school academics; on a Colorado news investigation, Barbour (2016) published data citing online student scores in core achievement as 14 to 26 percentage points below brick-and-mortar students.

With academic concerns, there is a reason to review virtual school student achievement. However, the academic data published for virtual schools are often under-explored and inconsistent; a conflicting academic study published by Paul and Wolf (2020) included the explanation that virtual school academic data is comparable to brick-and-mortar academic data when accounting for the rate of student mobility. Few researchers have compared virtual schools with EMOs and those without EMOs. An EMO provides virtual schools with services touted to produce academic results, i.e., quality curriculum, an effective learning management system, and teacher professional development; the impact of schools both with and without EMOs should be further explored to understand better if and how virtual schools can be effective. The attention around the inability of virtual schools to produce academically prepared students and the lingering public perception surrounding the Colorado state audit, which led to stricter virtual school oversight, has hindered the growth of virtual schools (Barbour 2016). Further analysis of the two models for virtual schools is needed to clarify academic results and provide the public with a more educated understanding of virtual schools.

Purpose of the Study

The focus of this study was on the difference in student achievement between Grades 3-5 Colorado public education students attending virtual schools with EMOs and those in Colorado public virtual schools without EMOs during the 2021-2022 school year. The first purpose of this study was to determine if there is a difference in ELA achievement, as measured by the Colorado Measures of Academic Success (CMAS) assessment, between Colorado third through fifth-grade public virtual students who attend schools with an EMO and those who attend Colorado public virtual schools without an EMO. The second purpose of this study was to determine if there is a difference in the reading subscore of ELA achievement, as demonstrated on the CMAS, between Colorado third through fifth-grade public virtual students who attend schools with an EMO and those who attend Colorado public virtual schools without an EMO. The third purpose of this study was to determine if there is a difference in third through fifth-grade math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO during the 2021-2022 school year.

Significance of the Study

Since 2004, the rising demand for virtual schools has continued to rapidly grow (Hart et al., 2019). The results of this study might benefit not just Colorado education but schools across the nation as effective models of virtual schools are needed to meet educational demands effectively. Virtual schools with and without EMOs present differences in the curriculum, platform, and instructional strategies (Bulkeley, 2003). The results of this study could inform district leadership who choose to either partner with EMOs or create their own virtual school resources about the academic data of the two virtual school models. Also, virtual school leaders and EMOs might be better informed and should seek to improve based on the findings of this study.

Public policy for virtual schools might be more informed with this study. Currently, laws are passed for public schools and applied to virtual schools by default; with a better understanding of virtual schools, more informed and specific laws could be enacted. With the growth of virtual schools over the last decade, all states could potentially use this research to review current virtual school-specific policies. Since the most recent CDE (2010) review of virtual schools was more than 10 years old, this research can assist CDE leaders with a more thorough analysis of recent academic data and inform CDE practices specific to virtual schools.

Parents reviewing virtual school options might better understand virtual school quality based on the results of this study and make better-informed education decisions for their student's schooling. Colorado students will be better informed about the school choice options and make decisions about education options based on personal academic goals. More informed parents and students can increase the benefits of school choice for all.

Delimitations

Lunenburg and Irby (2008) identified delimitations as the boundaries a researcher imposes on the research to set a specific scope for the study. This study was completed with the following delimitations:

1. The study was limited to third-, fourth-, and fifth-grade students enrolled in 16 Colorado virtual schools.
2. The study was conducted solely using ELA, reading subtest, and math scores on the CMAS.
3. This research was focused on 10 full-time virtual schools with EMOs and six

without EMOs. It does not account for blending learning or virtual education in traditional classrooms to account for the vastly different ways students can learn virtually without fully attending a virtual school.

Assumptions

As defined by Lunenburg and Irby (2008), assumptions are the premises that a researcher accepts for the sole intent of the research. The following assumptions were made concerning this research study:

1. Students participated in the CMAS at all the virtual schools reported in the study.
2. Students performed to their best effort on the CMAS.
3. Teachers administered the CMAS assessments in a standardized manner.
4. Student enrollments were recorded without error.
5. Students were enrolled full-time in virtual schools throughout the school year from which data were analyzed.

Research Questions

The research questions are provided to guide the analysis of the 2021-2022 CMAS scores for virtual education students. The questions direct the analysis of the data for students in Grades 3-5 regarding the performance on each subject portion of the CMAS.

RQ1

To what extent is there a difference in Grades 3-5 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO?

RQ2

To what extent is there a difference in Grades 3-5 reading subtest scores of ELA assessment achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO?

RQ3

To what extent is there a difference in Grades 3-5 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO?

Definition of Terms

The definitions below are articulated for the relevant terms important to understanding this study. The researcher used these definitions to focus on the variables in this study. The terms are specific to virtual education and the operational structure of relevant schools.

Blended Learning

A working definition of blended learning, as outlined in 22-5-199, C.R.S., is “a formal education program through which a student learns at least in part through digital content with some element of student control and at least in part a supervised physical location that is not the student’s home” (CDE, 2022, p. 1).

EMO

Western Michigan University (2022) defined EMO as a company or organization that operates one or more schools, partially or fully utilizes public funds, and provides a public education as directed by state law for public schools. EMOs can be either for- or not-for-profit entities.

Learning Platform

The Lorman Team (2021) defined a learning platform as one that digitally delivers education content in addition to various tracking and reporting capabilities. A learning platform also houses student information and provides data management and analysis.

Virtual Education

CDE 2022 defined virtual education in Colorado as a school that uses digital content completely under the student's control, with teacher supervision and instruction provided digitally. The student participates in a physical location that the school does not provide (CDE, 2022).

Organization of the Study

In summary, this study is a quantitative research study designed to analyze the 2021-2022 assessment data for online public schools operated both with and without an EMO. Covered in Chapter 1 were the purpose of the study, the statement of the problem, the significance of the study, the delimitations and assumptions, the research questions, and the definition of terms. In Chapter 2, a review of the current research regarding the focus of this study is included. In Chapter 3, the methodology utilized in the study is presented. The results of the study are included in Chapter 4. Chapter 5 provides a study summary, findings related to the literature, and conclusions.

Chapter 2

Review of the Literature

In this chapter, an analysis and summary of the available research on the topic of this study are provided. The research compiled focuses on studies that compare virtual schools with brick-and-mortar schools. Additionally, research that compares schools with and without EMOs is reviewed. The limitations of the studies, as presented by the research, and the gaps in the literature are also discussed. The analysis of the available research provides evidence of the need for further study of the topic.

The Evolution of Virtual Schools and EMOs

The section below reviews the currently available research for understanding the evolution of virtual education and the growth and expansion of this education option. Additionally, operating models available to K-12 online schools are reviewed within the available research. Finally, the current research regarding vendors available for schools to purchase K-12 online services is discussed to understand how options for operating models have expanded with the popularity of virtual education.

Post the COVID-19 pandemic, online education is no longer a term any K-12 school parent or student is unfamiliar with understanding. However, full-time virtual education has existed as a schooling option for students who have chosen to attend school online for many decades, not just since the COVID-19 pandemic. In the last two decades, full-time virtual schools (online or cyber schools) have grown in popularity, with fast expansion beginning in 2010 (Molnar et al., 2015). The Virtual High School (VHS) was the first online collaborative of multiple high schools to expand course offerings to students through technology; VHS was founded in 1995 and launched classes for students in 1997 (Watson & Murin, 2014). The early expansion of online schools included the grant-funded launch of the Florida Virtual School (FLVS) in 1996 and the tuition-funded Dakota Interactive Academic Link consortium in the same year (Watson & Murin, 2014). FLVS became a fully funded public statewide virtual school in 2003 and operated as such in 2022. The initial opening of virtual schools occurred in the 1990s and early 2000s but has since continued to grow.

Statewide virtual school options have grown in popularity since FLVS began. During the 2015-2016 school year, 24 states offered students education through a state-supported virtual school (Evergreen Education Group, 2017). Of the 24 schools, only five had fewer enrollments for the 2015-2016 school year than for the 2012-2013 school year (Evergreen Education Group, 2017). This growth demonstrates that states which utilize tax dollars to offer public online education continue to grow with the overall expansion of virtual education. However, state-supported virtual schools often have large enrollments of brick-and-mortar students. The majority, 84%, of the enrolled student data for the 2015-2016 school year indicated that state virtual schools provided supplemental courses for high school students rather than a full-time online program (Evergreen Education Group, 2017). Thus, the statewide virtual schools appear to leave a gap in the need to serve families seeking a full-time virtual school education.

The growth in popularity can be viewed from the lens of year-over-year expansion; Molnar et al. (2019) discussed that the enrollments in virtual schools from 2016-2017 to 2017-2018 increased by over 2,000 students. Another example of the growth in popularity can be demonstrated by enrollment data for FLVS, which reported an enrollment of 5,300 students in 2013-2014 and 13,840 students in 2021-2022 (Watson

& Murin, 2014; US News and World Report, 2022). While the growth in popularity throughout the 2000s expanded the options for online school, the onset of a nationwide pandemic in 2020 exposed all students to the option of full-time virtual school enrollment. During the pandemic, Florida online schools enrolled over 19,000 students during the 2020-2021 school year, Wisconsin online schools expanded by 84%, and Colorado online district schools reported large increases in enrollment (Erwin, 2021). During the 2021-2022 school year, brick-and-mortar schools returned to face-to-face or blended instruction, and it was expected that the expanded populations of virtual schools would decrease significantly. However, while enrollments did decrease with schools returning to business as usual, many students enrolled for full-time virtual education (Erwin, 2021). To keep up with the demand, virtual schools have continued to open; 33% of all public schools in the United States are now a virtual online option for full-time students (National Center for Education Statistics, 2022).

Online school enrollments have primarily grown in EMO-operated virtual schools during both the pre-and post-pandemic growth of virtual education. In 2003-2004, EMO-operated virtual schools served less than 20,000 students; by the school year 2011-2012, EMO schools served more than 145,000 students (Miron et al., 2013). Thus, online school enrollment increase has mostly been felt by virtual schools with an EMO. Student enrollment is not the only entity that has grown; the available EMO schools also grew during this time. Data indicate that in 2009-2010, there were 60 EMO-online schools, and in one year, this grew to 91 EMO-online schools fully operational during the 2010-2011 school year (Molnar et al., 2013). The growth of EMO-online schools expanded into the second decade of the 2000s. EMO-operated virtual schools in 2017-2018 enrolled, on average, 1,345 students, whereas non-EMO schools enrolled, on average, 320 students (Molnar et al., 2019). The pandemic-era growth of full-time online schools was maintained throughout 2021-2022 despite the public sentiment that enrollment would decline; this maintained growth was most strongly experienced by EMO schools (Molnar et al., 2021). This impact is evidenced further by the data that highlights the EMO- virtual schools contain more than half the student population of online students in the United States (Molnar et al., 2021).

With the expansion of virtual education and organizations that serve or manage them on the rise, there is more scrutiny of the effectiveness of virtual education for students. The literature on effectiveness is present, yet lacks the depth and amount of research in comparison to education organization research for face-to-face education or any amount of the research present for comparisons of face-to-face education. The present literature provides an incomplete and confusing picture; thus, society still lacks a clear picture of virtual school performance.

Student Performance in Virtual Education

Education institutions exist solely for the growth and development of the attendees. From preschool to higher education, the purpose is measured in outcomes related to the students’ social, emotional, and academic growth. The academic outcomes of educational institutions have provided consistent data and comparative markers for the judgment of the effectiveness of the institution over the years of institutions existing. When identifying the success of virtual education, the comparison of academic outcomes has been the primary focus of the research.

Comparison of Virtual Education Student Data and Brick and Mortar Student Data

With the evolution of virtual schools, the academic performance of virtual school students has been a topic of research. Researchers are working to identify if the schools are successful. If success is determined, researchers attempt to ascertain what factors contributed to the success of these schools.

Little research is available to understand the overall academic performance of full-time virtual schools across the nation currently and over the history of virtual schools (Molnar et al., 2019). Barth (2014) discussed the lack of available data and research with the criticism that available data is specific to individual schools, small pockets of schools by region, and not completed by researchers but rather by the media. This argument is furthered by the limitation that, due to the media serving as researchers, the research has been published in varying formats, making it difficult to know the full scope of the available research (Arnesen et al., 2019). Without a full understanding of available virtual school performance data or the qualifications of the researchers, it is still unknown how academic data across virtual schools compare.

Of the available research, the results across the years of virtual school existence are analyzed to determine success trends and strategies that support better student outcomes. Wang and Decker (2014) analyzed all Ohio full-time virtual schools and the student academic outcomes from 2007 to 2011; the researchers discussed the large growth in enrollment of full-time virtual schools throughout the years, but the lack of available data to understand the school's success. Of available data, the virtual schools performed lower than their brick-and-mortar counterparts, by significant amounts, in relationship to state test scores and graduation rates (Wang & Decker, 2014).

A review of the available research from the 1990s and the first decade of the 2000s included the analysis of all full-time virtual schools concerning academic performance. Barbour and Reeves (2009) criticized the student success of full-time virtual school students concerning state test scores and graduation cohort rates. Student academic success on state tests was criticized in comparison to the high pass rates of students of brick-and-mortar student counterparts (Barbour & Reeves, 2009). This data and the lack of available comparison data for student academic success have led to questions about why virtual schools continue to expand without more understanding of the student's ability to succeed academically (Barbour & Reeves, 2009; Wang & Decker, 2014).

More recent analyses of virtual school student performance are still difficult to locate despite calls for a better understanding of academic performance by researchers in the early 2000s. Virtual schools were criticized in a recent version of the annual report on virtual schools published by the Department of Education (Molnar et al., 2019). In the report, the 2017 and 2018 student performance data are reviewed based on the state report card for each school; the largest concern the researchers discussed is that scores were only issued to 44% of the virtual schools in both years, with the missing 56% of data being unreported due to frozen report cards or state policy for virtual school accountability (Molnar et al., 2019). The report further notes criticisms of virtual schools based on the available data. Specifically, only 52% of full-time virtual schools met the benchmark for acceptable performance based on the state accountability rating (Molnar et al., 2019).

Despite reported poor academic performance appearing in the state report card analysis, the results of the Spitzer and Musslick (2021) study indicated that state virtual school student performance was better than their brick-and-mortar peers. During the COVID-19 pandemic, when most students were educated online, an analysis of student course performance in math was completed in Germany (Spitzer & Musslick, 2021). The researchers analyzed student performance on homework and assessment responses and focused on students who participated in virtual education with the same curriculum and on the same learning platform. When selecting courses to analyze, the researchers chose a research method that would only compare similar courses to study consistency in the student experience for math courses online, thus ensuring the experience of the student did not skew outcomes. Spitzer and Musslick (2021) also compared students who used the learning platform before and after the pandemic. The analysis of these two groups of students provided a model of performance data for both established and new online students. Spitzer and Musslick (2021) found that students were more successful on math homework and assessments in the virtual environment across both pre-and post-pandemic users than in person.

The math course research is a recent example in the literature demonstrates elements of success in virtual school course performance. However, course performance data of virtual schools have been analyzed for many years. Bigbie and McCarroll (2000) completed a review of FLVS course data and found that over half of the students enrolled at the end of the course scored an A in their course, with only a 7% course failure rate. Additional analysis of student performance in FLVS found that online students outscored brick-and-mortar peers on an assessment of algebraic understanding (McLeod et al., 2005). Additionally, a review of online schools nationwide found no difference in course performance based on the school operating model (Barbour, 2010). Course performance and algebraic understanding are not the only areas where FLVS students outscored brick-and-mortar peers in high-stakes testing; the Advanced Placement exams show more favorable scores for FLVS students than brick-and-mortar students (Evergreen Education Group, 2017). Students are thus performing well in courses and on some comprehensive exams, but schools are critiqued for lack of ability to show student success in each state's expected academic framework.

With the poor performance of virtual schools on display on state report cards yet not in daily academic performance or other end-of-course assessments, questions persist about the true student academic performance in online schools. Barbour (2018) compiled the available research and trends in virtual education. The research on the student population who attend virtual schools was a notable aspect of the study (Barbour, 2018). Students have chosen to attend and stay enrolled in the statewide public virtual school rather than the local brick-and-mortar option (Barbour, 2018). The FLVS course data of a 7% failure rate was further attributed to the 25-50% of students who dropped out of a course before completion (Bigbie & McCarroll, 2000). Cavanaugh et al. (2005) published a similar finding of high course performance attributed to the high dropout rate of virtual students. The findings suggest that students may perform better than brick-and-mortar peers due to students who struggle in virtual school opting to leave the school if they are failing. In his study, Barbour (2018) concluded that the selectivity allowed to virtual school students accounts for high course performance yet poor state report card results of online schools.

Barbour's conclusion of selectivity of enrollment is echoed by Kennedy and Ferdig (2018) in their comprehensive study of available online research. The challenge of comparative qualitative studies for full-time virtual and brick-and-mortar students has been partially due to the issue of greater attrition in full-time virtual schools (Kennedy & Ferdig, 2018). The option to quickly withdraw from virtual schools creates a need for in-depth and complex studies to be created by researchers to attempt to understand the academic performance of virtual students (Kennedy & Ferdig, 2018). The compounding factor of continuous enrollment is only one of the many factors limiting available comparative research.

The selectivity of enrollment is not the only contributing factor to student performance in online schools, as mandated state assessment attendance is also selective (Barbour, 2018). Students are not in a building every day where assessments can be built into the daily schedule, but rather, parents must attend to assessments on the scheduled day and time that is not in the family's normal daily schedule. Selective assessment participation has been evident for many years in online schools, as Ballas and Belyk (2000) found in the early years of online schools. Ballas and Belyk (2000) found that online students participated in assessments at a rate of 65-75%, while brick-and-mortar students participated at a rate of 90-96%. This trend has continued as online schools have grown. In Oklahoma, 91% of students participated in 2020-2021 assessments, but participation rates of online schools ranged from 31-83% across schools (Slanchik, 2021). Without comparable participation rates between brick-and-mortar and virtual school students, the question remains of validity in the comparison of the results between the two.

The studies which compare brick-and-mortar and online learning have not been comprehensive or published by education researchers in a large scope (Barbour, 2018). With further analysis of current research, Barbour (2018) questioned if there are any conclusions regarding online student performance. The learning format may not determine student success but rather the profile of an online learner and the curriculum and teaching methods (Barbour, 2018).

The profile of a learner as the rationale for potentially poor student results in online schools has been echoed by other researchers. Topin and Topin (2016) published 17 questions that families should ask before enrolling students online because the study data indicated that a self-motivated and independent learner is key to online student success. The motivation level of a learner and parent selection to engage are not the only factors that research has shown impact virtual school performance.

Chingos and Schwerdt (2014) indicated that the demographic profile of a learner is crucial to comparing student success. In their study, FLVS students were found to be comparably successful to brick-and-mortar peers when the pre-high-school characteristics of students were considered (Chingos & Schwerdt, 2014). If students are thus compared on a level playing field, the success rate of virtual schools is not dismal as other results indicate. Chingos and Schwerdt’s results are supported by a Pearson (2018) efficacy report. Pearson (2018) reviewed student success in virtual schools with student mobility accounted for, and the results were that the success of virtual schools on state accountability has been comparable to that of brick-and-mortar schools.

Comparison of Student Virtual School Performance Across Virtual Schools

While the studies supporting virtual schools provide insight into the path forward for research regarding virtual school success, more work must be done to understand fully how virtual schools can be effective. The current research comparing online school performance to one another is lacking. True success cannot be ascertained without comparing data among schools with similar characteristics.

The term online learning is difficult to define with the variety of online learning models available by state. This challenge has led to an inadequate literature base of online school comparison (Curtis & Werth, 2015). Additionally, available research used by policymakers to create K-12 online education policies has often been conducted with older students in post-secondary environments (Dixson, 2010; Hung & Zhang, 2008). The little research available for online learning environments for K-12 schools makes understanding teacher preparation and need difficult to understand thus, leading to less insight into successful teaching practices (McAllister & Graham, 2016). The lack of clarity around online schools and the available research has made data comparisons and best practices among online schools difficult to ascertain on a large scale.

The terminology is not the only challenge in comparing online schools against one another, as oversight and standards vary greatly by state (Watson, 2021). While this is true of brick-and-mortar education standards across states, the nuances of virtual schools compound the issue. Some states regulate the vendors available to online schools, and other states allow all vendors access to sell in the state (Watson, 2021). Other state variables that impact the ability to compare virtual schools include the staffing plans of virtual schools; for example, some states allow part-time and adjunct educators while others do not (Watson, 2021). The nuances of virtual schools are not only limited to state regulations of virtual schools, but also the level of approval states require (Clark, 2016). While states may appear to have comparative approval standards for online course providers, there may be nuances in the level of approval required (Clark, 2016). Additionally, evaluation processes may vary by the region or population of students served in a state (Clark, 2016). Brick-and-mortar schools are not afforded the same flexibility or standards across states. These variables, compounded with state accountability frameworks and the wide variety of operating model options, continue to compound the limited comparative research available regarding virtual school performance.

Gulosino and Miron (2017) compared 121 virtual schools in an attempt to identify trends among operating models of schools. Related to state assessment results of the analyzed schools, only 22 (18.18%) outperformed the state average (Gulosino & Miron, 2017). Additionally, in schools with nonprofit EMOs, five of the 10 schools (50%) reported results above the state average, while six of the 26 (16.84%) district schools outperformed the average, and for-profit EMO schools reported a similar average as district schools with an average of 16.67% (Gulosino & Miron, 2017). Provided in the study were comparative data regarding graduation rates for virtual schools with an overall assertion that all online and blended school graduation rates were less than half of the national average (Gulosino & Miron, 2017). Specific graduation rate data for online operating models provided evidence that schools with nonprofit EMOs had the highest on-time graduation rate, 50.1%, which was still below the national average of 81%, and the district-operated schools had rates similar to for-profit-EMO schools with an average directly below 41% (Gulosino & Miron, 2017). The trends discussed in this study were limited based on published and available data. Gulosino and Miron noted the availability of published academic data for online schools as a study limitation. This study provided one look into the comparison of online schools but is one of few available studies.

In conflict with Gulosino and Miron (2017), who determined that nonprofit EMOs were the most successful in producing student results, is the result of Erwin (2021), who provided evidence that the EMO of a school was not what impacts success but rather the difference between charter and non-charter schools. Erwin (2021) found that charter schools were less successful than online schools run by districts, regardless of if the district contracts an EMO. Additional post-pandemic review of virtual schools and brick-and-mortar virtual schools indicated that virtual schools with experience, which are often the EMO-based schools based on the student population data cited above, outperform brick-and-mortar attempts at virtual learning (Kingsbury, 2021). Experienced virtual schools provide more opportunities for students to actively learn, have more family communications, and better engage students (Kingsbury, 2021). Erwin (2021) and Kingsbury (2021) published studies whose results conflict with Gulosino and Miron in relationship to the model of the EMO operator as the driver of success. Erwin (2021) and Kingsbury (2021) provided evidence that the experience and operating model of the school impact results. Thus, research is inconclusive and largely lacking in providing a clear picture of student success in virtual schools, as there are many models for and nuances of virtual schools.

Trends in Online School Research

A few trends among online school practices can be noted in the available research. The student-to-teacher ratio is higher in virtual schools than in brick-and-mortar schools, with virtual schools reporting almost double the class size of brick-and-mortar schools (Gulosino & Miron, 2017). Of the teacher ratios in online schools, for-profit-EMOs reported the highest ratio with a 44:1 average ratio, and schools with nonprofit EMOs reported the lowest with an average ratio of 19:1 (Gulosino & Miron, 2017). However, there was no analysis of ratios for EMO schools compared to non-EMO online schools offered in the study.

Another notable trend was the lack of understanding regarding teacher preparatory program needs to develop appropriately for the online environment. McAllister and Graham (2016) discussed this in a study on the lack of available resources to understand virtual schools. McAllister and Graham (2016) found that only nine states offered online teacher preparatory programs, and the license requirements for online educators were predominantly not outlined by each state. The requirements for a preparatory program for online teachers were also in question and were unclear. The expectations of online educators continue to grow, yet the understanding of how to train teachers for the unique environment is still in question (Kennedy & Ferdig, 2018). The need for a field experience component of online teacher preparatory programs has not been explored in-depth and is recommended from researchers' analysis (Archambault & Kennedy, 2014). Without trends noted among virtual schools of effective teacher practices, the ability to design teacher preparatory program standards has yet to be standardized in the same manner as brick-and-mortar teacher preparatory programs.

To address the teacher preparatory need, further analysis of content, tools, and technology would be needed to create a pedagogical framework for teachers to provide a quality preparation plan (Dawson & Dana, 2014). Moore-Adams et al. (2016) completed an attempt at developing this framework, but this attempt has not been further studied by other researchers. The confusion about the need for a preparatory program also expands into a lack of research for online teacher mentoring programs (Dawson & Dana, 2014). The lack of trends and conclusive research leaves teacher preparation needs as one of the trends of online student performance data clearly in need of addressing.

Best Practices for Online Educators

With the trends of online schools largely demonstrating a lack of comprehensive research, the best practice areas for online schools are still developing. The best practice area with perhaps the most discussion among online schools is related to course design standards for all online schools. This work was originally done by iNACOL as the leader of online school research. In the study about the iNACOL standards development process, online educators were provided a platform to collaborate on the process for national standards (Adelstein & Barbour, 2017). The collaboration led to broad quality standards for online course design provided to all educators by iNACOL in 2011, and Quality Matters created other standards in 2014 (Adelstein & Barbour, 2017). However, the broad scope of the 2011 standards and the proprietary-only access of the 2014 standards led to a starting point that has yet to be fully developed or agreed upon by most online schools (Adelstein & Barbour, 2017).

This criticism has been addressed by the 2017 Quality Matters collaboration with the Digital Learning Collaborative. On the National Standards for Quality website, the organizations have provided standards for online teaching, programs, and course design for all professionals (Quality Matters, Virtual Learning Leadership Alliance, & Digital Learning Collaborative, 2023). These standards are criticized for the broad scope of applicability available in the standards (Lowenthal & Hodges 2015). Additionally, the standards provide a three-step method for application but are criticized as not clear on how best to apply the standards nor the best practices supporting the standards (Lowenthal & Hodges, 2015). The standards are not perfect but are the best the online schools currently have available to operate from based on the limited, non-proprietary, available research.

A comprehensive literature review of the available research on K-12 online schools found clear evidence that online schools are growing rapidly (Arnesen et al., 2019). This finding is supported by other comprehensive literature reviews (West, 2016). However, this was the only identified theme in the literature, which is not useful in creating inferences or noting trends of success. In addition, the literature is largely theoretical (40%), with interpretive and inferential articles growing rapidly (Arnesen et al., 2019). This increase in inferential and interpretive articles may lead to more understanding of school trends, but the research is lacking. Of available distance learning research, the focus is not predominantly focused on K-12 focused rather on the collegiate or hybrid education models (Arnesen et al., 2019; Barth, 2014). A final criticism of the research is that it is not concentrated in any set of journals or publications, which creates less ability to discern trends in the research (Arnesen et al., 2019). The comprehensive literature reviews highlight the need to continue researching K-12 online school student success.

Education Management Organizations' Rationale for Partnership

Numerous for-profit and nonprofit EMOs operate public virtual schools, some of which are only provided in one state and others which are provided nationwide. Two specific for-profit EMOs, Stride Learning (K12 schools) and Pearson (Connections Academy Schools), operate many of the statewide public virtual schools in the United States. The two tout similar benefits and rationale for partnership when charter boards or districts seek full-time virtual school implementation.

Stride Learning (2023) focuses on the breadth of curriculum available to students in their virtual schools and that the curriculum is aligned and regulated for consistency. Additionally, the curriculum is focused on career readiness and creating the opportunity for students to have a personalized education plan (Stride Learning, 2023). The support for teachers through comprehensive training and technology integration is presented as one of the top determining factors boards and districts partner with Stride Learning (2023). Pearson Virtual Schools (2023) also noted the ability to support educators, provide powerful technology, and offer students a large course catalog as the rationale for partnership. The support for boards and district leadership during school startup and operation is also noted (Pearson Virtual Schools, 2023). Both companies have promoted ease of implementation for districts with a customized turnkey solution for creating a virtual school.

In addition to the operational ease rationale for partnership, the two EMOs celebrate outcomes from the schools that they operate. Both EMOs have published parent satisfaction results as a data point that models their success (Pearson Virtual Schools, 2023 & Stride Learning, 2023). Additionally, Stride Learning (2023) publicizes the scholarship dollars earned by students annually, and the number of underrepresented students served in their schools. Pearson Virtual Schools (2023) published the acceptance rate of students to postsecondary institutions and their number of BESSIE and Tech Learning Awards as outcomes to celebrate.

Both EMOs provide the rationale for districts and boards to choose a partnership and for parents to opt for enrollment. However, neither focus marketing on promoting the academic outcomes of students that are represented on state accountability frameworks across the nation. The ability to know if parent satisfaction, ease of school implementation, and wide body of curriculum thus, create student success is still not understood.

An analysis of the comparative EMO and non-EMO academic outcomes studies is limited even when the virtual element is removed. One of the brick-and-mortar comparison studies was completed by Gilblom and Sang (2020), who provided comparative research of Ohio Charter Schools that were or were not operated by an EMO. The study analyzed the closure rate of schools as the marker of school success and focused on schools across Ohio in large urban areas. Gilblom and Sang (2020) concluded that schools operated by either a for-profit or nonprofit EMO are less likely to close than standalone district schools. The researchers highlighted that the potential rationale for this is the extensive support an EMO can provide a school for training, curriculum, and operations that standalone schools cannot access (Gilblom & Sang, 2020).

Mac Iver and Farley-Ripple (2007) also researched brick-and-mortar schools with EMOs and those without EMOs in a study focused on middle school math achievement results of students in Philadelphia schools. The results of the study demonstrated minimal achievement differences among students across the schools (Mac Iver & Farley-Ripple 2007). The one element that minimally impacted student results was the length of time the school was in operation. The established schools had students who slightly outperformed students in newer schools (Mac Iver & Farley-Ripple 2007). The researchers concluded that there was no evidence of an operating model significantly impacting the academic achievement of students in the study.

Interestingly, the results of both Gilblom and Sang (2020) and Mac Iver and Farley-Ripple (2007) support the rationale for the partnership between Pearson Virtual Schools and Stride Learning. The consistent implementation and ongoing support of an EMO meet a need in school startup, which can aid the length of time a school can stay in operation (Gilblom & Sang, 2021). The length of operation can then demonstrate more academic success for schools as the school progresses in age (Mac Iver & Farley-Ripple, 2007). However, the researchers (Gilblom & Sang, 2021; Mac Iver, & Farley-Ripple, 2007) do not recognize virtual schools nor focus on the academic outcomes represented in academic accountability frameworks. Similar to the EMOs' rationale for partnership, the studies lack the analysis needed to understand if virtual schools with EMOs are academically successful per accepted accountability framework standards.

Michigan is one of the only states to attempt to understand academic performance, by state accountability framework, of K-12 virtual schools at the operating model level (Watson, 2021). The most recent iteration of the Michigan K-12 effectiveness study was completed in 2018, with four prior comparative studies completed. Freidhoff (2022) differentiated academic and enrollment data by school operating models. The schools are local education agencies (LEA), district-sponsored schools that are not partnered with an EMO, or a public-school academy (PSA), statewide schools with a charter board and an EMO. The schools were also compared to schools with full- and part-time enrollments (Freidhoff, 2022). For full-time virtual students, district (LEA) schools are responsible for the majority of the enrolled state's full-time learning population, with 80% of the available schools operating under this model (Freidhoff, 2022). However, the large number of district schools does not preclude the EMO (PSA) schools from having equal enrollment to the district schools, as both operating models are responsible for about 50% of the full-time enrolled population (Freidhoff, 2022). The researcher also provided data for intermediate school district (ISD) schools. ISD schools can either be district or charter-run but are only accountable for a small percentage of the full-time virtual school enrollment, as 0% of the overall full-time enrolled population is enrolled at a school operated by an ISD. Based on the enrollment data, the number of students across the district and EMO school operating models would be equal, thus making a comparison of the academic data perhaps more level (Freidhoff, 2022).

The academic performance data compared by operating model time was limited to course pass rates. Freidhoff (2022) found an overall course pass rate for district schools of 64%, while EMO (PSA) schools had a rate of 65%. No ISD data were reported for course pass rates, as too few student enrollments exist for these schools (Freidhoff, 2022). Course pass rates for both district and EMO schools rose from the 2019-2020 to the 2020-2021 school year (Freidhoff, 2022). Course pass rates rose at a much faster pace in district schools (22% higher in the 2020-2021 school year) than in EMO schools (7% higher in the 2020-2021 school year, which indicates the district schools are closing the course completion gap between the two operating models quickly (Freidhoff, 2022).

Freidhoff (2022) did provide comparative high school state assessment proficiency data for all virtual schools compared to brick-and-mortar schools. Of virtual learners, 49% were proficient on the reading and writing assessments compared to the 57% statewide proficiency rate (Freidhoff, 2022). In mathematics, 26% of virtual learners were proficient as compared to the state proficiency rate of 35% (Freidhoff, 2022). Full-time virtual students were proficient in reading at a rate of 66%, while part-time students were proficient at a 36% rate. In mathematics, full-time students reported a proficiency rate of 41%, with part-time enrollments reporting a proficiency rate of 20% (Freidhoff, 2022). The data were not separated by operating model. However, the data did provide insight into the potential success of full-time virtual schools compared to part-time virtual offerings by districts.

Friedhoff (2022) was one of the few researchers who undertook a comparative data analysis by school operating type and was not able to create clear distinctions between models to provide definitive data. Friedhoff (2022) acknowledged the study limitation by noting that schools are expanding schooling options under the same building codes, thus increasing the likelihood that some full-time virtual school data may stem more from a hybrid model. Additionally, the data for performance metrics, other than course completion, is not isolated by the enrollment model but is limited only to full- and part-time enrollment analysis. Additionally, of the available comparison, course pass rate, the data is only analyzed for courses students completed (Freidhoff, 2022). With only completed courses analyzed, the potential for course pass data to be skewed by students withdrawing from the school or dropping out is present.

With the noted limitations, Freidhoff's (2022) study is still one of the most comprehensive comparisons available to researchers concerning schools that offer full-time virtual school academic performance as provided by operating models. Freidhoff concluded simply that varying operating models can successfully offer virtual programs. This conclusion needs further analysis that stems from more than one comparative data point but is at least the beginning of a foundation for the virtual education-specific research field.

Summary

Provided in this chapter was a review of the available research related to the expansion of online schools over the last three decades and the continued expansion in the post-pandemic world. Additional research was analyzed comparing brick-and-mortar student achievement results with online student achievement results, which are unfavorable to online schools. The comparative research criticisms are also discussed. The chapter concludes with research related to the comparative data of online schools and the trends of successful online schools reviewed. The following chapter describes the research methods utilized in this study.

Chapter 3

Methods

The purpose of this chapter is to present the methods utilized to complete this study. The chapter includes an explanation of the selected quantitative research design and the independent and dependent variables. The chapter also provides detailed information about the selection of participants, the measurement, the data collection procedures, data analysis and hypothesis testing, and the limitations of the study.

Research Design

A quantitative causal-comparative research design was utilized in this study. A causal-comparative design was selected because two groups of third-, fourth-, and fifth-grade students were compared. With causal-comparative research, the independent variable is not manipulated because it has already occurred and cannot be controlled (Lunenburg & Irby, 2018). The independent variable used in this study was the management structure (with an EMO, without an EMO) of Colorado virtual schools. The dependent variables in this study were third-, fourth-, and fifth-grade student CMAS scores in ELA, reading, and math from the 2021-2022 school year.

Selection of Participants

The sample comprised students enrolled in Grades 3-5 in a fully virtual public school in Colorado. The selected virtual schools operated with one of two management structures: schools that had an EMO or did not have an EMO. A purposive sampling procedure was used to select the 10 EMO and six non-EMO Colorado virtual schools in the study. Purposive sampling is a sample selected based on the knowledge of the group sampled by the researcher (Lunenburg & Irby, 2008). A virtual school's Grade 3-5 student population data were included in this study if the following criteria were met:

1. The school served Grades Kindergarten-8 during the 2021-2022 school year.
2. The school operated as a public school during the 2021-2022 school year.
3. The school operated with the same management structure during the 2021-2022 school year.

Measurement

Scores from the ELA, reading subtest, and math portions of the CMAS were used to measure student achievement based on the overall average score for each grade level. The CMAS utilizes a vertical score scale known as the national standard score. The scale score allows for comparisons across the same grade levels by subject area but should not be used to compare student performance across grade levels (CDE, 2019a). ELA and math scores for all grade levels range from 650 to 850. The ELA test provides a separate reading scale score ranging from 110 to 190 (CDE, 2019a).

The CMAS ELA test is administered in three parts. Each part has a maximum time limit of 90 minutes. The ELA assessments for each grade level (3-5) include the areas of oral expression and listening, reading for all purposes, writing composition, and research inquiry and design. The math assessment is administered in three parts with a maximum testing time of 60 minutes for Grades 3-5. None of the math assessments allow for calculator use. The math test includes number and quantity, algebra and functions, data, probability and statistics, and geometry. The math, ELA, and reading subtest assessments include test items that are either selected or constructed response and are completed online.

Validity is the degree to which a specific instrument measures what it is intended to measure (Lunenburg &Irby, 2008). The CMAS has been tested for content and concurrent validity. Cronbach (1971) made the point that validation is the task of the interpreter.

> In the end, the responsibility for valid use of a test rests on the person who interprets it. The published research merely provides the interpreter with some facts and concepts. He has to combine these with other knowledge about the person he tests. (p. 445)

The steps in developing the CMAS are as follows: internal review by the Colorado Educator Development Committee, external review with the Colorado State Department assessment partner Pearson, Colorado Educator Development Committee item testing in classrooms, data review, and state legislative review for authorization of assessment.

The validity of the CMAS assessment data explanation is presented by CDE (2019a) in the *Mathematics and ELA Technical Report*. Construct validity is determined if an assessment measures what it was designed to measure. To ensure construct validity, the CMAS assessments were aligned with universal design standards to allow for accessibility by most students, the item development process included an internal item development plan with aligned test design expectations and accounted for attrition as committee review occurred, and the assessments were considered with the focus on the Colorado standards framework (CDE, 2019a). The gathering of construct validity evidence for all CMAS assessments is built into the assessment development process. The process steps included evaluation by bias and sensitivity experts, a variety of educators, and assessment specialists (CDE, 2019a). The process for ensuring construct validity equates to assessments that are free from bias, precise, and appropriate.

The CMAS ELA and math assessment developers utilize the classical test theory (CTT) framework to establish assessment reliability and estimate reliability based on the internal consistency method. In the CTT approach, the reliability coefficient is the proportion of the variance in observed scores that is accounted for by the variance in true scores (CDE, 2019a). The internal consistency method involves the same group of participants receiving a single test form to determine if participant responses are consistent on the items within the test. The Cronbach's coefficient alpha statistic is the estimate of internal consistency provided by CMAS from the spring 2019 administration to review test reliability (CDE, 2019a).

The coefficient alpha range is 0.0 to 1.0, with a value closer to 1.0 indicative of a greater proportion of observed score variance that is accounted for by variance in true scores. Internal consistency can be impacted by two elements: test homogeneity, if items are more often similar, participants are likely to respond with consistency across the assessment and the length of the test (CDE, 2019b). The coefficient alpha estimates are provided for the ELA, reading, and math assessment scores (see Table 3). The coefficients, which are all .84 and above, provide strong evidence for the reliability of the assessments.

Table 3

Cronbach Coefficient Alphas From CMAS Spring 2019 Administration

Content Area	Grade	Coefficient Alphas
ELA	3	.89
	4	.89
	5	.89
Reading subscale	3	.88
	4	.87
	5	.84
Math Assessment	3	.91
	4	.92
	5	.91

Note. Adapted from: *CMAS Mathematics and ELA Technical Report 2019-Tables* by Colorado Department of Education, 2019b. (https://www.cde.state.co.us/assessment/cmas-dataandresults-2019)

Data Collection Procedures

Prior to data collection, the researcher submitted a request to the Baker University Institutional Review Board (IRB) on January 18, 2023, for approval to conduct the study and utilize the archived data in the study. The IRB request was approved on January 18, 2023 (see Appendix). All CMAS data were obtained from the CDE online database. The data for the CMAS ELA assessments and math assessments scores were downloaded as separate Excel files for the school year 2021-2022 on December 22, 2022. The files were merged into one Excel file with a tab for Grade 3, 4, and 5 data.

Data Analysis and Hypothesis Testing

Data from the 2021-2022 CMAS ELA and math assessments were utilized to answer the three research questions in this study. Independent sample *t* tests were used to test each of the hypotheses. This section provides the research question, hypothesis, and data analysis explanation for each research question.

RQ1

To what extent is there a difference in Grades 3-5 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO?

H1. There is a statistically significant difference in Grade 3 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

H2. There is a statistically significant difference in Grade 4 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

H3. There is a statistically significant difference in Grade 5 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

Three independent-samples *t* tests were conducted to address RQ1. An independent-samples *t* test was chosen for the hypothesis testing because the hypothesis test involves the examination of the mean difference between two mutually exclusive independent groups, and the means are calculated using data for numerical variables. An average of the student scores on the CMAS ELA assessment was calculated for each

Colorado public virtual school. For each test, two sample means, calculated from the virtual school averages for schools with an EMO and those without an EMO, were compared. The level of significance for each test was set at .05. When appropriate, an effect size, as measured by Cohen's *d*, is reported.

RQ2

To what extent is there a difference in Grades 3-5 reading subtest scores of ELA assessment achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO?

H4. There is a statistically significant difference in Grade 3 reading subtest achievement, as measured by the ELA sub-test reading CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

H5. There is a statistically significant difference in Grade 4 reading subtest achievement, as measured by the ELA sub-test reading CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

H6. There is a statistically significant difference in Grade 5 reading subtest achievement, as measured by the ELA sub-test reading CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

Three independent-samples *t* tests were conducted to address RQ2. An independent-samples *t* test was chosen for the hypothesis testing because the hypothesis test involves the examination of the mean difference between two mutually exclusive independent groups, and the means are calculated using data for numerical variables. An average of the student scores on the CMAS reading sub-test of the ELA assessment was calculated for each Colorado public virtual school. For each test, two sample means, calculated from the virtual school averages for schools with an EMO and those without an EMO, were compared. The level of significance for each test was set at .05. When appropriate, an effect size, as measured by Cohen's *d*, is reported.

RQ3

To what extent is there a difference in Grades 3-5 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO?

H7. There is a statistically significant difference in Grade 3 math achievement scores, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

H8. There is a statistically significant difference in Grade 4 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

H9. There is a statistically significant difference in Grade 5 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

Three independent-samples *t* tests were conducted to address RQ3. An independent-samples *t* test was chosen for the hypothesis testing because the hypothesis test involves the examination of the mean difference between two mutually exclusive independent groups, and the means are calculated using data for numerical variables. An average of the student scores on the CMAS math assessment was calculated for each Colorado public virtual schools. For each test, two sample means, calculated from the virtual school averages for schools with an EMO and those without an EMO, were compared. The level of significance for each test was set at .05. When appropriate, an effect size, as measured by Cohen's *d*, is reported.

Limitations

Factors impacting the generalizability of study results or interpretations of the conclusions based on results are considered study limitations (Lunenburg & Irby, 2008). The researcher cannot control the conditions or outcomes of these factors. However, by stating the limitations of a study, a researcher can explicitly outline the boundaries of the study (Lunenburg & Irby, 2008). Limitations of this study included:

1. External factors such as motivation or attendance could impact student assessment achievement.
2. Student participation in the CMAS can vary by school as parent opt-out policies of each district vary.
3. Where the student was enrolled for most of the school year as opposed to the school where the student was assessed is unknown.
4. Teacher professional development related to standardized assessments may impact achievement scores.
5. Student experiences in the CMAS testing environment may impact student achievement data.

Summary

Chapter 3 included an explanation of the research design, the selection of participants, and the measurement. Additionally, the chapter included the data collection, data analysis and hypothesis testing, and the limitations of the study. Chapter 4 includes the descriptive statistics and the results of the hypothesis testing.

Chapter 4

Results

The purpose of this chapter is to present the analysis of the results of the study. The chapter includes the descriptive statistics and the results of the hypothesis testing. The chapter also provides the additional analyses that were conducted.

Descriptive Statistics

The data set utilized in the hypothesis testing was available through the CDE website. Of the data sets available, there was a lack of robust data to conduct the analyses for each hypothesis. There was no data available related to RQ2; therefore, H4, H5, and H6 could not be tested as planned. The ELA assessment reading test occurred, but the reading subtest scores were not published publicly nor sent to schools.

Hypothesis testing was able to be conducted for H1-H3 and H7-H9. However, the data sets available for the 10 EMO schools and the six non-EMO schools were not as robust as planned. The reason for this is because if a school had fewer than 16 students tested at a grade level, the data for the grade level was not provided, which hindered a full data set for analysis.

To access a more complete dataset, the individual schools were sent an email requesting access to individual student data with student-identifiable information removed. The study purpose and explanation of the need were provided to each school. Two of the 16 schools replied that they did not have the data, and 14 schools were not responsive. In addition to contacting schools, the researcher emailed the CDE Assessment Division Assessment Data Specialist and Student Data and Results contact.

In the email, the data for schools, which were missing data on the public document, was requested. The email included the communication that all student-identifiable information could be removed when provided. The Data Specialist provided a form to request the data through the data governance committee. The review by the formal committee denied providing the data as students could potentially be identified even with identifiable information being redacted.

As there were no other paths to accessing complete data sets, the analyses were conducted with the data available. The available data produced a small data set for each of the EMO and non-EMO groups but enough data to conduct testing for six of the nine hypotheses. As no data was published for the ELA assessment reading subscore, the related hypotheses were not tested.

Table 4 provides information for the CMAS ELA assessment. In the table, the number of schools included in the study design and the number of schools with a valid score for hypothesis testing are provided. The table includes the available scores by grade level as the hypotheses testing occurred by grade level and in both EMO and non-EMO schools.

Table 4

Number of Schools and Valid CMAS ELA Scores for Grades 3-5 in EMO and Non-EMO Virtual Public Schools

Grade	Schools	Valid Scores
EMO		
3	10	6
4	10	6
5	10	7
Non-EMO		
3	5	2
4	6	2
5	6	3

Table 5 provides information for the CMAS math assessment. In the table, the number of schools included in the study design and the number of schools with a valid score for hypothesis testing are provided. The table shows the available scores by grade level as the hypotheses testing occurred by grade level and is grouped in both EMO and non-EMO schools.

Table 5

Number of Schools and Valid CMAS Math Scores for Grades 3-5 in EMO and Non-EMO Virtual Public Schools

Grade	Schools	Valid Scores
EMO		
3	10	6
4	10	6
5	10	8
Non-EMO		
3	5	2
4	6	2
5	6	3

Hypothesis Testing

The results of the hypothesis testing are included in this section. Results were based on the 2021-2022 CMAS assessments. Each research question is followed by the description of the hypothesis testing, each hypothesis statement, and the results of the hypothesis testing for that hypothesis.

RQ1

To what extent is there a difference in Grades 3-5 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO?

Three independent-samples *t* tests were conducted to address RQ1. An independent-samples *t* test was chosen for the hypothesis testing because the hypothesis test involves the examination of the mean difference between two mutually exclusive independent groups, and the means are calculated using data for numerical variables. An average of the student scores on the CMAS ELA assessment was calculated for each Colorado public virtual school. For each test, two sample means, calculated from the virtual school averages for schools with an EMO and those without an EMO, were compared. The level of significance for each test was set at .05. When appropriate, an effect size, as measured by Cohen's *d*, is reported.

H1. There is a statistically significant difference in Grade 3 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

The results of the independent-samples *t* test indicated there was not a statistically significant difference between the two means, $t(6) = 0.578$, $p = .584$. The sample mean for Grade 3 ELA achievement in Colorado public virtual schools with an EMO ($M = 732.00$, $SD = 30.14$, $n = 6$) was not different from the sample mean for Grade 3 ELA achievement in Colorado public virtual schools without an EMO ($M = 719.00$, $SD = 8.83$, $n = 2$). H1 was not supported.

H2. There is a statistically significant difference in Grade 4 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

The results of the independent-samples *t* test indicated there was not a statistically significant difference between the two means, $t(6) = 0.700$, $p = .510$. The sample mean for Grade 4 ELA achievement in Colorado public virtual schools with an EMO (M = 735.50, SD = 19.78, n = 6) was not different from the sample mean for Grade 4 ELA achievement in Colorado public virtual schools without an EMO (M = 725.00, SD = 8.49, n = 2). H2 was not supported.

H3. There is a statistically significant difference in Grade 5 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

The results of the independent-samples t test indicated there was not a statistically significant difference between the two means, $t(8) = 1.631$, $p = .141$. The sample mean for Grade 5 ELA achievement in Colorado public virtual schools with an EMO (M = 746.14, SD = 17.52, n = 7) was not different from the sample mean for Grade 5 ELA achievement in Colorado public virtual schools without an EMO (M = 729.00, SD = 2.65, n = 3). H2 was not supported.

RQ2

To what extent is there a difference in Grades 3-5 reading subtest scores of ELA assessment achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO?

Three independent-samples t tests were planned to address RQ2. An independent-samples t test was chosen for the hypothesis testing because the hypothesis test involves the examination of the mean difference between two mutually exclusive independent groups, and the means are calculated using data for numerical variables. However, the CMAS results for the Grades 3-5 reading subtest scores of the ELA assessment were not available through the CDE. Therefore, the hypothesis tests for H4-H6 were not conducted.

H4. There is a statistically significant difference in Grade 3 reading subtest achievement, as measured by the ELA sub-test reading CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

H5. There is a statistically significant difference in Grade 4 reading subtest achievement, as measured by the ELA sub-test reading CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

H6. There is a statistically significant difference in Grade 3 reading subtest achievement, as measured by the ELA sub-test reading CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

RQ3

To what extent is there a difference in Grades 3-5 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO

Three independent-samples *t* tests were conducted to address RQ3. An independent-samples *t* test was chosen for the hypothesis testing because the hypothesis test involves the examination of the mean difference between two mutually exclusive independent groups, and the means are calculated using data for numerical variables. An average of the student scores on the CMAS math assessment was calculated for each

Colorado public virtual schools. For each test, two sample means, calculated from the virtual school averages for schools with an EMO and those without an EMO, were compared. The level of significance for each test was set at .05. When appropriate, an effect size, as measured by Cohen's *d*, is reported.

H7. There is a statistically significant difference in Grade 3 math achievement scores, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

The results of the independent-samples *t* test indicated there was not a statistically significant difference between the two means, $t(6) = 0.861$, $p = .422$. The sample mean for Grade 3 math achievement in Colorado public virtual schools with an EMO ($M = 724.17$, $SD = 27.53$, $n = 6$) was not different from the sample mean for Grade 3 math achievement in Colorado public virtual schools without an EMO ($M = 706.50$, $SD = 0.71$, $n = 2$). H7 was not supported.

H8. There is a statistically significant difference in Grade 4 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

The results of the independent-samples *t* test indicated there was not a statistically significant difference between the two means, $t(6) = 0.725$, $p = .496$. The sample mean for Grade 4 math achievement in Colorado public virtual schools with an EMO ($M = 723.00$, $SD = 17.51$, $n = 6$) was not different from the sample mean for Grade 4 math achievement in Colorado public virtual schools without an EMO ($M = 713.50$, $SD = 3.54$, $n = 2$). H8 was not supported.

H9. There is a statistically significant difference in Grade 5 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO.

The results of the independent-samples *t* test indicated there was not a statistically significant difference between the two means, $t(9) = 1.167$, $p = .273$. The sample mean for Grade 5 math achievement in Colorado public virtual schools with an EMO ($M = 726.50$, $SD = 18.92$, $n = 8$) was not different from the sample mean for Grade 5 math achievement in Colorado public virtual schools without an EMO ($M = 712.67$, $SD = 11.24$, $n = 3$). H9 was not supported.

Additional Analyses

The difference between the EMO and non-EMO scores was large for all grade levels in both subjects, but the test results indicated that the difference was not significant. The small sample of schools available for the *t* tests prevented the tests from detecting the significance of the difference. Therefore, additional analyses were conducted using weighted means and weighted standard deviations that considered the number of valid scores available for students from each virtual school. Table 6 and Table 7 below contain the number of students with valid scores. These numbers were used in the calculations of the weighted means and standard deviations.

Table 6 provides information for the CMAS ELA assessment. In the table, the number of schools included in the study design and the number of students in each school with a valid score for the additional analyses are provided by grade level. The analyses occurred by grade level and in both EMO and non-EMO schools.

Table 6

Number of Schools and Number of Students with Valid CMAS ELA Scores for Grades 3-5 in EMO and Non-EMO Virtual Public Schools

Grade	Schools	Number of Students
EMO		
3	10	226
4	10	269
5	10	295
Non-EMO		
3	5	56
4	6	63
5	6	67

Table 7 provides information for the CMAS Math assessment. In the table, the number of schools included in the study design and the number of students in each school with a valid score for the additional analyses are provided by grade level. The analyses occurred by grade level and in both EMO and non-EMO schools.

Table 7

Number of Schools and Number of Students With Valid CMAS Math Scores for Grades 3-5 in EMO and Non-EMO Virtual Public Schools

Grade	Schools	Number of Students
EMO		
3	10	224
4	10	267
5	10	314
Non-EMO		
3	5	56
4	6	63
5	6	65

The results of the tests are presented below for the difference in CMAS scores of students in Grades 3-5 for the ELA and math assessments between Colorado public virtual schools with an EMO and those without an EMO. To determine if there was a statistically significant difference in Grade 3 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO, an independent-samples *t* test was conducted using the weighted sample statistics. The results of the test indicated there was a statistically significant difference between the two means, $t(280) = 4.022$, $p = .000$. The sample mean for Grade 3 ELA achievement in Colorado public virtual schools with an EMO ($M_{\text{weighted}} = 740.35$, $SD_{\text{weighted}} = 34.43$, $n = 226$) was higher than the sample mean for Grade 3 ELA achievement in Colorado public virtual schools without an EMO (M_{weighted} = 718.93, SD_{weighted} = 35.98, n = 56).

To determine if there was a statistically significant difference in Grade 4 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO, an independent-samples *t* test was conducted using the weighted sample statistics. The results of the test indicated there was not a statistically significant difference between the two means, $t(330) = -0.666$, $p = .506$. The sample mean for Grade 4 ELA achievement in Colorado public virtual schools with an EMO (M_{weighted} = 735.23, SD_{weighted} = 29.83, n = 269) was not different than the sample mean for Grade 4 ELA achievement in Colorado public virtual schools without an EMO (M_{weighted} = 738.35, SD_{weighted} = 34.17, n = 63).

To determine if there was a statistically significant difference in Grade 5 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO, an independent-samples *t* test was conducted using the weighted sample statistics. The results of the test indicated there was a statistically significant difference between the two means, $t(360) = 4.937$, $p = .000$. The sample mean for Grade 5 ELA achievement in Colorado public virtual schools with an EMO (M_{weighted} = 745.81, SD_{weighted} = 26.11, n = 295) was higher than the sample mean for Grade 5 ELA achievement in Colorado public virtual schools without an EMO (M_{weighted} = 728.85, SD_{weighted} = 25.22, n = 67).

To determine if there was a statistically significant difference in Grade 3 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO, an independent-samples *t* test was conducted using the weighted sample statistics. The results of the test indicated there was a statistically significant difference between the two means, $t(278) = 4.681$, $p = .000$. The sample mean for Grade 3 math achievement in Colorado public virtual schools with an EMO ($M_{\text{weighted}} = 732.76$, $SD_{\text{weighted}} = 30.77$, $n = 224$) was higher than the sample mean for Grade 3 math achievement in Colorado public virtual schools without an EMO ($M_{\text{weighted}} = 706.54$, $SD_{\text{weighted}} = 39.00$, $n = 56$).

To determine if there was a statistically significant difference in Grade 4 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO, an independent-samples *t* test was conducted using the weighted sample statistics. The results of the test indicated there was a statistically significant difference between the two means, $t(328) = 3.165$, $p = .002$. The sample mean for Grade 4 math achievement in Colorado public virtual schools with an EMO ($M_{\text{weighted}} = 726.91$, $SD_{\text{weighted}} = 26.73$, $n = 267$) was higher than the sample mean for Grade 4 math achievement in Colorado public virtual schools without an EMO ($M_{\text{weighted}} = 714.25$, $SD_{\text{weighted}} = 28.95$, $n = 63$).

To determine if there was a statistically significant difference in Grade 5 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO, an independent-samples *t* test was conducted using the weighted sample statistics. The results of the test indicated there was a statistically significant difference between the two means, $t(377) = 4.487$, $p = .000$. The sample mean for Grade 5 math achievement in Colorado public virtual schools with an EMO ($M_{\text{weighted}} = 729.17$, $SD_{\text{weighted}} = 29.82$, $n = 314$) was higher than the sample mean for Grade 5 math achievement in Colorado public virtual schools without an EMO ($M_{\text{weighted}} = 711.48$, $SD_{\text{weighted}} = 28.74$, $n = 65$). These results contribute to understanding the difference in student academic performance between EMO and non-EMO virtual schools.

Summary

Chapter 4 included the descriptive statistics and the results of the hypothesis testing. Also presented in this chapter were the additional analyses completed with the data set. The following chapter includes a study summary, the findings related to the literature, and the conclusions.

Chapter 5

Interpretation and Recommendations

This chapter provides an overview of the study in which student achievement on the CMAS ELA and math assessments for Grades 3-5 students were analyzed. The students were enrolled in a full-time public virtual school that was or was not operated by an EMO. This chapter includes a study summary, findings related to the literature, and conclusions.

Study Summary

CMAS ELA and math assessment data from the 2021-2022 school year were utilized to determine the differences in academic outcomes across Colorado virtual schools with and without an EMO. The data were analyzed for students in Grades 3-5 who were enrolled in full-time public virtual schools in Colorado. The students attended a virtual school either operated by an EMO or not operated by an EMO. The data analysis tested the academic outcomes of the students, with the operating model (EMO or non-EMO) being the variable utilized. This section includes an overview of the problem, the purpose statement and research questions, a review of the methodology, and the major findings.

Overview of the Problem

Colorado virtual schools are criticized about student academic outcomes by the CDE and other researchers for consistently low performance each year (CDE, 2010; Barbour, 2016). Research is available that highlights brick-and-mortar student achievement as greater than that of virtual schools throughout the state. However, the comparison of brick-and-mortar student scores to that of virtual schools is not an equitable one. Paul and Wolf (2020) found that when accounting for student population demographics, brick-and-mortar and virtual school students perform the same. To analyze virtual school performance, virtual schools should be compared to one another rather than brick-and-mortar schools. Virtual schools use various operating models that may account for student achievement gaps, and exploring this data is needed to identify best practices for virtual school operations and allow parents, legislators, and the community to identify the best path forward for student enrollment in virtual schools.

Purpose Statement and Research Questions

The first purpose of this study was to determine if there is a difference in ELA achievement, as demonstrated on the CMAS assessment, between Colorado third- through fifth-grade public virtual students who attend schools with an EMO and those who attend Colorado public virtual schools without an EMO. The second purpose of this study was to determine if there is a difference in the reading subtest of ELA achievement, as demonstrated on the CMAS, between Colorado third through fifth-grade public virtual students who attend schools with an EMO and those who attend Colorado public virtual schools without an EMO. The third purpose of this study was to determine if there is a difference in Grades 3-5 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and those who attend Colorado public virtual schools without an EMO during the 2021-2022 school year. To address the purposes of this study, three research questions were posed.

Review of the Methodology

A quantitative causal-comparative research design was utilized in this study. The independent variable used in this study was the management structure (with an EMO, without an EMO) of Colorado virtual schools. The dependent variables were Grades 3, 4, and 5 student CMAS scores in ELA, reading, and math from the 2021-2022 school year. The participants were students enrolled in Grades 3-5 in a fully virtual public school in Colorado, either operated by an EMO or not operated by an EMO. Data for the CMAS ELA assessment and math assessment scores were downloaded from the CDE website for analysis. Independent sample *t* tests were conducted to test each of the hypotheses with the participant data found on the CDE website in December 2022. Additional analyses were conducted after the initial hypotheses test. The additional analyses tested the hypotheses using weighted means and weighted standard deviations and were calculated using the number of students with valid scores at each school.

Major Findings

The findings of the study were produced from the CMAS data analyzed for both RQ1 and RQ3. The reading subscale scores were not available through the CDE website and were not provided to individual schools; thus, the analysis for RQ2 could not be completed. The analysis results indicated there was not a statistically significant difference in the ELA achievement of students in Grades 3-5 in Colorado public virtual schools with an EMO and without an EMO. There also was not a statistically significant difference in the math achievement of students in Grades 3-5 in Colorado public virtual schools with an EMO and without an EMO.

The number of schools and available valid scores are included in Tables 4 and 5 (see pp. 48-49). The data demonstrate a substantial difference between the scores in both ELA and math. The difference in the means and the small sample size potentially influencing the results of the hypotheses tests led to additional analyses. Additional analyses were conducted using weighted means and weighted standard deviations that took into account the number of valid scores available for the students from each virtual school due to the small sample size of data. To determine if there was a statistically significant difference in Grades 3-5 ELA achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and students who attend Colorado public virtual schools without an EMO, independent-samples t-tests were conducted using the weighted sample statistics. The results of the tests indicated there was a statistically significant difference between the two achievement means for students in Grades 3 and 5. The sample mean for Grades 3 and 5 ELA achievement in Colorado public virtual schools with an EMO was higher than the sample means for Grades 3 and 5 ELA achievement in Colorado public virtual schools without an EMO. The difference in the sample means for grade 4 ELA achievement, as measured by the CMAS, between stunts who attend Colorado public virtual schools with an EMO and students who attend Colorado public virtual schools without an EMO was not statistically significant.

The results of the additional analyses also indicated that the differences in Grades 3-5 math achievement, as measured by the CMAS, between students who attend Colorado public virtual schools with an EMO and students who attend Colorado public virtual schools without an EMO were statistically significant. The sample means for Grades 3-5 math achievement in Colorado public virtual schools with an EMO were higher than the sample means for Grades 3-5 math achievement in Colorado public virtual schools without an EMO.

Findings Related to the Literature

Examined in this section are the study's findings as they relate to the literature regarding student academic outcomes for students enrolled in Colorado full-time public virtual schools that either operate by an EMO or are not operated by an EMO. There were difficulties comparing the current study to past research. At the time of the study, there was no identifiable educational research that compared public full-time virtual schools' academic outcomes nor research that compared full-time public virtual schools based on the operating model. This study provided a step in filling the gap for future research. Since no research exists in the literature concerning student outcomes for full-time virtual school students in EMO or non-EMO virtual schools, the findings from the current study could not be directly compared to any other studies.

The research regarding online charter schools that most closely mirrors this study was completed by Gulosino & Miron (2017). However, the findings of the current study cannot support or be in contrast to Gulosino and Miron's (2017) findings because those researchers studied the academic outcomes of both online and blended schools that were operated by either a for-profit EMO, a charter board, or nonprofit EMO, or a school district. Gulosino and Miron included academic outcome data from both blended and online models, which consider primarily brick-and-mortar school students with an online course enrollment rather than this study that focuses on only full-time virtual school students. Additionally, the researchers reviewed schools for academic success based solely on on-time graduation rates and considered private, charter, and public schools (Gulosino & Miron, 2017). Because Gulosino and Miron did not focus on students in primary grade levels nor on outcomes of academic assessments, the results cannot be compared. Gulosino and Miron (2017) concluded that charter boards, nonprofit EMOs, were the operators of virtual and blended schools producing the highest on-time graduation rate of virtual and blended schools. The researchers also concluded that EMO-operated schools performed comparably to district-operated schools (Gulosino & Miron, 2017). The current study did not review results for high school students, consider charter operators in the model, or account for blended learning. It is difficult to ascertain if the comparable results of EMO- and district-operated schools presented by Gulosino and Miron are representative of a result in opposition to the higher academic outcomes this study produced for EMO-operated schools. The similarity between Gulosino & Miron's study and the current study is that a lack of available academic data for virtual and blended schools is noted as a study limitation.

Erwin (2021) analyzed virtual school student performance by comparing the academic outcomes of virtual school students based on the school's charter or non-charter status. Erwin compared, as did the current researcher, only full-time online schools. However, the operator of the school was not considered in the comparison (Erwin, 2021). Rather, Erwin considered both full-time virtual schools operated by districts and those operated by EMOs as the same and focused the analysis solely on the charter status of the school. Erwin found charter schools to be less successful virtual schools than non-charter schools, regardless of the entity that operated the school. This study's findings demonstrated numerous factors that might impact virtual school performance, but there was no delineation of the operator when comparing academic results. Therefore, the results of the current study cannot be in support or in contrast to Erwin's results.

Kingsbury (2021) focused research on full-time virtual schools by comparing academic results across a span of virtual schools. Kingsbury considered all virtual schools equitably regardless of charter status and did not account for the operating model of the school in the study. Kingsbury concluded that the virtual schools with the highest student outcomes were those in operation the longest. Additionally, Kingsbury noted that schools operated by EMOs were likely to be in operation the longest. However, since Kingsbury did not test hypotheses specific to the operating model nor draw conclusions related specifically to the operating model, the results of this study cannot be found to support or contrast with its results.

The lack of available research specific to this study's topic does not allow for comparisons to be drawn between its results and the results of previous research. Researchers whose studies most closely align with the topic analyzed either all virtual schools or isolated schools related to charter operations, and the researchers did not draw conclusions not related to only the operation of the school by an EMO or not operated by an EMO. The researchers have conclusions that conflict with one another but none of the studies related to full-time virtual schools are the same in factors considered. However, the one similarity among the studies discussed in this section and Chapter 2 is that all cite a lack of available data related to full-time school student performance as a significant limitation to the topic (Erwin, 2022; Gulosino & Miron, 2017; Kingsbury, 2021).

Conclusions

This section presents the implications for action based on the results of the study. The recommendations for future research are offered for future researchers to continue the exploration of the study's topic. Finally, the concluding remarks provide an overview of the study's purpose and outcomes related to the intention of the work at the onset of the study.

Implications for Action

The findings of the study provide the public with more awareness of the impact an EMO may have on student academic results in a virtual school. Families and students may use the information to be more informed when selecting a full-time virtual school to attend. Families can also use the findings to determine if a full-time virtual school is the best flexible learning option for their students.

The study assists Colorado policymakers with access to more knowledge regarding the impact of an EMO on public full-time virtual schools and student performance outcomes. Colorado policymakers can use the study to guide school choice regulatory decisions as that state continues implementing guidance for virtual school operations. The need for further research is a present theme throughout the study which policymakers can acknowledge and use to determine public funding for future research related to the topic.

Finally, authorizers of virtual schools can utilize the findings to further explore operating models when either starting a school or renewing a contract to continue authorizing a school. Colorado districts who have previously partnered with an EMO can use the results as a guide to analyze student results in their own school prior to renewing a contract. Colorado districts that have operated virtual schools without the use of an EMO can utilize the study results to further explore EMO options and the academic outcomes of each EMO's individual success. There is more research needed on the topic as the small sample size of the study decreases the ability to draw clear conclusions on if the success of virtual school students is impacted by the operator of the school. However, the families, policymakers, and districts have more information for further explorations and the options relative to virtual school operations.

Recommendations for Future Research

Future research should be completed on the topic to better inform authorizers and operators of virtual schools as well as the public on how student success can be attained in the virtual school environment. Comparing schools across the nation to one another becomes increasingly more challenging as states produce their own standards and assessments and are granted waivers of federal regulations. Thus, to best continue this research, other researchers should conduct similar tests across the virtual schools in other states. Similar research in each state could then assist with assessing broader conclusions related to virtual school student success by region or nationwide.

Additionally, research could be conducted to analyze student success not related to state assessment scores. Researchers might compare student academic success in virtual schools with and without an EMO on each school's entire state report card. The state report card compares student achievement not only on standardized assessment but also in relation to graduation rate, social-emotional learning, and post-secondary success across most states. Since each state's report card is unique, this research should also be conducted in individual states to ensure fair comparisons are made. A comparison of schools utilizing the state report card data might allow for conclusions to be made from a broader set of data rather than one data point. The data set would not be solely reliant on student participation in assessments.

To compare schools across the nation, rather than by state, researchers can compare virtual schools on the ESSA targeted list for support. The ESSA guidelines require states to report the schools that perform in the lowest 5% of the state each year and identify the schools for comprehensive federal support (Office of Elementary and Secondary Education, 2023). An analysis of the annual ESSA support list could include identifying the percentage of schools on the list that are virtual schools and of the virtual schools that have EMOs. Comparing the EMO virtual schools with those that are not EMO operated and analyzing the reasons the schools are targeted for support can demonstrate changes in school success by operating models over the year. Thus, researchers could be provided with a more holistic picture of virtual school performance across the nation rather than individualized by state, as the ESSA standards are reported with a standard calculation nationally, even across states with waivers related to ESSA regulations (Office of Elementary and Secondary Education, 2023).

Future research that occurs in other states with the state assessment results for primary students might provide a comparison to this study with others that are similar. Further research of virtual schools based on report card data in other states can allow for a broader set of data to be included and expand the sample size as it is not reliant on assessment participation. To compare schools across states, research conducted on schools targeted for ESSA support is recommended.

Concluding Remarks

As more families need flexible schooling options, virtual school enrollment might continue to grow. Without the presence of clear quantitative research focused on EMO and non-EMO-operated virtual schools related to student academic success, families, students, and policymakers are not fully informed on how to select a virtual school or create legislation to best support students enrolled in the schools. This study begins the work needed to inform families and policymakers. Additionally, with this study, operators of Colorado virtual schools have more information to select an operating model for their virtual schools.

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Appendix

Appendix. Institutional Review Board Approval

Baker University Institutional Review Board

January 18th, 2023

Dear Amanda Adams and Susan Rogers,

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

Please be aware of the following:

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

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

Sincerely,

Nathan D. Poell

Nathan Poell, MLS
Chair, Baker University IRB

Baker University IRB Committee
Tim Buzzell, PhD
Nick Harris, MS
Scott Kimball, PhD
Susan Rogers, PhD