VIRTUAL CLASSES: A COMPARATIVE STUDY ON THE OVERALL EFFECT OF VIRTUAL SCIENCE CLASSES ON HIGH SCHOOL STUDENTS' COURSE GRADES

by

Melinda Lee Maier

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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ABSTRACT

Due to the rapid growth of technology and implementation of virtual learning into the lives of students, there is a push for the evaluation of virtual educational programs. The purpose of this quantitative, causal-comparative study was to compare the impact of traditional, face-to-face instruction and virtual instruction on students' course grades. The sample included 272 high school students in Florida; 125 students were enrolled in a virtual honors-level course and 147 students were enrolled in a traditional, face-to-face honors-level course. The students were enrolled in honors biology, chemistry, or physics. The theories guiding this study were social learning theory, self-determination theory, cognitive load theory, and online readiness. Data were collected from archival information of students' course grades after the science course was completed, and the delivery method was noted. Separate *t* tests were conducted for each of the science courses. Assumption testing was run with the Kolmogorov-Smirnov and the Wilks-Shapiro tests. Results were not tenable; therefore, Mann-Whitney U tests were run. No statistically significant difference was found between median course grades of students who completed honors-level biology virtually or in a face-to-face format. It was also found that there was a statistically significant difference between course grades in honors-level chemistry and honors-level physics. The average course grade was higher for all three virtual classes than for the face-to-face classes. Recommendations for future research include examining the difference between the classes of virtual biology, virtual chemistry, and virtual physics, comparing how many virtual classes a student completes to the student's course grade, and more research on virtual classes at different grade levels.

Keywords: virtual education, face-to-face education, virtual readiness, cognitive load theory, self-determination theory, social learning theory.

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Dedication

This research is dedicated to my son Julius. Through all of this, you have been my sunlight in dark times. You are the greatest blessing and I am so appreciative to God for allowing me the honor of raising you. Thanks goes out to Keith who persuaded me to continue on this path even through the hard times. Thanks also goes out to the friends and family members who encouraged me along the way. Bebe, you have always stood in my corner, thank you.

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I would like to acknowledge Dr. Michelle Barthlow. Thank you for all of your help and guidance along the way. I truly appreciate it. I would like to thank my Lord and Savior for His guidance throughout this process. Without His grace and mercy I would not be the person I am today.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

AP	Advanced Placement
CLT	Cognitive Load Theory
FLVS	Florida Virtual School
SDT	Self-Determination Theory
SLT	Social Learning Theory

CHAPTER ONE: INTRODUCTION

Overview

Chapter One includes a brief background and explanation of the problem, purpose, and significance of this study. This study investigated a comparison of the effect on a student's course grade of completing a course virtually compared to through a traditional, face-to-face method. Chapter One identifies the research questions, hypotheses, and description of variables, as well as defines terms that pertain to the study.

Background

Instructional methods have long been studied in the field of education. Given the depth and breadth of educational research, numerous studies on traditional, face-to-face instruction exist. However virtual education has increased in popularity, particularly within the United States, over the last two decades. Many institutions believe that this instructional method will hold a prominent place in the future of education (Allen & Seaman, 2014). Further, as the use of technology increases, the demand for virtual options will increase. Yet despite the popularity of virtual education, there are few studies comparing the difference between virtual education and traditional education performance (Brandle & Lengfeld, 2017). Available literature comparing student performance in the traditional classroom compared to the virtual classroom has often resulted in inconsistent findings (Lack, 2013).

Technology and education often go hand in hand. Changes in technology elicit major changes in instructional activities and delivery, and virtual instruction has transformed the educational landscape. The exponential growth of virtual education indicates that it will encompass the majority of educational delivery methods in the future (Nash, 2015). Thirty-two percent of students in the United States are taking at least one virtual course (Abdul-Alim, 2013).

One such example of virtual education expansion exists in the state of Florida, where a prerequisite for graduation is the successful completion of one virtual course. Florida Virtual School (FLVS) is gaining in popularity now that one virtual course is necessary to graduate high school (Herold, 2013). FLVS is the first completely virtual public high school of its kind and is widely recognized as the most efficacious virtual school in the United States (Baugh, 2015). It is an option that most students in Florida are taking advantage of to satisfy their graduation requirements. FLVS, a virtual public-school district spanning the state, is open to students in kindergarten through 12th grade, with full-time and part-time enrollment options (Jester, 2014). Students have the option to take virtual classes free of charge that span core courses as well as foreign language, SAT preparation, honors, Advanced Placement (AP), and even physical education courses. FLVS continually increases in size and currently is the largest K-12 virtual school in the nation. It employs nearly 1,500 people and serves 130,000 students with a yearly budget of over 150 million. FLVS offers a large course selection which includes more than 150 courses (Catalanello & Sokol, 2012).

Historical Overview

Historically, traditional, face-to-face classes have been the means of education throughout the world. Face-to-face education is rooted in the social learning theory (SLT). According to SLT, changed behavior or learning occurs when people observe other people's behavior (Bandura, 1977). In the course of learning, people not only perform responses, but they observe the consequences of such actions as well. In the face-to-face classroom, students can witness other student's behavior and learn from this behavior. The students are also witnessing the consequences from such behavior and learn in that manner as well. With the shift

in education from face-to-face classes to virtual classes, interaction between students and teachers is changing.

Virtual education has positively impacted our society by infusing an optimism that has ushered in a new era of teaching and learning in schools (Capra, 2011). Many institutions believe that the virtual method of instruction is imperative for the future of education (Allen & Seaman, 2014). With progress, however, come some growing pains. Generally speaking, principles and practices of pedagogy have existed for centuries and measurement of student and staff performance has steadily improved over time. Virtual learning has many facets that can make performance management difficult. Blurred lines between traditional and virtual education create the need for effective evaluation of student progress, teacher performance, and pedagogical theories within the virtual school environment.

There are many reasons virtual education is in high demand. Ease of accessibility, the openness of different choices, and acceleration for the gifted and talented are some of these reasons. Academic leaders in the United States indicate that virtual learning is critical to the long-term growth of their institutions, reporting that the increase in demand for online courses or programs is greater than that for face-to-face courses (Yu-Chun, Walker, Belland, & Schroder, 2013). This further presents the need for student, curriculum, and teacher performance management to be uniquely defined within this learning environment.

Student success measurement leads to the subject of student readiness. This term is defined as students' preference for the form of delivery (Warner, Christi, & Choy, 1998). Are students ready for the changes that virtual school presents? As demand increases and students' confidence in electronic means of education increases, student readiness is also affected for the good. A factor that affects students' motivation and satisfaction is online learners' readiness

(Yilmaz, 2017). As students and teachers utilize virtual education, readiness for virtual learning increases because all involved parties are gaining experience and learning how to engage in autonomous learning.

Societal Overview

The quality of virtual education is a complex matter, especially given its multifaceted nature. Some authors link its quality to learning processes, products, and services based on the use of information and communication technologies (Marciniak, 2015). If quality of virtual education is low, then students and the educational community are not benefitting from the new educational delivery method and in turn student's readiness may not evolve into a successful model. There are many factors that influence the quality of virtual courses which include learner's expectations, readiness, identity, and participation in online courses (Kebritchi, Lipshuetz, & Santiague, 2017). Research on the assessment of virtual education is critical to inform educators about considerations and changes necessary for improving the quality of courses delivered virtually (Kebritchi et al., 2017). Student readiness is a vital element that must grow with their experience in virtual education and the success of a student in a virtual class is greatly attributed to their readiness to self-govern their own learning. Improving the quality of the courses delivered would only help the transition from face-to-face instruction to virtual instruction.

Virtual education is changing the model of education today. This unique opportunity allows students to take courses that are outside the realm of classes that are offered in the traditional school system. Virtual classes are transforming the traditional brick-and-mortar delivery method into a collective and networked participation of individuals to include teachers and students in an ever-changing and developing community of virtual instruction (Yadav,

Tiruwa, & Suri, 2017). Online learning has become an imperative part of higher education and will affect graduation rates for the better (Hackey, Wladis, & Conway, 2013).

Conceptual Framework

The concept of online readiness introduced by Warner et al. (1998) and featured three main components which were later expanded into the five subcomponents. The original three components were: confidence with technology, ability to engage in autonomous learning, and student preference (Warner et al., 1998). Through time and progression, online learning readiness was split into five subcomponents which include self-directed learning, learner control, motivation for learning, computer self-efficacy, and online-communication self-efficacy (Hung, Chou, Chen, & Own, 2010).

Hung et al. (2010) described learner readiness as consisting of five sub dimensions. Self-directed learning focuses on learner's ability to take responsibility for the learning context to reach their learning objectives. The concept of learner control refers to virtual learners' control over their learning efforts to direct their own learning. Thirdly, motivation for learning is related to online learners' learning attitudes, and the concept of computer/Internet self-efficacy is about online learners' ability to demonstrate proper computer and Internet skills. Finally, the concept of online communication self-efficacy centered on describing learners' adaptability to the online setting through questioning, responding, commenting, and discussing.

Online readiness is important to the success of virtual learners because it determines if the student has the capability to govern their own learning or can develop these qualities with instruction over time. Virtual learners need to understand the dynamics of a virtual setting, how virtual learning works, interactions, relations, perceptions, role of learner, and instructors. Learners could benefit if they gain understanding of the instructor's role, which is of facilitator

and guide (Vonderwell & Savery, 2004). Readiness is a variable which is often emphasized and measured in distance learning, e-learning, and virtual learning researchers (Horzum, Kaymak, & Gungoren, 2015). Readiness is an aspect of learning that plays a part in the success of virtual learners and can be studied by looking at their technological ability, previous virtual experience, and ability to be an autonomous learner.

SLT is rooted in learning that occurs on the basis of observation of other people's behavior. For learning to occur, a person must be motivated to act based on observing a behavior, performing such behavior, and being positively reinforced for such behavior (Bandura, 1977). Students learn in a face-to-face classroom by interacting with and observing their peers. Motivation to learn is a component of SLT. Bandura (1977) proposed learning involved four different stages: attention, retention, reproduction, and motivation. SLT applies to face-to-face classes because students are able to observe their peers and the teacher and reproduce behaviors if they have the motivation to carry out the action.

Another facet that has an influence on virtual learners is self-determination theory (SDT), which is concerned with the social factors that foster or hinder human flourishing (Ryan & Deci, 2017). SDT proposes three types of motivation that affects social factors: intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation is being able to complete a task based on a person's own inherent interest or satisfaction. Extrinsic motivation is characterized as obtaining a separable outcome, and amotivation is defined as "the state of lacking intention to act" (Butz & Stupnisky, 2017, p. 121). SDT underlines the existence of three psychological needs which include autonomy, competence, and relatedness. These three factors are needed for optimal motivation (Sanchez-Oliva, Pulido-Gonzalez, Leo, Gonzalez-Ponce, & Garcia-Calvo, 2017).

Motivation is a factor that influences a student's success with virtual education. The conceptual and empirical evidence from SDT, with regard to education, suggests that a system that emphasizes teachers' and learners' motivation, achievement, and well-being should consider the extent it provides a platform that supports basic psychological needs (Carr, 2015). Through SDT, it is important to understand the full concept of how the three types of motivation affect students' success in a virtual environment.

Problem Statement

Virtual education has become a graduation requirement in some states. High school students have to enroll in at least one class on the Internet in the state of Florida (Ackerman, 2010). The intent is to expose students to virtual classes to provide experience with technology and to allow them to be successful after high school. There is a lack of research as to the effectiveness of virtual classes compared to traditional face-to-face classes in regard to effect on a student's GPA. Researchers that examine a comparison from face-to-face versus virtual formats have conflicting conclusions about whether the students have the same learning outcome (Arias, Swinton, & Anderson, 2018).

There have been mixed results in studies when comparing the effectiveness of online education versus face-to-face education (Murphy & Stewart, 2015). Scant research exists that evaluates the impact of online learning as measured by a student's course grade. There is little empirical evidence in comparing the difference in student performance from online education versus traditional education (Brandle & Lengfeld, 2017). There is a need for research on virtual education so people are aware of the benefits and drawbacks of this type of educational delivery method, particularly when considering individual student and teacher patterns of behavior as related to readiness (Kooiman, Sheehan, Wesolek, & Retegui, 2017). Despite the increasing

development of virtual education in recent years, its effectiveness compared to traditional classroom learning is understudied, and what studies there are have returned mixed results (Ross, 2013). As enrollment in virtual classes increases and technology is changing the delivery method of education, there is a need for more research in this field of study (Fernandez, Ferdig, Thompson, Schottke, & Black, 2016).

The lack of data comparing online learning to face-to-face instruction goes beyond FLVS. In fact, there lies a great discrepancy between research in the effectiveness of virtual education compared to traditional face-to-face education (Brinson, 2017). Furthermore, a need for more research in evaluating the effectiveness of virtual schools and classes exists. According to Brinson, there was an evaluation of 56 studies on the effectiveness of virtual education compared to traditional education and the results were mixed. The problem is that studies examining the effectiveness of virtual classes compared to traditional classes have produced mixed results.

Purpose Statement

The purpose of this quantitative, causal-comparative study was to compare virtual classes to face-to face classes and how each delivery format impacts students' course grades, since there is a gap in the current research in this area. A causal-comparative research design seeks to find relationships between independent and dependent variables after an action or event has occurred. The researcher's goal was to determine whether the independent variable affected the outcome, or dependent variable, by comparing two or more groups of individuals ("Causal-Comparative Design," 2010). The study utilized a causal-comparative design because the students have already taken the courses and the researcher examined the impact the delivery method had on a student's course grade.

The independent variable in this study was the course delivery format, either a virtual class or a face-to-face class in high school science to include honors biology, honors chemistry, and honors physics. The independent variable was not manipulated in this causal-comparative study. A causal-comparative study attempts to identify cause and effect relationships. The dependent variable, or measurable variable, of this study was course grade. This study assessed a student's course grade after the virtual school class or face-to-face class was taken.

The population of this study included Florida high school students who have participated in and completed a virtual course or a face-to-face course in honors biology, honors chemistry, or honors physics and earned a grade in the course. Students were randomly chosen, and all students were enrolled in courses in Florida. The study had a sample size of 272 students; 93 completed honors biology, 91 completed honors chemistry, and 88 completed honors physics. The data collected from this research study provided more information on the effectiveness of virtual schools in comparison to traditional classroom settings.

Significance of the Study

Comparing the effectiveness of virtual education to the effectiveness of traditional education shows mixed results when studied (Ross, 2013). In studying recent research, Brinson (2017) concluded that when focusing on empirical evidence that comparatively assessed the effectiveness of virtual education compared to traditional face-to-face education there are discrepancies in the data that show different results for different research studies. This study added to the literature on the effects of virtual education compared to that of traditional face-to-face formatted classes in the fields of biology, chemistry, and physics.

Currently, there are 24 state virtual schools who serve more than 460,000 supplemental students and more than 200,000 in Florida (Beck & LaFrance, 2017). There is an emergence of

virtual education being offered to students but from a lack of research, the effectiveness of these institutions is questionable. The knowledge gained from a training institution is the main result of an educational process and its quality must assure this (Barbera, 2004). Virtual education must meet the needs of the students while delivering quality educational experiences.

This research study provided valuable information that assessed the effect of virtual school classes on student's course grade compared to those same courses offered at a traditional school. Since students across the state of Florida are mandated to take a virtual school class for graduation, it would be imperative that virtual school classes not hinder students in Florida from being competitive with their course grades compared to other students outside the state that are not mandated to take a course in a virtual format.

Research Questions

RQ1: Is there a difference in students' course grades between students enrolled in a virtual high school *biology* course and students enrolled in the same *biology* course taught in a traditional classroom format?

RQ2: Is there a difference in students' course grades between students enrolled in a virtual high school *chemistry* course and students enrolled in the same *chemistry* course taught in a traditional classroom format?

RQ3: Is there a difference in students' course grades between students enrolled in a virtual high school *physics* course and students enrolled in the same *physics* course taught in a traditional classroom format?

Definitions

1. *Blended Learning* - combination of traditional face-to-face learning and asynchronous or synchronous e-learning (Liu et al., 2016).

2. *Florida Virtual School (FLVS)* - synonymous with distance learning in the state of Florida. It is the first completely online public high school in the state and is widely recognized as the most efficacious online school in the United States (Baugh, 2015).
3. *Virtual Learning* - the experience where teachers and learners are separated physically, only connected through a virtual network system where educational contents are shared and virtual communication occurs within students, teachers and staffs (Hassan, Abiddin, & Yew, 2014).

CHAPTER TWO: LITERATURE REVIEW

Overview

Virtual classes are consistently increasing in number, and the number of students in attendance in these courses is also increasing. This chapter will review research related to efficiency of virtual courses and traditional courses, factors that influence a student's learning, and the overall effects of these courses on students. This chapter will also address inconsistencies in the research and results reported in existing literature, as well as reveal need for more research related to virtual education.

Conceptual Framework

The conceptual framework is a gateway to introduce previous theories and concepts while offering a basis for the researcher's hypotheses. By definition, a conceptual framework is an instrument for organizing inquiry and inventing a theory-based and data-driven argument for the importance of the problem, rigor of the method, and implications for further development of theory (Antonenko, 2015). Virtual learning is grounded in theories and concepts that include: (a) SDT, (b) cognitive load theory (CLT), (c) SLT, and (d) the concept of online learner readiness. All of these theories and concepts are linked to student achievement in virtual courses and impact the students' course grades.

Self-Determination Theory

The term motivation is derived from the Latin verb *movere*, meaning to move. In other words, motivational theories attempt to answer questions about what prompts individuals to move and toward what factors (Pintrich, 2003). SDT examines how biological, social, and cultural conditions that either heighten or diminish the inherent human capabilities for growth, engagement, and wellness (Ryan & Deci, 2017). SDT focuses on types, rather than amount, of

motivation, with an emphasis on autonomous motivation, controlled motivation, and motivation as predictors of performance (Deci & Ryan, 2008).

SDT is based on two types of motivation, intrinsic motivation and extrinsic motivation. Intrinsic motivation is defined as "completing a task or activity out of pure enjoyment or interest" (Kessler, 2013, p. 274). Extrinsic motivation is defined as "completing a task or activity based on an instrumental reason to obtain something tangible in return such as a consequence or reward" (Kessler, 2013, p. 273). SDT research contributes behaviors to the sum of extrinsic and intrinsic motivation both working in unison to influence the total motivation of the person (Ryan & Deci, 2017). SDT research has concluded that tangible rewards can often undermine intrinsic motivation, and the conditions for this are clear and predictable (Kessler, 2013). At times, extrinsic motivation may interfere with intrinsic motivation, thus becoming an inhibitor.

Since virtual education is becoming more widely used across the world, motivation is one of the main components influencing the success of virtual learners. Yet, Taylor et al. (2014) have noted that many studies using the SDT perspective attempt to examine the relationship between how motivation in an academic area affects student achievement, but the results have been inconsistent. SDT research suggests that motivation is multidimensional, and behavior is often motivated by both internal and external factors (Johnson, Stewart & Bachman, 2015).

Studying motivation can provide useful data on which type of motivation is attributed to retention and success in virtual education. Johnson et al. (2015) conducted a study that surveyed 235 students who took an online course at a large, public, urban university in the southeastern portion of the United States. The results showed that extrinsic motivation for students predicted how many virtual classes the students completed, and when comparing previous research, the

outcome was not in the expected direction. This finding contradicted past research that attributed intrinsic motivation to student persistence. The study concluded with a recommendation for more research in the effects of extrinsic motivation in the sustainment of taking online classes over a longer period of time.

Since the inception of documented research regarding SDT, a significant relationship has not been found that tied SDT to learning outcomes. Chen and Jang (2010) examined how SDT predicted six learning outcomes (predicted grade, final grade, perceived learning, hours per week studying, number of times they clicked on course material, and course satisfaction). Chen and Jang's (2010) study did not support their predicted effect on learning outcomes, nor did the study back up previous studies linking SDT to gained learning outcomes in the traditional face to face classroom (Deci & Ryan, 2008; Deci, Vallerand, Pelletier, & Ryan, 1991; Jang, Kim, & Reeve, 2012). The study did, however, enrich educators' understanding of what motivates virtual learners and helped them develop standard learning practices. Overall, the study showed a need for research in the field of how motivation affects virtual learners and their success in a different educational platform.

Since virtual education is not limited to the United States it is also important to compare learners from different social backgrounds. Lim (2004) conducted a study to compare United States and Korean virtual learners and document the differences in motivation. He identified six motivation factors: reinforcement, course relevance, interest, self-efficacy, affect, and learner control. The results of the study showed that virtual learners from the United Sates exhibited significantly higher motivation scores for course relevancy, course interest, reinforcement, and self-efficacy. Virtual learners from Korea exhibited higher motivation scores for learner control. It was also noted that American students feel more accomplished when they finish virtual

assignments than their Korean counterparts. This observation can be attributed to a student's readiness and computer self-efficacy, and the intrinsic feeling of accomplishment in finishing a course using their personal skills. Lim (2004) suggested that future studies should include an investigation on how variables influence student learning achievement and outcomes in a virtual learning environment.

SDT research focuses on how intrinsic and extrinsic motivation factors in with virtual education. This theory provides a basis for explanation of one factor that influences a person's success within virtual education and how it impacts a student's success in completing and doing well in virtual courses. Each facet of motivation can be attributed to either the success or retention of learners in a virtual community. Future studies that examine the different types of motivation and how they affect learners will provide more information on how successful students are as they take on more virtual education courses. Even though applying SDT to a face-to-face environment has been fruitful and has been found in research, there have been limited attempts and limited research applying it to virtual learning (Hsu, Wang & Levesque-Bristol, 2019).

Cognitive Load Theory

CLT refers to a human's working memory required to gain information and carry out learning tasks. It assumes that human memory is divided into two parts which include working memory and long-term memory (Sweller, 1988). Working memory refers to the facet of memory where people consciously and intentionally process information and construct new knowledge (Kalyuga & Singh, 2016). This theory looks mainly at the architecture for biologically secondary skills. Biologically secondary skills are a more specialized form of ability which requires the mastery of a skill. Compared to biologically primary skills, which are

necessary for growth and evolution, biologically secondary skills essentially fine tune primary skills (Sweller & Paas, 2017). CLT has an impact on the success of students who take virtual classes.

CLT describes three different areas of cognitive load imposed on a learner's working memory which include intrinsic, extraneous, and germane (Sweller, 1988). Intrinsic cognitive load describes information processed for the learning task at hand and is influenced by the learner's knowledge of the subject material and inherent difficulty of the information. Extraneous cognitive load refers to the irrelevant aspects of instruction that impose additional burdens, such as large pieces of information that need to be processed in order to understand the content. Germane cognitive load adds additional cognitive burden to working memory and are hindrances to learning (Sweller, Ayres, & Kalyuga, 2011). Germane cognitive load refers to the effort needed to fuse together the new information into meaningful mastery.

Altogether, intrinsic, extraneous, and germane cognitive load are three facets of CLT which contributes to a framework for instructional design that provides insight for educators to try and maintain intrinsic cognitive load while decreasing extraneous load and promote germane cognitive processing (Chen, 2016). CLT operates under the basis of learning that results from information being processed, with a limiting working memory. CLT is responsible for a number of advances in educational practices because it focuses on the implications of human cognitive architecture for the characteristics of effective learning and instruction (Sepp, Howard, Tindall-Ford, Agostinho, & Paas, 2019).

Through research on CLT, many learning environments have been impacted through these advances in educational practices. One example of advancement is the evidence revealing the theory that physically enacting the concepts to be learned may support the consumption of

the information more effectively (Hu, Ginns, & Bobis, 2014, Mavilidi, Okely, Chandler, Cliff, & Paas, 2015). Another example of advancement in educational practice, as a direct result of research in CLT, is the theory that information is acquired more effectively when it is integrated rather than distributed (Chandler & Sweller, 1992). Research in CLT has resulted in overall betterment of educational practices and the theory continually changing as more research is completed and evaluated.

Research on CLT has focused primarily on identifying the device that enhances the cognitive learning outcome. However, researchers have given less attention to how cognitive load and motivation work hand in hand (Feldon, Callan, Juth, & Jeong, 2019). There is a need, in research, for studies that look at how cognitive load and motivation work together highlighting the results of both working simultaneously. CLT has advanced rapidly and has been used to enhance learning and teaching in certain subject areas (Sweller et al., 2011). Research studies of virtual education, based on cognitive load, continue to identify new issues and aspects that direct the researcher in justifying the effectiveness of the technology and application in virtual education, which include a learner's prior knowledge and motivation (Kalyuga & Liu, 2015).

Another aspect of CLT is extraneous load. This may be minimized by lowering the purposeless load through lessening the effect of the environment on learning (de Araujo Guerra Grangeia et al., 2016). Working memory necessary for information processing can be increased when extraneous load is decreased (Hadie et al., 2018). The extent to which virtual learning environments affect cognitive processes has been given little attention in the research. Comparatively, Novak, Daday, and McDaniel (2018) remarked that many studies have shown that students employ different learning habits in a virtual setting compared to a traditional classroom setting.

Social Learning Theory

SLT provides a useful framework that is rooted with learning through a social interaction and setting. Bandura (1977) proposed that this type of learning is comprised of four different stages which are attention, retention, reproduction, and motivation. The first stage, attention, is where a person is observant of a behavior or knows what behavior someone is seeking in them. The second stage of retention is where a person remembers what they have observed. The third stage of reproduction is where a person processes the attention and retention stage and mimics or reproduces the behavior. The fourth stage is motivation, and this is where the person is motivated to reproduce the behavior and this stage occurs through reinforcement.

Through traditional, face-to-face education, students are able to transition through all stages of the SLT. According to Gibson (2004), changed behavior or learning occurs through the observations of others or models that occurs from their priorities or preferences toward different outcomes or behaviors. Students in a face-to-face classroom are constantly observing behaviors of their peers and teachers. This provides a foundation for success, so students understand what acceptable behavior looks like to reach desired outcomes. SLT provides a platform in which students can learn through direct and indirect observation and continue to have learning experiences when they are participating in the observer role.

There is interaction with peers and teachers in a virtual environment as well. Students in a virtual environment may be influenced by social interactions from their face-to-face peers as well as peers in their virtual environment (Miller & Morris, 2014). True virtual peers are individuals who only have communication and a relationship through electronic means and never meet face-to-face. Miller & Morris (2014) claim research surrounding the influence of virtual

peers is limited and warrants further research in developing a deeper understanding of social learning and interaction. The major research in the field of SLT is concentrated on face-to-face interactions for learning.

Online Learner Readiness

The concept of learner readiness to take virtual classes is one facet of success in virtual education. Warner et al. (1998) defined readiness for online learning as a combination of student's learning preference, their ability to use technology for communication, and their ability to take responsibility for autonomous learning. On the other hand, Hung et al. (2010) defined a student's readiness for online learning as their ability to be self-directed learners which ties in their motivation to learn, and employ learner control. Readiness places a strong emphasis on being a self-regulated, self-directed learner. The current rapid increase in virtual education enrollment creates an urgent need for self-regulated learning (Tsai, 2018). Self-regulated learners are defined as learners who are metacognitively, motivationally, and behaviorally active participants in the process of their own learning (Zimmerman, 2008). Self-regulated learning skills are important in virtual learning environments in which students need to be in charge of their own learning process and be in control of complex decision making about which problem-solving tasks to prioritize (Baars, Wijnia, & Paas, 2017).

Readiness for learners is a factor that influences the success of learners in a virtual class. According to Warner et al. (1998), the concept of readiness for online learning was proposed in Australian vocational education and is a factor that influences the success of learners in a virtual class. A concept of readiness for online learning was developed. Readiness for online learning is defined in terms of three aspects; (a) students' preferences for the form of delivery as opposed to face-to-face classroom instruction, (b) student confidence in using electronic communication

for learning and, in particular, competence and confidence in the use of Internet and computer-mediated communication, and (c) ability to engage in autonomous learning (Warner et al., 1998). The increasing use of technology has created a shift in the way people are learning. The effectiveness of such usage depends on how people perceive and accept the new technology.

It is important to understand if the student is ready to take a virtual class and what their level of readiness is. According to recent studies, Buzdar, Ali, and Tariq (2016) found that students are not confidently prepared to adopt virtual learning. There are factors that influence a student's success in a virtual class and not all students are at the level of comfort approaching a new format of education. Since the dropout rate is increasing for virtual learners, Farid (2014) conducted a review of student readiness. This review shows that, for virtual school students, learning readiness is a multidimensional construct that entails factors that include computer Internet self-efficacy, self-direction, motivation, interaction, and attitude. There are many factors that influence a student's online readiness and some students are forced to drop their virtual class because they are not entirely ready to succeed in a virtual environment.

One aspect of readiness is how comfortable they feel in a virtual environment. Since most students have studied in a traditional classroom, it can be daunting for some students to change to a new format of instructional delivery. In a small study, Fincham (2013) conducted an evaluation of virtual learning with 28 participants. Some students in the study were more comfortable than others with engagement in the virtual classroom, some were more comfortable than others in face-to-face seminars, but all students gained from a blend of learning methods. As with any innovation, frequent and regular use is the best way for staff and students to learn how to get the most from the experience (Fincham, 2013). A blended format allows students to

ease into converting to a class that is completely virtual by allowing them a glimpse into what virtual classes may entail.

In summarizing the research on the dimensions of online learning readiness and providing a clearer direction for future research, several key traits that successful virtual learning students possessed were identified. These traits included self-directed learning, motivation for learning, awareness of and interest in the topic, computer and Internet self-efficacy, learner control, and online communication self-efficacy (Hung et al., 2010). In this aspect, knowledge and skills of the students for motivation, communication, control and independent learning in readiness for learning are all important elements in meeting the individual needs of the students (Kaymak & Horzum, 2013). Learner readiness provides prior knowledge to be successful in beginning an online class.

Some studies tie learner readiness and motivation together because they are two key aspects that influence the success of online learners. Horzum et al. (2015) conducted a study to look at the relationship between online learning readiness, academic motivation, and perceived learning via structural equation modeling in the research. The study consisted of a sample size of 420 students, even though the total student population was only 750. A correlation research model was used. In the structural equation modeling, online learning readiness and academic motivation turned out to be the significant variables that predict perceived learning. The results showed positive and significant correlations between online learning readiness, academic motivation, and perceived learning, all correlation values were positive. Further analysis found that academic motivation and perceived learning increases when online learning readiness increases (Horzum et al., 2015). The results showing the correlation between motivation and online learner readiness gives this study credibility.

There have been other studies involving online learner readiness and other characteristic traits that make a successful virtual learner. Kaymak and Horzum (2013) conducted a study on online learner readiness, structure and interaction in online learning. There were 320 students involved in the sample of the study, with a population of 1,180 students. A quantitative research model was used in this study. This research found a positive relationship between readiness of virtual learning and interaction, which means that as interaction increases, the probability of students fulfilling their learning needs also increases. Student readiness plays a role in the success of a virtual learner and student interaction in the class activities also draws students toward success. Lau and Shaikh (2012) conducted a study to examine if there were personal qualities that affected learning readiness. The personal qualities that the study examined were gender, ethnicity, learning style, course year level, and financial status. There were 304 students involved in the study in which a quantitative approach was used, and a survey was used to collect data. The results from this research study found that one personal quality that affected learning readiness was having computer self-efficacy, but similarly the participants in the study were undecided toward learning preference. The results also showed that there were four human characteristics that significantly affected learning preferences. These characteristics include gender, ethnicity, course level, and financial aid status. Ethnicity and financial aid status showed significant effects on technical skills. The study also revealed that students' ethnicity significantly affected their attitudes toward computers. Chinese students scored significantly lower on learning preference but significantly higher on technical skills compared to their Malaysian counterparts.

Students exhibit different learning preferences and there are various factors that affect the student's success in learning all of the standards in the course (Lau & Shaikh, 2012). Learners

who choose to take a virtual course would need preliminary skills and characteristic traits such as the ability to motivate themselves enough as a learner to persevere through the course. Communication from other constituents like a teacher or students may not exist. Another skill that is necessary to be a successful virtual learner is computer literacy. Students will be severely lacking or nonexistent. Lastly, computer literacy is essential for success, students must be able to navigate the online course and engage in all activities as required.

By nature, distance education programs require learners to take ownership of their own learning, as opposed to traditional learning environments, where learners are required to follow a developmental sequence by the help of course books or other instructional materials (Kirmizi, 2015). Student online learning readiness continues to influence most institutions including all areas from their curricular development and pedagogies to entire academic divisions dedicated to web specific delivery. Institutions should measure student readiness because it can be of great concern for institutions as they face this challenge (Blankenship & Atkinson, 2010). A student's level of learner readiness is critical for success in a virtual course.

Related Literature

Education is increasingly urged to enroll more students, ensure student learning, improve graduation rates, and to do all this more efficiently. Educational institutions are seeking to determine how to achieve each of these goals. Online learning has been adopted by many institutions across the globe to expand access to instructional programs while addressing the increase of recent high school graduates, young adults, and even middle-aged students who seek further education or training, and to do so with an eye to controlling costs or avoiding construction of new buildings (Meyer, 2014; Mohapatra & Mohanty, 2017). Thirty-eight states appropriated less money to state-funded public higher education from 2011 to 2012. With the

push to have more students enroll in public education, increase graduation rates, and ensure student learning, virtual education can very well be the means to accomplish these goals. With the rising costs of education in a traditional, public school, classroom setting, virtual education offers an alternative.

Distance education holds tremendous promise, offering viable and attractive options for advancing student skills, increasing access, and potentially lowering the cost of educational services (Vasquez & Serianni, 2012). Several studies (Allen & Seaman, 2013; Watson, Murin, Vashaw, Gemin, & Rapp, 2011) have looked at learner readiness and the effects on success for virtual learners. There are many factors that contribute to a student's success in any learning environment. It is important to study the effectiveness of each learning platform to see which facets of the learning environment are conducive for productive learning to take place. Distance learning involving communication technology such as Internet-based distance learning enables institutions to conduct classes on limited budgets and with limited teaching staff while providing the same education quality to both distance and regular students (Pukkaew, 2013).

There are many factors that influence students in a virtual environment. Watson et al. (2011) investigated factors that influence success, and this qualitative study examined factors associated with students who were not successful in virtual courses. Their findings concluded that students who take virtual courses need support and to feel connected to the course and their instructor. The implication is that, without this institutional support, virtual education attrition rates increase. Watson et al. (2011) further stated that allowing online students to explore their learner readiness strengths and weaknesses, prior to enrollment within a virtual learning environment, could lead to positive results and an increase in virtual education retention, not only for the local university in this study, but for other education institutions as well.

Technology in Virtual Education

Given the popularity of technology-driven pedagogies and application across different course modalities, there is some question whether such methods positively influence student learning (Frantzen, 2014). Technology has transformed education, teaching attainment, and therefore has transformed learning (Goodchild, 2018). Frantzen (2014) conducted research and found that there is a positive effect on student learning in virtual courses if there is a sequential introduction of technologically based projects. He stated that there is a positive effect on student learning if the course assignments are technology based versus written work. Technology has enhanced learning and the utilization of different types of technology in a virtual format deepens the student's understanding of content thus allowing the student a different delivery format compared to a face to face classroom setting.

Virtual education is, by definition, grounded in technology usage; therefore, students must be able to utilize the required technology. Student readiness is key for students to be able to keep up with the demand of technological skills in the virtual classroom. Technology is changing at a rapid speed and for students to be successful in virtual courses, they need to be able to adapt to the everyday changes of the course modality. Success in a virtual format is heightened if a student has an active approach. Characteristics such as sufficient meta-cognitive competence, a high level of motivation, and capacity for learning from past experiences. Student readiness and motivation are key aspects of student success in a virtual environment. There are prerequisite technological skills that are important for students to possess to be successful in a class where the format is based on technology. Virtual classes utilize technology and inevitably students must be familiar with such technology to be able to at least navigate and be successful.

Since in this era of learning it is mandatory to be computer literate, even students in brick and mortar settings utilize technology (Hung, 2016).

Virtual education is experiencing growth in numbers and also interest. Allen and Seaman (2013) tracked virtual education for 10 years in the United States from 2002 to 2012. During this time the number of students taking at least one virtual course increased from 570,000 to a new total of 6.7 million. Among the topics studied were: time and effort put into virtual classes by faculty, learning outcomes of virtual classes online compared to face-to-face classes, faculty acceptance of virtual learning, and widespread adoption of virtual learning. The first report was written in 2003 and indicated 57.2% of academic leaders rated the learning outcomes in virtual education as the same or superior to those in face-to-face which, during 2013, increased to 77%. This shows an increase in leaders agreeing that learning outcomes in virtual education are the same or higher than brick and mortar settings. Over time, virtual education is viewed as equivalent in its benefit for students.

Changes in Virtual Education

All 50 states and Washington, DC, now offer some virtual experience in K-12 education. Of these, 40 states have state virtual schools or state-led online learning initiatives (LaFrance & Beck, 2014). Quality assurance applications and concepts in virtual education are still being researched and emerge with an evolving relationship with social, economic, cultural, and technological developments (Vlachopoulos, 2016). While K-12 virtual schooling has grown in popularity, research-based investigations into the instructional practices implemented to support student's academic success are still lacking (Barbour & Reeves, 2009). Research is needed to provide feedback on the effect of instructional practices to know if the practices are beneficial to the student's success.

K-12 virtual schooling is gaining recognition as an alternative to the traditional face-to-face educational setting by providing students with access to anytime, anywhere learning opportunities (DiPietro, 2010). According to the United Nations Educational, Scientific, and Cultural Organization, education is a means to empower children and adults alike to become active participants in the transformation of their societies. A society where technology has transformed and is transforming depends highly on education to pass along knowledge, understanding, and knowhow of the technology that leads to the transformation (McFarlane, 2011). Technology is a new dimension of education and it allows students to broaden their horizons while meeting the needs of tomorrow by continued learning of the technology skills necessary to succeed.

Virtual education has exhibited major growth in the last 20 years allowing more and more students the opportunity to partake in virtual classes. At the K-12 level, virtual education experienced rapid development since its emergence in the late 1990s. Thousands of students were attracted to virtual education because of the advantages it brings such as flexible and expanded learning time, more educational opportunities, and increased access to resources (Liu & Cavanaugh, 2011). Virtual education is increasing in popularity and it is quickly infiltrating from university studies to high school students enrolling in courses.

Historically, distance education has been the province of adult and university study programs. However, the context is quickly expanding to include adolescent learners (Borup, Graham, & Davies, 2013). Virtual courses are an alternative to traditional classroom courses and allow students a choice in which method is more effective for them. Virtual learning is defined as "teacher-led education that takes place over the Internet, with the teacher and student separated geographically" (Watson et al., 2011, p. 2). Since the teacher and student do not have

to be face-to-face this allows more flexibility in each person's schedule. Students can access their coursework at any time granted they have access to the Internet and a computer.

A study conducted with 250 students from Open High School of Utah, a virtual charter school, investigated see how online learning can transform student learning. The students were surveyed to evaluate the overall effectiveness and grade outcomes for their virtual courses. The results showed a significant correlation between students' grade and their overall time spent on learner-learner interactions and social learner-learner interactions (Borup et al., 2013). This research is significant because it provides pertinent information regarding why students achieve higher scores in virtual classes. The students' grades were a direct reflection of the amount of interaction students enjoyed with each other.

When students feel a part of a community, they are more apt to be successful in a virtual course. Discussion boards are a major part of virtual courses and this allows students a way in which to communicate, voice concerns, or just respond to questions that each student may have. As previously mentions, interaction has shown to be a contributor to success. The more interaction that students have with peers and the teacher, the more comfortable they feel. This form of communication adds support to a student and the more responses the student receives from the teacher or other students the higher the confidence that student may possess (Borup et al., 2013). Student engagement through thinking, talking, and interacting with the content, other students, and the instructor is crucial for the success of a virtual learner because students can feel isolated or disconnected to the class if they do not interact on a regular basis (Dixson, 2015).

There is a need for worthy analysis of virtual school classes versus a traditional classroom setting. It is important to know if students are succeeding in a virtual school class since they are being required to complete one virtual class for graduation requirements in some

states. The goal of education is to build students' knowledge base and allow them to be successful learners. In 2009, the U.S. Department of Education performed a meta-analysis and review of virtual learning studies and found that "classes with virtual learning on average produce stronger student learning outcomes than do classes with solely face-to-face instruction" (Means, Toyama, Murphy, Bakia & Jones, 2009, p. 18). In these findings there arose other concerns such as the amount of time on assignments greatly differs between virtual and face-to-face traditional teaching methods. There is a need for more research in regard to virtual instruction as technology changes and enrollment in online courses increases (Fernandez et al., 2016).

Comparison of Virtual Education to Traditional (Brick-and-Mortar) Education

Ilgaz and Gülbahar (2015) examined the readiness and satisfaction of virtual learners. The study proved that readiness of the learner in the virtually formatted class was directly linked to access of technology, time management, and delivery approach of the instructor. The participants of the study determined their success was directly linked to increased interaction with the professor and other students in the class. This allowed the students to feel more of a community feel instead of being alone in the educational process. After the virtual learning experience, it was observed from the results of quantitative analysis that the participants' satisfaction levels were mainly affected by instructional content, communication, usability, and teaching process. The dimension they were most happy about was instructional content, which can be said to be the heart of virtual learning (Ilgaz & Gülbahar, 2015). Virtual learning offers a wide array of delivery methods that are centered around technology, which allows all students to have access to different courses they may not be able to directly have access to in a face-to-face formatted classroom.

Virtual classes differ from traditional classroom setting in respect to teacher-student support, time on tasks, technology issues, and access to support materials. The most prevalent issue is that students taking virtual classes have greater scheduling flexibility. There are many factors that play a role in how successful a student can be in a different style learning setting. Traditional classroom settings allow students to get immediate feedback from questions and allow teachers the opportunity to deliver the material in many different ways. Virtual classes have a set format in which students are required to exert the effort to learn. When a student needs help, the responsibility is on the student to reach out.

In comparing a traditional classroom setting to a virtual format of education, it is important to look at many factors that influence the educational process. Research regarding these factors provides important information into the success of virtual education. The implementation of a quality approach is dependent upon not only the producer, but also the student's involvement (Vlachopoulos, 2016). Virtual learning is different than traditional classroom learning by the advantages of mobility and interactivity of the training environment, ability to learn from anywhere in the world, and the existence of educational resources (Kerimbayev, 2016). Virtual learning is also beneficial because students can learn at their own pace, but it also requires students to exhibit virtual competence, engagement, and self-efficacy (Panigrahi, Srivastava & Sharma, 2018).

Virtual school has positive and negative attributes and can either expand or hinder a student's learning experience. Having the ability to access class any time, from any place, enables students to juggle extracurricular activities, sports events, and even employment schedules (Morgan, 2015). Students can utilize a computer to gain educational services and this allows the student to focus on schoolwork instead of the other variables that take place in a

traditional classroom setting. This model is beneficial for students who are able to keep a steady pace in their schoolwork. As society moves from an age of scarcity of information to an endless bound of information, opportunities for students to learn virtually have increased and the need for self-directed learning is emerging (Bonk, Lee, Kou, Xu, & Sheu, 2015).

With the advancements in technology, students on different continents were introduced to the Internet and communication throughout the world overnight (Oliveira, Gonçalves, Martins, & Branco, 2017). The Internet has opened possibilities for educational classes throughout the world. Comparing virtual education and traditional education, students may encounter trouble with technology, or a lack of technology which will limit their ability to be successful in the class, as in traditional settings those problems may not occur. Students also have to possess initial computer knowledge to be able to utilize the entire course and the supplements that come with the coursework. There are some aspects to taking a virtual class that differ from taking a class in a traditional classroom setting.

In some counties in Florida, students are not able to take AP courses because they are not offered through all high schools. Virtual school allows these students to have a direct access to AP courses through technology, and other courses that may not be offered at their particular high school. This choice eliminates any disparity between high schools, when compared to other students in the state. Today's students who are experiencing scheduling conflicts want flexibility to add to their current course choices or move faster in their program of study. Virtual school can afford this flexibility, as well as accommodate those who have illnesses which render them homebound or may have moved in from another state and need to catch up on high school requirements or make up failed courses for grade forgiveness (Goss, 2011). In the state of Florida, all residents of the state are entitled to free admission to FLVS. Students are required to

have the technology and Internet access. Some high schools offer use of technology, so students are able to complete the course and have the required tools.

As the use of technology increases, the demand for virtual school will increase. Students will be drawn to technology with the increased need for one-on-one help. Each student learns and understands material through different means. Technology can be a tool utilized to teach from multiple angles which allows constant engagement with the student (Moe, Cuban, & Chubb, 2009). The more ways a student is shown a certain educational standard, the easier it is for the student to learn and understand the concept. Virtual schools implement a multitude of ways to cover material and can accommodate every style of learner. Teachers can also utilize other means of presentation which require technology such as interactive labs and other science demonstrations for students to learn. Students can learn in a multitude of ways in a virtual environment because technology is growing every day.

FLVS was established in 1997 and functions as its own school system that is open to the public (Herold, 2013). Students from all over the country can enroll in virtual school classes offered by FLVS. Other countries also have access to FLVS. This allows each country an equal opportunity to have the same education as the students attending school in the United States. Students in the state of Florida are utilizing FLVS to acquire the one virtual class needed for graduation requirements and it is impacting the students' GPA. Since FLVS has only been in existence for 22 years, and is changing every year, it is important to make sure that it is evaluated effectively and efficiently.

FLVS is a growing virtual educational establishment that gains recognition and support and it is also considered the most efficacious virtual school in the United States (Baugh, 2015). It has built a distinctive educational philosophy, approach, and culture. At the same time, it has

maintained its identity as a public school and remains part of the system (Tucker, 2009). FLVS is growing in student numbers and is allowing students from the state of Florida to participate in classes that may not be offered to them at their public high school. FLVS offers over 110 courses and they accommodate students from working on GED courses to AP level courses. FLVS courses are delivered over the Internet through a variety of web-based and technology-based delivery formats. Access to traditional resources is also available and aid in the learning process (Findley, 2009). The credit students earn from FLVS is transferable and accepted by high schools in the state of Florida. It is important that if students are willing to take a virtual class that it goes toward their graduation requirements.

FLVS is one example of a virtual educational facility that tries to reach students and provide a successful educational experience. The days of teaching all students to follow along on the same page in the textbook are over. Funneling all students into a one-size-fits-all education is no longer acceptable (Young, Birtolo, & McElman, 2009). Students are engaged and have an option when it comes to the delivery method of education in today's world. Students are able to take most courses that they may not find at their local high school by means of virtual classes, in a different format than what they are used to seeing. Students have an option that many adults did not have in the past:~~,~~ They are able to complete courses via the Internet and utilize technology in such a way that they can learn almost anything from the comfort of their own home or in any setting that provides Internet access and a computer.

Virtual school, such as FLVS, is an institution to help students meet requirements to be successful in life. Students are allowed to attend FLVS cost free if they are Florida residents. FLVS, an online public-school district spanning the state, is open to students in kindergarten through 12th grade, with full-time and part-time enrollment (Jester, 2014). There is a need for an

increase in research to evaluate the effectiveness of FLVS on student performance. There are many debates about the effectiveness of virtual schools versus traditional face-to-face teaching delivery methods. Both institutions have to be evaluated using the same methods. This would be the only way to conduct controlled research in which other factors do not influence the outcome.

At times there is competition between virtual school and the tradition classroom setting. FLVS does not try to compete with traditional public schools. The school's mission is carefully crafted to fit in with, not fight with, Florida school districts. The school offers courses that are not available at traditional, face-to-face schools, or that do not fit well into a student's schedule, or that a student must take for a second time (Peterson, 2009). FLVS is an asset for students who have failed courses or need a class that does not fit their schedule during the traditional school day. Some students utilize FLVS to get ahead on their academic credits needed for graduation. FLVS is a great asset for students to allow them to have another option other than the traditional classroom setting and it opens possibilities for students to engage in different ways.

Evaluation of Virtual Education

A major question in reference to virtual education is the quality of education the student is receiving. The success or failure of virtual schools therefore depends on the ability of policymakers and parents to evaluate their quality. Policymakers need to know whether a given virtual school meets some minimum standard so as to be acceptable as a choice for parents dissatisfied with their traditional options (Chingos, 2013). To get a consensus on virtual education in comparison to education in a traditional classroom setting, both forms of delivery would have to have the same quality. Both forms of delivery would also have to be evaluating the students on the same grade point scale to evenly compare. There are many facets of

education that come into play when comparing one delivery method to another delivery method. To be accurate in looking at statistical data through course grades, both educational methods would have to be similar enough to rule out any outlying variables which could influence the results.

A myriad of delivery methods comes within the sphere of virtual learning, including telephone and web discussions, hands-on activities, web conferencing, videoconferencing, e-mails, and face-to-face meetings. Virtual courses offer students and teachers opportunities beyond the scope of their local districts, universities, and even states (Fox, 2006). Students partake in all types of experiences with virtual classes because technology is a major component that is already implemented into the subject material. Students can be provided different instructional methods in one lesson so that all types of learners can benefit. There are endless possibilities with virtual education because technology in today's world has become prevalent.

According to Alcena (2014) parental involvement is also another factor in the success of students in any educational setting. This can be problematic for virtual schools because they do not have the opportunity to have a face-to-face interaction with the students or parents. In order for parental involvement to occur and be effective, schools must provide parents with diverse opportunities to play their part in their children's education (Alcena, 2014). The more parental involvement that students have the more successful the student is in any academic setting. Since technology is involved, contacting parents on a large scale can be easier if they use all the means necessary. Through virtual classes, parents have access to information pertaining to their child's progression in the program which creates an open line of communication between the parent and the teacher.

In Florida, policies have been considered that will impact the future of virtual education and the students who participate in this format. Students who take virtual classes should be treated in the same manner as children enrolled in traditional face-to-face classes (Spangler, 2008). Both styles of institutions have to make sure they are serving the students with credible educational opportunities while delivering a beneficial learning experience where students can be successful and earn graduation credit. FLVS is funded by calculating how many students pass courses, conversely, traditional public school is funded, by how many students are enrolled (Catalanello & Sokol, 2012).

Virtual Science Courses

In the field of science, distance education causes constraints within the lab portion of these courses. The required laboratory exercises are part of the skill acquisition process (Potkonjak et al., 2016). Since FLVS offers science classes to students, it is important that students still acquire the hands-on skills needed in these classes, so they gain the experience that students in the same courses in face-to-face environments gain. A comparative evaluation of these courses is pertinent, so students understand the full scope of the course and students are served equally in both environments. Laboratory practicums give students experience with using different skills and also different equipment to develop their needs in a science environment. These skills are necessary if students pursue careers in the science field.

Simulated lab experiences are as effective as hands-on lab experiences and FLVS incorporates them into many of its science courses (Basis Policy Research, 2013). Through technology, students can explore different labs that a face-to-face classroom may not have the supplies necessary to handle. Online learning can be a pathway that allows science students to develop the necessary skills they may not be able to acquire in the face-to-face classroom.

Virtual labs are available to all students whether they are in virtual school or traditional school. The value of the virtual labs versus traditional wet labs is yet to be determined, even though the learning outcome achievement with simulations or remote labs can be considered similar or even higher to the ones in a traditional laboratory setting in a classroom (Viegas et al., 2018). Virtual labs definitely have different characteristics and can evoke different skills learned by each individual student.

Impacts of Virtual Education on Students

Another concern related to virtual education is whether students experience enough social interaction in a virtual setting to become productive citizens in society (Keengwe, Adjei-Boateng, & Diteeyont, 2013). Virtual education is criticized for the perception that there is no communication going on in classes. The Internet is the way many teenagers already connect with the outside world, make and maintain friendships, and learn. A virtual learning environment paves the way for excellent social, cognitive learning by means of providing a learning platform where students have a sense of belonging (Maldonado & Ordover, 2009). Students are able to join groups to discuss courses, relay information, and even work on group projects together to accomplish the task at hand. The Internet plays a crucial role in communication and allows people to break down barriers that once existed with communication across a distance.

Students in the state of Florida must take a virtual course before graduation as it is a graduation requirement. The goal of this requirement is that all students will be more fluent with technology and to adjust to the changing world. This allows students to have an opportunity to advance their content knowledge that they may not be able to acquire in a brick and mortar setting (Heissel, 2016). This delivery method may contribute to developing a student's

understanding and better use of communication tools to become successful. Technology is a large part of society and the push for virtual courses is opening new avenues students can learn and understand the content that is being presented to them (Stöhr, Demazière, & Adawi, 2016). Virtual education has numerous opportunities to incorporate different modes of teaching and can ultimately reach all learning styles. Virtual education has made courses available and has served millions over the last decade (Moloney & Oakley, 2010).

FLVS builds accountability throughout its program on both the teacher and student sides, says Robin Winder, the director of student learning for the school (as cited in Davis, 2012). Teachers must be certified in their subject areas; they are supervised by an instructional leader who, during their first year, monitors their teaching on a nearly weekly basis. This strategy is implemented to make sure there is accountability on the part of the teacher, and the school wants to make sure they are reaching all students through their delivery format. There are many methods that FLVS has implemented to allow students to have the most successful transition into virtual learning. Teachers and students are monitored. The communication is open between administrators, teachers, students and parents which make the learning process easier (Davis, 2012).

Implementation of new technology based educational will grow in time. The transition between in-class to virtual education will take some years. The rapid development and availability of technology with the use of the Internet has started a technology driven change (Stöhr et al., 2016). Limitations on the necessary infrastructure and changing students' behavior, among other considerations, will graduate the speed of this process. Since virtual education is always changing, the applications need to speed up the learning process of the individuals, and to adapt to their needs better than books or multimedia/online presenters of content and exams

(Ghersi, 2007). There is always a need for time to process the changes set forth through virtual education. Virtual education continues to grow in strength and popularity among students and as time lapses more and more states will make a virtual class mandatory for graduation requirements.

Direction of Virtual Education

Virtual education may become the next full time implemented program for many students because it does not bind the student to a location. On the one hand, from a practical point of view, virtual education environments are very interesting for those people who want to study throughout their lives, as it is possible to learn whenever and wherever you wish (Barbera, 2004). With this academic tool, students can ultimately be successful from anywhere around the globe as long as they have access to the Internet and a viable electronic device. Technology allows students to learn about the world around them from the comfort of their own home. Virtual education provides more flexibility (Reese, 2015).

One major dilemma about virtual classes is the lack of research and the lack of feedback to know if the virtual institutions are preparing students the way in which traditional educational institutions have in the past. There is a lack in research to determine the quality of virtual education (Esfijani, 2018). The main goal of any educational institution is to deliver a quality education and be consistent with that effort. Evaluation through research of how effective in preparing students an institution is, is imperative for the success of that institution. Also, this information is important for the student as well, so they know what to expect from a virtual education.

FLVS is expanding its boundaries. Pearson and FLVS have formed an agreement to offer schools across the globe more than 100 virtual courses in all subject areas for Grades 6

through 12 (Evergreen Education Group, 2017; "Pearson and Florida Virtual School," 2011). So instead of just Florida residents benefitting from the virtual experience, students from across the world can join this new educational experience. Virtual education is quickly becoming popular all around the country and world. There is much evidence that supports the consensus that online education will continue to be one of the fastest growing markets in the United States in the field of education for the foreseeable future (Moloney & Oakley, 2010). Virtual education has ultimately given education a new platform and can be utilized by so many around the world. Advances in technology have contributed to the educational field.

Summary

It can be concluded from the available literature that there has been a huge increase in enrollment in virtual education, especially at FLVS. This new generation of virtual learning has found its way into existence and has shown a potential for improving students' learning experience and broadening the availability of courses. The Internet has had a lasting impact on people. Students utilize this tool for research, learning, and entertainment. Virtual schools have become the forefront to a new era of education. Since it is a fairly new concept, that students can take classes via the Internet, there is no concrete evidence of its' lasting effect. The effect of the latest version of distance learning in unclear, but it does create a path for new studies to come (Greenway & Vanourek, 2006). Research on the impacts of virtual education is needed and quantitative data can testify as evidence to alleviate the concerns of the overall impact of distance learning.

All delivery types of education seem to want the same result, which is that students learn the concepts and standards for the course they are enrolled in. Upon further analysis, it can be concluded that no single medium can offer the ideal teaching and learning experience on its own

(Mihai, 2014). All delivery formats for courses have specific intentions and can allow students many possibilities to become involved. There are positive and negative aspects of every delivery format and each format should have its own evaluation so that information is gathered and publicized so that people are aware of the positive and negative effects that the delivery style can exhibit. With the exponential growth of technology, there is an ultimate push to have virtual classes offered to all students in Florida.

Since students must take a virtual class before graduation in the state of Florida, it is important to know if this course will affect their course grade because they will be compared to students from other states when entering college. Colleges use students' course grades as one criterion for admission to an academic institution. Students that take online courses may have an advantage or disadvantage when applying for college and it is important to know this information to make decisions for the student's future. Virtual courses and traditional face to face classes both impact a student's GPA but research is needed to ascertain whether virtual schooling creates a positive or negative influence because course grades can impact college acceptance heavily. Khlaisang and Songkram (2019) found numerous studies have demonstrated that learning in a virtual environment enhances student's motivation, learning outcomes, 21st century skills, and communication. There has not been a great amount of studies linked to showing how these enhancements have impacted a student's course grade.

FLVS is one of the options that students can utilize when trying to pursue their educational goals virtually. Virtual education is an option for all students across the state of Florida. Florida is one of the few states so far requiring at least one virtual course before graduation. This course also has an impact on a student's course grade. A student's learning style and involvement in the course can have as much impact as the style of how the course is

taught when comparing virtual learning to a face-to-face classroom setting. A concern that both proponents and opponents of virtual education have is the effectiveness of the technology in enhancing and promoting student learning and gaining the necessary skills to be successful in the educational arena (Kincey, Farmer, Wiltsher, McKenzie, & Mbiza, 2019). Research is needed to see the effectiveness of the course that is taught in a virtual format so a comparison can be made to the same course provided in a traditional format.

Research on virtual education needs to be conducted so people are aware of the benefits and drawbacks of this educational delivery method (Kooima et al., 2017). With the use of the Internet possibilities could be endless and there is an abundance of virtual opportunities being offered to students that was not in existence 20 years ago. The increasing development of technology, especially information technology in education has led to many changes, including the cases that can be pointed to the emergence of virtual education. A new method of education has emerged in the form of virtual education (Nejad & Nejad, 2011). This new method of education is expanding exponentially and is being utilized all across the world.

Virtual education could be the tomorrow of education. As time passes, more and more virtual courses are developed, and more and more students enroll in a virtual format. As more and more classes are offered by more and more virtual education facilities, students have the opportunity to explore new technology and be on the cutting edge of this enormous shift in education. Virtual education is shaping a new age of education and it is shifting from the traditional face to face to a virtual platform.

CHAPTER THREE: METHODS

Overview

The purpose of this study was to examine the effects of taking online courses compared to traditional face-to face courses on a student's course grade. This chapter contains the research design, research questions, hypotheses, a description of participants and setting, procedures, instrumentation, and data analysis used for research.

Design

The researcher used a causal-comparative design to determine if there was a difference between the effect of taking a course virtually compared to taking the course face-to-face on a student's course grade. Causal-comparative designs are a subgroup of ex post facto research. Gall, Gall, and Borg (2007) defined ex post facto research as "designs that rely on observation of relationships between naturally occurring variations in the presumed independent and dependent variables" (p. 306). Honors biology, honors chemistry, and honors physics are the academic subjects that were utilized for research. The type of causal-comparative design that was implemented was exploration of effects. Causal-comparative studies seek to discover the causes and effects of a behavior by comparing individuals who have engaged in the behavior with individuals who have not engaged in the behavior. Such studies occur after the treatment has taken place (Gall et al., 2007).

The researcher investigated how the independent variable of delivery format, virtual or face-to-face instruction, affected the dependent variable of student course grade. Data were taken from three courses: high school honors biology, honors chemistry, and honors physics. Each course was examined individually. The researcher did not manipulate the independent variable. The independent variable is the one that can be controlled and that can be varied; the

dependent variable is the one that cannot be directly controlled and whose variance is measured as the independent variable is changed (Leatham, 2012). The independent variable is the one in which the researcher purposefully varies, and the dependent variable is the variable that is affected as a result from the change in the independent variable.

As the nation's oldest and largest state virtual educator, FLVS, is often held up as a model for similar state-backed endeavors to follow when designing a funding system and putting e-school accountability measures in place (Davis, 2012). FLVS is utilized by many school districts as the primary place for students to take a virtual class to fulfill graduation requirements. Evaluation of the program and impact on students is not widely researched, and there is a dire need for the results of this evaluation to inform people of the overall effectiveness of virtual education.

Course	Students (Virtual class)	Students (Face-to-face class)
H. Biology	45	48
H. Chemistry	42	49
H. Physics	38	50

Research Questions

RQ1: Is there a difference in students' course grades between students enrolled in a virtual high school *biology* course and students enrolled in the same *biology* course taught in a traditional classroom format?

RQ2: Is there a difference in students' course grades between students enrolled in a virtual high school *chemistry* course and students enrolled in the same *chemistry* course taught in a traditional classroom format?

RQ3: Is there a difference in students' course grades between students enrolled in a virtual high school *physics* course and students enrolled in the same *physics* course taught in a traditional classroom format?

Hypotheses

The null hypotheses for this study were:

$H_0$1: There is no statistically significant difference between a student's course grade after taking a virtual school *biology* course compared to a student's course grade taking the same *biology* course in a traditional classroom format.

$H_0$2: There is no statistically significant difference between a student's course grade after taking a virtual school *chemistry* course compared to a student's grade course grade taking the same *chemistry* course in a traditional classroom format.

$H_0$3: There is no statistically significant difference between a student's course grade after taking a virtual school *physics* course compared to a student's course grade taking the same *physics* course in a traditional classroom format.

Participants and Setting

The participants for this study were selected from a sampling of high school students located in a suburban setting from a central county in Florida. This research was conducted utilizing students from a middle- to low-income area. The sample size for this study was 272 participants, which included 93 students who completed honors biology, 91 students who completed honors chemistry, and 88 students who completed honors physics. The participants consisted of 125 who were enrolled in virtual classes and 147 who were enrolled in face-to-face classes. Gall et al. (2007) noted, "In causal-comparative research, there should be at least 15 participants in each group to be compared" (p. 176). In the research study there were 45

participants in virtual honors-level biology classes and 48 participants in face-to-face classes for honors-level biology for a total of 93. Also, there were 42 participants in virtual chemistry and 49 participants in face-to-face chemistry for a total of 91 participants. For honors-level physics, there were 38 participants in the virtual classes and 50 participants in the face-to-face classes. The first group consisted of students taking the course in a face-to-face traditional format. The second group consisted of students taking the course in a virtual environment. Each group consisted of three subgroups, one each for students who were enrolled in honors biology, honors chemistry, or honors physics classes.

The sample was collected by utilizing the district's statistical department. Students were selected if they were enrolled in an honors physics, honors chemistry, or honors biology course during the 2018–2019 school year. To qualify to be selected for the study, the students chosen were continuously enrolled in the course from the first to the last day. The students selected for the study had earned a final grade for the class. The students used for the study had completed the course using the traditional method of delivery in a face-to-face classroom or taken the course virtually. The sample was randomly selected from the predetermined selection of participants that had completed the above qualifications. For the course of honors physics, the entire sample was used.

The sample was chosen from all students enrolled in public school in a central county in Florida during the 2018–2019 school year. The study was limited to high school students who were enrolled in honors biology, honors chemistry, or honors physics during the school year. Students ranged in grade level from ninth to 12th. Students were between the ages of 13 and 19. There were 132 male students and 140 female students who chose to take the honors-level high school science classes and earn a grade in the course, so the numbers of students were a

controlled variable. There were 178 Caucasian students who participated, 54 African American students, 12 multiracial students, one Asian student, and 27 Native American Indian students.

The setting utilized in the study was a central school district in Florida. The courses that were involved were high school honors physics, honors chemistry, and honors biology conducted either in a face-to-face format or a virtual format. The course was provided free of charge for the students. The virtual and face-to-face versions of each course had the same course description and addressed the same standards in the class. In the biology courses, each student had to take the End Of Course (EOC) exam at the end of the year as the final exam. The EOC is a standardized test that all biology students in the entire state of Florida complete. In the physics and chemistry class, a final exam was given for the virtual and face-to-face classes. Each course consists of exams, laboratory experiments, and class assignments. The virtual courses and face-to-face courses that were studied utilize the same teaching resources gathered from Collaborate, Plan, Align, Learn, Motivate and Share, the official source for Florida's standards information and course descriptions.

Instrumentation

The data utilized for the study were archival and were compiled from the central office at the district. The researcher asked the administrator at the central office for students in each category. The data were stripped of any identifying information that includes name and student identification number before the data were sent to the researcher. The student's earned course grade was an unweighted calculation and was given using the scale of an A as equal to four points which is a course average of 90-100, B as three points which is a course average of 80-89, C as two points which is a course average of 70-79, and D as one point which is a course average of 60-69. No points were awarded to a student who earned lower than a 59 average. This was

the grading scale used by virtual classes and face-to-face classes. The courses were all honors classes. The data were collected on a spreadsheet provided to the researcher with the students identified by a number, which was not their student identification number. The data also included format of course, age, sex, and race.

Procedures

To conduct the study, the researcher submitted the research proposal to the Institutional Review Board (IRB) for approval; the approval letter is located in Appendix A. The researcher contacted the district about the study and gained approval to receive the information and data needed. The approval is provided in Appendix B. The requested data were provided by the district to the researcher through a password-protected email account. The data were stripped of any identifying information that included name and student identification number before the data were sent to the researcher. The data were stored on a password-protected computer that only the researcher had access to.

Course grades are considered archival data and are illustrated through student transcripts and stored within school databases (Salkind, 2003). Archival student data consisting of course grades, course delivery method, and type of course taken was requested. Also, demographic information, including students' sex, race, age, and academic grade level was collected. A spreadsheet created using Microsoft Excel with the requested data representing individual columns and rows symbolizing individual student data was provided from the county (see Appendix B). The requested archival student data were from the 2018–2019 school year. The requested information was received, and each row from the Microsoft Excel spreadsheets was entered into SPSS data analysis system where the appropriate data analysis tests were performed.

Data Analysis

Three separate *t* tests were conducted to analyze the data and address each research question to determine if the null hypotheses should be rejected. The *t* test for a single mean assesses "whether a sample mean differs significantly from a specified population mean" (Gall et al., 2007, p. 317). For this study, the independent variable was the delivery method, virtual school or traditional face-to-face classroom instruction, of the three science courses: honors biology, honors chemistry, and honors physics. The dependent variable was the student's course grade after completing the high school science course.

Data were screened by first looking for incomplete data sets. If a student was missing information, the information was not utilized. Any student missing a final course grade was deleted from the list. There were 28 participants that were not utilized because a course grade was not earned. Extreme outliers were evaluated using box-and-whisker plots. Each outlier was evaluated to determine whether it should be excluded or retained. The proper screening of data was imperative to the overall effect of the statistics on the body of knowledge.

All data analysis was conducted using SPSS. Results were presented in frequency tables and graphs for a visual representation of the comparison of means. Also included in the descriptive analysis was measures of central tendency for the study variables, including mean and standard deviation of the data. SPSS was used to run the Levene's Test of Equality of Error which is an Assumptions Test of Equal Variance and also the Kolmogorov-Smirnov test which is an Assumptions Test of Normality. In the analysis of the data the following results are found in Chapter Four: Number, number per cell, degrees of freedom, t value, significance level, effect size (Cohen's *d*), and power. A Mann-Whitney U test was also run on SPSS because of the failed assumption tests. All of these results can be found in Chapter Four.

CHAPTER FOUR: FINDINGS

Overview

This chapter contains a detailed data analysis for this study as well as a restatement of the research questions, purpose, and hypotheses. The purpose of this study was to investigate the impact of virtual classes compared to face to face classes on students' class grades in honors biology, honors chemistry, and honors physics. The independent variable in this study was course delivery method, either virtual or face-to-face. The dependent variable was student course grades. The research questions and hypotheses for this study are identified below:

Research Questions

RQ1: Is there a difference in students' course grade between students enrolled in a virtual high school *biology* course and students enrolled in the same *biology* course taught in a traditional classroom format?

RQ2: Is there a difference in students' course grade between students enrolled in a virtual high school *chemistry* course and students enrolled in the same *chemistry* course taught in a traditional classroom format?

RQ3: Is there a difference in students' course grade between students enrolled in a virtual high school *physics* course and students enrolled in the same *physics* course taught in a traditional classroom format?

Null Hypotheses

$H_0$1: There is no statistically significant difference between a student's course grade after taking a virtual school *biology* course compared to a student's course grade taking the same *biology* course in a traditional classroom format.

$H_0$2: There is no statistically significant difference between a student's course grade after taking a virtual school *chemistry* course compared to a student's course grade taking the same *chemistry* course in a traditional classroom format.

$H_0$3: There is no statistically significant difference between a student's course grade after taking a virtual school *physics* course compared to a student's course grade taking the same *physics* course in a traditional classroom format.

Descriptive Statistics

There were 272 participants in the study. The sample consisted of 51% female and 49% male participants. Of this sample, 20% were reported as being black, 10% were reported as being Native American Indian, 4% were reported as being multi-racial, .003% were reported as being Asian, and 66% were reported as white. Also, of this sample, 32% of the participants were reported as Hispanic and 68% were reported as non-Hispanic. Descriptive statistics were obtained on the dependent variable, students' course grade, for each group. Descriptive statistics can be found in Table 1 for Honors Biology, Table 2 for Honors Chemistry, and Table 3 for Honors Physics.

Table 1

Honors Biology Descriptive Statistics

Group	*N*	Mean	*SD*
Grade			
Virtual	45	3.22	0.85
Face to face	48	2.83	1.00

Table 2

Honors Chemistry Descriptive Statistics

Group	*N*	Mean	S*D*
Grade			
Virtual	42	3.36	0.82
Face to face	49	2.82	0.99

Table 3

Honors Physics Descriptive Statistics

Group	*N*	Mean	*SD*
Grade			
Virtual	38	3.68	0.47
Face to face	50	2.90	1.02

Results

Data Screening

Data screening was conducted on each group's dependent variable. The researcher sorted the data on each variable and scanned for inconsistencies. The researcher did not include students who did not earn a grade at the end of the course. There were 28 participants who did not earn a course grade and whose data were not utilized. No other data errors or inconsistencies were identified. Box-and-whisker plots were used to detect outliers on each dependent variable. No extreme outliers were identified so all data was retained. See Figures 1, 2, and 3 for box and whisker plots.

Figure 1. Box plot: honors biology.

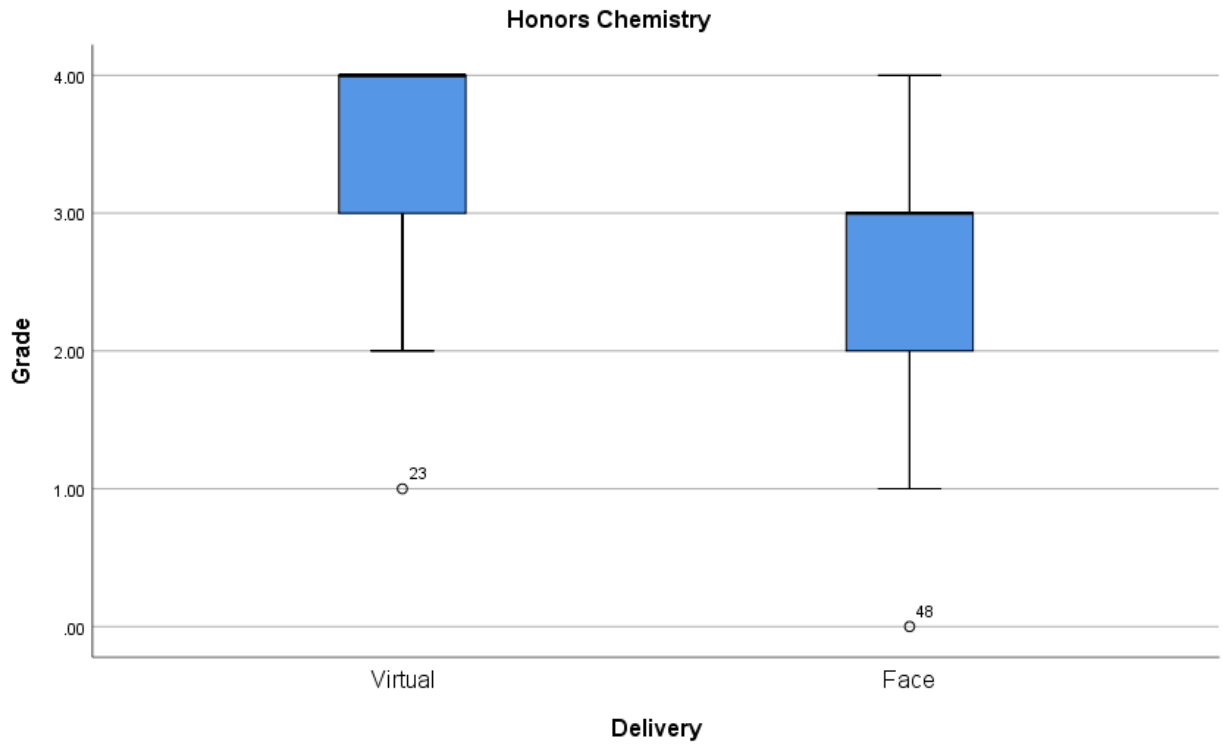

Figure 2. Box plot: honors chemistry.

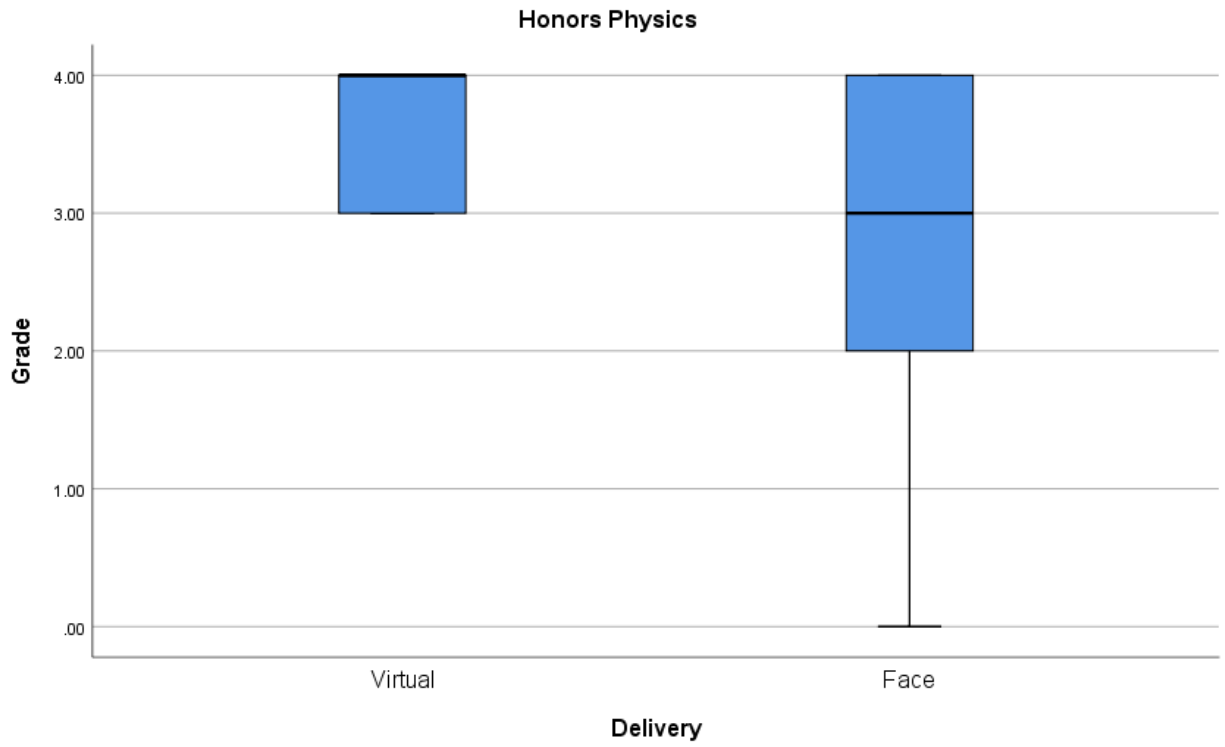

Figure 3. Box plot: honors physics.

Assumptions

An independent samples *t* test (*t* test) was used to test the null hypothesis. The *t* test required that the assumptions of normality and homogeneity of variance are met. Normality was examined using a Shapiro-Wilk test. Shapiro-Wilk was used because there were less than 50 participants in each group. There were violations of normality on all data sets. See Tables 4, 5, and 6 for the results of the tests for normality.

Table 4

Tests of Normality for Honors Biology

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	*df*	Sig.	Statistic	*df*	Sig.
Virtual	.264	45	.000	.798	45	.000
Face-to-face	.237	45	.000	.857	45	.000

[a]Lilliefors significance correction

Table 5

Tests of Normality for Honors Chemistry

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	*df*	Sig.	Statistic	*df*	Sig.
Virtual	.331	42	.000	.753	42	.000
Face-to-face	.277	42	.000	.8870	42	.000

[a]Lilliefors significance correction

Table 6

Tests of Normality for Honors Physics

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	*df*	Sig.	Statistic	*df*	Sig.
Virtual	.433	38	.000	.586	38	.000
Face-to-face	.239	38	.000	.835	38	.000

[a]Lilliefors significance correction

The assumption of homogeneity of variance was examined using the Levene's test. No violation was found where $p = .30$ for honors biology, and $p = .68$ for honors chemistry. The assumption of homogeneity was of variance met. While examining honors physics, a violation was found where $p = .0004$ and the assumption of homogeneity was not met. A Mann-Whitney U test was run due to the violations of normality.

Results for Null Hypothesis One

A *t* test was used to test the null hypothesis regarding differences in course grades between virtual and face-to-face learners who were enrolled in honors biology. Equal variance was assumed. The null hypothesis was not rejected at a 95% confidence level where $t(91) = 2.02$, $p = .05$, $\eta^2 = .4$. The effect size was medium. The virtual group ($M = 3.22$, $SD = 0.85$) had higher course grades than the face-to-face learners ($M = 2.83$, $SD = 1.00$).

Due to the violation of the assumption of normality, a Mann-Whitney U test was performed. A Mann-Whitney U test indicated that the median course grade (3) was the same for virtual classes in honors biology and for face-to-face classes in honors biology, U = 843, p = .054. Based on the results of the Mann-Whitney U test, the null hypothesis was not rejected.

Results for Null Hypothesis Two

A *t* test was used to test the null hypothesis regarding differences in course grades between virtual and face-to-face learners who were enrolled in honors chemistry. Equal variance was assumed. The null hypothesis was rejected at a 95% confidence level where $t(89) = 2.8$, p = .006, $\eta^2 = .59$. The effect size was medium. The virtual learner group (M = 3.36, SD = 0.82) had higher course grades than the face-to-face learners (M = 2.82, SD = 0.99).

Due to the violation of the assumption of normality, a Mann Whitney U test was performed. A Mann-Whitney test indicated that the median course grade was higher for virtual classes in honors chemistry (4) than for face-to-face classes in honors chemistry (3), U = 700, p = .005. Based off the results of the Mann-Whitney U test, the null hypothesis was rejected.

Results for Null Hypothesis Three

A *t* test was used to test the null hypothesis regarding differences in course grades among virtual and face-to-face learners who were enrolled in honors physics. Equal variance was not assumed due to the violation of the assumption of equal variance. The null hypothesis was rejected at a 95% confidence level where $t(86) = 4.7$, p = .0001, $\eta^2 = .98$. The effect size was large. The virtual learner group (M = 3.68, SD = 0.47) had significantly higher course grades than the face-to-face learners (M = 2.9, SD = 1.02).

Due to the violation of the assumption of normality, a Mann Whitney U test was performed. A Mann-Whitney test indicated that the median course grade was higher for virtual

classes in honors physics (4) than for face-to-face classes in honors physics (3), U = 527, p = .000. Based off the results of the Mann-Whitney U test, the null hypothesis was rejected.

CHAPTER FIVE: CONCLUSIONS

Overview

The purpose of this study was to examine high school honors science courses to see if there was a difference in course grades between students who completed the course virtually compared to students who completed the course in a face-to-face format. This chapter provides a detailed summary of the findings as well as a discussion and a presentation of the limitations, implications, and recommendations for future research.

Discussion

The purpose of this study was to examine the effects of taking virtual courses compared to traditional face-to-face courses on a student's course grade in high school science courses, including honors biology, honors chemistry, and honors physics. High school students in the state of Florida must enroll in and successfully complete a virtual course to meet graduation requirements (Herold, 2013). Prior studies directly comparing virtual education to face-to-face education have had conflicting results (Arias et al., 2018).

Research Question One

The first research question sought to discover if there was a statistically significant difference between course grades when comparing students taking virtual honors biology to students taking face-to-face honors biology. The average course grade for students taking virtual school honors biology was higher than the average course grade for students taking the face-to-face honors biology course. The analysis of the data found no statistical significance; therefore, there was evidence to fail to reject the null hypothesis. Even though there was no statistical significance in relation to honors biology in this research project, the results of the *t* test and the Mann-Whitney U test indicated a value which would be very close to rejecting the null

hypothesis. Therefore, there is more research needed in this area. Also, taking into account that both the mean and median scores were higher for students enrolled in virtual classes compared to face-to-face classes, the results from this study do not support previous findings that students in virtual classes score lower on tests (Coates et al., 2004). The previous study was supported by SLT because students in a face-to-face classroom would have more opportunity to learn through interaction (Bandura, 1977).

Research Question Two

The second research question sought to discover whether there was a statistically significant difference between course grades of students who completed honors-level chemistry virtually compared to students who completed face-to-face honors-level chemistry. The analysis of the data found a significant difference; therefore, there is evidence to reject the null hypothesis.

A student's motivation is influenced by both internal and external factors (Johnson et al., 2015). In previous research, there have been mixed results in the findings when comparing face-to-face classes with virtual classes. Previous studies found that virtual classes were perceived to be ineffective (Ponzurick, Russo France, & Logar, 2000), while more recent studies have shown an increase in perceived effectiveness of online courses (Wood, Solomon, & Allan, 2008). This research study would support the latter of the findings because students who were enrolled in virtual science classes and completed the class had a higher average for the class compared to the students who were enrolled in face-to-face classes.

Research Question Three

The third research question sought to discover whether there was statistical significance between course grades of students who completed honors-level physics compared to students

who completed face-to-face honors-level physics. The analysis of the data found statistical significance; therefore, there is evidence to reject the null hypothesis. The average course grade for students taking virtual school honors physics was higher than the average course grade for students taking the face-to-face honors physics course. The analysis of the data found the difference between the population medians to be statistically significant. Therefore, there is evidence to reject the null hypothesis.

Virtual school classes employ technology as a means of delivery for educational purposes. Students must work through technology to gain the necessary skills and material to be successful in their academic course. Across all three honors science courses, students' course grades were higher for students enrolled in virtual classes compared to face-to-face classes. In honors chemistry and honors physics, there was a significant difference found in the effects of virtual school classes on students' course grades compared to the grades of students who completed the course in a face-to-face format.

The results of this study have indicated that there is a significant difference in the course grades of students in virtual classes versus face-to-face classes in honors chemistry and honors physics, with a favor toward virtual classes. The results of this study also indicate that there is no statistically significant difference between the course grades of students in virtual classes and students in face-to-face classes in honors biology. These results do support the mixed findings in previous research. Some studies found that student achievement was higher in virtual classes compared to face-to-face classes (Ireland et al., 2009, Kearns, Shoaf, & Summey, 2004), but other studies have found no significant difference when comparing virtual classes to face-to-face classes (Buckley, 2003, Posley, 2013). Despite conflicting results, this research study found that students performed better in virtual classes compared to face-to-face classes because the mean

score in each science course was higher for the virtual class. In previous research, studies have found inconsistencies and mixed results when comparing virtual education to face-to-face education and the factors that influence these different results (Arias et al., 2018, Coates et al., 2004). There have been many studies done on different factors that influence virtual learners compared to face-to-face traditional learners, but replication of the studies is sparse. This study has confirmed the findings of mixed results because there was no significant difference found between the median course grades in virtual honors biology compared to face-to-face honors biology, but there was a significant difference found between students' course grades in honors chemistry and honors physics when comparing virtual classes to face-to-face classes.

There are contradictions in SDT research, and this study supported Chen and Jang's (2010) study that concluded that SDT is not linked to gained learning outcomes in the traditional face-to-face classroom. This study served as more research into the field of how extrinsic motivation of class grades is a driving force into the success of a learner enrolled in virtual classes. Since in all three research groups the average course grade was higher for students enrolled in virtual classes compared to students enrolled in face-to-face classes, extrinsic motivation of earning a high course grade is a factor. Both extrinsic motivation and intrinsic motivation affect the students' success in both delivery formats of a class.

Previous studies have related online learner readiness to success in virtual classes (Kaymak & Horzum, 2013; Means et al., 2009; Panigrahi et al., 2018). This study solidifies those findings because the average scores were higher in virtual classes compared to face-to-face classes. Motivation and online learner readiness have been paired in previous studies. This study contradicts Buzdar et al.'s (2016) study, which found that students are not prepared and confident to adopt virtual learning. The results of this study showed that students in a virtual

environment have performed better compared to their counterparts in a face-to-face classroom.

Implications

This study adds to the body of knowledge by reporting the difference in science course grades based on content delivery method. The results of this study showed that students' average course grades in high school honors-level science courses were higher for students who completed the courses virtually compared to students who completed the course in a traditional, face-to-face format. The main driving force in this study was the fact that the state of Florida mandates that students must enroll and successfully complete a virtual course as a graduation requirement. Since, to date, there are only four states that have this graduation requirement, it is imperative to know how this affects student's grades. The focus of this study was the difference in course grades between students who enroll in virtual classes compared to students who enroll in traditional face-to-face classes.

Through data analysis it was found that there was no statistically significant difference in course grades between students enrolled in virtual biology and students enrolled in face-to-face biology. On the other hand, through data analysis, it was found that there was a statistically significant difference between students' course grades when comparing virtual and face-to-face classes in chemistry and physics. The researcher believes the significant difference found in the physics and chemistry classes is due to the students' online learner readiness and the fact that students are better prepared to take virtual classes as they increase in age and maturity and have more experience with technology. The literature addresses that the ability of a student to be an autonomous learner contributes to their online learner readiness (Warner, 2013). The researcher believes that as people age, they become more responsible learners, taking ownership of their own learning.

Motivation also plays a role in the success of a learner. There have been conflicting studies that indicate that success in virtual classes can be attributed to extrinsic and intrinsic motivation. A study in previous research indicates that extrinsic motivation was associated with to the success of virtual learners (Johnson et al., 2015). This study solidifies the idea that the extrinsic motivation of a course grade influenced the success of virtual learners because the average course grades were higher for virtual learners compared to learners who were enrolled in face-to-face classes. The researcher believes that both extrinsic and intrinsic motivation play a key role in the success of a virtual learner.

Limitations

This study was derived from the mandate that a student must successfully enroll in and complete a virtual course as a graduation requirement in the state of Florida. The first limitation of the study was that only one county in the state of Florida was utilized in the research study and relatively small sample sizes per course were used. If more participants were used in a larger area in Florida, this would strengthen the external validity. A sample selected from a broader range of counties in Florida that includes the diverse communities that make up the state would better represent the population of high school students in Florida.

The second limitation was that the data collected were on a small scale with the numbers 0 through 5 used. If course grade was reported using a scale of 0 through 100, the mean and median values would be more representative of the actual score. This would increase the internal validity of the experiment. In this study, a grade of A represented 4 points, but there is a wide range of scores that make up an A value. The scores that represent an A range from 89.5 to 100. If the students' score in the class was provided on a 100-point scale, then there would be more differences observed.

Another limitation was the causal-comparative design. There are limitations in the causal-comparative research design, which include reverse causation and the inability to construct random samples because the events have already occurred (Salkind, 2010). The limitation of reverse causation can occur in research studies where the dependent variable is actually the cause. This researcher did not have the ability to construct random samples, as students had already completed each course and the sampling came from students who had already taken the course, which limited the randomness of the sampling.

The violations of normality leading to the use of a nonparametric test, the Mann-Whitney U test, is a limitation. The Mann-Whitney U test was implemented because there were violations of normality in each of the science courses, and nonparametric tests do not contain any assumptions. The medians were used to compare the results for the research study.

Recommendations for Future Research

1. Students' online learner readiness should be studied to find out if the number of virtual classes successfully completed impacts students' grades.
2. Further research using on-level science classes would be appropriate.
3. A quantitative study, based on a student's letter grade, using a 100-point scale, would be a better representation of numerical data.
4. More research comparing students' course grades in virtual biology compared to traditional, face-to-face biology may be appropriate.
5. Future studies comparing the differences between virtual and face-to-face biology, chemistry, and physics classes may be beneficial.
6. A quantitative study on the amount of student interaction and participation with the virtual class and the impact to their course grade would be advantageous.

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APPENDIX A: IRB Approval

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

September 23, 2019

Melinda Maier
IRB Application 3918: Virtual Classes: A Comparative Study on the Overall Effect of Virtual Science Classes on High School Student's Course Grades

Dear Melinda Maier,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Your study does not classify as human subjects research because it will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued non-human subjects research status. You may report these changes by submitting a new application to the IRB and referencing the above IRB Application number.

If you have any questions about this determination or need assistance in identifying whether possible changes to your protocol would change your application's status, please email us at irb@liberty.edu.

Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office

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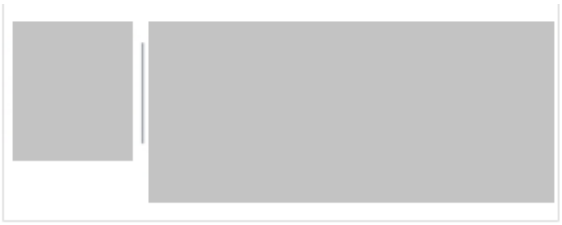
APPENDIX B: Research Notice of Approval



[redacted] Application to Conduct Research

Research Notice of Approval

Approval Date: **September 20, 2019** Study ID Number: **312**

Expiration Date: **September 19, 2020**

Project Title: ***VIRTUAL CLASSES: A COMPARATIVE STUDY ON THE OVERALL EFFECT OF VIRTUAL SCIENCE CLASSES ON HIGH SCHOOL STUDENT'S COURSE GRADE***

Requester: **Ms. Melinda Maier**

Sponsoring Agency/Organization/Institutional Affiliation: **Liberty University**

Thank you for your request to conduct research in [redacted] We have reviewed and approved your application. This *Research Notice of Approval (R-NOA)* expires one year after issue date, September 19, 2020.

Once you have submitted your fully approved IRB with no conditions remaining, our department will release the requested archival data. Following [redacted] protocol, only de-identified data will be released.

You are responsible for submitting a Change/Renewal Request Form to this department prior to implementing any changes to the currently approved protocol. If any problems or unexpected adverse reactions occur as a result of this study, you must notify this department immediately. Allow 45 days prior to the expiration date, if you intend to submit a Change/Renewal Request Form to extend your R-NOA date. Otherwise, submit the Executive Summary (along with the provided Cover Page) to conclude your research with [redacted] and within 45 calendar days of the R-NOA expiration. Email the form/summary to [redacted] All forms may be found at this link.

Should you have questions, need assistance or wish to report an adverse event, please contact us at [redacted] or by phone at [redacted].

Sincerely,

[redacted]

Director, Research and Evaluation