Virtual School Student Engagement and Mathematics Achievement a Quantitative Study: Does Monitoring Virtual School Student Engagement Impact Mathematics Achievement?

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Abstract

The current causal-comparative quantitative study examined whether weekly monitoring of student engagement throughout one semester impacted student achievement as measured by changes from pre- to posttest on student STAR™ Math Normal Curve Equivalent (NCE) scores for middle and high school virtual school students at one Florida Virtual School franchise (FLVS). A causal-comparative research design compared the changes in NCE scores by student engagement status to test whether significant differences existed between the means of students who were engaged and students who were not engaged. NCE growth data and teacher on pace data were utilized to conduct two independent individual sample *t*-tests on middle school student data, and high school student data respectively. The results of the independent sample *t*-tests indicated that both high school and middle school students at the participating school district who were consistently on pace throughout one semester of a mathematics course rendered a higher mean growth as measured by the STAR™ Mathematics NCE scores than did high school and middle school students who were not considered engaged. The results also indicated that virtual school students who were not consistently engaged did not achieve the same amount of growth as virtual school students who were consistently engaged.

Dedication

This dissertation is dedicated to my wife and two sons. I could not have done this without your support, humor, and sacrifices. Hopefully this accomplishment will be an inspiration to both Austin and Chase as they grow into young adults and set their own goals, dreams, and aspirations.

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It humbles me to think of the amount of time and emotional equity others have exhausted on my behalf, and to my benefit, throughout the doctoral program. Thank you to God for everything; thank you to my wife for your patience and emotional support; thank you to Austin and Chase for allowing me time to work, and being well-adjusted young men; thank you to my mom and dad for driving two hours every Wednesday night; and thank you to Dr. Justin Hawpe for providing color commentary, expertise, and insight in your role as class facilitator.

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Chapter 1

Introduction

Since the early 1990s, virtual schooling has grown from a novelty form of learning to a viable educational option for K-12 students (Bettinger & Loeb, 2017). The rise in Kindergarten through 12th grade (K-12) virtual schools has affected the educational landscape (Kim, Park, Cozart, & Lee, 2015). According to Bettinger and Loeb (2017), virtual school courses provide the potential to advance educational opportunities beyond the confines of brick-and-mortar classes, as well as create challenges for educational leaders, teachers, and stakeholders. Gulosino and Miron (2017) noted that enrollment in virtual school had increased rapidly since the early 1990s. Gemin, Pape, and Evergreen Education Group (2017) reported that by 2014, all 50 states offered some type of virtual education to K-12 students. Barbour (2017) summed up the growth by stating, “the use of online learning at the K-12 level has seen exponential growth for much of the past two decades” (p. 423).

The rapid growth in virtual schools and virtual school enrollment has outpaced the research and development necessary to meet challenges specific to virtual school students (Barbour, 2017; Bettinger & Loeb, 2017; Glass, 2009; Pazzaglia, Clements, Lavigne, & Stafford, 2015). According to Kim, Park, Cozart, and Lee (2015), the exponential growth created several challenges that were specific to virtual school students, teachers, and administrators, like accountability and student achievement. It was reported in 2015, that virtual school student engagement was a top challenge for school administrators and teachers (Gill et al., 2015; Zweig, Stafford, Clements, & Pazzaglia, 2015).

Gill et al. (2015) and Zweig et al. (2016) found in separate surveys that both district leaders and teachers view low engagement levels as their greatest challenge. Gill et al. (2015) and Zweig et al. (2015) reported in their respective research that the results indicated teachers and administrators perceived student engagement as the greatest obstacle to the success of virtual school students. Zweig et al. (2015) recommended further study on the impact of virtual school engagement as it relates to virtual school student achievement.

Reeves and Tseng (2011) and Woodward et al. (2015) each stated that more research was needed to fully understand how engagement impacts the achievement of virtual school students. Kim et al. (2015) and Lefkowitz (2015) argued a similar point by mentioning that a void in research on virtual school engagement strategies exists. Taylor and Parsons (2011) claimed that engagement strategies are well-established for traditional school students but failed to mention virtual school students. Kim et al. (2015) argued that traditional face-to-face engagement strategies might not be transferable to the virtual school setting due to the limited amount of interactions between virtual school students and instructors. As such, more investigation is warranted when it comes to improving the engagement of virtual school students (Lefkowitz, 2015). "Clearly, student engagement is a rich research area. Educators must continue to seek to understand and apply specific, well-considered, if not agreed upon, strategies that support student engagement in learning both in and beyond the classroom" (Taylor & Parsons, 2011, p. 5).

Background

The number of K-12 virtual schools in the United States increased rapidly from 1996 to 2018 (Crockett, 2018; McNally, 2012). In 1996, three schools provided virtual school services in the United States, and fewer than 200 total students were enrolled. By 2018, all 50 states offered a form of K-12 virtual education. As a result of the rapid growth, investigations into distinct differences between virtual schools and traditional schools currently exist, albeit only a limited number (Barbour, 2014; Barbour, 2017; Crockett, 2018; McNally, 2012). Taylor and McNair (2018) stated that researching the efficacy and effectiveness of virtual school student achievement was essential but difficult to measure. According to Taylor and McNair (2018) part of the challenge of exploring virtual school issues was the varied organizational structure and operation of virtual schools throughout the United States. For example, some districts made no distinction between virtual school and traditional school when reporting data while other virtual schools did not differentiate between part-time students and full-time students (Miron & Urschel, 2016). The administrative operation of the virtual school is different enough from traditional schools, especially in terms of mobility and attendance, that simple measures used to measure academic achievement of traditional school students do not paint the full picture of virtual school student achievement (Barbour, 2014; Crockett, 2018; Taylor & McNair, 2018). Miron and Urschel (2016) stated that traditional indicators of achievement fail to provide reasonable comparative information.

Both Hamane (2014) and Lefkowitz (2015) speculated that one indicator of success in K-12 virtual schools might be student engagement. Hamane (2014) stated that while virtual student engagement has been researched at the higher-education level, little has been studied on the impact of engagement on student success at the K-12 level. In 2007, Angelino, Williams, and Natvig reported that student engagement in online classes was a significant issue for higher education students. Angelino et al. (2007) argued that the lack of engagement by online students in higher education classes caused higher than average student attrition and failure rates. Revealed in the study was the economic impact of online student attrition and failure rates posed a chief concern to academic institutions. Zweig et al. (2015) argued that attendance was a substantial issue for virtual school students since student engagement was a significant issue at every age group. Zweig et al. (2015) found in a survey of virtual school teachers in Wisconsin that student engagement and perseverance were the most frequently reported challenges. The results of the Zweig et al. (2015) study swayed the leadership at Wisconsin Virtual School to request more research focused on the impact of student engagement strategies. "Strategies for engaging students in online courses may also need more attention in preservice training and should be considered when designing and evaluating online learning programs" (Zweig et al., 2015, p. 9). Gill et al. (2015) stated the following about the challenges faced by virtual school administrators:

> We asked principals of online charter schools an open-ended question about the greatest challenge they face as the leaders of online schools. We received a wide variety of responses, but one issue far outpaced all others: student engagement, identified as the greatest challenge by one-third (33 percent) of principals. (p. 36)

Both the Zweig et al. (2015) and Gill et al. (2015) studies provided evidence that student engagement in virtual settings may be impactful on student achievement. A 2015 study by Lefkowitz regarding virtual school engagement levels revealed that strategies may increase the amount of self-driven or agentic engagement of virtual school students. According to Lefkowitz (2015), agentic engagement is student-initiated contributions to their own learning. For example, virtual school students may seek out secondary and tertiary sources beyond what is assigned by a teacher to understand the course constructs better. Lefkowitz (2015) suggested further studies regarding the impact of virtual school student engagement on student achievement. Lefkowitz (2015) theorized that if agentic engagement increased over time, and engagement levels were perceived as a success factor for virtual students, then strategies based on increasing the level of virtual school student agentic engagement could improve student learning and achievement.

Statement of the Problem

The problems virtual school administrators and stakeholders found the most challenging and worthy of research student achievement and student engagement (Gill et al., 2015; Lefkowitz, 2015; Miron & Urschel, 2012; Zweig et al., 2015). Lefkowitz (2015) believed that attendance in virtual school classes could improve agentic engagement and, in turn, increase student success. In a 2007 study, Allensworth and Easton found the attendance and the on-track status of virtual school students were indicators of student success. The problem addressed in the current study investigated whether a strategy designed to report weekly student engagement status would be impactful on the mathematics achievement of middle and high school virtual school students.

A minimal amount of research literature exists regarding the impact of student engagement strategies on virtual school student achievement (Gill et al., 2015; Lefkowitz, 2015; Miron & Urschel, 2012; Zweig et al., 2015). Gulosino and Miron (2017) argued for more quantitative research in the field of K-12 virtual education, stating that “little is known about online schooling in general, and a weak existing research base on virtual and blended schools in particular" (p. 3). Findings from the Zweig et al. (2015) and Gill et al. (2015) studies prompted the researchers to suggest that virtual school educators and administrators indicated engagement research as a crucial element to the continued design and evaluation of online learning programs.

Purpose of the Study

The purpose of this causal-comparative quantitative study was to examine whether weekly monitoring of student engagement throughout one semester of an online mathematics course impacted achievement in mathematics at one Florida Virtual School franchise school in the state of Florida serving middle school and high school students. Student achievement in mathematics was measured by changes in the Normal Curve Equivalent (NCE) scores on the STAR™ Mathematics Progress Monitoring Test pre- and posttest scores. The current study also investigated whether the minimum engagement strategy was more impactful for middle school students or high school students by comparing changes between pretest and posttest NCE scores between those two separate groups.

Significance of the Study

The current study is significant because it could increase the understanding of how increased student engagement might lead to improvement in student achievement for virtual school students, fulfilling the request for further investigation by Gill et al. (2015), Lefkowitz (2015), and Zweig et al. (2015). Findings from the current study may be employed as an assessment tool for the validation and improvement of a specific minimum engagement strategy used at the participating virtual school. The study may also be useful in future teacher preparation programs to help develop and implement strategies that improve engagement of virtual school students. Results of the current study will add to the knowledge of both achievement and engagement of virtual school students and improve the understanding of the relationship between these constructs.

Delimitations

According to Lunenburg and Irby (2008), delimitations are limits placed on the scope and boundaries of a study. The following were delimitations of the study:

- To ensure the consistency and similarity in the data, only one virtual school in Florida was analyzed in the study;
- Participants were limited to middle school (6^{th}-8^{th} grade) and high school (9^{th}-11^{th} grade) students; and
- The measurement instruments were limited to only teacher engagement reports and STAR™ Mathematics NCE pre- and posttest data since the participating school maintained and collected these two sets of data.

Assumptions

According to Lunenburg and Irby (2008), assumptions are the accepted underlying postulates and conventions on which a study relies on the purpose of the research. Assumptions of the current study were as follows:

- Representative sample was assumed to be capable of learning and able to achieve the predicted growth assigned by the STAR™ pretest if they were not being monitored weekly;
- The data measuring engagement and the STAR™ pre- to posttest NCE score change measured what they were intended to measure; and

- The delivery method of full-time virtual school students and part-time virtual school students did not impact the results, since some full-time and part-time students participated in the same virtual mathematics courses; and therefore, participated in the study.

Research Questions

The research questions were based on the fundamental elements central to the study. The two questions were designed to guide the study. Each of the questions was derived from the working hypothesis of the current study that increasing virtual school student engagement as measured by student on pace status in mathematics courses would be accompanied by an increase in student mathematics achievement.

RQ1. To what extent is there a difference in student growth as measured by changes in STAR™ Mathematics pre- and posttest NCE scores between high school mathematics students who were engaged and high school mathematics students who were not engaged as indicated by their on pace status at the end of one semester in one Florida Virtual School franchise?

RQ2. To what extent is there a difference in student growth as measured by changes in STAR™ Mathematics pre- and posttest NCE scores between middle school mathematics students who were engaged and middle school mathematics students who were not engaged as indicated by their on pace status at the end of one semester in one Florida Virtual School franchise?

Definition of Terms

The definition section of the current study defines all critical terms including the variables of the research question (Lunenburg & Irby, 2008). The current study investigated concepts regarding virtual school student engagement strategies. As such, terms selected for definition in the following section included those that may improve the understanding of virtual school constructs.

Agentic Engagement. "Agentic engagement is a measure of the students' ability to self-regulate and self-monitor with respect to their own education" (Lefkowitz, 2015, p. 48).

Asynchronous online learning. Asynchronous online learning is a form of online instruction in which the teacher to student exchange of information does not take place simultaneously or require simultaneous participation (Silva, 2013).

Blended School Course. According to Weltzer-Ward (2014), a blended school course is "a course which utilizes both a face-to-face classroom and an online classroom; synonymous with hybrid course" (p. 4).

Franchise. "Many districts in the state of Florida franchise with FLVS to offer our online curriculum using only district instructors. Students remain in their zoned district and school in this model and, also benefit from FLVS curriculum and technology to take their online courses" (FLVS, 2019, p. 10).

Growth Difference. According to Renaissance Learning (2015), the difference in the predicted growth and actual growth on the STAR™ Mathematics Progress Monitoring Assessment is defined as growth difference. "To enhance the utility of STAR assessments for indexing growth, two types of growth metrics are calculated annually: Student Growth Percentiles (SGP) and growth norms. Both are norm-referenced estimates that compare a student's growth to that of his or her academic peers nationwide" (Renaissance Learning. 2015, p. 111).

Normal Curve Equivalent. “Normal Curve Equivalent (NCE) is a norm-referenced score similar to percentile rank but based on an equal interval scale. The difference between any two successive scores on the NCE scale has the same meaning throughout the scale” (Renaissance Learning, 2016, p. 1).

Pace. The academic pace of a student is measured by their engagement in the curriculum as prescribed by the instructor and virtual school curriculum provider (Gill et al., 2015). When a student has engaged in all the assigned materials, homework, and reading at a given time, they are considered on pace (Kim et al., 2015).

Student Engagement. “Engagement refers to the specific conditions in which a set of motivational variables such as persistence and focused actions interact among themselves” (Montenegro, 2017, p. 118). According to Taylor and Parsons (2011), “one way to define student engagement is to see how it is measured” (p. 5). The current study measured student engagement using student on pace status.

Synchronous Online Learning. Online instruction that happens simultaneously in real time (Silva, 2013).

Traditional School. According to McFarlane (2011), traditional schools are “schools with established physical location where the essential factors of time and place are essential in determining contact between teachers and students, and where teachers meet face-to-face in social communication to facilitate exchange in the teaching and learning process” (p. 7).

Virtual School. Taylor and McNair (2018) defined a virtual school as a school where most of the teaching and learning takes place online. A virtual school is different from a traditional school because students and teachers do not interact with each other in a physical space. “A virtual school is a form of distance education in which teacher and learner are separate, and instruction is mediated” (Berge & Clark, 2005, p. 9).

Organization of the Study

The dissertation is comprised of five chapters. The first chapter of this study provided an overview of the background, a statement of the research problem, research questions, the purpose of the study, and limitations of the research. Chapter 2 provides a review of the literature that pertains to each research question, as well as the constructs stated in the purpose of the study. Chapter 3 contains the methodology, research design, rationale for the research and analysis methods, as well as information regarding the collection, handling, and storage of data. Chapter 4 consists of the data analysis employing statistical procedures and, a presentation of the results. Chapter 5 serves as the conclusion of the dissertation with a discussion of the major findings which includes the implications of the findings, recommendations for future or further research, and conclusions.

Chapter 2

Review of the Literature

The topics presented in Chapter 2 include the history of virtual schools, the history of the Florida Virtual School, virtual school student achievement studies, and virtual school student engagement research. The literature review was organized to funnel the research relevant to the study from the history of the virtual school to specific virtual school engagement strategies.

The review begins with the history of virtual schools in the United States and presents the history and related studies on student achievement of the Florida Virtual School. A review of pertinent literature regarding the constructs of virtual school student engagement and virtual school student achievement follow.

History of the Virtual School

The evolution of the virtual school has progressed from correspondence learning, to distance learning, from credit recovery to blended learning, and finally culminating as fully online K-12 virtual schools. According to Watson and Murin (2014) virtual schools, also referred to as cyber schools, are those which offer a completely online learning environment. Watson and Murin (2014) defined the three categories of virtual schools as:

- Online charter schools that are overseen by charter school authorizers, which may be school districts or other entities;
- District-run virtual schools that are neither charter schools nor managed by local education agencies; and

- Schools-within-a-school held accountable as part of the larger school in which they reside. (p. 2)

Virtual schools launched in the United States during the early 1990s. A few early adopters, such as Florida Virtual School (FLVS) in 1996, the Virtual High School (VHS) in 1997, and the Dakota Interactive Academic Link (DIAL) consortium in 2002 (Watson, 2008; Watson et al., 2013) afforded students the opportunity to earn a K-12 diploma in a wholly isolated educational environment through online learning (Barbour, 2014; Watson & Murin, 2014). Before the availability of the fully online learning environment, a few K-12 schools and many colleges offered correspondence or distance learning. According to Edgenuity (2017), the history of the virtual school can be traced back to the early correspondence by mail courses. The idea of earning credit away from the confines of brick-and-mortar schools is a concept nearly three centuries old (Barbour, 2014; Edgenuity, 2017; Waters, Barbour, & Menchaca, 2014).

The advent of high-speed internet propelled access beyond correspondence and distance learning courses and transformed into fully virtual learning environments (Edgenuity, 2017). As technology advanced and the internet became available on a macro level, so did its utilization by educators (Barbour, 2014; Gill et al., 2015). Barbour (2014) suggested that the increased utilization of the internet by school educators included adopting online modes of curriculum delivery. The first internet course offerings were utilized for either student credit recovery or as a supplement to the curriculum (Barbour, 2014). The transition from correspondence and distance learning to virtual classrooms only took about 20 years to complete. Watson and Murin (2014) found that the movement from internet utilization for credit recovery to fully online schools was relatively abrupt. Watson and Murin (2014) stated the following regarding the propagation of internet learning before 1995:

> Ten years ago, the K-12 online learning world was mostly contained within a few well-defined dimensions: there were state virtual schools and fully online charter schools, but there was essentially no blended learning and very little district-level activity. The landscape was dominated by the cyber charters offering fully online education to students in Pennsylvania and Ohio, and the state virtual schools offering supplemental online classes to students in states like Florida, Illinois, and Kentucky (p. 2).

Watson and Murin (2014) also reported that the number of states with schools offering online credit recovery classes steadily grew from 11 to 50 between 2004 and 2011. The expansion of the virtual school as shown in Figure 1, required little more than a decade to reach all 50 states (Rice, 2014; Waters et al., 2014).

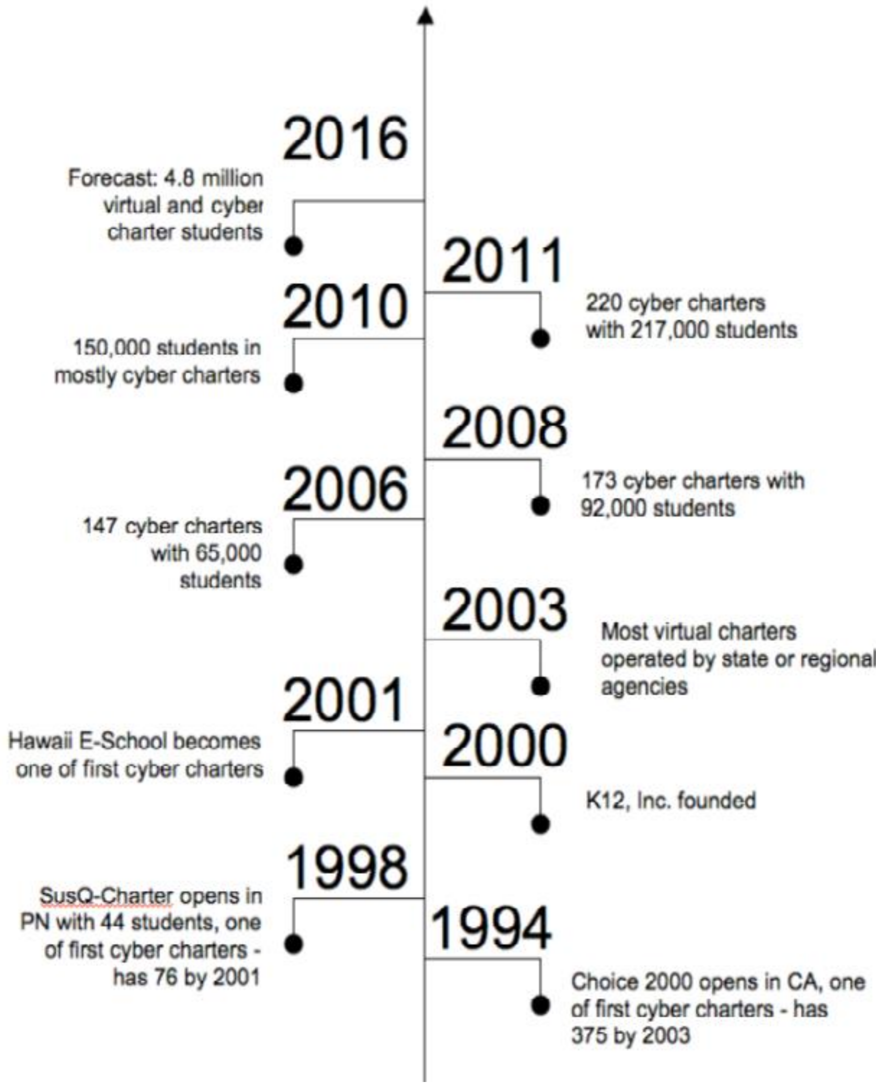

Figure 1. Growth and evolution of U.S. online charter schools. Reprinted from "The Nature of Online Charter Schools: Evolution and Emerging Concerns" by L. H. Waters, M. K. Barbour, and M. P. Menchaca, p. 381. Copyright 2014 Journal of Educational Technology & Society.

Gemin et al. (2017) argued that the rapid expansion of virtual schools along with limited regulations created a problem. The number of organizations offering K-12 virtual schools outpaced the regulations required to control them (Adelstein & Barbour, 2017). Stakeholders, including the federal government, state legislatures, local boards of education, and private entities, continued to look for ways to improve the governance of virtual school (Barbour, 2014; Gill et al., 2015; Rice, 2014; Watson & Murin, 2014). According to Peterson (2011), as more individual U.S. states attempted to target improvement of online school accountability, more stakeholders were forced to focus on issues beyond student achievement. "Part of the debate [on virtual school accountability issues] will be over the quality of virtual education. Unfortunately, that debate is currently focusing more on educational inputs than on student outcomes" (Peterson, 2011, p. 2591).

In response to the call for accountability, experts formed the International Association for K-12 Learning (iNACOL) and began to develop standards focused on K-12 virtual school governance and accountability (iNOCAL, 2011). The group, iNOCAL, decided that virtual school accountability could be defined by five areas of focus or five standards areas. The five standards covered content, instructional design, student assessment, technology, and course evaluation and support. The International Association for K-12 Online Learning (Bakken et al., 2011) claimed that a set of overarching standards for all virtual schools was necessary to fix the problems of governance ambiguity. According to Bakken et al. (2011), each category consisted of indicators that were designed to measure effectiveness on a scale that ranges from zero to four. The standards, known as the iNACOL standards were published in 2011 and accepted by K-12 educational leaders and scholars (Adelstein & Barbour, 2017). According to Bakken et al. (2011), several organizations in the United States adopted the standards in course development and evaluation.

The iNACOL standards are research-driven accountability measures designed specifically for virtual education which have been widely adopted by virtual schools, districts, and states (Adelstein & Barbour, 2017; iNOCAL, 2011). "The mission of the International Association for K-12 Online Learning (iNACOL) is to ensure all students have access to world-class education and quality online learning opportunities that prepare them for a lifetime of success" (Bakken et al., 2011, p. 2). While the virtual school community accepted the standards as an improvement to the lack of any specific standards, no actual research or data collected had been performed to test the validity and reliability until a 2017 study by Adelstein and Barbour. The authors determined that even though a more comprehensive review was needed, the standards measured the constructs they were intended to measure (Adelstein & Barbour, 2017). The history of virtual schools is relatively short (Watson & Murin, 2014). With roots to one of the first three full-time virtual schools and the first state-wide virtual school system, Florida has a relatively long history with the virtual school system and schools (Florida Taxwatch, 2007; Florida Virtual Schools (FLVS), 2012; Watson & Murin, 2014).

History of the Florida Virtual School

The Florida Virtual School was born out of a program meant to improve student achievement by utilizing technology and moving beyond the status quo (Marshall et al., 2017). In 1997, the Florida State Legislature developed and initiated a program that they would name the "break the mold" project. The program allocated $1.3 million to organizations willing to design and implement an online instructional tool that would allow students in Florida to access the educational curriculum from anywhere at any time (Florida TaxWatch, 2007). Mackey and Horn (2009) detailed the initial months of the "break the mold" project from the perspective of the original designers. In the article Florida Virtual Schools: Building the First Statewide Internet-Based Public High School, Mackey and Horn (2009) stated the following:

> In the fall of 1997, the Florida Department of Education (DOE) awarded two Florida school districts, Orange and Alachua, a $200,000 "Break the Mold" grant to co-develop an online high school to serve students throughout Florida. The districts assembled a team, which adopted a new mindset and asked if we didn't have to follow the rules that already exist [for schools], what would they be? Through trial and error and a focus on building an education option for students whose needs were not fully met, the team established what became the Florida Virtual School (FLVS), the nation's first statewide, Internet-based public school. (p. ii)

After the initial plans for the project were agreed upon by officials at both Orange County Public Schools and Alachua County Public Schools, the development of curriculum started in earnest (Mackey & Horn, 2009). Since there were no previously created online curriculum programs in 1997, programmers from IBM helped develop the first online software curriculum as well as acted in the capacity of technology consultants. According to Mackey and Horn (2009), because the online courses were not constrained by time, developers included far too many constructs in a course. Mackey and Horn (2009) highlighted how the first chemistry course developed was so packed with content that educators estimated it would take a brick-and-mortar constrained classroom teacher two years to cover. As a result, early developers quickly realized that any unnecessary information not required by Florida State standards needed to be removed.

Concurrent with the development of curriculum, the group of administrators and consultants of the program sought teachers and students for the initial enrollment. Mackey and Horn (2009), reported that "after six months of intensive planning and development, the Florida Online High School, which later became the Florida Virtual School (FLVS), opened in January 1998 with 77 enrollments in six courses" (p. 6). The first virtual school launched with a total of seven full-time teachers (Florida Virtual Schools, 2012). The original six courses offered to the initial class of the Florida Online High School were AP Computer Science, Algebra I, Geometry, American History, Chemistry, and SAT Prep. Over the next two years, the number of courses offered grew significantly. In the 1998-1999 school year, the number of courses available to students increased to 16. By the beginning of the 1999-2000 year the number of courses continued to rise, eventually reaching 36 (Florida Virtual Schools, 2019). As the number of courses offered increased over the next six years so did the enrollment.

Marshall et al. (2017) reported the significant historical events of the FLVS between 1996 and 2003:

- In 1996, Orange County Public School and Alachua County Public School districts received a joint grant of $200,000 from the Florida Department of Education to develop and pilot an online school;
- In January of 1998, the first public online school in the nation, The Florida High School, launches with 77 students and seven staff members;

- In 1999; the initial funding of $200,000 ran out, and the Florida Legislature decides to add Florida High School as a line item to the state budget which meant that it did not compete with other schools in Florida for funding, but was constrained by funding which limited the number of students that could be enrolled;
- In 2002, after years of confusion with another school in Tallahassee named Florida High School, The Florida High School changed its name to Florida Virtual School.

According to Mackey and Horn (2009) by 2002-2003, the line item funding for the Florida Virtual School reached $6.3 million for 11,500 students which prompted the Florida State Legislature to remove the line item budgeting for the school and consider FLVS as an equal to other schools in the state. "The line-item funding worked well for FLVS in its start-up phase" (Mackey & Horn, 2009, p. 7). However, the start-up phase seemed to end, according to Mackey and Horn (2009), around 2003-2004. As shown in Figure 2, the number of Florida Virtual School students steadily grew throughout its start-up phase to total 14,000 by 2003-2004.

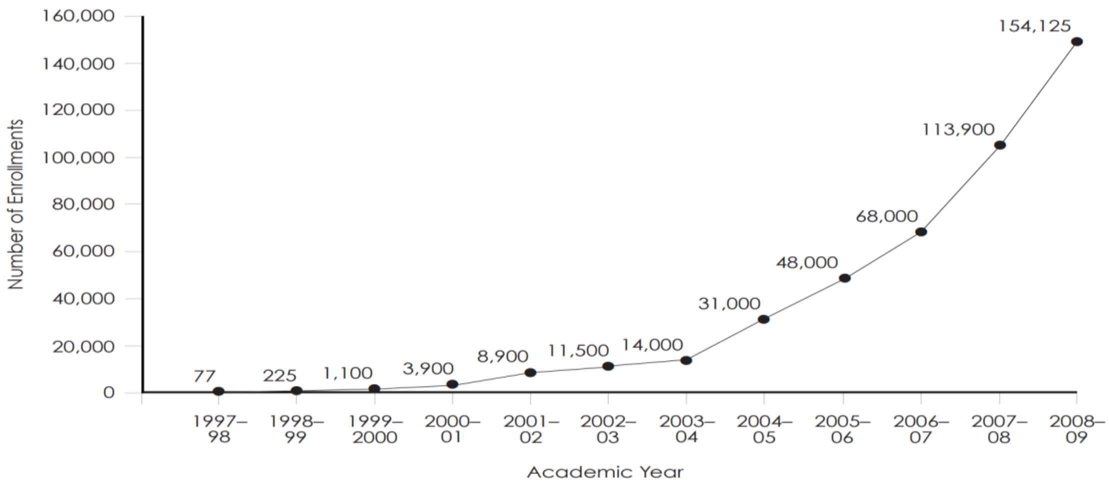

Figure 2: FLVS enrollment between 1997-2009. Reprinted from "Florida Virtual Schools: Building the First Statewide Internet-based Public High School," by K. Mackey and M. B. Horn 2009, p. 8. Copyright 2009 by Innosight Institute, Inc.

In late 2003, FLVS began an initiative to offer its services to middle schools. By the 2004-2005 school year, FLVS chose to expand into middle school courses. The expansion classes were primarily responsible for more than doubling the enrollment to over 31,000 (Florida Virtual Schools, 2012; Mackey & Horn, 2009). For the years of 2005-2006 and 2006-2007, the number of students enrolled continued to increase at an exponential rate (see Figure 2). As the number of student enrollments increased due to the inclusion of a middle school curriculum and partnerships with local school districts, the number of full-time teachers also increased.

In 2008, after years of rapid growth and success, FLVS was officially recognized by the Center for Digital Education as the number one provider of online education in the United States (Tucker, 2009). A year earlier the Florida TaxWatch (2007) organization released a study indicating that FLVS was a good investment and worthwhile expenditure to Florida taxpayers and the state. Florida TaxWatch (2007) based the findings of its study on two elements:

1. The student test scores on the Florida Standards Assessment; and
2. Cost-effectiveness of educating students by using the Florida Virtual School's model.

Florida TaxWatch reported in 2007, that not only did students from FLVS score higher on standardized test exams and AP exams, but the per-pupil cost when adjusted from part-time students, was more cost-effective than traditional schools.

According to Tucker (2009), the accolades and effectiveness study did not stop Florida state legislators from passing legislation requiring all school districts to offer a virtual education to all students K-12. The laws were changed to provide broader access in the form of K-8 education to the students in Florida (Tucker, 2009). FLVS did not offer a fully online K-12 program. As such, FLVS partnered with Connections Academy in 2009 to provide a full range of virtual school curriculum to the students of Florida.

Between the 2008-2009 and 2009-2010 school years, student enrollment in the Florida Virtual School grew by 38 percent (Watson, Murin, Vashaw, Gemin, & Rapp, 2011). Part of the growth was attributed to the newly established K-12 virtual education offering (Marshall et al., 2017). In 2011, Watson et al. reported that the "Florida Virtual School is roughly three times larger than any other state virtual school, and 10-25 times larger than most, with 213,926 course enrollments" (p. 22).

In 2012, because of an economic downturn and loss in tax revenue (McNally, 2012), the Florida legislature revised and passed the portion of the state legislation specific to FLVS funding (Watson et al., 2012). According to Watson et al. (2013), the following changes were made in the school funding laws:

- Funding was tied to successful scores on end-of-course tests instead of course enrollment numbers only;
- Required all full-time FLVS students to participate in state testing at their local brick-and-mortar school;
- Restricted funding to specific virtual instruction; and
- Required brick-and-mortar schools to provide classroom instruction to part-time virtual school students.

The new legislation requirements in combination with the loss of tax income due to the economic downturn had a negative impact on the enrollment and allocation for the Florida Virtual School. As shown in Table 1, after the new laws were implemented during the 2013-14 school year, FLVS students completed 96,327 fewer credits resulting in the allocation of $55 million less in total revenue between 2013-2014 and 2012-2013 (Marshall et al., 2017). The 2012 legislation also allowed school districts across Florida to select how they would provide virtual school to their students. As a result of several factors including growth, the 2012 legislation, and stagnating revenues, FLVS developed the FLVS franchise program which allowed districts to create their individual virtual schools while utilizing the expertise, virtual curriculum, and learning management system of FLVS. The program allowed FLVS to reduce staff while increasing the enrollment numbers.

Table 1

FLVS Cost Projections and Funding Per FTE

Year	Credit Completions	FTE Enrollment	Cost Per FTE
2012-2013	299,635	38,273	$5,182
2013-2014	203,308	33,885	$4,482
2014-2015	214,563	35,761	$4,503
2015-2016	222,956	37,160	$4,531
2016-2017	221,409	36,902	$4,578

Note: Marshall, J., Berry, C., Haldeman, P., Kruppenbacher, F., Pavelchak, J., & Whiting, J. (2017). *Florida Virtual School Annual Report* (2016-17). Orlando, FL: Florida Virtual School.

Gemin et al. (2017) reported that students enrolled in Florida Virtual School and the FLVS franchises continue to exceed the state and national averages on standardized tests. In the latest comparison of state standardized tests performed during the spring semester of 2017, FLVS full-time students outperformed state averages in biology, civics, U.S. History, Algebra 1, and Geometry. Marshall et al. (2017) also reported that FLVS students' achievement scores on the May 2017 Advanced Placement (AP) exams were 9.4% higher on average than state average AP exam scores.

The history of the Florida Virtual School is a case study in the management and flexibility of a virtual educational entity (Gemin et al., 2017). Over its first decade of existence, FLVS progressed to serve over 113,000 students per year. A legislative change to funding and economic downturn in 2012 coincided with the stagnation of growth in enrollment and revenue of FLVS.

History of the Florida Virtual School Franchise

Due to high demand, soaring enrollment, and a need to increase revenue, in 2003 FLVS launched an in-state franchise program designed as a cooperative effort between FLVS and the public-school districts throughout the state of Florida. According to FLVS (2012), the participating school district controls the responsibility of employing teachers, maintaining data, and upholding standards, while at the same time utilizing the FLVS curriculum and technology. FLVS franchise school districts independently operate district virtual schools under the auspices of FLVS which provides FLVS copyrighted course content and the FLVS Learning Management System (FLVS, 2012). According to the FLVS Franchise Agreement (2015), districts must "adhere to all branding policies as outlined in the FLVS Marketing and Communications Franchise Policy Guide" (p. 19).

By 2019, FLVS reported the guidelines for FLVS franchise districts as follows:

- All public school districts in the state of Florida may enter into a franchise agreement with FLVS;
- District FLVS franchises may operate virtual schools under the name of their school district;
- District FLVS franchises will employ their teachers and administrators;
- FLVS franchise schools will use the FLVS curriculum, FLVS Learning Management System, and many other educational resources as they deem necessary;
- The district staff will administer state and local testing; and
- FLVS will offer training and mentoring to district administration and staff of FLVS franchise schools.

Florida Virtual School Student Academic Achievement

In the book, *Saving Schools: From Horace Mann to Virtual Learning*, Peterson (2011) stated that when comparing achievement data of FLVS to Florida public schools, the FLVS students outperformed on standardized tests. Peterson (2011) used state standardized tests scores from the FLVS as evidence that the academic achievement of virtual school students and course rigor of virtual school classes were equal to their brick-and-mortar equivalents. According to Peterson, students enrolled in online classes reported that their online classes were as complicated or more difficult than face-to-face classes. Moreover, the students in the Peterson study perceived that the instructors for online courses were as competent, and in some cases, better than the teachers in a traditional setting.

McNally (2012) also investigated student achievement of FLVS schools. McNally argued that due to the funding changes that caused fundamental changes in how FLVS conducted business, a new study on FLVS student achievement was necessary. The 2012 change referenced by McNally was a change to funding law which was the cause of massive losses in revenue to FLVS. The loss in financing spawned the idea of franchising curriculum and virtual learning services to each of Florida's school districts (FLVS, 2019; McNally, 2012). As such, McNally sought first to compare student achievement of FLVS students with traditional students, and second to compare differences in virtual school funding and tradition school funding.

The questions and format of the study closely resembled a previous 2007 Florida TaxWatch study which sought to answer how FLVS student achievement compared to that of traditional brick-and-mortar students and then test whether that achievement on a dollar to dollar comparison was worthwhile. The study by McNally (2012) targeted one specific school district instead of a state-wide average. The Florida TaxWatch (2007) found that on a statewide basis, the investment in FLVS was worthwhile since FLVS student standardized test scores exceeded those of traditional students and the FLVS per student cost was less than traditional school per student cost. However, McNally pointed out that the study conducted by Florida TaxWatch in 2007 utilized state averages and did not specify if all taxpayers in all districts benefited from their investment in FLVS. As such, McNally stated that the purpose of the study "was to determine how achievement by the students who enrolled in FLVS classes compared with students enrolled in the same classes in traditional classroom settings in the school district" (p. 18). The secondary purpose of McNally's study, was to determine if the instruction provided to students by FLVS was cost-effective. The two research questions of the study were:

- How did student achievement by the students who enrolled in FLVS classes compare with students enrolled in the same classes in traditional classroom settings in the school district?
- Was instruction of district students via FLVS a cost-effective approach during 2006-2007, 2007-2008, and 2008-2009? (McNally, 2012, p. 18)

McNally (2012) compiled data from three primary sources, FLVS, the participating school district, and the Florida Department of Education. The analyses performed in the study included a comparison of the Florida brick-and-mortar school averages and the FLVS school averages. The participants in the McNally study were purposefully selected from grade nine through grade 12 enrolled full time at FLVS, and grade nine through grade 12 enrolled full-time in one large school district.

The data from FLVS included three years of course grades, demographics, Algebra End of Course (EOC) test score averages, Geometry EOC test score averages, and AP scores. The participating district obtained course grade and standardized test score data from 10 middle schools and eight high schools.

To answer the first research question regarding how FLVS students performed compared to traditional students, McNally (2012) analyzed data from students who lived in the boundaries of the participating district but chose to enroll in FLVS courses. The enrollment data were analyzed on overall enrollment status and success of district students enrolled in FLVS courses. In the study, conducted by McNally, success was measured by analyzing grades, test score averages, and specific course comparisons between district FLVS students and district traditional students. McNally stated regarding the choice of courses used to measure success, “to determine if FLVS had a positive impact on the district students enrolled in its courses, the researcher chose three specific courses to analyze in-depth” (p. 54). Since Algebra 2, Geometry, and Spanish 1 were among the top 15 classes by enrollment over the three years of the study and data were available for the courses, they were analyzed more in-depth than others. According to McNally (2012) the results of the analysis of these variables did not reveal any apparent differences between the FLVS students and the traditional students.

McNally (2012) also analyzed standardized test scores as a measure of student achievement. Geometry scores from the Florida Comprehensive Assessment Test (FCAT) were selected for further analysis. The analysis were intended to determine if any differences existed in the average scores of the two groups. However, the results were inconclusive.

McNally (2012) pointed out in the study that students who enroll in both traditional district classes and FLVS courses have financial impacts on both schools. McNally stated that when a student is dually enrolled in both FLVS classes and traditional classes, the burden of resources such as building maintenance is placed on the brick-and-mortar school. As such, McNally suggested that further study would provide a better understanding of the actual financial impact on brick-and-mortar schools. In conclusion, McNally recommended a study of the equitability and feasibility of the usage of brick-and-mortar resources by FLVS as well as suggesting that district leadership develop a method to track student virtual school data.

Engagement in the Virtual School

Five specific studies on virtual school student engagement and the impact of engagement on student achievement were used in the current study to provide the foundation of the research. The authors of the studies have indicated the following: (a) engagement was perceived by both educators and administrators as a leading challenge for growth and success of virtual school students (Gill et al., 2015; Zweig et al., 2015); (b) virtual school curriculum engagement levels impacted student achievement (Pazzaglia, Clements, Lavigne, & Stafford, 2016); (c) the amount of self-driven engagement increases over time for virtual school students (Lefkowitz, 2015); and (d) the average engagement time of high achieving virtual school students exceeded the average engagement time of low achieving virtual school students (Kim et al., 2015).

"Recognizing the value of engagement and its vital role in the educational process, faculty should monitor student engagement as a formative strategy to examine the impact of their teaching and assessment activities" (Mandernach, 2012, p. 10). One of the major problems facing virtual school teachers and administrators is the fact that students tend to perform worse in virtual courses than in traditional courses (Miron, Shank, & Davidson, 2018; Pazzaglia et al., 2016). Nordine (2016) stated, "if a student isn't engaged in their online course, the likelihood they will not complete the course successfully is a fact" (p. 1). Gill et al. (2015) found that student engagement is the leading challenge of school stakeholders through a survey of 187 school administrators. Pazzaglia et al. (2016) reported that the time in which a student remained engaged in each online class impacted their success in the course. Lefkowitz (2015) reported finding that student self-driven engagement increased as experience in virtual school classes increased.

Engagement Challenges for Educators and Administrators. Zweig et al. (2015) hypothesized that the challenges for virtual school teachers are unique and unlike the challenges faced by teachers in brick-and-mortar schools. Zweig et al. believed that the challenges for virtual school teachers differed from those of traditional school teachers even though the specific challenges had not been previously identified. Zweig et al. argued that if the nature of the challenges were indeed unique to virtual school education, then training and professional development of virtual school teachers must follow suit.

To test their hypothesis, Zweig et al. (2015) created and administered a perceptual survey of 54 virtual school teachers in Wisconsin. Analyzing the results of a perceptual survey administered to virtual school teachers and identifying challenges unique to virtual school teachers was the intention of Zweig et al. (2015). "The current report provides additional information of one online learning program about the range of training that the online teachers participated in, as well as insight into the kinds of challenges they face" (Zweig et al., 2015, p. 9). The survey instrument was validated through a series of intellectual interviews and expert testing of validity on each question. The survey instrument included 19 closed-ended questions.

After reviewing the results of the survey, Zweig et al. (2015) noted that four of the top five results were student engagement related items, while the fifth was technology related. Zweig et al. stated that the findings of the study are evidence that teachers feel that their challenges are more of a product of student perseverance and engagement and not working conditions like isolation. The team used the findings to help promote professional development specific to virtual school teachers. Zweig et al. demonstrated that virtual school teachers face unique challenges and that engagement was one of the most significant of these challenges, which was important to the current study.

Allensworth and Easton (2007) argued that course completion and assignment completion were attributable factors of student engagement levels. Nordine (2016) and Mandernach (2012) both wrote articles with similar opinions on the natural connection between engagement and course completion. Nordine (2016) remarked that engagement is intuitively connected to course completion since a certain level of engagement is required for success. In an earlier study, Mandernach (2012) stated the following about the relationship of engagement to the course and assignment completion:

> Indicators of engagement in the online classroom can be monitored via three primary avenues: participation in asynchronous discussions, assignment activity, and course involvement. The key to monitoring

> engagement is to examine students' self-initiated course activity that extends beyond the graded expectations of the course. (p. 11)

Zweig et al. (2015) provided further evidence that student engagement is perceived as a significant challenge to educators in a perceptual survey of 54 virtual school teachers. Not only did teachers in the survey report that keeping students engaged was a challenge, two of the other four top indicators were previously linked in different research as measures of student engagement (Allensworth & Easton, 2007; Nordine, 2016). Student engagement was also determined as a key challenge perceived by administrators in a 2015 study by Gill, et al. In the study, Gill et al. (2015) revealed that student self-managed engagement is perhaps the most significant factor in the academic success of virtual school students. According to Gill et al., (2015) half of the 187 virtual school administrators who participated in the study indicated that student engagement was the principal challenge in the administration of virtual schools.

Gill et al. (2015) sought to conduct a "rigorous, systematic examination of the achievement effects of online charter schools across multiple states" (p. 1). Gill et al. (2015) gathered data from school administrators working in schools that were identified as eligible for inclusion. For a school to meet the criteria, the school must have been a public virtual charter school in the 2013-2014 school year with at least 20 students enrolled in full-time virtual classes. After a rigorous process that reduced 897 potential schools to 187 eligible schools, Gill et al. (2015), created a survey instrument which began with consults from several organizations experienced with virtual school education. The team of Gill et al. (2015) contacted iNACOL, the Arizona State Board of Education, the California Charter Schools Association, and the Ohio Alliance of Public

Charter Schools, to obtain endorsements for the study and to review and offer feedback on the survey instrument.

The survey was given to virtual school administrators and conducted during 19 continuous weeks via the internet, email, personal phone calls, and priority mail. Gill et al. (2015) stated the following regarding the response rates:

> At the end of the field period, there were 114 completed cases, 13 partial completions, 60 non-responses, and 143 schools determined to be ineligible: 17 were not public schools, 95 were not charters, and 31 did not operate a full-time program fully online. The final response rate for the survey was 67.9 percent of the population of schools ultimately deemed to be eligible (187 schools). (p. 46)

While Gill et al. (2015) did not obtain full participation, data was gathered on at least one school from every state that offered virtual charter schools. It was determined by Gill et al. (2015) that the survey results accurately indicated the state of the virtual charter school in 2013-2014. Gill et al. (2015) reported the following survey results:

- Virtual schools offer mainly individualized student-driven independent study courses;
- The average time spent in synchronous instruction for middle and high school students is three hours per week;
- Class size averages are 29.9 in virtual classrooms compared to 17.4 for brick-and-mortar classrooms;
- About half of the administrators in the survey reported that they had no previous experience with online education; and

- Hispanic and English language learners are underrepresented in virtual schools. (p. 21)

Gill et al. (2015) also stated that school administrators viewed student engagement as the most significant challenge in virtual student academic achievement. "When asked an open-ended question about their greatest challenges in leading online charter schools, principals identified student engagement most often—nearly three times as often as any other issue" (Gill et al., 2015, p. 21). The administrators also stated in their survey answers that the challenge of maintaining engagement appeared to be inherent in virtual school since the virtual school success required students to actively participate in their own learning. According to Gill et al. (2015), teachers are highly unlikely to be in front of students actively monitoring their engagement levels. In fact, as indicated by the survey results, virtual school teachers are the least likely to monitor students. The lack of synchronous class time in a virtual school setting prevents consistent monitoring of students (Gill et al., 2015). Even though, the logistics of virtual school teaching prevent face-to-face interaction, teachers reported that they were able to measure engagement through completion rates and on pace status. Gill et al. (2015) found that teachers monitored engagement of students in three ways: monitoring their online activity, monitoring their pace, and monitoring their amount of live lessons time.

Table 2

Online Charter Principal's Greatest Challenges

Challenges	**Percent**
Student engagement	33
School/CMO/district administration	13
Public perception	11
Parent engagement	11
Finding and analyzing meaningful data	10
School structure	8
Being located remotely from students	7
Accountability systems	7
Funding	7
Challenging student population	6
Want more teacher-student interaction	6
Getting my job done in the available time	6
Finding quality teachers	4
Student recruitment and retention	3
School culture	2

Note: Adapted from Gill, B., Walsh, L., Wulsin, C. S., Matulewicz, H., Severn, V., Grau, E., Lee, A., & Kerwin, T. (2015). Inside online charter schools. Cambridge, MA: Mathematica Policy Research.

According to Gill et al. (2015), school administrators and teachers perceive engagement as such an important factor in the success of online students that 99 percent of schools indicated the implementation of some engagement policy. Gill et al. (2015)

found that 91 percent of school administrators indicated that their school had a class participation policy, and 71 percent claimed an attendance policy linked to live (synchronous) lessons. It was also found that most schools provide an intervention strategy for students who were not consistently engaged. The most common intervention expressed by school leaders were parent phone calls (97 percent) and parent emails (95 percent). In fact, parent engagement tied for third on the list of perceived virtual school challenges of administrators (see Table 2). Gill et al. (2015) stated the following regarding parental engagement:

> Most online charter schools have substantial expectations of parents—surely necessitated in part by the limits of the schools' tools for keeping students engaged, but perhaps also a side effect of the small number of contact hours they provide for students. (p. 22)

In the study, Gill et al. (2015) examined the extent that virtual school leadership expected active parental engagement in the learning process. Gill et al. (2015) reported that while nearly all schools expect parents to help the student maintain the pace dictated by the curriculum, only 49 percent of teachers were in weekly contact with parents. Fifty-one percent of administrators indicated that they communicated with parents about once per month. Gill et al. (2015) claimed that because of the limited live contact time between staff and students, a large portion of the responsibility to the challenges faced by administrators are passed on to the parents. The results of the Gill et al. (2015) study were used in a parallel study by Woodworth et al. (2015). The purpose of the Woodworth et al. (2015) investigation was to test how enrollment in a virtual school impacted the achievement of virtual school students by utilizing the findings of Gill et al. (2015).

The Impact of Engagement on Virtual School Student Achievement. The current study intended to determine if engagement affected student growth in the form of mathematics achievement. Books, peer-reviewed articles, and scholarly works founded on the principle that student engagement affects student achievement were included in the literature review. Research and investigations by Pazzaglia et al. (2016), Lefkowitz (2015), and Kim et al. (2015), were conducted on the relationship between achievement of virtual school students and engagement. Lefkowitz (2015) held that agentic engagement of virtual school students improved over time; Pazzaglia et al. (2016) provided evidence that virtual school students who were not consistently engaged with the curriculum achieved at a slower rate than their peers; and Kim et al. (2015) found that the level of engagement of virtual school students affected mathematics achievement.

Lefkowitz (2015) argued that due to the relatively high amount of autonomy required of virtual school students, self-engagement, also known as agentic engagement, would increase over time. Lefkowitz suggested that because levels of engagement impacted student success, increased amounts of agentic engagement may improve student achievement. Lefkowitz also sought to test the construct of agentic engagement to determine if levels of student self-engagement were higher in virtual school students than brick-and-mortar students. "Agentic engagement is a construct that has a unique fit with virtual instruction in that students who work virtually are more responsible for their education than traditional students" (p. 3). Lefkowitz (2015) intended to improve the gap in research between engagement, agentic engagement, and the uniqueness in the student experience of virtual school learning.

For the study, Lefkowitz (2015) chose a quantitative correlation and causal-comparative research design to determine whether factors like virtual learning, age, or grade-level could be used as indicators of the level of virtual school student agentic engagement. According to Lefkowitz (2015), agentic engagement is measured by five characteristics which differentiate it from other forms of engagement:

1. Proactiveness;
2. Intentionality;
3. Enrichment of the learning opportunity;
4. Input, condition, and flow of individual instruction; and
5. Does not measure teacher competence or effectiveness.

Lefkowitz (2015) suggested that the differences between agentic engagement and the broad term engagement fit the specific characteristics necessary for the success of virtual school students more than that of brick-and-mortar students. As such, Lefkowitz selected 168 full-time virtual school students in grades six through 12 for the study. The participants all attended the same FLVS franchise school in the state of Florida.

The survey instrument utilized by Lefkowitz (2015) included a five-item questionnaire. The questionnaire was a five-point Likert scale survey which collected ordinal data. Lefkowitz (2015) discussed how the data from the survey were coded for additional analysis:

> The data collected from the survey were technically ordinal, but the researcher approximated the data to continuous measures. There were two

> related sets of variables, collected from the same respondents: their perceptions of their agentic engagement in the previous brick-and-mortar school environment and the current virtual school environment.
> Inspection of their values did not reveal them to be extreme, and they were kept in the analysis. (p. 30)

Participants in the Lefkowitz (2015) study were asked to take part in the survey twice and from two different perspectives. The participants were asked to recall their current levels of agentic engagement. The second time the participants answered the questions they were asked to answer from the perspective of their time before attending virtual school while they were enrolled in traditional school. The survey instruments were tested for reliability and validity and subsequently found to be both reliable and valid.

A total of 87 students responded to a survey instrument administered using SurveyMonkey©. The student response data were analyzed and tested against the hypotheses. The analysis provided evidence to support only one hypothesis. Lefkowitz (2015) intended to determine whether age, grade-level, or years of experience in virtual school were impactful on the amount of student agentic engagement. Data results from paired sample *t*-tests were used as evidence that the variables student age and student grade level could not be determined as predictors of student agentic engagement level, while the variable years of virtual school experience was indeed found to be a statistically significant predictor of agentic engagement. Lefkowitz (2015) suggested that the findings indicated that the variables age and grade level did not affect agentic engagement levels, but attendance and time experienced in virtual school did improve student engagement. The results were used to provide evidence that agentic engagement and the experience specific to virtual school students are interrelated. Lefkowitz stated that “teachers can improve on the quality of the virtual instruction by engaging students in a conversation and by helping a student be a steward of his or her education” (p. 53). Lefkowitz (2015) stated that the implementation of engagement specific strategies could further improve student agentic engagement. Lefkowitz (2015) also suggested more study into the relationship between increased virtual school student engagement and student achievement.

The conclusions of the study were used to provide suggestions for future studies related to agentic engagement and virtual school student achievement. Lefkowitz (2015) opined that virtual school students who oversee their interaction with the curriculum and who remained engaged are more likely to have higher levels of academic achievement. Lefkowitz suggested additional research be conducted on student engagement to improve the knowledge of how engagement strategies impact student academic achievement.

Pazzaglia et al. (2016) pointed out that studies on the impacts of strategies and engagement had been conducted on virtual school students at higher education levels. However, according to Pazzaglia et al. higher education results are only meaningful to higher education stakeholders. Pazzaglia et al. stated that the problem was that research results of the higher education scholars do not answer questions pertaining to K-12 virtual school administrators and researchers. Pazzaglia et al. (2016) claimed that little was understood about the K-12 virtual school student engagement since most literature focused on higher education issues. In 2016, Pazzaglia et al. compared higher education and K-12 views on virtual school student engagement to determine if similarities or differences existed. Pazzaglia et al. reported that the literature focused on higher education students tend to view the lack of student engagement as an economic issue because students who failed a course were more likely to drop out and cost the school through the loss of tuition revenue. But in K-12 education, virtual school leadership view the lack of student engagement as an achievement issue (Pazzaglia et al., 2016). As such, Pazzaglia et al. argued that the literature and investigations surrounding the problem of engagement in K-12 settings must focus on student success, not on revenue.

Kim et al. (2015) aimed to understand how motivation, engagement, and attendance impacted the achievement of virtual school mathematics students. Kim et al. stated that research of the challenges facing virtual school leadership had not kept pace with the growth of online education. "There is a need to understand how students' motivation and engagement influence their achievement in virtual high school mathematics courses so that support can be planned and implemented accordingly" (Kim et al., 2015, p. 262).

Kim et al. (2015) wanted to determine how high performing virtual school mathematics students and low performing virtual school mathematics students differed regarding changes in engagement. To accomplish this, Kim et al. (2015) compared changes in cognitive and emotional engagement with changes in the achievement of virtual school mathematics students at the beginning, middle, and end of one semester. Kim et al. (2015) defined engagement as "cognitive and effective participation in learning activities" (p. 263). The construct of cognitive engagement was further defined as the involvement with shallow and deep cognitive strategies, while emotional engagement was defined as the reactions of the student toward the learning activities.

For their study, Kim et al. (2015) employed an engagement survey instrument first introduced by Pekrun, Goetz, and Frenzel (2005). The survey instrument that Kim et al. (2015) used, known as the Achievement Emotion Questionnaire in Mathematics (AEQ-M), included the following variables in their definition of emotional engagement: boredom, anxiety, enjoyment, anger, shame, pride, and hopelessness.

Kim et al. (2015) selected participants from a population of students enrolled in grade 6 through grade 12 self-paced virtual mathematics classes at a specific school in the United States. Student participants were full-time and part-time virtual school students. The participants completed two separate surveys to test cognitive and emotional engagement respectively. Kim et al. (2015) utilized the Motivated Strategies for Learning Questionnaire (MSLQ), a 40 item Likert-scale survey developed by Pintrich and DeGroot in 1990, to test for cognitive engagement. According to Pintrich and DeGroot (1990), the reliability of each MSLQ question ranges from .52 to .93. Kim et al. (2015) stated that the validity of the MSLQ had been tested several times and found to be valid. Engagement scores were established with the AEQ-M survey. The AEQ-M was administered to all students three times over the course of the semester. Of the 59 AEQ-M survey items, 41 were used, and 18 were excluded. Kim et al. (2015) chose to exclude 18 questions because they were specific to traditional classrooms and not transferable for virtual school students. The results of the two surveys were tested against student achievement which was measured by using student final grades with possible scores ranging from zero to 100.

After the data were collected, four separate MANOVA tests were conducted. The team analyzed the results of the MANOVA tests and investigated the differences in changes in emotional and cognitive engagement. "The results of repeated measures MANOVAs indicated that high performers and low performers differed with regard to their changes in motivation, regulation, and engagement throughout the course, specifically, in self-efficacy (part of motivation) and effort regulation (part of regulation)" (Kim et al., 2015, p. 266). The following findings were delineated from the data and reported in the conclusion of the study conducted by Kim et al. (2015):

- High performing virtual school mathematics students were more engaged throughout the semester than low performing students;
- Higher levels of effort and engagement resulted in higher grades;
- Designing support and strategies for engagement may include monitoring student effort;
- The number of students who were consistently on pace and engaged with the curriculum decreased over the course of the semester;
- Controlling metacognition may help students to control their learning; and
- No difference between high and low performing virtual mathematics students existed in their perceived intrinsic value of the course.

According to Kim et al. (2015) the findings suggested that "support for students' effort regulation may help not only with a lack of motivation from not viewing the intrinsic value of learning tasks but also with disengagement such as nonuse of cognitive strategies, which would, in turn, improve achievement" (p. 269). Kim et al. (2015) also argued that future research on engagement strategies is important since "understanding how students' motivation and engagement, as well as regulation, contribute to their learning provides information of how support can be planned accordingly in virtual high school mathematics courses" (p. 269).

Indeed, school policy linking achievement and student engagement tend to be well established in both virtual and traditional schools in the United States (Railsback, 2002). Railsback (2002) stated that evidence points to a conclusion that students who are not engaged tend to achieve less than students who remain engaged. Lefkowitz (2015), Kim et al. (2015), Pazzaglia, et al. (2016), and found similar evidence and recommended research on virtual school student engagement and academic achievement. Student engagement and academic achievement were difficult challenges faced by stakeholders of both virtual schools and traditional schools (Kim et al., 2015).

Summary

Chapter 2 included a review of the pertinent literature necessary for understanding the construct of virtual school student engagement strategies. The review contained the history of virtual schools including Florida Virtual School and the FLVS Franchise system. Chapter 2 also included various synopses of reports, books, investigations, peer reviewed research, and articles relevant to virtual school student engagement and virtual school student mathematics achievement.

Chapter 3

Methods

The purpose of this causal-comparative quantitative study was to examine whether weekly monitoring of student engagement throughout one semester of an online mathematics course impacted achievement in mathematics at one Florida Virtual School franchise school in the state of Florida serving middle school and high school students. Student achievement in mathematics was measured by changes in the NCE scores on the STAR™ Mathematics Progress Monitoring Test (STAR ™) pre- and posttest. The current study also investigated whether the minimum engagement strategy implemented at the participating Florida Virtual School franchise school was more impactful on mathematics achievement for middle school students or high school students by comparing changes between STAR™ Mathematics pretest and posttest NCE scores between those two student grade level groups.

Research Design

According to Lunenburg and Irby (2008), the causal-comparative research design is used to determine cause and effect relationships. "One type of nonexperimental quantitative research is causal-comparative research in which the investigator compares two or more groups in terms of a cause (or independent variable) that has already happened" (Creswell, 2014, p. 41). The current study was conducted to examine whether a minimal engagement strategy implemented during a one-semester online mathematics course resulted in differences between student achievement as measured by changes in pre- and posttest scores on student STAR™ Mathematics NCE scores for middle and high school virtual school students. The causal-comparative research design best fits the current research since the analysis compared two groups to determine if a significant difference existed between the means of the engaged and not engaged students. The current study utilized archival data from STAR™ Mathematics NCE scores and student engagement status.

The dependent variable for the investigation was the mean pre- to posttest changes in NCE scores on the STAR™ Mathematics test. The independent variable was engagement, a dichotomous variable coded as engaged and not engaged as designated by on pace status. The independent variables were tested against numerical values of changes in student growth rates using in an independent samples *t*-test. Data were imported into IBM© SPSS 25 statistics software and subsequently tested using the program comparison of means function. The numerical variables signified the changes in student NCE scores as defined by the STAR™ Mathematics posttest. The data were separated into two groups, which included a middle school group and a high school group. The middle school group consisted of grade six through grade eight student data and the high school groups consisted of grade nine through grade 11 student data.

All middle and high school students participated in the STAR™ Mathematics pretest at the beginning of the semester. The research variable measuring engagement was determined using the final end-of-course teacher report of student on pace status. The construct of student pace as a measure of engagement has been shown credible according to three studies; by Gill et al. (2015), Kim et al. (2015), and Pazzaglia et al. (2016). Pazzaglia et al. (2016) employed the variables of both pace (the amount of work completed) and time (the number of hours logged in per week) as measures of engagement. Pazzaglia et al. (2016) stated that one limitation of the study was that measuring the amount of time a student spent logged into the virtual curriculum was an imperfect measure of engagement. The current study excluded the time logged into the virtual curriculum as a measure of engagement. However, on pace status, or the amount of completed course material, was used as a measure of student engagement.

Selection of Participants

Participants for the current study were selected from one Florida Virtual School franchise site. The target population included middle and high school virtual school students enrolled in a single mathematics class at the participating FLVS franchise school. Because of the relatively small enrollment in virtual school mathematics courses at the participating school, a total purposive sampling technique was employed. According to Creswell (2014), total purposive sampling is a technique in which the investigator examines the entire population with a particular characteristic. The grade levels were selected based on student enrollment. Grades kindergarten through five were excluded due to anticipated low enrollment. The sampled students were grouped into sixth- through eighth-grade level students and high school level students.

Measurement

The current study was conducted to investigate whether a difference existed between the academic achievement of engaged and not engaged students by analyzing the average changes of mathematics achievement pre- and posttests. "One of the simplest methods for evaluating the effect of an intervention is the pretest-posttest paradigm, in which students are assessed twice—once prior to intervention, and once again at its completion" (Renaissance Learning, 2015, p. 123). The specific dependent variable measurement instrument, the STAR™ Mathematics test, was selected because it provided pretest and posttest comparisons, as well as growth expectations scores based on the projected changes in a student's NCE scores. It should be noted that STAR™ Mathematics NCE scores are not grade or age specific as the test results indicate skill level without regard to other factors like grade level.

> One key factor in conducting pretest/posttest designs is that if the same test form is used both times, then the results may be compromised due to students having previously been exposed to the test items. In an ideal situation, equivalent tests with no items in common should be administered; STAR Mathematics is ideal for this because tests administered to a student within 75 days of one another will have no items in common. (Renaissance Learning, 2015, p. 124)

The participating school was selected because their program included a strategy that required mathematics students to maintain a minimum level of engagement each week to perform all activities and assignments prescribed by the FLVS curriculum.

Renaissance Learning STAR™ Mathematics

STAR™ Mathematics is an adaptive computer-based assessment tool used by more than 32,000 schools across the United States. According to the creators of the program, Renaissance Learning (2015), the STAR™ Mathematics test is an adaptive test utilized by educators to assess student mathematics capabilities, growth, and achievement accurately. Renaissance Learning also stated the following in their 2015 STAR™ Enterprise Mathematics manual:

> STAR Enterprise assessments are designed to help teachers assess students quickly, accurately, and efficiently. STAR™ provides teachers with reliable and valid data instantly so that they can target instruction, monitor progress, provide students with the most appropriate instructional materials, and intervene with at-risk students. Administrators use real-time data from STAR to make decisions about curriculum, assessment, and instruction at the classroom, school, and district levels. (p. 1)

Development of the STAR™ Mathematics test included input from the common core mathematic standards as well as standards often found and evaluated in state high-stakes mathematics assessments. Renaissance Learning (2015) claimed that after reviewing all the similarities of state and national mathematics standards as well as state assessments, the group developed the STAR™ Mathematics test, which initially included approximately 2000 questions. The level of questioning on the test extended from kindergarten through grade 12. The test questions were tested and validated by performing statistical measures on data from thousands of students of each grade level. "Rigorous psychometric analyses resulted in the accurate placement of each test question on the STAR™ Mathematics scale" (Renaissance Learning, 2015, p. 3). The results of the psychometric analyses revealed that each of the approximately 2000 test questions in the STAR™ Mathematics test bank closely correlated to the rank order of learning progress as intended. The initial nationwide sample for the STAR™ test occurred in 1997. Renaissance Learning stated in their STAR™ Mathematics Manual (2015) that the test questions span from kindergarten level, to high school level and are continually updated through the rigorous validation and analysis of millions of samples each year.

According to Renaissance Learning (2016), NCE scores can be scaled from one test to another. For instance, the change at the time of the posttest for a student who scored 550 on a pretest would only be compared to students who also scored 550 on their pretest. "NCEs are useful in making comparisons between different achievement tests and for statistical computations such as determining an average score for a group of students. NCE scores range from 1 to 99. NCEs are used mostly for research purposes" (Renaissance Learning, 2016, p. 1).

STAR™ Mathematics Validity. Renaissance Learning performed validity and reliability analysis on the STAR™ Mathematics test in 2015. The results of the validity testing are shown in Table 3. Renaissance Learning (2015) stated that the results provided empirical evidence to show a strong correlation between student STAR™ Mathematics test scores and student scores from 44 state standardized mathematics assessments scores.

Table 3.

Internal Consistency and Reliability of STAR™ Mathematics Enterprise

	Predictive		Concurrent	
Grade	Students	Average Correlation	Students	Average Correlation
All	259,663	0.72	36,265	0.63
6-12	66,949	0.77	13,003	0.64

Note: Adapted from data found in Renaissance Learning, 2015, p. 26.

In 2017, Holub investigated the reliability of the STAR™ Mathematics test. Holub (2017) performed an independent study of the correlation between STAR™ Mathematics scores and the Pennsylvania System of School Assessment (PSSA) scores in 2016 as part of a test of the effectiveness of data-driven student achievement strategies. An analysis of the results indicated a strong correlation between student STAR™ Mathematics scores and state assessment scores. Holub's (2017) research rendered an average correlation coefficient between the STAR™ Mathematics test scores and state assessment test scores of $r = .85$. As such, Holub concluded that the STAR™ Mathematics scores were a strong predictor of PSSA scores.

***STAR™ Mathematics Reliability*.** To ensure the reliability of the test over time, Renaissance Learning (2015) continually checks the predictive strength of each of the STAR™ Mathematics test questions. Renaissance Learning performed general reliability, split-half reliability, and alternate form reliability tests in 2015. The results of the validity test are shown in Table 4. The general reliability test was a test of the variance attributable to the trait the test measured. Since the STAR™ Mathematics test is an adaptive style test in which correct or incorrect test responses are used to determine the next test question, a split-half reliability test was conducted. Split-half reliability testing provided a reasonable estimate of the internal consistency for the STAR™ Mathematics test. A third test measuring the retest reliability coefficient was employed to determine if retest results of the same student were reliable. Renaissance Learning stated that the results of all three reliability analysis tests provided evidence that the STAR™ Mathematics test is reliable as a measure of student achievement, progress, and growth (Renaissance Learning, 2015).

Table 4

Internal Consistency and Reliability of STAR™ Mathematics Enterprise

	Predictive		Retest Reliability	
Grade	Students	Reliability Coefficient	Students	Reliability Coefficient
All	9,311,595	.97	60,000	.93

Note: Adapted from data found in Renaissance Learning, 2015, p. 25.

The independent variables of engaged or not engaged, as well as middle and high school, were used to group students. Teachers at the participating school recorded grades and engagement data weekly over the course of the Fall 2018 semester. The teacher data were used to determine the participants' engagement category. To be considered engaged students were required to meet pace requirements in at least 13 of 16 weeks, as well as be on pace at the end of the course or last measurement. Students who were not classified as engaged for 4 or more weekly reports or who were not engaged in the final report were considered not engaged. The engagement variable was coded as either 1 or 0 and represented engaged or not engaged, respectively.

The data from two groups, middle school and high school, were used in the current study. The middle school group combined grades six through eight and the high school group combined grades nine through eleven. The combining of grade levels within the groups was done to increase the number of students and improve the chances that the number of participants equaled or exceeded 30 to meet the central limit theorem. This combination of grade levels did not impact the STAR™ Mathematics test score data as they are comparable regardless of student level, student age, or student mathematics course (Renaissance Learning, 2015).

Data Collection Procedures

The current causal-comparative quantitative study utilized appropriate collection procedures to obtain the data of interest pertaining to the purpose of the current study. Permission to collect and analyze data began with a formal Institutional Review Board (IRB) review by Baker University on January 22, 2019 and a formal request for data from the participating FLVS franchise school administration on January 22, 2019 (Appendix A). The participating school district required a formal research request before data or research could be conducted. The formal request for research sent to the participating school district included the purpose statement, rationale and methodology, reasoning behind the choice of the school district, and the benefit of the current study's possible results to the school district. Per direction by the participating school district, an abstract of the current study was also provided. A statement within the formal research request proposal promised the anonymity of the school district to the extent that is reasonable. The data requested of the participating school district included both January 2019 testing window NCE results and first semester 2018-2019 engagement data. Student STAR™ Mathematics data was requested for student NCE scores and NCE change scores for all middle and high school mathematics students. The engagement data requested included all middle and high school mathematics students' weekly engagement, attendance, and pace reports. A further request required a district staff member from the participating school district to remove all identifiable student information from the data and match NCE score data to engagement data. A research request proposal form and abstract were sent as a formal request for data to the participating school district research committee on January 17, 2019 and was approved on January 22, 2019, see (Appendix B).

The STAR™ Mathematics test was administered by teachers of the participating school at least two times between August 2018 and January 2019. Students were required to take the STAR™ Mathematics pretest at the beginning of their mathematics course. In the current study, all student pretest data were collected from tests that were completed within the same testing window during the last two weeks of August 2018. Likewise, the posttest data were similarly collected during the January 2019 testing window. The collection, scoring, and maintenance of the STAR™ Mathematics test data were performed by Renaissance Learning and results were provided to the participating school district. Students who either did not participate in the STAR™ Mathematics test or whose data could not be linked to their pace and attendance were excluded from the current study.

All data requested of the participating school district were compiled by a district data coordinator, and any personally identifiable elements were removed. The data were delivered as a password protected Microsoft Excel© spreadsheet and was subsequently transferred to a 128-bit encoded secure password protected computer hard drive. The data will be maintained for a period of three years following the completion of the current study and destroyed thereafter.

Data Analysis and Hypothesis Testing

RQ1. To what extent is there a difference in student growth as measured by changes in STAR™ Mathematics pre- and posttest NCE scores between high school mathematics students who were engaged and high school mathematics students who were not engaged as indicated by their on pace status at the end of one semester in one Florida Virtual School franchise?

H1. There is a difference in student growth as measured by changes in STAR™ Mathematics pre- and posttest NCE scores between high school mathematics students who were engaged and high school mathematics students who were not engaged as indicated by their on pace status at the end of one semester in one Florida Virtual School franchise.

An independent samples *t*-test of mean differences was conducted to test H1. According to Lunenburg and Irby (2008), an independent samples *t*-test is a quantitative parametric comparison of the means between two groups. The results of the independent samples *t*-test are used to determine if a statistically significant difference between the means of the two dichotomous groups. The categorical variable of student engagement (engaged or not engaged) was used to group the dependent variable (changes between STAR™ Mathematics pre- and posttest NCE scores) of high school students enrolled in mathematics courses and participating at the minimum engagement intervention. The level of significance was set at .05

RQ2. To what extent is there a difference in student growth as measured by changes in STAR™ Mathematics pre- and posttest NCE scores between middle school mathematics students who were engaged and middle school mathematics students who were not engaged as indicated by their on pace status at the end of one semester in one Florida Virtual School franchise?

H2. There is a difference in student growth as measured by changes in STAR™ Mathematics pre- and posttest NCE scores between middle school mathematics students who were engaged and middle school mathematics students who were not engaged as indicated by their on-pace status at the end of one semester in one Florida Virtual School franchise.

An independent samples *t*-test of mean differences was conducted to test H1. According to Lunenburg and Irby (2008), an independent samples *t*-test is a quantitative parametric comparison of the means between two groups. The results of the independent samples *t*-test are used to determine if a statistically significant difference exists between the means of the two dichotomous groups. The categorical variable of student engagement (engaged or not engaged) was used to group the dependent variable (changes between STAR™ Mathematics pre- and posttest NCE scores) of middle school students enrolled in mathematics courses and participating at the minimum engagement intervention. The level of significance was set at .05.

The IBM© SPSS 25 statistical software was used to perform an independent samples *t*-test of the independent data to the dependent data. The dependent variable, growth rate, was measured using the differences between the pre- and posttest NCE scores as reported on all students' STAR™ Mathematics score growth reports. The independent variables, engaged and not engaged, were dichotomous measurements of the participants at the end of their mathematics course. The participating school district teachers monitored student engagement and maintained records of student on pace status weekly for one semester. The final measurement of engaged or not engaged was taken from the final on pace status report.

Limitations

Simon (2011) described limitations as "weaknesses included in the study that the researcher cannot control" (p. 2). The potential limiting factors for this study included the sample size, data measurement, and participating school setting. The sample size of the study may limit the research because of the relatively low number of students within each group and subgroup. While the minimum number of participants required was set at 30 per each sub-group in the current study, larger sample sizes may have provided different results. A second limitation of the study was the choice of the measurement instrument employed to compare the two groups of engaged and not engaged students. The results are limited since other factors may exist that impact the STAR™ Mathematics NCE scores more than merely student engagement level within and between the dichotomous groups of engaged and not engaged. Finally, the current study used data from one Florida Virtual School franchise school. Different outcomes may have been found if more FLVS schools had participated in the study, or if different virtual schools outside the FLVS system were included in the study.

Summary

Chapter 3 provided details regarding the methodology and rationale of the research design, including the selection of participants, the measurement instrument used, procedures for statistical analysis, and limitations of the study. Chapter 3 also served to restate the purpose of the study and state the research questions and hypotheses tested. Chapter 4 will consist of the results of the data analysis including descriptive statistics and outcomes of the hypotheses testing.

Chapter 4

Results

This causal-comparative quantitative study sought to examine the relationship between student engagement and mathematics achievement. Specifically, the current study investigated whether students' engagement in the course, as indicated by on pace status at the end of one semester, affected student mathematics achievement as measured by changes in the NCE scores on the STAR™ Mathematics Progress Monitoring Test (STAR ™) pre- and posttest scores. Independent samples *t*-tests were performed using IBM SPSS version 25 software to measure the impact of the independent variable of engagement on dependent variable of STAR™ Mathematics NCE gains, to investigate whether engagement level led to a statistically significant difference in STAR™ Mathematics gains. Chapter 4 will describe the results obtained from the statistical data analysis procedures conducted.

Descriptive Statistics

The descriptive statistics sought and collected for the current study included high school student gender and student grade level. The purpose of collecting participant age and grade level data was to help provide further evidence that male and female student data employed in the statistical analysis and subsequent results were equally represented in the data. Descriptive statistics were analyzed and reported for both high school and middle school. A total of 63 high school student scores were used in the analysis for the study. Of the 63 high school students, 36 or 57% were female students, and 27 or 43% were male. Table 5 illustrates the descriptive statistics and percentages of high school participants for the categories of gender and grade level. As shown in Table 6, the participants were comprised of 27 ninth-grade, 27 tenth-grade, and nine 11th grade students who represented 43%, 43%, and 14% respectively. Of the 63 high school participants, only nine were 11th grade students. The lower percentage of 11th grade students was due to both lower enrollments at the participating school in 11th grade and lower participation by teachers of 11th grade students.

Table 5

High School Participant Descriptive Statistics by Gender

Gender	Total	Percentage
Male	27	43
Female	36	57

Table 6

High School Participant Descriptive Statistics by Grade Level

Grade Level	Total	Percentage
Grade 9	27	43
Grade 10	27	43
Grade 11	9	14

Middle school student gender and student grade level were sought and collected for the current study as well. The purpose of collecting participant age and grade level data was to help provide further evidence that male and female student data employed in the statistical analysis and subsequent results were equally represented in the data. A total of 71 middle school students' scores were used in the analysis for the study. Of the 71 middle school students, 41 or 58% were female students, and 30 or 42% were male. Table 7 illustrates the descriptive statistics and percentages of middle school participants for the categories of gender and grade level. As shown in Table 8, the participants were comprised of 16 sixth-grade, 24 seventh-grade, and 31 eighth-grade students who represented 23%, 34%, and 43% respectively.

Table 7

Middle School Participant Descriptive Statistics by Gender

Gender	Total	Percentage
Male	30	42
Female	41	58

Table 8

Middle School Participant Descriptive Statistics by Grade Level

Grade Level	Total	Percentage
Grade 6	16	23
Grade 7	24	34
Grade 8	31	43

Hypothesis Testing

The hypothesis testing was performed to address the two research questions. The results of the hypothesis testing are detailed below.

RQ1. To what extent is there a difference in student growth as measured by changes in STAR™ Mathematics pre- and posttest NCE scores between high school mathematics students who were engaged and high school mathematics students who were not engaged as indicated by their on-pace status at the end of one semester in one Florida Virtual School franchise?

H1. There is a difference in student growth as measured by changes in STAR™ Mathematics pre- and posttest NCE scores between high school mathematics students who were engaged and high school mathematics students who were not engaged as indicated by their on-pace status at the end of one semester in one Florida Virtual School franchise.

An independent samples *t*-test was conducted to address RQ1. As shown in Table 9, the average difference in student mathematics achievement growth, as measured by the change in NCE score, from pretest to posttest of engaged students was compared to the average difference in growth from pretest to posttest of not engaged students. The level of significance was set at .05.

Results indicated that high school participants who were consistently engaged throughout one semester achieved higher mean gains scores or changes between pre- and post-NCE mathematics scores (M = .10, SD = 10.13) than those who were not consistently engaged (M = -6.28, SD = 10.67). The results of the independent samples *t*-test were found to be significant, t (69) = 2.41, p = .02. The results of the independent samples *t*-test indicated that a statistically significant difference existed between the mean NCE gains scores of the two groups. A Cohen's *d* test of effect size was subsequently performed on the data which resulted in a Cohen's *d* of .74. See Table 9 for the group statistics.

Table 9

High School NCE Change by Engagement Status

Status	N	Mean	Std. Deviation	Cohen's *d*
Engaged	42	4.90	10.16	0.74
Not Engaged	21	-1.91	6.78	0.74

As shown by the results of the independent samples *t*-test, a significant difference did exist between the two independent groups. According to Cohen (1988), an effect size of less than .20 indicates that results should be deemed as trivial even if the *p*-value is significant. The effect size (Cohen's $d = .74$) of the current study participant groups was large enough to be considered a large effect meaning a non-trivial difference existed between the two groups.

As such, the results provide enough evidence to state that participating high school students whose engagement status indicated that they were consistently on pace in their respective mathematics courses averaged more growth as measured by the STAR™ Mathematics NCE scores ($M = 4.90$, $sd = 10.16$) than high school students who were not considered engaged ($M = -1.91$, $sd = 6.78$). The results also indicated that high school virtual school students who are not consistently engaged do not achieve the same amount of growth as virtual school students who are consistently engaged. This supports H1.

RQ2. To what extent is there a difference in student growth as measured by changes in STAR™ Mathematics pre- and posttest NCE scores between middle school mathematics students who were engaged and middle school mathematics students who were not engaged as indicated by their on-pace status at the end of one semester in one Florida Virtual School franchise?

H2. There is a difference in student growth as measured by changes in STAR™ Mathematics pre- and posttest NCE scores between middle school mathematics students who were engaged and middle school mathematics students who were not engaged as indicated by their on-pace status at the end of one semester in one Florida Virtual School franchise.

An independent samples *t*-test was conducted to address RQ2. As shown in Table 10, the mean difference in student mathematics achievement growth, as measured by the change in NCE scores, from pretest to posttest of engaged students was compared to the average difference in growth from pretest to posttest of not engaged students. The level of significance was set at .05. Results indicated that middle school participants who were consistently engaged throughout one semester achieved higher mean changes between pre- and post-NCE mathematics scores (M = .10, SD = 10.13) than those who did were not consistently engaged (M = -6.28, SD = 10.67). The results of the independent samples *t*-test were found to be significant, t (69) = 2.4, p = .02. The results of the independent samples *t*-test indicated that there a statistically significant difference existed between the two means. A Cohen's *d* test of effect size was subsequently performed on the data which resulted in a Cohen's *d* of .62. See Table 10 for the group statistics.

As measured by the results of the independent samples *t*-test, a significant difference did exist between the two independent groups. According to Cohen (1988), an effect size of less than .20 means that results should be deemed as trivial even if the *p*-value is significant. The effect size (Cohen's $d = .62$) of the current study participant groups was large enough to be considered a large effect meaning a non-trivial difference existed between the two groups.

As such, the results provide enough evidence to state that participating middle school students whose engagement status indicated that they were consistently on pace in their respective mathematics courses averaged more growth as measured by the STAR™ Mathematics NCE scores than did middle school students who were not considered engaged. The results also indicate that high school virtual school students who are not consistently engaged do not achieve the same amount of growth as virtual school students who are consistently engaged. This supports H2.

Table 10

Middle School NCE Change by Engagement Status

Status	N	Mean	Std. Deviation	Cohen's *d*
Engaged	49	.1020	10.13	.62
Not Engaged	22	-6.277	10.67	.62

Additional Analyses

The results of the study indicated that both high school and middle school students at one virtual school in the state of Florida who remained engaged throughout the semester attained higher NCE mean growth scores compared to virtual school students who did not remain consistently engaged. In the current study, students who were not consistently engaged throughout the semester were identified as not engaged regardless of the level of non-engagement.

For instance, students who were not on pace for one week of the semester were counted equally with students who were not on pace for several weeks throughout the semester. As such, two additional independent samples *t*-test were conducted to determine if the level of engagement throughout the semester would impact the results. Table 11 and Table 12 show the results of the independent samples *t*-test of high school and middle school students with the exclusion of students who were not on pace for one week. The results for high school were significant when the one-time not engaged students were included, $p = .007$, and statistically significant when the one-time not engaged students were excluded, $p = .003$. Therefore, regardless of the number of times a student was not on pace or engaged throughout the semester, the outcome was similarly significant in that there was a difference between engaged virtual school mathematics students and not engaged virtual school mathematics students in terms of growth.

Table 11

Comparison of High School Engagement Results Between Included One-Time and Excluded One-Time Not-Engaged Students

	N		Mean			
	Engaged	Not Eng.	Engaged	Not Eng.	*t*	Sig. (2-tailed)
Included	42	21	4.90	-1.91	2.78	.007
Excluded	42	13	4.90	-4.34	3.11	.003

Table 12

Comparison of Middle School Engagement Results Between Included One-Time and Excluded One-Time Not-Engaged Students

	N		Mean			
	Engaged	Not Eng.	Engaged	Not Eng.	*t*	Sig. (2-tailed)
Included	49	22	.1020	-6.28	2.414	.018
Excluded	49	18	.1020	-7.15	2.505	.015

Summary

Chapter 4 included a summary of the descriptive statistics of the participants including student gender and grade level. The chapter also included the results of the data analysis and hypothesis testing for the two research questions. The results revealed that differences in achievement existed between engaged and not engaged virtual school students in one virtual school in Florida. The difference between engaged and not engaged student NCE pre- to posttest scores was similar for both middle and high school virtual school students.

The interpretations of the results are presented in Chapter 5 with a summary of the major findings, and a discussion of how the results of the study related to research covered in Chapter 2. Also presented in Chapter 5 are the implications of the findings and suggestions for future research.

Chapter 5

Interpretation and Recommendations

The rapid growth in virtual schools and virtual school enrollment has far outpaced the research and development necessary to meet these challenges (Barbour, 2017). In terms of achievement of virtual school students, educational leaders and stakeholders claim that they face many challenges and are in need of better information and more specific student engagement strategies (Watson et al., 2013). According to Lefkowitz as of 2015 the study of virtual school student engagement had yet to be sufficiently addressed. Gill et al. (2015) and Zweig et al. (2015) reported that both district leaders and teachers viewed low engagement levels of the online curriculum as their greatest challenge and indicator of achievement. The current study sought to build and improve on previous K-12 virtual school student engagement research, and to advance the development of strategies that will lessen the challenges of maintaining high engagement levels among virtual school students.

This chapter consists of an overview of the current study through a brief summary of the key aspects covered in the previous four chapters including the purpose of the research, and problem statement. The research questions and methodology are also summarized in Chapter 5, and the literature reviewed in Chapter 2 is related the major findings of the research. In addition, the major findings, implications of the results, relation of findings to the research literature, and recommendations toward future study are included in the chapter.

Study Summary

The intent of this study was to improve upon the knowledge of virtual school student engagement by providing empirical evidence of whether or not engagement impacted student achievement in mathematics for middle and high school virtual school students at one Florida Virtual School franchise. The current study relied heavily on the recommendation for further research found in previous virtual school student engagement research by conducted by Gill et al. (2015), Kim et al. (2015), Lefkowitz (2015), and Pazzaglia et al. (2016).

The study took place over the course of the first semester of the 2018-2019 school year. The participating school district was a FLVS franchise virtual school in a Florida school district. The school was selected due to the focus on student engagement, as well as their data collection procedures. Data were collected by teachers in the school district and coded by a representative of the district before being analyzed statistically with independent samples *t*-tests. Results of the current study were found in Chapter 4 with the major findings and implications following.

Overview of the problem. Since the early 1990s, the online learning landscape has grown exponentially (Barbour, 2014). Access to education outside the confines of a traditional brick-and-mortar setting has been an essential addition for students seeking credit recovery, who lack access to advanced level courses, who are homebound, or who are highly mobile due to the geographical movement of their parents. Experts suggested that the rapid rise in the number of virtual schools and virtual school students created issues and concerns that have impacted student learning and have not been sufficiently investigated (Miron & Urschel, 2012; Watson, 2008; Watson & Murin, 2014). Student achievement and academic success are two of the major concerns which have not been addressed. According to Kim et al. (2015), and Zweig et al. (2015) teachers and administrators consider engagement as the leading factor of virtual school student success.

Virtual school student engagement is one of the greatest concerns regarding virtual school student success of both virtual school administrators and virtual school teachers (Kim et al., 2015; Zweig et al., 2015). In 2015, Lefkowitz found that students with more years of experience in a virtual school had higher levels of agentic engagement. Pazzaglia et al. (2016) found a positive relationship between the amount of time a virtual school student spent engaged in coursework and the outcome in terms of course success and grade.

Purpose statement and research questions. This causal-comparative quantitative study was conducted to analyze student data from two groups of virtual school students enrolled in mathematics courses at one Florida Virtual School franchise to investigate if achievement of the group of students who remained engaged throughout one semester differed from the group of students who did not remain consistently engaged throughout the same semester. The purpose of the current study was to examine whether weekly monitoring of student engagement throughout one semester impacted student achievement as measured by changes in the pre- to posttest NCE scores on the STAR™ Mathematics Progress Monitoring Test (STAR ™) at one virtual school district in the state of Florida serving middle school and high school students.

Review of the methodology. The current study relied on teacher on pace data to determine student engagement status, as well as STAR™ Mathematics NCE change data.

Student engagement status and NCE gains scores were the variables in the study. Renaissance Learning (2015) found in a longitudinal study that the STAR™ Mathematics was a valid and reliable measure that could be used to monitor student progress. Renaissance Learning (2015) stated that with a mean reliability coefficient of .85, the test was a reliable predictor of student achievement on standardized test scores.

Total population sampling was applied for the current study. Participants were selected from one participating virtual school district in the state of Florida. The participating school district included a franchise of FLVS, which was chosen because FLVS is both the oldest and largest virtual school in the United States. Moreover, student achievement at FLVS have been historically equal to or above state averages in mathematics (Marshall et al., 2017). While several Florida Virtual School franchises were considered for use in the study, the participating school specifically maintained student on pace data that was coded into engaged or not engaged.

Independent samples *t*-tests were conducted for each research question. The results revealed that significant differences in achievement existed between engaged and not engaged virtual school students in one virtual school in Florida. The differences between engaged and not engaged student NCE pre- to posttest gains scores were similar for both high and middle school virtual school students.

Major findings. One of the intended purposes of this study was to add to the knowledge of virtual school student engagement by providing empirical evidence of whether or not engagement impacted student achievement in mathematics for high school and middle school virtual school students at one Florida Virtual School franchise. The premise used to create the hypotheses for the current study was that students who remained engaged in their virtual school mathematics course would have higher mean NCE gains scores compared to students who did not remain consistently engaged. It should be noted that the NCE gains score represents the amount of difference in growth between the individual test taker and the average growth of the population of the test takers for a given period. Therefore, an NCE gains score of zero does not mean that the student showed zero or no growth over a given period. Instead, an NCE gains score of zero represents that the individual improved at the same rate over a period of time as the mean for all test takers.

The hypotheses were confirmed by the results of two independent samples *t*-tests. The results of this study indicated the following:

- Mathematics growth at one FLVS franchise school of consistently engaged virtual school students differs significantly from the mathematics growth of students who were not consistently engaged for virtual school students at the high school level.
- Mathematics growth at one FLVS franchise school of consistently engaged virtual school students differs significantly from the mathematics growth of students who were not consistently engaged for virtual school students at the middle school level.
- High school students enrolled in a virtual school mathematics course at one FLVS franchise school who are consistently engaged rendered higher mean mathematics growth over time compared to virtual school students who were not consistently engaged.
- Middle school students enrolled in a virtual school mathematics course at one FLVS franchise school who are consistently engaged rendered higher mean

mathematics growth over time compared to virtual school students who were not consistently engaged.

- The amount of inconsistent engagement, or number of times a student was not engaged during the semester, did not change the outcome of engaged students achieving higher mean gains in mathematics for the high school group of virtual school students at one FLVS franchise school.
- The amount of inconsistent engagement, or number of times a student was not engaged during the semester, did not change the outcome of engaged students achieving higher mean gains in mathematics for the middle school group of virtual school students at one FLVS franchise school.
- As shown in Figure 3, virtual school students enrolled in a mathematics course who remained engaged throughout the semester obtained higher mean gains than those who did not remain consistently engaged throughout the semester.

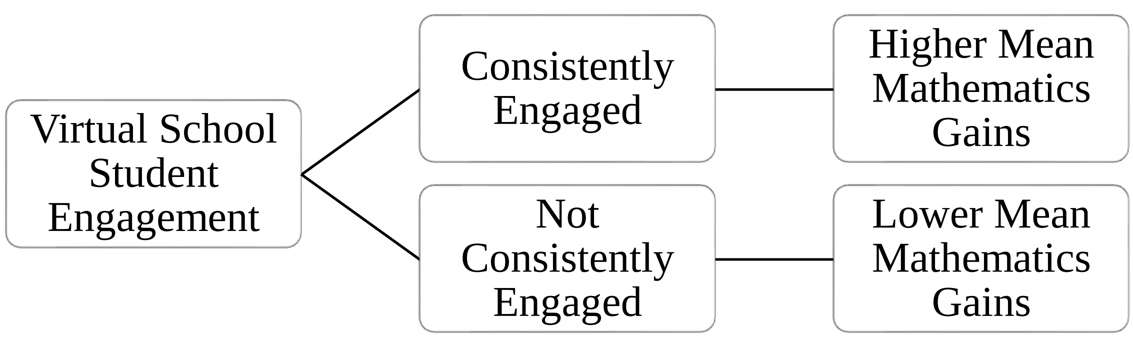

Figure 3. *Virtual school student engagement flow chart.*

Findings Related to the Literature

The purpose of this study was to examine whether weekly monitoring of student engagement throughout one semester impacted student achievement as measured by changes in the Normal Curve Equivalent (NCE) score on the STAR™ Mathematics Progress Monitoring Test (STAR ™) pre- and posttest scores in one virtual school district in the state of Florida serving high school and middle school students. The current study also investigated whether the minimum engagement strategy was more impactful for middle school students or high school students by comparing changes between pretest and posttest NCE scores.

Chapter 2 of this dissertation was a review of literature pertinent to the investigation into the impact of virtual school student engagement on mathematics achievement. A second purpose of the study was to add to the knowledge of virtual school student engagement research by Kim et al. (2015); Lefkowitz (2015); Pazzaglia et al. (2016) and Zweig et al. (2015) through an empirical examination of whether weekly monitoring of student engagement affected student mathematics achievement.

Kim et al. (2015) reported that teachers perceived the lack of student engagement as a major concern for virtual school teachers. The teachers referenced in the Kim et al. (2015) study viewed the lack of student engagement as the cause for low standardized test scores and poor student growth. According to Kim et al. (2015) the findings indicated that student success might rely on maintaining consistent engagement. The current study found empirically that the average success as measured by growth on the STAR™ Math differed between engaged and not engaged virtual school students.

Lefkowitz (2015) studied the increase over-time of agentic engagement of virtual school students in one Florida virtual school. Lefkowitz (2015) determined that the amount of student self-learning and engagement increased for students as they became more familiar and spent more time engaged with the virtual school curriculum. The results of the Lefkowitz study provided a foundation for future engagement studies targeting virtual school students. Lefkowitz (2015) stated that the investigation of virtual school student engagement was important and urged future researchers to look into how engagement and agentic engagement impact student achievement and success. The current study utilized a similar grouping of middle and high school students. The results of the current study fulfill a call by Lefkowitz (2015) to increase engagement research on virtual school students. Similarly, the results may indicate that if virtual school student agentic engagement increases over time and students who remain engaged outperform students who do not remain engaged, then perhaps agentic engagement is reduced when a student breaks the cycle of consistent engagement within a semester.

Zweig et al. (2015) found that administrators perceived engagement among virtual school students as a major concern. The administrators reported in a survey that they perceived the lack of engagement of some virtual school students as a barrier to success. The results of the current study also indicate that a lack of consistent engagement with the curriculum does reduce the amount of student growth as compared to students who were consistently engaged.

Pazzaglia et al. (2016) reported that the findings in their non-empirical study indicated that the amount of time spent engaged with the curriculum each week by students who are enrolled in virtual courses impacted success. Pazzaglia et al. (2016)

recommended further empirical studies to confirm the insights gained through the investigation. The results of the current study confirm that in one case at a Florida virtual school, students who remained engaged consistently outperformed students who did not remain engaged consistently.

Conclusions

As the number of K-12 virtual schools grows, the support in curriculum and learning services must also grow. Educational stakeholders expect a certain amount of student success regardless of the type of school the student attends. Especially important to the body of knowledge on student success is the relatively small amount of investigation into virtual school specific topics. One particular virtual school theme targeted by the current study was virtual school student engagement as it related to mathematics achievement. While the results of the study cannot be generalized, when added to the already existing knowledge and research of virtual school student engagement by Pazzaglia et al. (2016); Kim et al. (2015); Lefkowitz, (2015); and Zweig et al. (2015), a reasonable argument can be made that engagement impacts student achievement. The results of the current study indicated that virtual school mathematics students who remained consistently on pace throughout the entirety of one semester averaged higher NCE growth scores than their peers who did not remain on pace consistently.

Implications for action. The results of the current study indicated a significant difference between engaged students and non-engaged students on the basis of mathematics growth. Moreover, statistically significant results occurred for both groups tested. These results have implications in the areas of professional development and teacher training. The results also have implications for the virtual school curriculum creators.

The current study findings imply that virtual school leadership should enhance professional development to target student engagement. The average growth of students considered engaged out-paced the average growth of students who were considered not engaged. This finding implies that if administrative leadership could develop strategies and practices that increase the number of students who would be considered engaged under the current study's premise, then student success would also be increased.

Similarly, the teachers of virtual school courses should also find meaningful implication in the results of the current study. It could be argued that teachers can have the greatest impact on student engagement since the teachers have the greatest amount of contact with the students enrolled in their courses. Therefore, virtual school teachers should develop procedures and policies to improve student engagement and maintain consistent contact with students to prevent the loss of consistent engagement. It is recommended that virtual school teachers should focus their efforts on improving student engagement.

Higher education leadership of teacher education programs should also find interest in the result of the current study. While individuals training to become teachers may not know if they will eventually teach in a brick-and-mortar setting or in a virtual setting, the exponential growth of the virtual education sector increases the chances that teachers may have to teach a virtual course at some time in the future. Therefore, it is imperative that higher-education leaders of teacher education preparation programs focus a portion of the teacher training program on virtual school specific challenges. One of the major challenges of virtual school teachers and leaders is reported as student engagement. As such, the results of the current study implied that teachers could contribute to increased achievement and success of virtual school students through improved knowledge and training on engagement strategies. Teacher education leadership should also consider implementing virtual school specific courses into the required teacher education curriculum.

Recommendations for future research. In the current study, only virtual school student archival engagement and STAR™ Mathematics data from one Florida Virtual School franchise in the state of Florida was utilized for investigation. Therefore, the results of the current study only apply to the one school and one group of teachers and administrators at the participating school. The recommendations for future research include research that expands the scope of the current study, research that focusses on more descriptive demographic data, and a similar study conducted in other curricular areas.

It is recommended that a further study with a larger scope in terms of the participants, perhaps including all FLVS students, should be conducted to help determine if the results found in the current study exist on a larger scale. A better understanding of virtual school student engagement could be obtained through a similar quantitative study of virtual school engagement on a larger scale or in a different setting.

In the current study, no differentiation was provided for the level of student non-engagement. A student who was not engaged one time was equally weighted as a student who was not engaged several times. Therefore, further study is recommended which differentiates the level of disengagement could help determine if there exists a difference between virtual school students who were never engaged, sometimes engaged, and almost always engaged.

In the current study, the investigation of differences among student engagement and achievement based on demographic data were not conducted. A more precise understanding could be gained from a future investigation of how engagement impacts students of different ages, gender, or socio-economic status. A summation of the raw data of the current study showed that a difference in the sum of NCE growth did exist between male and female students (Appendix C). However, no statistical measure was conducted on the data.

While the current study only focused on virtual school student mathematics achievement, a similar study in other curricular areas such as English, science, and history will broaden the scope and increase the knowledge of how pace status and engagement impact student achievement as a whole. Likewise, increasing the amount of time between pretest and posttest evaluation may provide additional evidence that the results found in the current study exist on a larger scale than what was investigated in the current study.

One of the major obstacles of conducting the current study was the limited amount of data available on virtual school student achievement. Improved knowledge on factors impacting virtual school students on a macro level will require a more common and set standard of data keeping procedures. As such, a need exists for future research and development of a set of unified virtual school data maintenance and collection procedures.

Concluding remarks. The purpose of the current study was to gain a greater knowledge of how virtual school student engagement impacts student learning. The results of the current study indicated that at the participating school district, students who remained engaged throughout one semester had higher average growth scores in mathematics than students who did not remain engaged. As such, the results of the current study indicate that student engagement was an important factor in the mathematics achievement of the participating students. Future research should focus on similar engagement strategies with the goal of increasing the amount of student interaction with the curriculum. As enrollment in virtual school courses increases, the importance of investigating the challenges specific to the virtual school student population becomes more imperative.

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Appendices

Appendix A: Baker University IRB Approval

BAKER UNIVERSITY

Baker University Institutional Review Board

January 22nd, 2019

Dear Anthony Fulton and Sharon Zoellner,

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.

Please inform this Committee or myself when this project is terminated or completed. As noted above, you must also provide IRB with an annual status report and receive approval for maintaining your status. If you have any questions, please contact me at npoell@bakeru.edu or 785.594.4582.

Sincerely,

Nathan D. Poell

Nathan Poell, MA
Chair, Baker University IRB

Baker University IRB Committee
Scott Crenshaw
Erin Morris, PhD
Jamin Perry, PhD
Susan Rogers, PhD

Appendix B: Participating School District Request for Research Approval

[redacted]

January 22, 2019

Dear Mr. Fulton,

Our District Research Committee has reviewed your proposed study, "Virtual School Student Engagement and Mathematics Achievement a Quantitative Study: Does Monitoring Virtual School Student Engagement Impact Math Achievement," and approved it with the following requirements/comments:

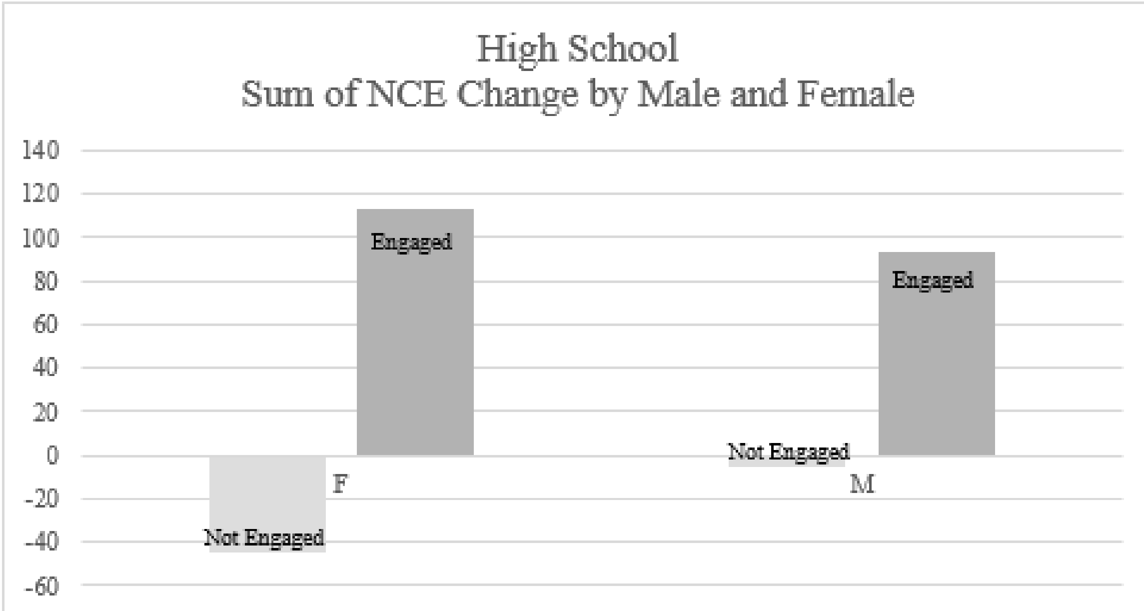
- Please conduct any research activities/tasks at the direction of [redacted], principal.
- Please ensure confidentiality of data and provide our office with a copy of the final report.
- Consider incorporating some additional variables in your study (e.g. demographic characteristics of students) to assist with interpretation of results.

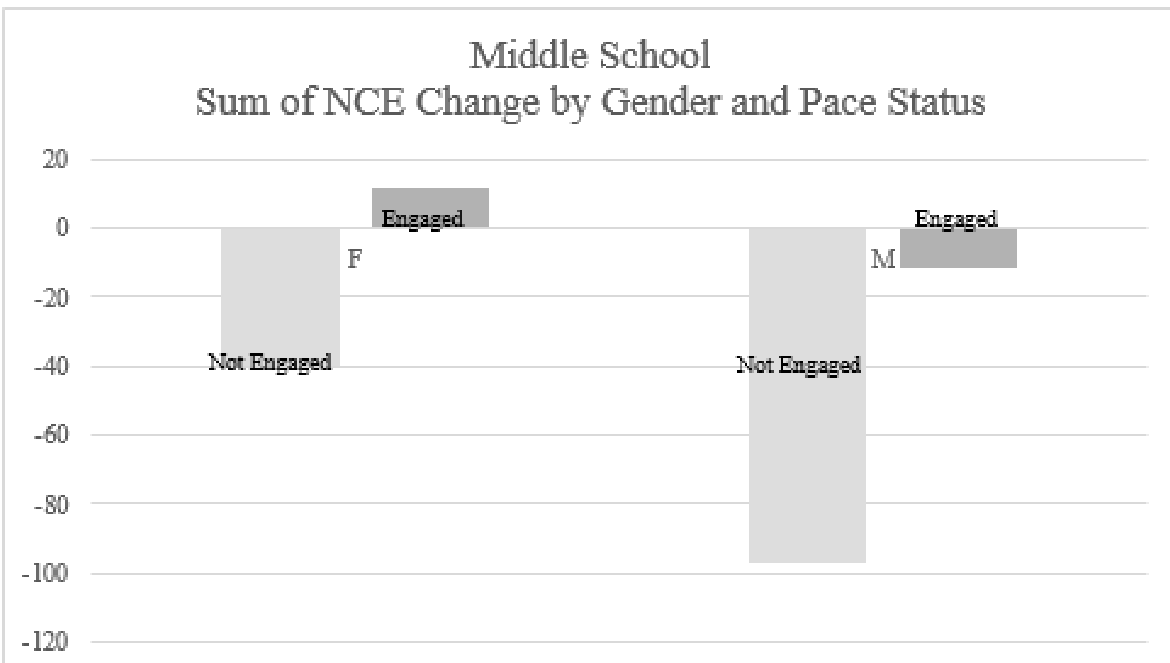
Please feel free to contact me via email to [redacted] or by telephone, [redacted] if you need anything further, and we look forward to seeing the results of your study.

Sincerely,

[redacted] Research & Assessment

Appendix C: NCE Score Change by Engagement Status and Gender


High School
Sum of NCE Change by Male and Female
140
120
100
80
60
40
20
0
-20
-40
-60
Engaged
Engaged
Not Engaged
F
M
Not Engaged


Middle School
Sum of NCE Change by Gender and Pace Status
20
0
-20
-40
-60
-80
-100
-120
Engaged
Engaged
F
M
Not Engaged
Not Engaged