BLENDING ONLINE LEARNING VERSUS TRADITIONAL CLASSROOM LEARNING: A COMPARISON OF MATHEMATICS CONTENT MASTERY FOR HIGH SCHOOL STUDENTS OF HOMEOWNERS AND NON-HOMEOWNERS

by

Jeannette Marie Hallam

Liberty University

A Dissertation Presented in Partial Fulfillment
Of the Requirements for the Degree
Doctor of Education

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ABSTRACT

The purpose of this causal-comparative study was to compare the methods of traditional face-to-face classroom instruction and blended online instruction for students from differing home environments who were repeating a Mathematics I course at the high school level. This quantitative study, conducted at three high schools in Georgia, used the theories of self-regulated learning, student-centered learning, Keller’s ARCS (Attention, Relevance, Confidence, and Satisfaction) model of motivational design of instruction, and cognitive load theory to compare the two approaches to learning. The participants in this study consisted of 398 high school students taking a Mathematics I class for the second time in either a traditional classroom setting or a blended online setting between January of 2010 through June of 2013. Archival data was collected regarding demographic information and student outcomes on Georgia’s End of Course Test (EOCT) from each school’s student information system. Archival data was also collected from county tax records to verify homeownership status for the parents or guardians of student participants. A pretest/posttest causal comparative design was used. The pretest consisted of each student’s previous EOCT score while the posttest consisted of each student’s End of Course Test score after repeating the course. Two-way Analysis of Covariance (ANCOVA) was used to analyze the archival data in the study. Results of the study indicated a statistically significant difference on the posttest when comparing the blended online setting and the traditional classroom setting, but no statistically significant difference based on a family’s homeownership status and no significant interaction between the mode of instruction and parents’ homeownership status.

Keywords: online learning, blended learning, homeownership, mathematics achievement, high school.
# Table of Contents

ABSTRACT .......................................................................................................................... 3

List of Tables ...................................................................................................................... 7

List of Figures ..................................................................................................................... 8

List of Abbreviations .......................................................................................................... 9

CHAPTER ONE: INTRODUCTION ..................................................................................... 10

  Background ......................................................................................................................... 10

  Problem Statement ............................................................................................................ 14

  Purpose Statement ............................................................................................................. 17

  Significance of the Study ................................................................................................... 17

  Research Question ........................................................................................................... 20

  Null Hypotheses .............................................................................................................. 21

  Definitions ......................................................................................................................... 21

CHAPTER TWO: LITERATURE REVIEW ............................................................................. 24

  Introduction ....................................................................................................................... 24

  Title Searches, Articles, Research Documents, and Journals Researched ....................... 27

  Theoretical Framework ..................................................................................................... 28

  Strategies for Varying Student Populations ..................................................................... 37

  Homeownership Status and Academic Achievement ..................................................... 43

  Uses of Online Learning .................................................................................................. 45

  Perceptions of Online Learning ....................................................................................... 52

  Quality in Online Learning and Instruction .................................................................... 55

  Overview of the Literature ............................................................................................... 59
CHAPTER THREE: METHODS .......................................................................................... 61
- Design ....................................................................................................................... 61
- Research Question .................................................................................................. 62
- Hypotheses .............................................................................................................. 62
- Participants and Setting .......................................................................................... 62
- Instrumentation ....................................................................................................... 71
- Procedures ............................................................................................................... 74
- Data Analysis ......................................................................................................... 80

CHAPTER FOUR: FINDINGS ......................................................................................... 85
- Research Question .................................................................................................. 85
- Null Hypotheses ...................................................................................................... 85
- Results ...................................................................................................................... 85

CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS .......... 90
- Discussion ............................................................................................................... 90
- Conclusions ............................................................................................................. 95
- Implications ............................................................................................................. 97
- Limitations .............................................................................................................. 98
- Recommendations for Future Research ................................................................. 101

REFERENCES ............................................................................................................ 105

APPENDICES ............................................................................................................... 132
- A. Georgia Performance Standards for Mathematics I ............................................. 132
- B. IRB Exemption Letter .......................................................................................... 136
C. IRB Change in Protocol Form ................................................................. 137
D. Research Approval from School System............................................... 138
List of Tables

1. Features of Education2020 and Alignment with Research..........................57
2. Demographic Statistics for Population by Mode of Instruction.....................63
3. Demographic Statistics for Population by Homeownership Status...................64
4. Effect Size, Statistical Power, and Alpha Levels........................................65
5. Demographic Statistics for Research Sites................................................66
6. Recommended Practices and Application in Blended Online Learning..............68
7. Results for Tests of Normality...............................................................87
8. ANCOVA Results for Online Learning Compared to Traditional Learning.........88
9. ANCOVA Results for Homeowners Compared to Non-Homeowners...............89
List of Figures

1. Procedures for Selection and Distribution of Samples.................................80
List of Abbreviations

Analysis of Covariance (ANCOVA)

Attention, Relevance, Confidence, and Satisfaction (ARCS)

College and Career Ready Performance Index (CCRPI)

C. C. School System (CCSS)

End Of Course Test (EOCT)

Educational Resources Information Center (ERIC)

Georgia Department Of Education (GADOE)

Georgia Testing Identification (GTID)

Interactive Educational Systems Design (IESD)

International Association of K-12 Online Learning (iNACOL)

Institutional Review Board (IRB)

Marzano Research Laboratory (MRL)

National Association of Educational Progress (NAEP)

Response To Intervention (RTI)

State Longitudinal Data System (SLDS)

Statistical Package for Social Sciences (SPSS)

Science, Technology, Engineering, and Mathematics (STEM)

Universal Design for Learning (UDL)

United States Department Of Education (USDOE)
CHAPTER ONE: INTRODUCTION

Background

Online learning, a mode of instruction, which relies on an Internet based program as a medium for instruction, is emerging as a popular method of instruction and learning at the secondary level (Johnson, Adams-Becker, Estrada, & Freeman, 2015; Picciano & Seaman, 2009; Wicks, 2010). However, according to the International Association of K-12 Online Learning (iNACOL, 2012) and Murphy et al. (2014), there are insufficient research findings on a blended approach to online learning at the secondary school level or its application with at-risk learners to determine its effectiveness (Corry & Stella, 2012; Leh & Jitendra, 2013; U.S. Department of Education [USDOE], 2010; USDOE (2012). The faculty of many collegiate programs use online learning in the form of distance learning, which consists only of online instruction, to reach a larger population of students and to provide a more flexible learning schedule for busy professionals. Research has shown that, while this may be a convenient means of learning, it does not always result in a better understanding of the content in comparison to a face-to-face course on campus. In fact, it has been found that general online learning is equivalent to, not superior to, face-to-face learning at the university level (Bowen, Chingos, Lack, & Nygren, 2013; DiRienzo & Lilly, 2014; Kim & Frick, 2011; McFarlane, 2011; USDOE, 2010).

According to Corry and Stella (2012), in their framework for research in online learning for K-12, further research is needed in regard to blended online learning as a delivery model in comparison to traditional classroom learning. Additionally, they recommended that further, empirical studies should be conducted to determine the effectiveness of this model for the instruction of different types of learners.
The model of online learning can vary, depending upon the needs of the students and the decisions made by school administrators. However, at other high schools, such as the sites for this current study, the faculty use a blended model of online instruction: that is, students learn online but with the added support of a face-to-face instructor. The students in this study use the learning platform Education2020, renamed as Edgenuity in 2013 (Edgenuity, 2013a). This program provides structured instruction for middle and high school courses, which is aligned with content standards for most states. Within this program, students view video lessons taught by certified instructors, engage in activities and practice opportunities, and participate in formative and summative assessments. Also, teachers have control over different settings to allow for customization (Edgenuity, 2013c).

Online learning has recently emerged as a trend in high schools throughout many states in the U.S. and was named as one of six key trends in educational technology for 2016 and 2017 (Johnson et al., 2015; Picciano & Seaman, 2009; Wicks, 2010). However, some students at the high school level may require more instructional support than students at the college level due to differences in knowledge and skills, and consequently, may require additional support, even with an online course (Moisey & Hughes, 2011). When a certified instructor facilitates a blended model of online instruction within the normal schedule of the school day, students may benefit from online instruction while they receive support from the facilitator. However, researchers have not studied this form of blended online instruction in depth in regard to effectiveness and, therefore, it is being used in schools without research support (Bowen et al., 2013; Corry & Stella, 2012; Murphy et al., 2014). Many school officials may think that online learning is effective, but to date, the focus of research has been more on pass rates or subjective grades than
on actual content mastery, thereby the practice is left without strong evidence (DiRienzo & Lilly, 2014; USDOE, 2010).

In addition to an increased use of online learning at the high school level, more attention is being paid to the area of mathematics in United States’ schools (Jobs for the Future, 2007; Permut & Dalzell, 2013). In Georgia, the College and Career Ready Performance Index (CCRPI), which replaced Adequate Yearly Progress (AYP), awards points for Science, Technology, Engineering, and Mathematics (STEM) programs and instruction. In addition, there is a greater emphasis in CCRPI on: (a) student performance on EOCTs, (b) content mastery for all students, and (c) student growth in the content areas (Georgia Department of Education [GADOE], 2012e). Students in Georgia must earn a scale score of 400 or higher on the EOCT, which converts to a grade of 70% or greater, to show content mastery. In the case of Mathematics I, students are assessed on a blend of algebra, geometry, and data analysis and probability in this way (GADOE, 2011).

Currently, students in the U.S. underperform in the STEM areas in comparison to students from other countries (Duncan, 2012; Hanushek, Peterson, & Woessmann, 2010). Georgia, the state in which the study was conducted, was ranked among the lowest performing states in terms of mathematics achievement for eighth grade students in a National Assessment of Educational Progress (NAEP) report (USDOE, 2013b). This situation placed students at risk. Students, who graduate without advanced mathematics knowledge, are at a disadvantage when they enter college and the job market. As a result, they are often employed in lower-level jobs, while individuals from other countries receive higher-level technology jobs in the U.S. (Friedman, 2007; USDOE, 2013a). Government officials want to increase the number of U.S. citizens employed in these jobs and, for that reason, emphasize a focus on STEM in schools
(Jobs for the Future, 2007). United States students will be unable to compete for these jobs if they cannot even pass the most basic mathematics classes at the high school level. In addition, if they pass these classes, but still do not understand the content, they may struggle in entry-level jobs (The American Diploma Project, 2004; Friedman, 2007; National Math + Science Initiative, 2013).

There are two types of at-risk students, who are not mentioned in the literature in regard to online instruction: those who live in rental housing, and those who are homeless. According to Aaronson (2000), family homeownership status correlates to levels of student achievement in school, regardless of income levels. Currie and Yelowitz (2000) and Haurin, Parcel, and Haurin (2001) reported that students, who lived in rental housing, were more likely: (a) to be held back a year at one or more grade levels, (b) to have lower achievement scores on standardized tests, and (c) to have more behavior problems in school than children of homeowners. In addition to the factors noted for students from rental households, homeless students are more likely to experience developmental delays and social or emotional problems (Brumley, Fantuzzo, Perlman, & Zager, 2015; Moore, Vandivere, & Ehrie, 2000). These same students show lower levels of engagement in school and higher rates of suspension and expulsion from school when compared to their peers from families who own homes. These attributes are ascribed to differences in high rates of residential mobility for students in rental households and for homeless students (Astone & McLanahan, 1994; Fantuzzo, LeBoeuf, Chen, Rouse, & Culhane, 2012; Kerbow, 1996; Rumberger, 2002; Scanlon & Devine, 2001; Vandivere et al., 2006; Voight, Shinn, & Nation, 2012).

Quality instruction is one factor, which was by noted by Hopson and Lee (2011) and Temple and Reynolds (1999), that can be used to counteract the effects of student mobility.
Pavlakis (2014) maintained that the presence of school-based support structures help to counteract the effects of student mobility and homelessness. It has been found that students, who moved for positive reasons or to a better quality school, were more likely to overcome the effects of mobility and showed higher achievement levels in comparison to students, who moved due to negative reasons or to a school with the same quality of instruction (Swanson & Schneider, 1999; Voight et al., 2012). Additionally, students, who moved to a better neighborhood, but stayed in the same school, did not experience an increase in academic achievement, as the housing may have improved, but the quality of the education received did not improve (Turner & Acevedo-Garcia, 2005). The use of blended online learning, if it is found to be an effective mode of instruction, may be one way in which quality instruction and student supports can be used to improve the outcomes for these students.

**Problem Statement**

Faculty in high schools across the country use online instruction with students of differing: (a) backgrounds, (b) socioeconomic status, and (c) levels of academic preparedness. McFarlane (2011) noted that the emergence of online learning is one of the ways that the curriculum is changing to meet the needs of diverse learners such as: (a) those with disabilities, (b) those from varied backgrounds or cultures, or (c) students from different socioeconomic levels. However, in a meta-analysis conducted by the staff of the USDOE (2010), it was found that there are only a “small number of rigorous published studies contrasting online and face-to-face learning conditions for K-12 students” (p. ix), and only one of those studies was focused on the area of high school mathematics. In that study, O’Dwyer, Carey, & Kleiman (2007) found that eighth and ninth grade students, who participated in a blended Algebra I course, performed slightly better on some items of a posttest in comparison to students in a traditional classroom.
setting. However, there was not a statistically significant difference in posttest scores between the two groups of students when they controlled for the effects of a pretest. The researchers concluded that online instruction is a viable approach for mathematics instruction at the secondary level and comparable with traditional learning. However, also, they noted a need for further research in regard to student learning and mastery at the high school level.

In recognition of this gap in research, Murphy et al. (2014) attempted to add to the body of knowledge through the conduct of study in which they compared the effectiveness of blended online learning and traditional classroom learning across several K-12 grade levels, subject areas, and in different states. In this study on high school students, they concluded that ninth grade students in the traditional classroom environment performed significantly better on a posttest \( p = .026 \) than did students in the blended online environment in the two content areas studied: mathematics and language arts. In the tenth grade students, the researchers found that students in the blended online environment performed better on a posttest than did the students in the traditional classroom in the content area of language arts. The only subject area that was studied during students’ tenth grade year was language arts. Murphy et al. (2014) recommended that there should be further research in online learning for K-12 learners and concluded that there was not yet adequate research in this field to make decisions about the application of online learning.

Without sufficient data, in regard to student mastery of content with blended learning, school leaders take a great risk with content understanding and mastery when they utilize this method of instruction (USDOE, 2010). Furthermore, “it is vital that the educational community and in particular state and local decision-makers have access to high-quality research they can use to inform their ongoing investments in online learning initiatives” (O’Dwyer et al., 2007, p.
This researcher hopes to add new information to the small but growing body of research in mathematics content mastery for high school students who participate in blended learning.

In addition, most of the research on educational strategies is focused on factors that take place within the school environment, but approximately 75% of the achievement gap is formed by factors that occur outside of the school (Murphy, 2009). A student’s home life and background are more likely to predict student achievement than what occurs within the walls of the school (Hopson & Lee, 2011; Rothstein, 2008). Therefore, in order to plan for school improvement and for increases in student achievement, school leaders should focus on social factors outside of the school. While it may be unrealistic for educators to affect social policy, they can look at school improvement in the context of social factors. By the study of educational strategies and programs in terms of their ability to counteract social constraints, like frequent moves, temporary housing arrangements, and homelessness, school leaders can create more meaningful and effective programs for at-risk youth (Bower, 2012).

The use of online learning continues to increase in high schools even with insufficient data in regard to its use in terms of content mastery, especially in the subject area of mathematics (iNACOL, 2012; Johnson et al., 2015; Murphy et al., 2014; O’Dwyer et al., 2007). In regard to student content mastery in the area of high school mathematics, research is especially limited, but vital for the growth of STEM initiatives to benefit high school students. The problem is there is a lack of data regarding students’ homeownership status and performance with online learning at the high school level. It is anticipated that the findings from this study will fill the gaps in research for this population of students in terms of online learning and mathematics mastery.
Purpose Statement

The purpose of this causal-comparative study was to compare the methods of traditional face-to-face classroom instruction and blended online instruction for students from differing home environments, who were required to repeat a Mathematics I course at the high school level. The outcomes for these students were measured by the Georgia EOCT. The independent variables were the type of instruction (i.e., online or traditional) and homeownership status of the students’ parents (i.e., homeowner or non-homeowner). The dependent variable was the posttest EOCT score. The covariate was the pretest EOCT score. Data were analyzed for students at three Georgia high schools, while controlling for student pretest scores.

For the purpose of the study, blended online instruction is defined as online instruction in a structured setting with live teacher support. The students in the blended online setting interacted with the online program during the majority of the instructional time. Traditional classroom instruction was defined as face-to-face instruction with interaction between classmates and the general education teacher during the learning process. The role of the teacher in each setting differed, as the teacher in the blended online classroom helped to facilitate the online instruction, whereas the teacher in the traditional classroom delivered instruction.

Significance of the Study

There is a lack of research pertaining to the effectiveness of online instruction for students at the high school level, especially in the area of mathematics (iNACOL, 2012; Murphy et al., 2014; O’Dwyer et al., 2007). In 2010, staff of the USDOE found that, through the conduct of a meta-analysis, there was only one study in which the effectiveness of online instruction vs. traditional instruction was assessed in the area of high school mathematics. Prompted by these findings and recommendations from the USDOE, Murphy et al. (2014) conducted a study into
the effectiveness of blended online learning across several grade levels and academic content areas in K-12 education. They found that the use of traditional instruction was more effective than blended learning in the area of high school mathematics. Safavi, Rostamy-Malhalifeh, Behzadi, and Shahvarani (2013) conducted a research study in Iran. They found that high school students demonstrated higher levels of content mastery after completion of a face-to-face mathematics class in comparison to students in an online mathematics class. In their meta-analysis, the staff of the USDOE (2010) found that, in the current literature, researchers have considered many online programs for college distance learning and the qualitative aspects of online learning. More data about effective instructional practice is required to support the continued use of online instruction in high schools. Two studies (Murphy et al., 2014 & Safavi et al., 2013) showed that face-to-face instruction is superior to different forms of online instruction when the latter is used in high school mathematics. However, O’Dwyer et al. (2007) found no significant difference in content mastery. These three studies, which were inconsistent in their methods, populations, and results, indicate the need for further research in this area (Murphy et al., 2014; O’Dwyer et al., 2007; Safavi et al., 2013).

Since the use of online instruction is becoming more common in high schools, it is important to evaluate this mode of instruction in comparison to traditional face-to-face classroom instruction for students at the high school level. Instructional methods at the college and high school levels have differed for years in regard to the amount of support and the intensity of learning that takes place (Nilson, 2010). Generally, expectations for college students are much higher than those for the average high school student. As a consequence, results for online learning at the college level cannot be generalized to the high school setting. Also, these
differences make assessment of the efficacy of online instruction necessary at the secondary level, as it is distinct from the more thoroughly researched higher education setting. In a publication (Johnson et al., 2015) commissioned by The New Media Consortium, blended online learning was identified as one of six trends in educational technology and recommended it as a focus for educational growth in 2016 and 2017 (Johnson et al., 2015). Christensen, Horn, and Johnson (2008) predicted that 50% of high school courses will be available online by the year 2019, yet there is no research to show that this is an effective practice. The purpose of much of the research about online learning is to assess student satisfaction with online classes. Understanding the efficacy of online instruction is important to the future of education given this trend. In a 2012 report by iNACOL, the researchers noted that,

> While a small body of research focused on the effectiveness of online learning was funded by the U.S. Department of Education from 2002-2011, more data collection and research is needed in the field of K-12 online learning. (p. 2)

In addition, they noted that there are significant gaps in online learning research including blended online learning, which was analyzed in this study.

> More emphasis is needed by researchers on the actual effectiveness of online instruction and blended online instruction with at-risk high school students (USDOE, 2010). The relationship between homeownership status and performance in online learning is largely under-researched. Effective instruction and school supports are shown to counteract the negative effects of housing mobility often experienced by students in rental housing and homeless students (Hopson & Lee, 2011; Pavlakis, 2014; Temple & Reynolds, 1999). However, models of effective instruction are lacking in terms of mathematics instruction, and the findings are unclear in terms of online learning for these populations of students (USDOE, 2010).
Mathematics skills are essential in a technologically advanced society (Friedman, 2007). According to a report published by the National Mathematics Advisory Panel (2008), students in the U.S. do not learn the math they need and are not prepared for the workforce, yet the number of STEM related career fields are growing faster than any other job sector in this economy. If workers do not have the skills and knowledge to fill these positions, they will be limited to lower paying jobs and, potentially, the U.S. will lose opportunities for economic development to foreign countries (Achieve, 2008; Friedman, 2007). Peterson’s (2005) findings indicated the urgency of this situation, since 25% of citizens in countries such as Korea, Finland, Japan, and the Netherlands perform at high levels of mathematics, while only 5% of U.S. citizens perform at the same level.

The results and conclusions from this dissertation project may be used to make decisions in regard to the mode of instruction for different groups of students at the high school level in the area of mathematics. Also, the results may lead to more exploration with blended online learning at other levels of education, with different subject areas, and with different populations of students, such as gifted students. Additional research could be completed in regard to online distance learning with no face-to-face interaction, more commonly known as virtual academies. The results can be used to improve education practice and programs in public high schools (Wicks, 2010). In terms of mathematics, the results from this study may guide decisions in the best methods of instruction for students of differing housing environments.

**Research Question**

**RQ1:** Is there a difference in Mathematics I EOCT scores between students taking blended online classes and students taking traditional face-to-face classes that is connected with parental homeownership status?
Null Hypotheses

The null hypotheses for this study were:

\( H_{01} \): There is not a significant difference between Mathematics I EOCT scores of students who participate in blended online classes and those of students who participate in traditional face-to-face classes while controlling for pretest EOCT scores.

\( H_{02} \): There is not a significant difference between Mathematics I EOCT scores of students whose parents’ homeownership status is either homeowner or non-homeowner while controlling for pretest EOCT scores.

\( H_{03} \): There is not a significant interaction among Mathematics I EOCT scores of students who participate in blended online classes and students who participate in traditional face-to-face classes in connection with their parents’ homeownership status being either homeowner or non-homeowner while controlling for pretest EOCT scores.

Definitions

1. **Blended online learning** - A mode of online instruction that provides face-to-face contact with an instructor, with the majority of instruction provided through the Internet (Watson & Gemin, 2008).

2. **Education2020/Edgenuity** - An online learning program designed to provide structured instruction to students at the middle school and high school levels. Courses are offered for credit, for remediation, or for tutoring. The courses are accessed through the Internet, with a unique log in and password for each student, who uses the program. Each course is designed to meet state content standards with video lessons taught by certified educators, interactive activities such as labs, and learning tools for students. Lessons are taught with formative and summative
assessments included throughout. Also, there are teacher and administrator controls that allow customization of options to better meet student needs (Edgenuity, 2013a; Edgenuity, 2013c).

4. *End of Course Test (EOCT)* - Criterion referenced multiple-choice test administered in the state of Georgia toward the end of selected high school courses. The test is meant to measure mastery of course content for each student compared to predetermined standards. This test is administered in two sections. Each section of the test takes approximately 1 hour. The number of questions varies for each subject area (GADOE, 2008).

5. *Homeowner* – The home status of students whose parents own their home and live within that home.

6. *Infinite Campus* - An online student information system used by school districts to keep track of real-time student data such as grades, programs, attendance, test scores, and demographic information. Reports can be created in Infinite Campus based on criteria set by the researcher regarding student information to aid in data collection and analysis (Infinite Campus, 2013a).

7. *Mathematics I* - The mathematics course used for this study is a blend of: (a) algebra (e.g., rational, radical, and polynomial expressions, simple equations, basic functions and graphs); (b) geometry (e.g., proofs, coordinate geometry, properties of polygons); and (c) statistics (e.g., sample statistics and curve fitting), as established in the Georgia Performance Standards noted in Appendix A (GADOE, 2006).
8. *Non-homeowner* - The home status of a student, who lives in an apartment, rental home, motel, vehicle, campsite, homeless shelter, or living in the residence of an individual other than a parent or guardian (National Center for Homeless Education, 2012; National Center for Homeless Education, 2014).

9. *State Longitudinal Data System (SLDS)* - An online database of student information for the state of Georgia. This free system is accessed through a link in a student information system maintained at the school. Teachers and other school staff can use this system to look at individual student records such as: (a) attendance, (b) grades, (c) assessment scores, (d) enrollment, and (e) courses. The database is comprised of data from the 2006/2007 school year to the present (GADOE, 2014).

10. *Traditional instruction* - A class that meets face-to-face with instruction delivered by the certified classroom teacher. While this type of instruction may include some technology, the classroom teacher serves as the main deliverer of instructional.
CHAPTER TWO: LITERATURE REVIEW

Introduction

Presented in this Chapter is a summary of the methods used to locate scholarly sources in the literature and a review of the current literature in regard to blended online learning. The literature, which pertains to models of effective instruction in high school mathematics, is included in this review as well. Since most of the research in the area of online learning at the high school level is focused on qualitative aspects of the programs, these benefits are noted. The available information in regard to the quantitative studies of online learning for high school students were evaluated and presented within this chapter. Additional literature sources were reviewed in regard to homeownership status of parents and its effect on educational achievement. The theoretical framework, present in this chapter, links the models of effective instruction to the practices embedded in online learning and traditional classroom learning. In addition, this theoretical framework is used to link the recommended practices for students from different housing backgrounds.

While the focus of the majority of research, which pertains to online learning, is on the population of postsecondary students and not students at the high school level, online learning programs have been implemented in high schools across the U.S. (Barbour & Reeves, 2009; iNACOL, 2012; Picciano, Seaman, Shea, & Swan, 2012; USDOE, 2010). In addition, several states have now made online learning experiences mandatory at the secondary level (Lawrence, 2012). Also, online schools in which no face-to-face interaction is required are available to high school students (Picciano & Seaman, 2009; Wicks, 2010). All of these changes have been made without a strong research base to support the use of any form of online learning (Cavanaugh,
Barbour, & Clark, 2009; iNACOL, 2012; Langenhorst, 2011; Murphy et al., 2014; O'Dwyer, 2010; USDOE, 2010; Wicks, 2010).

In this review of the available literature on the topic, there were many studies, which were used to measure student satisfaction with online learning and student pass rates in online courses as well as case studies of programs of online instruction at the high school level (Butz, 2004; Cavanaugh et al., 2009; Dexter, 2011; Eduviews, 2009; Edwards & Rule, 2013; Jung, Choi, Lim, & Leem, 2002; Perry & Pilati, 2011; Watson & Gemin, 2008; Woods, Maiden, & Brandes, 2011). However, there is a lack of literature on the actual effectiveness of the online delivery system in regard to student mastery of the content as measured by reliable means (Barbour & Reeves, 2009; USDOE, 2010). In a report from the iNACOL (2012) in regard to the top federal policy issues, it was noted that:

While a small body of research focused on the effectiveness of K-12 online learning was funded by the U.S. Department of Education from 2002-2011, more data collection and research is needed in the field of K-12 online learning. Online and blended learning provides personalized learning and increased access to high quality courses otherwise not available to students. There are, however, important gaps in the knowledge base in this emerging field. (p. 2)

While there are many benefits to the use of online instruction such as: (a) expanded course options, (b) student-centered learning, (c) an alternative method of instruction for struggling students, and (d) interactive learning models, there are no research results that clearly support these options for different student populations at the high school level (Wicks, 2010).

Students in the Aldine Independent Schools in Texas have used online instruction since the year 2000 (Watson & Gemin, 2008). It is used for at-risk students as an alternative method of instruction. The year before the program was implemented, students recovered only 700 half-credits through traditional methods. However, 7 years later, staff members of the Online Learning Center were able to help students recover approximately 4,500 half credits a year.
Watson and Gemin did not note whether enrollment numbers changed across the 7-year span. Along the path to success with credit recovery, school administrators added support to give students a greater opportunity to be successful. One such support was one-on-one tutoring provided by National Honor Society students. In an attempt to maintain the integrity of the standards and content, also, students were required to pass a final exam before they could receive credit. While this model seems like a valid success story and a good reason to implement online learning for credit recovery, it only provided evidence of improved mastery of course content as measured by course grades (Gall, Gall, & Borg, 2007; Malouff, 2008). While neither blended online instruction nor traditional face-to-face instruction can guarantee content mastery, further studies are needed to determine whether blended online instruction is comparable to face-to-face instruction for content mastery in mathematics (Corry & Stella, 2012; Edwards, Rule, & Boody, 2013).

Many postsecondary school officials have used an online delivery system with much success for several years, and an abundance of research demonstrates that it can be just as effective as face-to-face instruction (Kim & Frick, 2011; McFarlane, 2011; National Education Association, 2002; USDOE, 2010). It is important to note, however, that the students at the post-secondary level vary greatly, from the average high school student in terms of: (a) brain development, (b) readiness levels for different modes of instruction, and (c) other characteristics (Boylan, 2011; Ratey, 2002). It should not be assumed that what works at the collegiate level also works in public high schools (Corry & Stella, 2012; Edwards et al., 2013; Nilson, 2010). At the postsecondary level, online instruction is used to provide greater convenience for working students and also greater access for students in more remote geographical areas (Ally, 2011; Kanuka, 2011; Liberty University, 2013). These students have already proven their academic
readiness through the application and testing process required for college acceptance (Kobrin, Patterson, Shaw, Mattern, & Barbuti, 2008). The use of research findings, based on students who have succeeded in high school and advanced to postsecondary education, lack external validity when used to make a comparison with a student, who struggles to pass a basic high school mathematics course.

Title Searches, Articles, Research Documents, and Journals Researched

Research databases including EBSCO, Education Research Complete, ERIC, and ProQuest were accessed through the Liberty University online library to provide a range of scholarly sources. Terms used in these searches included: (a) online learning in combination with mathematics, (b) high school, (c) instructional strategies, (d) self-determination, (e) theories, (f) housing status, and (g) academic achievement. With use of the sources identified, the researcher snowballed them in order to consider the list of references for each source, and to find other items. If there were titles of interest, they were acquired. Also, this researcher accessed materials from respected online learning consortiums, organizations for qualitative research, the Georgia Department of Education, reports from the U.S. Department of Education, as well as documents from the research sites for this study.

First, the search for literature was focused on online learning for high school students. This search led to the meta-analysis from the USDOE (2010) in regard to online learning. Within that analysis, research studies were mentioned that related to blended online learning and online learning with mathematics. The researcher reviewed those studies based on the applicability of the content to this investigation and the validity and reliability of the study. Of the 300 studies reviewed by the researcher, many were rejected due to limitations in external validity. Additional sources were rejected because of a lack of reliable results due to small
sample size or flaws in experimental design. Other studies were omitted, as they did not relate closely enough to the scope of this study.

Sources, which pertained to instructional techniques, were selected based on the quality of information within each source. Additionally, these sources were selected based on the qualifications of the authors as experts in the field of education and instructional strategies based on their education, experience, and credentials. The researcher also asked for information from colleagues in education and a library reference clerk in a neighboring county. The key words of: (a) Universal Design for Learning, (b) differentiation, and (c) brain development in adolescence were used to locate scholarly articles related to appropriate educational strategies.

To better understand the link between housing status and resulting academic achievement, the researcher first looked at an annotated bibliography from the Center for Housing Policy (2007). The authors of this document summarized several research studies in which a relationship between housing and mobility and student academic achievement at varying grades and levels of mobility was found. From those sources, the researcher opened the search to include more information on mobility related to renting and homeless status. After reading all related studies in full, additional sources were found based on a more detailed search of EBSCO and ERIC which included the search terms, homelessness and renting vs. owning in combination with educational achievement.

**Theoretical Framework**

Online learning is grounded in theories of: (a) self-regulated learning, (b) student-centered learning, (c) Keller’s ARCS model of motivational design of instruction, and (d) cognitive load theory (Artino, 2008; Barnard-Brak, Lan, & Paton, 2010; Kim & Frick, 2011; Rogers, 2007; Zimmerman, 1989). All of these theories are related to one another in that they
lead to higher student achievement and improved post-learning outcomes. Each is described in more detail throughout this section (Abrami, Bernard, Bures, Borokhovski, & Tamim, 2011; Roschelle, Pea, Hoadley, Gordin, & Means, 2000; Weimer, 2002). The students, who participated in this study, presented differing and unique challenges in terms of learning and educational approaches. These challenges will be examined to explain possible disparities in the results from this study. Finally, the researcher will review different uses of online learning in secondary education and evaluate the contributions that these case studies make toward a body of knowledge.

Social Cognitive View of Self-Regulated Learning

Zimmerman’s (1989) self-regulated learning theory, which dates back to the 1960s, describes students as active participants in their own learning process. The social cognitive model of academic self-regulated learning is defined as “the extent to which learners are meta-cognitively, motivationally, and behaviorally active in achieving their learning goals” (Lynch & Dembo, 2004, p. 2). Self-regulation means that students are able to: (a) monitor their own time, (b) reflect on their own learning, (c) set learning goals, (d) utilize learning strategies to solve problems or complete tasks, and (e) seek assistance when needed (Barnard-Brak et al., 2010). The social cognitive part of the theory is related Bandura’s (1986) work, who maintained that there are three areas of learning, which influences self-regulation: (a) self, (b) environment, and (c) behavior. Regulation of self includes the ability to: (a) organize tasks and information, (b) transform information to create meaning, (c) set goals, (d) manage time, (e) monitor progress, (f) maintain records, (g) review notes and assessments, and (h) study materials as needed (Samruayruen, Teeraputon, & Samruayruen, 2012). The ability to seek assistance and information from other individuals or text and the structure of the environment are components
of environmental self-regulation strategies and important parts of social interaction within the self-regulated learning theory (Kim & Baylor, 2006; Zimmerman, 1989). Regulation of behavior involves self-assessment of progress and self-administered consequences when the goals are not met (Samruayruen et al., 2012).

Since its inception, self-regulated learning theory has evolved to include a cyclical process of planning, action, and reflection (Zhao & Johnson, 2012; Zimmerman, 2002). Winne (2005) further evolved the theory into a Four Turning Points Model. The four steps in this model include: (a) understand the requirements of the learning environment, (b) set personal learning goals and develop a plan to reach those goals, (c) obtain the skills required to apply planned learning strategies, and (d) apply those strategies while learning. The steps are very similar to current trends in education related to teaching students how to think and learn instead of teaching them what to learn (Samruayruen et al., 2012). Zimmerman (2002) suggested that self-regulation could be both taught and modeled for students. Once students have these prerequisite learning skills, which are part of self-regulation, they can more readily achieve in academics (Artino, 2007; Whipp & Chiarelli, 2004; Samruayruen et al., 2012; Zimmerman, 2002).

Online learning, in its design, shifts some of the responsibility for learning from the teacher to the student (Ally, 2011; Caplan & Graham, 2011). When students take responsibility for their learning, self-regulated learning is activated (Artino, 2008). Within the online learning setting, students are forced to take responsibility for their learning and make choices that assist them in completion of the course (Ally, 2011). According to Seckel (2007), “Online learners must be able to identify their individual learning style, level of motivation, and additional characteristics necessary for successful e-learning” (p. 22). Lynch and Dembo (2004) concluded
that there is a correlation between student levels of self-regulation and achievement in blended online courses.

In addition to forcing students to use their present self-regulation skills, the use of blended online learning can help build self-regulation skills in students who may lack this skill (Artino, 2008). Many high school students, who attempt to recover credits, may be very skilled with the use of technology and the Internet, but they may not yet be ready for independent learning (Seckel, 2007). The use of blended online instruction allows the instructor to give individualized feedback and support based on students’ current levels of self-regulation in learning. This feedback and support, as Artino suggested, can be scaffolded as students continue through the course.

**Student-Centered Learning**

The concept of student–centered learning was advocated by Hayward (1905) and further developed by Dewey (1956). Rogers built on their work when he developed the client-centered therapy models in the late 1950s. Rogers’ work helped to move the theory into the field of education by an emphasis on a shift of control from the teacher to the learner (O’Neill & McMahon, 2005). In student-centered learning theory, students are given choices in their learning, and there is a focus on what the students do to achieve learning as opposed to what the teacher does to achieve learning for the students (Harden & Crosby, 2000). Lea, Stephenson, and Troy (2003) noted the following tenets as essential for student-centered learning:

1. the reliance on active rather than passive learning, 2. an emphasis on deep learning and understanding, 3. increased responsibility and accountability on the part of the student, 4. an increased sense of autonomy in the learner, 5. an interdependence between teacher and learner, 6. mutual respect within the teacher learner relationship, 7. and a reflexive approach to the teaching and learning process on the part of both teacher and learner. (p. 322)
In this theory, the teacher is more of a facilitator and resource while the student is the one responsible for learning (Brandes & Ginnis, 1986). The main foci in student-centered learning are the: (a) learning environment, (b) content, (c) context, and (d) teaching practices (Neumann, 2013). When students have control over any one of these factors, student-centered learning is can take place.

With the use of online learning programs, there is a greater capacity for flexibility, individualization, and a student-centered approach, which can be more difficult to achieve with traditional face-to-face instruction (Caplan & Graham, 2011). With many online programs, students have the power to: (a) work at their own pace, (b) repeat lessons for full understanding, and (c) monitor their own progress (Thomson, 2010). One such example described by Watson and Gemin (2008) was that:

Diagnostic testing that allows students to demonstrate mastery of the elements of a subject that they learned in their prior attempt to pass the course, and move on to the parts of the course that they need to focus on, keeps students engaged. (p. 14)

This is a prime example of when the student can control the content of the course in the practice of student-centered learning. According to Rogers (2007) and Marzano (1992), this type of implementation of student-centered learning can increase: (a) student motivation, (b) engagement, and in turn, (c) academic performance.

**Keller’s ARCS Model of Motivational Design of Instruction**

As noted in the previous theoretical models and in current research, motivation is a key component to student learning and effective instruction (American Psychological Association, 1993; Lynch & Dembo, 2004; Seckel, 2007). Motivation is defined as “the process whereby goal-directed activity is instigated and sustained” (Schunk, Pintrich, & Meece, 2008, p. 4), and motivation is interdependent with both student-centered learning and self-regulated learning.
Schunk et al. (2008) and Song (2000) concluded that motivation is an important component for effective online learning, as motivated learners: (a) are more engaged, (b) will challenge themselves more, and (c) perform at higher levels of achievement.

Motivation can be the effect of the attitude of the learner, as when a student is excited about trying online learning, or the effect of the learning environment, as when added supports are provided within the blended online learning (Brophy, 2010; Keller, 2008; Turner & Patrick, 2008). Also, motivation can be influenced by a combination of attitude and environment. In his discussion of motivation in blended online learning, Keller (2008) suggested that “Combining technology-based delivery systems with classroom delivery offers opportunities to integrate motivational support strategies in novel ways” (p. 182). When students are motivated, self-regulation can occur more readily, and student achievement will likely increase (Artino, 2007; Lynch & Dembo, 2004; Zimmerman, 1990).

According to Keller’s theory (1983, 2008), there are four main factors that contribute to student motivation with learning: (a) attention, (b) relevance, (c) confidence, and (d) satisfaction. First, students’ attention must be held by the instruction. With the use of blended online instruction, this can be achieved by a reduction in distractions in the learning process (Kim & Frick, 2011). In many cases, students work without social interaction and use headphones to listen to lectures or videos. The lack of distractions helps the students to remain on task. Also, the technology format in online instruction is novel and exciting for high school students (Edwards & Rule, 2013; Rideout, Foehr, & Roberts, 2010; The Nielsen Company, 2009).

Next, the instruction must be relevant to students’ wants and needs (Keller, 2008). With the use of pretests to customize instruction, students can show mastery of standards before each unit (Edgenuity, 2013c). If the student does show mastery of the required content through the
pre-quiz, the program allows them to skip that unit and move on to the next lesson. By use of this feature, students have tangible evidence of accomplishment as they move through the course and also are able to use their time to work on more complex lessons that they have not yet mastered (Marzano Research Laboratory [MRL], 2012). When students are allowed to work at their own pace, they can maintain their motivation in the class and subject area (Nilson, 2010; Rogers, 2007; Weimer, 2002). In many face-to-face classrooms, some students who struggle: (a) can become overwhelmed, (b) get lost in a concept, or (c) get behind in the content of the course, which causes a drop in motivation. However, with online learning and individualized pacing, students can build and maintain intrinsic motivation, which can continue beyond the end of the online class (Rogers, 2007). When students are placed at the center of instruction and their student-centered learning opportunities increase, the use of blended learning increases student motivation (Thomson, 2010).

The third factor, which can be used to increase student motivation, includes activities and interactions that allow students to build confidence in their own skills (Keller, 2008). With a blended online program, the teacher can work with students to build confidence in skills within the first few weeks of the course. If the student struggles, the online format of the course allows the teacher the freedom to help a student one-on-one and differentiate instruction without neglect of instruction of the other students in the class. This extra attention can help students build confidence from continued success in the academic content (Kim & Frick, 2011). When students can build confidence based on their hard work and abilities, they are more likely to maintain motivation (Keller; Weiner, 1974).

The fourth factor in Keller’s (1983) model is satisfaction with the course and instruction. Students, who participate in relevant instruction, while they build confidence in skills and
knowledge, will likely be satisfied with the course (Roschelle et al., 2000). Also, the teacher’s presence to provide support and interaction in the blended course design helps to increase satisfaction with the course (Keller, 1983). In their study, Sun, Tsai, Finger, Chen, and Yeh (2008) found that e-learner satisfaction is driven by many factors including: (a) the learner’s attitude toward technology, (b) instructor behaviors and attitudes, (c) the flexibility and quality of the course, (d) the quality of the technology available, (e) the design of the overall program, and (f) the learning environment. Based on their research findings, along with those of Edwards and Rule (2013) and Seng and Mohamad (2002), most students, who enrolled in online courses, were very satisfied with the learning experience.

In the last part of Keller’s theory, added in 2008, it was noted that effective learners maintain motivation by the use of self-regulation strategies. The presence of self-regulation allows students to stay on track even in the presence of: (a) distractions, (b) other goals, and (c) problems the students may encounter throughout the learning process (Zimmerman, 1998). In the blended online environment, the teacher is present to support any struggles that students may experience in terms of self-regulation, or the teacher can help support students as they learn self-regulation skills (Artino, 2008). When students can maintain motivation through self-regulation, Lynch and Dembo (2004) found that higher levels of learning and achievement could be achieved.

The use of online learning can help to motivate students through the provision of interesting, relevant, and satisfying work (Interactive Education Systems Design [IESD], 2013; Kim & Frick, 2011; Weimer, 2002). In addition, those who are successful with online learning can gain more confidence and become more motivated to continue in education, whether it is in the classroom or the online setting (Kim & Frick, 2011). When students are enabled to succeed
in their own ways, they will have both the skills and the momentum to continue growing academically. Also, they will learn about themselves and gain knowledge about their own strengths, weaknesses, and learning processes (Roschelle et al., 2000).

**Cognitive Load Theory**

With its origination in the 1980s, cognitive load theory pertains to the efficient use of one’s cognitive processing capacity in the learning and application of new knowledge (Chandler & Sweller, 1991; Paas, Renkl, & Sweller, 2003; Paas & Van Merriënboer, 1994; Sweller, Van Merriënboer, & Paas, 1998). According to Paas, Tuovinen, Tabbers, and Van Gerven (2003), limitations in working memory capacity, especially for children and young adults, need to be considered in the design of instruction. In the process of learning information, it is necessary to use working memory, as well as auditory and visual channels in the brain. However, by the creation of mental models, or schemas, to relate material during the learning process, instructors can help students to automate processes and thus bypass working memory after initial learning has taken place. Also, instructors need to avoid overload of information in either the visual or auditory channels of the brain and in working memory (Chandler & Sweller, 1991; Skuballa, Schwonke, & Renkl, 2012).

In cognitive load theory, cognitive overload can decrease students’ motivation, especially in the first few weeks of a course (Kim & Frick, 2011). Use of the blended online format allows students to work at their own rate, and as a result, cognitive demands can be adjusted as needed in order to reduce the possibility of cognitive overload (Edgenuity, 2013c; Mayer & Moreno, 2003; Rogers, 2007). Additionally, the use of online learning can synchronize visual representations of instruction with narration. This helps to minimize the need for storage of
information during the learning of processes, and cognitive demands can be reduced (Mayer & Moreno, 2003).

**Strategies for Varying Student Populations**

While the theoretical basis for blended online learning applies to all students, different groups of students may have varied responses to teaching strategies, based on their needs, backgrounds, and readiness levels (Ackerman, 2012; Christensen et al., 2008; Harwell & Jackson, 2008; Jensen, 2005; Nilson, 2010; Tomlinson, 2001). As a result, it is important to plan instruction with a variety of strategies in mind for each segment of the audience (Tomlinson, 2001). In this current study, the researcher will investigate whether the use blended online learning is a successful strategy for high school students from different housing environments. In order to fully understand the different populations represented in this project, it is important to review the possible needs of these populations and recommended teaching strategies in regard to mathematics and STEM instruction at the high school level.

**Strategies for Teaching Students Who Struggle with Mathematics**

According to Marino (2010), many students who struggle with mathematics often lose interest and become frustrated with mathematics instruction before they reach high school as a result of failure on standardized and classroom tests earlier in their education. Additionally, students with high rates of mobility are at greater risk of missing prerequisite math skills in comparison to students with low rates of mobility (Bridgeland & Milano, 2012; Center for Housing Policy, 2007; Kerbow, 1996; Rumberger, 2002). This means that, by the time students get to high school, it is important for teachers to know and understand: (a) students’ backgrounds, (b) how to reach these students, and (c) how to address gaps in students’ knowledge. One method to build confidence in skills and meet the needs of these students, as
recommended through student-centered learning theory and Keller’s (2008) ARCS theory, is Universal Design for Learning (UDL) in the STEM areas (Basham & Marino, 2013). The four basic requirements for UDL are: (a) clear expectations or goals, (b) planning for varying students’ needs, (c) differentiation in methods and materials, and (d) timely monitoring of student progress (Universal Design for Learning Implementation and Research Network, 2011). These requirements are very similar to the practices recommended for online learning by MRL (2012). Through the implementation of UDL, school leaders can increase and maintain student motivation in order to help struggling students build confidence and skills in academic areas (Keller, 2008; Weiner, 1974).

In order to effectively implement UDL, teachers must plan instruction so that they can anticipate and address difficulties that students may have during the learning process (Meyer & Rose, 2000). Often, struggling learners have weaknesses with: (a) attention, (b) working memory, (c) long-term memory, (d) math computation, (e) conceptualization, (f) organization of information, (g) literacy skills, and/or (h) gaps in knowledge; all of these factors negatively affect mastery of math concepts at the high school level (Bridgeland & Milano, 2012; Geary, 2004; Harwell & Jackson, 2008; Jitendra, 2013; Ratey, 2002). With the use of UDL, the teacher is able to anticipate all these challenges before teaching the lesson and plan supports to address those weaknesses (Courey, Tappe, Siker, & LePage, 2013). This student-centered approach assists students to achieve at higher academic levels (Basham & Marino, 2013).

While UDL can be used to plan for a myriad of student needs prior to instruction, differentiation can provide adjustments during the lesson based on needs identified during instruction (Kristin, 2013). Tomlinson (2001) defined differentiation as: (a) proactive, (b) qualitative, (c) based in assessment, (d) variable in terms of process and product, (e) student-
centered, and (f) variable in terms of setting. This strategy is effective for struggling students, as it adjusts instruction to meet the needs of the learner in the moment (Geary, 2004; Harwell & Jackson, 2008; Jitendra, 2013).

Differentiation requires the teacher to determine the strengths and weaknesses of each student through the use of either classroom formative assessments or the results of recent achievement tests (Tomlinson, 2001). Teachers should then use these results to: (a) inform instructional decisions, and (b) make adjustments as necessary through a lesson. Gersten et al. (2009) found that the use of differentiation to provide feedback on student performance in mathematics was effective in the increase of understanding for students. Ackerman (2012) noted that, “Part of understanding differentiated instruction is recognizing that students have strengths across subjects while also having different interests, styles of learning, etc.” (p. 8). Also, differentiation involves the use of multiple modes of instruction to reach segments of the learner group (Ackerman, 2012; Tomlinson, 2001).

Since UDL and differentiation are very similar in their methods, with the main differences being when the adjustments are implemented and the rationale for the adjustments, they use many of the same techniques to adjust instruction (Kristin, 2013; The Universal Design for Learning Implementation and Research Network, 2011; Tomlinson, 2001). One such strategy is scaffolding. Based on their research findings, Brush and Saye (2001) recommended scaffolding the concepts of mathematics for students through the use of visual modeling for how to solve problems while, simultaneously, talking through the steps of the process and providing verbal hints during student practice. The process of multi-step mathematical problems can be scaffolded through the use of diagrams to visually represent a process, step-by-step instructions, or a checklist of operations, which can be used during independent practice. Next, the instructor
can scaffold mathematics metacognition through prompts to the student to ask the right questions in evaluation of the task. Lastly, teaching different strategies, in order to solve the same problem, can help students to identify methods that work best for them (Brush & Saye, 2001). All of these examples of scaffolding demonstrate ways in which instructors can reduce cognitive load (Mayer & Moreno, 2003).

The strategies of UDL and differentiation have been shown to work together to improve outcomes for students in mathematics classrooms (Gersten et al., 2009; Tomlinson, 2001). Since, usually, the instructor in the traditional mathematics classroom implements differentiation and UDL, these strategies need to be built into online classes in the design process (Sucre, 2010). Some options for differentiation in the online setting include differentiation of content after the use of formative assessments or tools to increase accessibility, such as screen readers or enlarged print (Scalise, 2007). Both differentiation and UDL can be implemented and advantageous in both the traditional and online setting, and they can be used together to improve outcomes for students (Harwell & Jackson, 2008; Heward, 2003; Kristin, 2013; Meyer & Rose, 2000).

**Strategies for Teaching Students of Low Socioeconomic Status**

Poverty is a major concern in the discussion of student achievement in schools (Brumley et al., 2015; Englund, Egeland, & Collins, 2008; Fantuzzo et al., 2012; Pavlakis, 2014; Voight et al., 2012). According to Howard, Dresser, and Dunklee (2009), the poverty rate is growing annually, especially among minority students. Often, the effect of poverty on school performance is evident as gaps in important school readiness skills when students start elementary school (Howard et al., 2009; Ratey, 2002). Sirin (2005) associated these factors with a lack of available resources, such as access to books or early educational opportunities. In addition, many children from impoverished homes perform at lower levels than their peers in
terms of standardized test scores, school grades, and are more frequently held back a grade. Also, poor students are more likely to drop out of high school (Day & Newburger, 2002; Miranda, 1991; Sirin, 2005). The tendency to drop out is exacerbated when students from low-income homes have low academic achievement (Englund et al., 2008).

Students from lower income households need additional support in the instruction of self-regulatory learning (Payne, 2005). In regard to instruction for low socioeconomic status students, Payne (2005) urged educators to rethink how they provide instruction. Payne suggested the following research-based strategies for student achievement to: (a) develop self-regulation skills, (b) increase and maintain motivation, and (c) decrease cognitive load.


Howard et al. (2009) suggested that educators should create a classroom experience that supports students from poor households. They noted that students need: (a) a structured environment, (b) frequent positive feedback, (c) choice and flexibility, and (d) positive relationships with staff. The relationship between the teacher and the student, as found by Croninger and Lee (2001), is vital for students from low socioeconomic households to stay in school through graduation. In, addition, Rawlinson (2011) emphasized that teachers should keep expectations high, even for students who have shown lower achievement in the past. She expanded on this and explained that students will rise to the expectation that is set by a caring teacher. In terms of the transition to high school and passing the ninth grade Mathematics I course, Serbin, Stack, and Kingdon (2013) emphasized the importance of a successful transition from middle school to high school
for students from lower income households. Even though the focus of this dissertation is on the
effects of blended online learning for students, who need to repeat repeating their ninth grade
mathematics course, it is not too late to assist these students with their transition into high school.

**Mathematics Readiness in Terms of Student Age and Brain Development**

Jensen (2005) and Ratey (2002) demonstrated that, at the age of 14 or 15, the brain,
especially the frontal lobe and anterior cingulate regions, is not fully developed. In terms of
education, this means that the younger the student, the less he or she is able to: (a) block out
distractions, (b) plan or problem-solve, and (c) focus on instruction for longer periods of time.
Also, in cases of malnutrition or health problems, these delays in brain development can be even
greater (Benton, 2008; Bower, 2012; Harwell & Jackson, 2008).

Jensen (2005), Medina (2008) and Ratey (2002) supported the idea that if sections of the
brain are not used regularly, those pathways eventually deteriorate and become used for other
purposes. In this case, the brain will devote new pathways to more regularly practiced
information instead of maintaining pathways for less used information, as is the case when
someone does not practice mathematics skills on a regular basis (Jensen, 2005; Ratey, 2002).
Without basic mathematics skills, it may be difficult for individuals to move on to higher-level
mathematical processes, because they have to depend on working memory for tasks that should
be automated (Kesler, Sheau, Koovakkattu, & Reiss, 2011). Geary, Hoard, Byrd-Craven, and
DeSoto (2004) found that higher-level mathematics requires a great deal of attention and
working memory, which may also be lacking in younger students. This heavy reliance on
attention and working memory in high school age students can contribute to cognitive overload
(Paas, et al., 2003). When students are required to use working memory on basic processes, the
task becomes even more daunting and difficult.
Additionally, not all brains will develop at the same rate and in the same areas (Medina, 2008; Ratey, 2002). Many teachers have the expectation that all students’ brains are ready to receive and process information and skills when it is planned in the curriculum. However, not all students’ brains are sufficiently developed to learn reading or mathematical skills when teachers are scheduled to teach those skills. To account for this, Medina recommended that teachers get to know students and their needs better. This should be accompanied with a more individualized approach, which consists of the use of UDL and differentiation (Connor et al., 2009). In an example of UDL, Kesler et al. (2011) suggested that basic mathematical skills and number sense can be systematically taught, and the neurons and pathways can be rebuilt in the brain, even in at-risk populations. Adaptive software, recommended by Medina (2008) and developed by Carol McDonald Connor, can match the premise of individualized student-centered instruction, which is present in online learning, with skills needed to achieve in mathematics (Archambault et al., 2010; Jung et al., 2002; Woods et al., 2011.)

**Homeownership Status and Academic Achievement**

Socioeconomic status should not be confused with homeownership status. In many cases, the two factors are related to one another, in that, students who are classified as homeless are often classified in the lower bracket of socioeconomic status (Hu, 2013). However, some families in the lower socioeconomic classification own homes with the assistance of housing programs throughout the U.S. These families enjoy the benefits of homeownership and students from those households are at less risk of academic failure (Aaronson, 2000; Currie & Yelowitz, 2000; Green & White, 1997; Haurin et al., 2001; Vandivere et al., 2006). According to Bridgeland and Milano (2012), Brumley et al. (2015) and Cutuli et al. (2013), mobility rates in housing are more indicative of academic success than the income level of the household.
Homeowners vs. Renters

Students of homeowners are at an advantage in terms of academic achievement when they are compared to students from rental households or students classified as homeless (Aaronson, 2000; Currie & Yelowitz, 2000; Green & White, 1997; Haurin et al., 2001; Vandivere et al., 2006). Their higher level of achievement is attributed to a lower rate of mobility in homeownership situations in comparison with rental households. Also, Green and White (1997) indicated that homeownership has a greater effect on student achievement for students from lower-income households than their peers from median to high-income households. In addition, Harkness and Newman (2003) indicated a positive relationship between years of homeownership and educational outcomes for low-income students.

Homeownership may not be the cause of higher achievement in school, but instead it may be a factor that leads to lower student mobility (Hu, 2013). Students, who live in rental households, are more likely to lack stable housing and are more likely to move at a higher rate than those from home owning households (Bridgeland & Milano, 2012). Many researchers (Aaronson, 2000; Bower, 2012; Braconi, 2001; Newman & Harkness, 2002; Rumberger, 2002; Sandel, Sharfstein, & Shaw, 1999), in their studies in the area of homeownership status and educational outcomes, had indicated that students’ mobility is a key factor in student achievement. According to the staff of the Center for Housing Policy (2007), “Residential mobility can help or hinder children’s education depending upon the reason, frequency, and timing of the move” p. 22). In a study by Kerbow (1996), students, who that changed schools at least four times by the sixth grade, were found to have a gap of about 1 year of knowledge in comparison to their less mobile peers. Rumberger (2002) determined that even one move can have a negative impact on a student’s education; more frequent moves can lead to grade
retention, and mobility in both elementary and high school is negatively correlated to high school graduation.

### Homeless Students

While students from rental households may experience some mobility from school to school, students, who are classified as homeless, experience increased mobility and less stability within the household (Moore et al., 2000; Vandivere et. al., 2006). Students classified as homeless can live in a wide variety of settings, which may include: (a) shelters, (b) hotels or motels, (c) vehicles, or (d) in a family member or friend’s home (National Center for Homeless Education, 2012; National Center for Homeless Education, 2014). Regardless of the specific setting, “Childhood turbulence is negatively correlated with school engagement levels, and the strength of the correlation increases with the child’s age” (Center or Housing Policy, 2007, p. 13). Moore et al. (2000) found that students, who lived in homeless arrangements, were more likely to have emotional and behavioral problems. Also, for students at the high school age, they found that this turbulence led to higher rates of: (a) skipping school, (b) in-school and out of school suspension, and (c) expulsion. In addition to these problems in school, homeless students: (a) perform at lower levels on academic assessments, (b) are more likely to experience developmental delays, and (c) are at a greater risk of other educational problems (Vandivere et. al., 2006). This is not related entirely to mobility, as the stressful living conditions experienced by the student can lead to further problems with learning and behavior.

### Uses of Online Learning

As previously stated, high school leaders across the country use online learning for a variety of reasons and with a variety of populations (McFarlane, 2011; Picciano & Seaman, 2009; Wicks, 2010). Depending on the needs of the students in the school, many high school
leaders opt to use online learning as a way to assist students in order to recover credits toward graduation (Eduviews, 2009; Watson & Gemin, 2008). Currently, students in rural areas are provided with courses online, which are not available in a classroom setting (Aronson & Timms, 2004). In addition, other school administrator save money when they implement a more flexible, and at times more cost effective, model in online learning (Eduviews, 2009; Picciano & Seaman, 2009).

Credit Recovery for Credit Deficient Students

Online learning has been used in many school districts as a means of credit recovery for students, who are credit deficient and at risk of dropping out of high school (Eduviews, 2009; Watson & Gemin, 2008). In several states, charter schools, and private schools, leaders have elected to provide online learning models in the form of virtual schools to assist students in earning credits (Christensen et al., 2008; Lawrence, 2012; Watson, Murin, Vashaw, Gemin & Rapp, 2013). One example is The Georgia Virtual School, in which students can earn credits that allow them to: (a) stay in school, (b) graduate from high school, and (c) become productive citizens (AdvancED, 2012; Watson & Gemin, 2008; Watson et al., 2013). There are different models of online credit recovery to assist students. They range from distance learning, with little student-teacher interaction, to classroom learning, with online components included in instruction (Bakken & Bridges, 2011).

The officials of the Florida Virtual School (Watson et al., 2013), in their application of online learning, have developed localized campuses where students can work in a lab with a facilitator. This facilitator can provide students with the extra support they may require to be successful. One of their program directors, Cindy Lohan, noted of the blended design that, “online learning gives students seeking credit recovery the individual attention they need to be
successful” (as quoted in Watson & Gemin, 2008, p. 9). Keller (2008), Kim and Frick (2011), and Weiner (1974) noted that this extra attention can build student confidence and lead to increased motivation and further success with the content.

In some programs, students who are behind in credits can even accelerate their learning by taking more classes than are usually allowed in the typical school day (Dexter, 2011; Watson & Gemin, 2008). In The Bridge Program, in the Salem-Keizer School District in Oregon, students are allowed to attend classes on a separate site 2 hours a day, which also allows them to work additional hours from home. During the time in the classroom, students work on online courses with the support of a highly qualified teacher and, in some cases, a mentor. This procedure, in addition to a mandatory attendance policy and an orientation session, is believed to provide the structure necessary to help these students succeed in passing classes at a faster rate than their peers in traditional classrooms. When this case study by Watson and Gemin was published, the school had just started to extend the hours of the program and the locations to make the program more accessible. Something unique to their program was that staff members sought out students within the district, who would be potential candidates for the program, and also recruited students, who had previously dropped out of that school district, so that they could earn a high school diploma.

In these blended online learning models, it is still difficult to determine whether the students understand the content of the courses they are passing, or are going through the motions and jumping through the necessary hoops to receive their high school diploma, as content mastery data is not provided in the reports (iNACOL, 2012; Picciano & Seaman, 2009; USDOE 2010; USDOE 2012). Additionally, some programs have built intensive supports, such as The Bridge Program (Watson & Gemin, 2008), and similar results from setting to setting would be
unlikely without the exact combination and proportion of interventions such as: (a) additional attention, (b) proactive instructors, (c) a structured environment, and (d) a flexible schedule. However, there is no quantitative research to show that these students master the material.

**Greater Availability of Course Offerings**

Aronson and Timms (2004) and staff of the USDOE (2010) have identified numerous qualitative reasons for school leaders to implement online instruction at the high school level. One of these reasons is to provide a greater richness in course offerings to high school students. Aronson and Timms (2004) reported that, at some schools, online courses are used to supplement the course offerings available to students due to either limited course offerings in smaller schools or schedule conflicts. Also, the provision of online courses can allow educators to offer several different online classes within the same classroom and with only one proctor instead of several teachers in separate classes (Picciano & Seaman, 2009; Watson & Gemin, 2008). Thus, the use of online instruction can greatly cut costs, because fewer teachers can be employed, while there is a provision of a greater variety of classes.

In rural areas with fewer educational options and resources, the use of online learning can provide students with opportunities to better prepare for college courses and content whereby they can be exposed to advanced level instruction, which may not be available otherwise. In a report on the condition of education, staff of the National Center for Educational Statistics (2005) mentioned the limited availability of advanced classes in rural areas. In the same study, the researchers found that students in urban or more populated areas were more likely to take advanced placement courses and assessments than their peers in rural areas. The disproportionate number of advanced placement courses in rural areas was attributed to a lack of highly qualified teachers and resources to support that level of instruction in rural districts. With
use of online instruction, these needs can be met. In addition, online instruction can be used to add more diversity to course offerings through an increase in available classes at all levels of achievement and in all subjects. The use of online learning can assist many school leaders to increase the availability of unique or advanced classes and STEM classes to students in order to help them better prepare for their college interests (Picciano & Seaman, 2009).

**Extra Remediation Outside of Class**

In an attempt to identify struggling students and provide remediation before they fail a class, some school officials have implemented online instruction as a way to help students make up work when they fall behind with face-to-face instruction. In these cases, students are assigned specific modules. Once the modules are finished, the teacher will adjust the student’s grade to reflect the grades earned in remediation of that topic (Watson & Gemin, 2008). This can be made available for students, who take the class for the first time, or for students, who retake a class in a traditional face-to-face setting. In online modules, district officials can provide a preview or a review of class content in preparation for the next class in a sequence. The students would not earn a credit for their participation in this approach, but instead would build up weaker areas to create a stronger base for future instruction in that content area. While this method is not yet grounded in research as an effective practice, it is being used across the nation as a Response To Intervention (RTI) strategy and is recommended in some studies as a possible RTI strategy for the development of higher order thinking skills and to increase mathematics understanding (Allsopp, McHatton, & Farmer, 2010; Bradberry-Guest, 2011; Heppen et al., 2012).
Cost Savings for Districts

In addition to the use of online classes as a way to improve learning for at-risk students, district officials may implement online instruction as a way to reduce costs associated with instruction (Aronson & Timms, 2004). When several online classes are combined within the same classroom, or when students are allowed to take classes from home, school leaders can save money through a reduction in staff (Aronson & Timms; Picciano & Seaman, 2009). Additionally, school officials can increase funds by use of the credit recovery options in online learning to keep students in school until graduation, thereby, maintaining the funding for the school derived from educating the students (Eduviews, 2009). The cost for this intervention depends on the structure of the program and the implementation used by school leaders, so it is possible that savings are not achieved uniformly.

The financial implications of online learning vary from district to district and are influenced by the decisions that school leaders make (Wicks, 2010). For example, school officials have the option of purchasing already created classes that are maintained by an outside company, or they and their faculty can create their own program and courses for online learning. Also, officials can contract with companies to provide the entire online learning service (Watson et al., 2013). Schools leaders will vary in how they implement and fund online learning based on: (a) the needs of the school, (b) the purposes identified by the administrators, and (c) the resources within the district (Wicks, 2010).

While the cost of programs for online learning may be substantial at the beginning of the program, over time many school leaders can save money through implementation of online classes in comparison to face-to-face instruction. However, when students are prevented from dropping out of school, school leaders can maintain the full funding for those students and
recoup the funds spent for the online program (Eduviews, 2009). Additionally, after courses are created and the program is running, some school-based programs can become profitable through increased enrollment or the selling of course designs (Aronson & Timms, 2004).

In Wicks’ (2010) summary of studies to measure the average cost of education per student in online schools and traditional schools, it was reported that in three different studies the cost of online education was notably lower per student than traditional instruction in a public school. However, cost savings is not a guarantee. For instance, in the traditional environment, students with disabilities cost twice as much to educate, and students with severe or profound special needs require an even greater amount of funding to educate in comparison to the average student (Federal Education Budget Project, 2013). Also, it would be very unlikely for students with severe or profound disabilities to participate in an online program. Therefore, this can skew the data for the public school expenditures per student, because it is dependent upon the number of students, who require extra assistance, which means that the comparisons mentioned by Wicks are potentially unreliable.

In terms of STEM education, insufficient funding was the major reason for a lack of progress in STEM initiatives in schools, as reported by school system employees from across the U.S. (IESD, 2012). The use of online learning could help spread STEM courses to all levels of public schools from high school to elementary school at appropriate levels. The developers of online learning are starting to see the needs within all levels of education, including elementary schools, and are developing online tools and programs to address those needs (Elementary STEM Solution, 2009; Lazaros & Bormann, 2013). With online learning, course offerings could be expanded at little or no additional cost to schools, where online options are available. This could be especially useful for smaller schools, where a low number of students might need a
course. The combination of efforts with other schools or an online school would make additional courses possible.

**Perceptions of Online Learning**

**Perceptions of Teachers and Administrators**

In a 2007-2008 survey of U.S. school administrators, Picciano and Seaman (2009) reported several concerns in regard to the value of online learning as it pertains to integrity of the curriculum and student mastery. The administrators surveyed indicated that the largest concern and the largest barrier to online implementation was in regard to course quality. Several respondents felt that online courses should not replace face-to-face instruction, and that online instruction does not provide the support that teachers can provide. Other administrators in the study pointed out that the lack of available research to show online learning as an effective option prevented them from use of this instructional model. While some participants were definitely reserved in their views of online learning, a larger group was supportive, but wanted more research to prove that it provides quality instruction. Concerns about online education that were identified included: (a) the authenticity of student work, (b) the increased risk of cheating, and (c) the abuse of online learning by virtual schools and charter schools through the compromising of standards and high expectations (Picciano & Seaman, 2009).

In Picciano and Seaman’s (2009) work, they reported that school administrators commented on funding for online education options. In several smaller districts, administrators noted that it was difficult to purchase courses and computers, and there was an inability to create courses. Other administrators responded that, without valid data, the expenditure of school funds to implement such a program would be irresponsible. In addition, administrators were worried about losing funding due to rules on seat time for students, as mentioned in the comments section.
for both funding and policy issues in the Picciano and Seaman survey. Research data collected by the staff of Eduviews (2009) showed that those funding concerns were unfounded and concluded that school administrators need to shift their thinking from the traditional school models to more innovative practices, such as online learning, to meet the ever-changing needs of students.

According to Picciano and Seaman (2009), teachers and administrators believed that some advanced students did not have the ability to self-regulate learning, and they found it difficult to believe that students who were academically deficient could be successful with models that require self-regulation. Also, there were comments and concerns in regard to students with below grade level reading abilities. Administrators felt that online classes were not a viable option for students without the ability to read. However, the current accessibility tools, which are available in online learning programs, can assist students by reading content aloud and providing other individualized supports (Sucre, 2010; Scalise, 2007).

In contrast, there were several supporters of the blended approach to online learning in Picciano and Seaman’s (2009) study. An anonymous participant commented:

Online + blended/hybrid courses provide a window to the 21st century education and workforce development. Courses should no longer be x numbers of hours in with a teacher in front of a classroom and a book in front of a student. (p. 18)

Other comments indicated that the respondents were pleased with several student-centered aspects, including: (a) the ability of students to work at their own pace in online classes, (b) the additional course offerings available to expand educational opportunities, and (c) even the potential of earning college credits through dual enrollment online programs for seniors and some high school juniors.
Overall, school administrators believed that online learning could address several student needs within school districts (Picciano & Seaman, 2009). Most importantly, online learning has the potential to meet the needs of different groups of students within each school. Additionally, some administrators commented that use of online learning has allowed educators to expand course offerings and provide a greater diversity in the content that students can learn. The expanded course offerings led to greater participation in advanced placement classes or even dual enrollment college level classes. In addition, value was assigned by the respondents, in that, students were allowed to recover credits to get back on track for high school graduation.

Perceptions of Students

To date, there have been no studies on the perceptions of online learning by high school students. While Sun et al. (2008) did not directly measure the attitudes of high school students, their findings indicated the potential for a similar result with a population of college students. In their survey of 295 students, who had taken online courses, Sun et al. found that most students at the college level were very comfortable with the use of computers and technology and were not nervous about taking such a course. The respondents did note that the instructor’s attitude, enthusiasm, and behaviors had a great influence on whether the student was satisfied with the overall course. However, instructor behavior is also an aspect of satisfaction in face-to-face courses (Dennen, Darabi, & Smith, 2007; Dipietro, Ferdig, Black, & Preston, 2008; Edwards & Rule, 2013).

As noted earlier, satisfaction is a key element in student motivation and achievement, and Sun et al. (2008) found that this factor was an influence in both the blended and the traditional settings. Of the other factors in the study, students appreciated the: (a) flexibility of online learning, (b) the ease of use of some of the programs used, and (c) diversified assessment tools
throughout the course, all of which are student-centered factors for learning. These factors are specific to online learning and not applicable in the traditional classroom setting. Overall, those surveyed were very satisfied with their online learning environments.

**Quality in Online Learning and Instruction**

**Characteristics of Quality Online Instruction**

Picciano and Seaman (2009) demonstrated that the quality of online instruction is a concern with both teachers and administrators in the field of education, since many believe a computer will never be able to replace an actual teacher. However, Wicks (2010) stated, “A fairly common misconception about online learning is that in the online environment, the teacher is less important than in the classroom” (p. 23). To address these concerns in regard to quality online instruction with emphasis on the role of the instructor, the iNACOL researchers (Bakken & Bridges, 2011) developed quality standards for online education. Additional research conducted by staff of MRL in 2012 noted specific strategies for traditional learning that could easily be incorporated into the online learning environment. According to the MRL recommendations adapted for online learning, teachers should implement the following strategies:

- Communicating course/assignment rules and procedures;
- Providing students with all materials needed to complete an assignment;
- Clearly presenting the goal/objective for each assignment;
- Offering encouragement and positive feedback to students;
- Accessibility to students via electronic communication as well as face-to-face;
- Monitoring student work;
- Knowing every student by name and being able to recognize them outside of the online environment;
- Allowing students to progress through assignments at their own pace;
- Providing help to understand and practice new knowledge;
- Allowing students to ask questions during online course/assignment;
- Treating all students equally; and
- Adding external resources to assignments aligned to local objectives. (p. 4)
While there is a shift in the role of the instructor when a blended online format is used, this set of recommendations, which are based on research, shows that the teacher still plays a vital role in the provision of what most students need to be successful (Bakken & Bridges, 2011; Carl, 2013).

**Overview of Education2020**

The online program, which was examined in this current dissertation, was Education2020, an online learning program designed to provide structured instruction to students at the middle school and high school levels (Edgenuity, 2013c). The name was changed from Education2020 to Edgenuity in June of 2013 (IESD, 2013). However, the name of the program was Education2020 when the Mathematics I course used in this study was developed and when the study participants were enrolled in the course. Therefore, the program is referred to as Education2020 in this study. Education2020, developed in 1998, has grown to currently offer over 100 courses for students from Grades 6-12, which covers all major content areas, while elective courses are provided as well. These course offerings fit with current needs in: (a) vocational pathways, (b) test preparation, and (c) credit recovery (IESD, 2013).

According to the staff of IESD (2013), a team of educators and instructional designers, who are employed by Edgenuity, develop courses to match state and national standards. Also, these researchers look at documents and research from high performance districts to create learning sequences and activities to maximize learning. After a course map is created, it goes through an approval process by content experts, and the units are developed to include best practices in online instruction as outlined by the iNACOL National Standards for Quality Online Courses (Bakken & Bridges, 2011). While the courses are created with iNACOL standards in mind, also, the content and structure fit guidelines as listed in MRL’s (2012) strategies for online teaching practices and the theoretical framework as shown in Table 1.
Table 1

*Features of Education2020 and Alignment with Research*

<table>
<thead>
<tr>
<th>Education2020 Feature</th>
<th>Alignment with Theories and Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive Tools and Supports such as:</td>
<td>• Self-Regulated Learning (Artino, 2008; Barnard-Brak et al., 2010)</td>
</tr>
<tr>
<td>• customizability</td>
<td>• Providing materials needed for instruction (MRL, 2012)</td>
</tr>
<tr>
<td>• teacher tools to provide support,</td>
<td>• Allowing students to track their own progress (MRL, 2012)</td>
</tr>
<tr>
<td>• graphs of student progress and assignment calendars for self-regulated learning.</td>
<td>• Monitoring of student work (MRL, 2012)</td>
</tr>
<tr>
<td>• diagnostic and prescriptive assessments</td>
<td>• Providing assistance as needed (MRL, 2012)</td>
</tr>
<tr>
<td>• detailed teacher reports to show time on task, and achievement</td>
<td>• Adding external resources (MRL, 2012)</td>
</tr>
<tr>
<td>• communication tools to allow parents to see progress and reports</td>
<td></td>
</tr>
<tr>
<td>Explicit Instruction</td>
<td>• Cognitive Load Theory (Kim &amp; Frick, 2011; Rogers, 2007)</td>
</tr>
<tr>
<td>• Activation or prior knowledge</td>
<td>• Keller’s model of motivational design of instruction (Kim &amp; Frick, 2011)</td>
</tr>
<tr>
<td>• Clearly communicated learning goals</td>
<td>• Communicating learning goals (MRL, 2012)</td>
</tr>
<tr>
<td>• Clearly communicated expectations</td>
<td>• Positive feedback and encouragement (MRL, 2012)</td>
</tr>
<tr>
<td>• Smaller segments of instruction with scaffolded practice</td>
<td></td>
</tr>
<tr>
<td>• Step-by-step instruction</td>
<td></td>
</tr>
<tr>
<td>• Modeling and demonstrations</td>
<td></td>
</tr>
<tr>
<td>• Frequent checkpoints for understanding with teacher and computer feedback</td>
<td></td>
</tr>
<tr>
<td>Higher Order Thinking Skills</td>
<td>• Self-regulated learning (Artino, 2008; Barnard-Brak et al., 2010)</td>
</tr>
<tr>
<td>• Teacher through processes, not just knowledge</td>
<td>• Allow students to ask questions (MRL, 2012)</td>
</tr>
<tr>
<td>• Teach and use knowledge in varied ways</td>
<td></td>
</tr>
<tr>
<td>• use of student engagement techniques</td>
<td></td>
</tr>
<tr>
<td>• Teacher when and how to use particular skills</td>
<td></td>
</tr>
<tr>
<td>• Form and test hypotheses</td>
<td></td>
</tr>
</tbody>
</table>
In addition to the research-based background in the development of the program and courses within the program, the Education2020 staff has also earned several awards and approvals. The awards in 2012 included a CODiE award for SIA-Best Virtual School Solution for Students and Bessie Awards for Best Education Software for MS World Cultures and Geography, Geometry, Human Geography, 3D Art II-Animation, English Language Arts 10, and Computer Science I & II. In 2011, Education2020 also won:

- The CODiE award for SIA-Best Virtual School Solutions for Students,
- Bessie Awards for: Best Education Software for Environmental Science, Algebra I, English Language Arts 9, Middle School Civics, Government, and Economics,
- The United States Distance-Learning Association Bronze Award for Best-Practice for Distance Learning Programming,
- The Tech and Learning Award of Excellence for New Product-Lesson Search and Best Upgraded Product - Virtual-Classroom Suite,
• EdTech Digest, Cool Tool Awards for Content Provider Solution – Virtual-Classroom Suite, Content Provider Solution Finalist – Lesson Search, and eLearning Solution – Virtual-Classroom Suite,

• Eddie Award ComputED’s 16th Annual Education Software Review Awards for Middle School Social Studies Website: MS Civics, Government, and Economics and High School Health Website: Foundations of Personal Wellness, and

• District Administration Top 100 Products

Additionally, Education2020 is approved by College Board Online as an Advanced Placement provider and by iNACOL Course Review. It has received the following approvals:

• California Learning Resource Network,

• University of California Office of the President,

• Georgia State Department Education Common Core Mathematics Adoption,

• Louisiana Course Choice Provider,

• Nevada State Department of Education Online Course Provider,

• State of New Mexico Public Education Department Textbook Adoption,

• North Dakota State Department of Education Online Provider,

• Oklahoma State Department of Education Online Provider,

• South Carolina Department of Education Instructional Materials Adoption,

• Virginia Department of Education Multidivisional Online Provider, and

• Washington State Department of Education Distance Learning Provider

**Summary of the Literature**

In previous meta-analyses of online education in high schools, there is agreement that there is insufficient empirical, quantitative data in regard to student achievement to support the
use of online instruction with high school students (Cavanaugh et al., 2009; USDOE, 2010). Cavanaugh et al. noted that most of the research in this area is limited to personal descriptions and experiences. Also, they noted that this type of qualitative research can lead to quantitative research in the field. However, early quantitative research studies, in the form of dissertations and articles in peer-edited professional journals, have failed to adequately address student mastery of content with online learning (Langenhorst, 2011). The USDOE (2010) staff found that there is a gap in the research pertaining to the actual effectiveness of these instructional methods. There are theories, which explain why blended online learning should work, and case studies and perception surveys note positive outcomes and attitudes toward online learning (Abrami et al., 2011; Dexter, 2011; Roschelle, et al., 2000; Sun et al., 2008; Watson & Gemin, 2008; Weimer, 2002). However, more quantitative studies are needed as educational research continues to be built in this area (Cavanaugh et al., 2009; Corry & Stella, 2012; Len & Jitendra, 2013; Murphy et al., 2014; O’Dwyer et al., 2007; USDOE, 2010).
CHAPTER THREE: METHODS

Design

The research design utilized in this study is causal-comparative in order to measure differences in the effectiveness of the modes of instruction as well as to consider differences based on homeownership status. A pretest was used, which consisted of students’ previous year EOCT scores to adjust for differences in the groups. The posttest consisted of students’ EOCT scores from their second attempt at the course. Use of this pretest/posttest type of research design helps to objectively compare the effectiveness of blended online instruction to that of traditional face-to-face instruction, as well as results for students from families who are homeowners in comparison to those whose parents are not homeowners (Field, 2012). With the use of a causal-comparative research design, the researcher attempts to show cause and effect by the comparison of outcomes for one dependent variable for individuals, who experience different selected independent variables (Gall et al., 2007). Typically, this design is used in the study of a circumstance that has already taken place (Rovai, Baker, & Ponton, 2013). In this study, the dependent variable was the posttest score on the Georgia Mathematics I EOCT. The first independent variable was the setting in which the student repeated the course, and the second independent variable was the student’s parental homeownership status. The covariate in this study was each student’s pretest score.

The covariate and the dependent variable were determined through the use of the Georgia EOCT, a criterion-referenced test. Previous studies of online learning have included flaws in objectivity of the researcher due to their classroom interaction with the subjects (USDOE, 2010). However in this case, the researcher was not directly involved in the teaching of the blended online or traditional courses, or the administration of the Georgia EOCT. The causal-
comparative design and the use of archival data increased the objectivity of the study and eliminated the chance that participants would perform differently based previous knowledge of the study, or that the researcher would bias the activity in some other way (Gall et al., 2007).

Research Question

The research question addressed in the study was:

RQ1: Is there a difference in Mathematics I EOCT scores between students taking blended online classes and students taking traditional face-to-face classes that is connected with parental homeownership status?

Hypotheses

The null hypotheses for this study were:

H₀₁: There is not a significant difference between Mathematics I EOCT scores of students who participate in blended online classes and those of students who participate in traditional face-to-face classes while controlling for pretest EOCT scores.

H₀₂: There is not a significant difference between Mathematics I EOCT scores of students whose parents’ homeownership status is either homeowner or non-homeowner while controlling for pretest EOCT scores.

H₀₃: There is not a significant interaction among Mathematics I EOCT scores of students who participate in blended online classes and students who participate in traditional face-to-face classes in connection with their parents’ homeownership status being either homeowner or non-homeowner while controlling for pretest EOCT scores.

Participants and Setting

The population for this study consisted of high school students, who participated in credit recovery for the subject of Mathematics I, in three Georgia public schools. The 448 students in
the population repeated Mathematics I for the first time between January 2010 and June 2013 either in a blended online setting or a traditional classroom setting and took the corresponding EOCT at the end of the second attempt at the course. This study consisted only of ninth grade students, who had not passed the Mathematics I course and were not able to be promoted to the tenth grade, per school system promotion guidelines (CCSS, 2014). Students, who transferred to the district during their enrollment in high school, were also classified as ninth grade students if they lacked a Mathematics I credit or an equivalent credit. Demographic information for the population is broken down by independent variable (see Table 2 and Table 3).

Table 2

*Demographic Statistics for Population by Mode of Instruction*

<table>
<thead>
<tr>
<th>Demographic Group</th>
<th>Online</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole population</td>
<td>$N = 84$</td>
<td>$N = 364$</td>
</tr>
<tr>
<td>Boys</td>
<td>$N = 51$</td>
<td>$N = 219$</td>
</tr>
<tr>
<td>Girls</td>
<td>$N = 33$</td>
<td>$N = 145$</td>
</tr>
<tr>
<td>White Students</td>
<td>$N = 47$</td>
<td>$N = 214$</td>
</tr>
<tr>
<td>Black Students</td>
<td>$N = 25$</td>
<td>$N = 116$</td>
</tr>
<tr>
<td>Students of other ethnicities</td>
<td>$N = 12$</td>
<td>$N = 34$</td>
</tr>
<tr>
<td>Homeowners</td>
<td>$N = 41$</td>
<td>$N = 160$</td>
</tr>
<tr>
<td>Non-Homeowners</td>
<td>$N = 43$</td>
<td>$N = 204$</td>
</tr>
</tbody>
</table>
Table 3

*Demographic Statistics for Population by Homeownership Status*

<table>
<thead>
<tr>
<th>Demographic Group</th>
<th>Homeowner</th>
<th>Non-homeowner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole population</td>
<td>$N = 201$</td>
<td>$N = 247$</td>
</tr>
<tr>
<td>Boys</td>
<td>$N = 136$</td>
<td>$N = 134$</td>
</tr>
<tr>
<td>Girls</td>
<td>$N = 65$</td>
<td>$N = 113$</td>
</tr>
<tr>
<td>White Students</td>
<td>$N = 141$</td>
<td>$N = 120$</td>
</tr>
<tr>
<td>Black Students</td>
<td>$N = 42$</td>
<td>$N = 99$</td>
</tr>
<tr>
<td>Students of other ethnicities</td>
<td>$N = 18$</td>
<td>$N = 28$</td>
</tr>
<tr>
<td>Online classroom</td>
<td>$N = 41$</td>
<td>$N = 43$</td>
</tr>
<tr>
<td>Traditional classroom</td>
<td>$N = 160$</td>
<td>$N = 204$</td>
</tr>
</tbody>
</table>

In this causal-comparative design, the sample of students, who completed Mathematics I for the second time from January 2010 through June 2013, was systematically randomized. Since the students were previously scheduled into the classes and settings, the researcher was prevented from the utilization of random assignments for the independent variable groups. However, in the scheduling process, most students were assigned classes by the computer-based scheduling program at each school, which eliminated possible bias. The demographic information, course rosters, and student transcripts for the proposed time period were accessible to this researcher through access rights granted by the school system, which served as site for this study and as a part of the research process. This access made it possible to retrieve information about the students and their scores in the study. A student’s homeownership status was determined based on a comparison of address and guardian information in the student
information system and county tax records available online. These data were based on the semester that each student repeated Mathematics I.

Gall et al. (2007) recommended a sample size of 96 participants for a medium effect size with statistical power at .7 at the .05 alpha level, a sample size of 375 participants for a small effect size with statistical power at .5 at the .05 alpha level, and a sample size of 270 participants for a small effect size with statistical power at .5 at the .10 alpha level. For this study, a total sample size of 398 students exceeded the minimum required for a medium effect size with statistical power at .7 at the .05 alpha level and also exceeded the minimum required for a small effect size with statistical power at .5 at the .05 alpha level (see Table 4).

Table 4

<table>
<thead>
<tr>
<th>Comparison Group</th>
<th>Sample Size</th>
<th>Effect Size</th>
<th>Required Statistical Power</th>
<th>Required Alpha Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of Instruction</td>
<td>$n = 398$</td>
<td>.418 (medium)</td>
<td>.7</td>
<td>$p &lt; .05$</td>
</tr>
<tr>
<td>Homeownership Status</td>
<td>$n = 398$</td>
<td>.1972 (small)</td>
<td>.5</td>
<td>$p &lt; .05$</td>
</tr>
</tbody>
</table>

The study took place at three suburban high schools within one school system in the state of Georgia. The approximate population of School A was 2,900 students (Infinite Campus, 2013b). The approximate enrollment of School B was 2,300 students. School C had an approximate enrollment of 1,850 students. The demographic breakdown of each site is displayed in Table 5 (Infinite Campus, 2013b). All three schools were average or above average in terms of student achievement, since student test scores matched or exceeded the state average in almost all areas (GADOE, 2012a).
Table 5

*Demographic Statistics for Research Sites*

<table>
<thead>
<tr>
<th>Demographic Group</th>
<th>School A</th>
<th>School B</th>
<th>School C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole population</td>
<td>N = 2,896</td>
<td>N = 2,290</td>
<td>N = 1,864</td>
</tr>
<tr>
<td>Boys</td>
<td>49.5%</td>
<td>48.5%</td>
<td>50.8%</td>
</tr>
<tr>
<td>Girls</td>
<td>50.5%</td>
<td>51.5%</td>
<td>49.2%</td>
</tr>
<tr>
<td>White Students</td>
<td>63.1%</td>
<td>63.7%</td>
<td>74.6%</td>
</tr>
<tr>
<td>Black Students</td>
<td>23.1%</td>
<td>28.1%</td>
<td>13.1%</td>
</tr>
<tr>
<td>Students of other ethnicities</td>
<td>13.8%</td>
<td>8.2%</td>
<td>12.3%</td>
</tr>
<tr>
<td>Students qualifying for Free or Reduced Lunch</td>
<td>34.9%</td>
<td>47.5%</td>
<td>25.1%</td>
</tr>
<tr>
<td>Students with Disabilities</td>
<td>8.7%</td>
<td>10.4%</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

The traditional face-to-face classroom and the blended online classroom were the instructional settings under investigation. Research completed in this dissertation study is limited to the practices, procedures, and guidelines within the schools, which were the research sites; these sites may not be representative of programs in other schools outside of this district.

The course involved in the study was Mathematics I. The content of this course was delivered through traditional classroom instruction and a blended online approach with use of Education2020. Implementation of blended online learning was in its second, third, and fourth years of implementation from 2011 to 2013 at all three research sites.
The blended online courses were offered during the regular school day on the high school campus as a normal part of a student’s schedule and at summer school. Within the lab, students had an assigned computer and used headphones to listen to digitally formatted instruction. At the 3 sites, there could be no more than 27 students in the lab at a time due to space limitations. All students within that class were completing credit recovery using Education2020. There was a certified content teacher in the room and a para-professional or special education teacher in the room to monitor computer use, student progress, and they interacted briefly in person with the students. Students had an assigned computer and participated in the online class as they: (a) viewed videotaped instruction, (b) listened to the instruction with headphones, and (c) then completed assignments and assessments. The time designated for students as they completed the course during the regular school day was 1.5 hours each weekday for 18 or 36 weeks, depending on the needs of the student. The time designated for students to complete this course at summer school was 4-8 hours a day each weekday for 4 consecutive weeks. Students completed all work independently. There was no interaction necessary between students, although students could assist each other if needed and with the approval of the teacher.

The blended approach used in this study incorporated several teacher practices recommended by Marzano (MRL, 2012), which have been shown to positively impact student achievement in the online setting as shown in Table 6 (Carl, 2013; CCSS, 2010). It was the responsibility of the classroom teacher to make sure that the students: (a) were on task, (b) attended class on a regular basis, (c) were on track to complete the course on time, and (d) followed school and classroom rules (CCSS, 2010). At the start of each class period, students logged onto their computer and the online program. Each student received updates on their progress from the computer program. The students started instruction where they left off the
previous day. When the class period was almost over, students finished the task in which they were actively engaged and logged off the computer.

Table 6

*Recommended Practices and Application in Blended Online Learning*

<table>
<thead>
<tr>
<th>Research-based Online Teacher Practices for Increased Student Achievement</th>
<th>Teacher Practices Used in the Blended Online Learning Model of this Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicating rules and procedures</td>
<td>Rules and procedures were communicated with students on the first day of class both verbally and with a written syllabus</td>
</tr>
<tr>
<td>Providing all materials needed for instruction</td>
<td>The program used for online learning provided all needed materials. If additional materials were needed, such as headphones or a calculator, the teacher provided those for the student.</td>
</tr>
<tr>
<td>Communicating learning goals for each assignment</td>
<td>Within the course structure, the students were presented with the goal for each lesson, both in the title of each lesson and during the beginning of each lecture.</td>
</tr>
<tr>
<td>Offering positive feedback and encouragement to students</td>
<td>Students interacted with the teacher each school day. Positive feedback and encouragement varied per student and teacher.</td>
</tr>
<tr>
<td>Allowing students to track their own progress</td>
<td>The student had access to two different progress graphs when they logged into the program. The first graph showed student progress in the class compared to their anticipated progress based on the start date and expected end dates entered by the teacher. The second graph showed the student’s current grade on a scale of 0-100% with color-coding for different percentage levels.</td>
</tr>
<tr>
<td>Research-based Online Teacher Practices for Increased Student Achievement</td>
<td>Teacher Practices Used in the Blended Online Learning Model of this Study</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Communicating electronically and face-to-face</td>
<td>The online program allowed for messages to be sent back and forth between the student and the teacher. Additionally, since the teacher was with the students each school day, face-to-face communication was also possible.</td>
</tr>
<tr>
<td>Monitoring of student work</td>
<td>The courses were set up to require the teacher to review the work of the student before allowing him or her to start each unit test. There was also a dashboard where the teacher could see the progress and grades of each student in the form of color-coded graphs.</td>
</tr>
<tr>
<td>Knowing each student by name and face</td>
<td>The daily interaction with the students for an entire semester insured that the teacher knew each student.</td>
</tr>
<tr>
<td>Allowing students to work at their own pace</td>
<td>While the teachers did encourage students to finish the course before the end of the semester, students were able to work at their own pace throughout the course. Extra time, beyond the semester, was given to students that had a documented need.</td>
</tr>
<tr>
<td>Providing assistance as needed</td>
<td>The content area teacher and the paraprofessional were both able to assist with the program and the content of the class and provided help during practice opportunities and assessments.</td>
</tr>
</tbody>
</table>
Also, students, who completed the course during the school year in the traditional classroom setting, attended class for 1.5 hours a day for either 18 or 36 consecutive weeks, depending on the needs of each student. Students, who attended summer school in the traditional setting, received 4 hours of instruction for 4 consecutive weeks. In these classrooms, the number of students did not exceed 32, as mandated by state class size regulations and local school board policy (GADOE, 2007). Within this setting, there was a combination of students, those who repeated the course and those who took the course for the first time, except in summer school where all students were repeating the course. The students in this setting completed a
combination of independent and group work as assigned by the instructor. In all of the classes involved in this study, there was a certified content area teacher in the classroom. However, in several of the classes, there was also a certified special education teacher, who provided services to students who needed extra assistance. Each classroom was equipped with one teacher computer, but did not include technology for student use. Calculators, protractors, and other necessary tools for mathematics were available for student use within the traditional classes and were used on a regular basis.

**Instrumentation**

The assessment tool used in this study was the Georgia EOCT. This was a criterion-referenced test, which was administrated toward the end of several, but not all, academic courses at the high school level, as mandated by the state. Currently, this exam is no longer in use and has been replaced with a new test in 2014 titled the Milestone Test (GADOE, 2015). The purpose of the exam was to assess student content mastery. The exam counted for either 15-20% of a student’s overall grade in the class, depending on which year the student started the ninth grade (GADOE, 2011). The test battery used in the study was for Mathematics I. The Georgia EOCT for Mathematics I was a multiple-choice, paper and pencil test, which consisted of 62 questions (GADOE, 2010). There were several versions of each test available for simultaneous administration. According to the Georgia DOE (2008), the different versions and the outcome from each version were equivalent in part due to the use of scaled scoring. The scaled scores for the Mathematics I EOCT ranged from 200-600, and the grade conversions followed the state guidelines for meeting expectations and exceeding expectations on the assessment (GADOE, 2011).
The validity and reliability of the EOCTs were already determined by the GADOE (2008). The validity was obtained through comparison of each test item to state content standards for content validity. Panels of teachers and experts within the state of Georgia, as well as an independent panel of evaluators known as Georgia’s Technical Advisory Committee, reviewed the tests on a consistent basis for alignment and quality. System test coordinators and system curriculum coordinators nominated the advisory committee members, with three nominations allowed per district (Eitel, T., April 2, 2012). The state officials used both the coefficient alpha and the standard error of measurement across several administrations of the test to report the reliability of individual tests. In past administrations, the reliability coefficients ranged from .86-.94, well above the generally accepted standard of .80 (GADOE, 2008; Gall et al., 2007).

The EOCTs were based on the Georgia Performance Standards as established by the Georgia Department of Education (GADOE, 2012d). Scores were reported to schools as a scaled score and a grade conversion. While scaled scores were reported, grade conversions provided the most meaningful data for schools and were used in the final calculation of a student’s grade. Students with a grade conversion of a 0-69 did not meet expectations for content mastery and, therefore, did not pass the test. Students with a grade conversion of 70-to 89 showed basic mastery of the content and were considered to have passed the test. Lastly, students with a grade conversion of 90-100 were classified as exceeding the expectations for the test (GADOE, 2011).

On the Mathematics I EOCT, content was broken down into the following areas and weights: (a) algebra (35%), (b) geometry (35%), and (c) data analysis and probability (30%) (GADOE, 2012d). The Mathematics I EOCT included a formulas page that was available as a reference for students throughout the test (GADOE, 2012c). The EOCT was administered in two
sections, 60 minutes each. Each district had the option to administer each section back to back in 1 day or across 2 separate days. The students were administered the EOCT on the same schedule and at the end of each semester. Students with an Individualized Education Program (IEP) or a 504 plan were eligible for state approved accommodations. The most common accommodations on the EOCT for students at the research sites were: (a) extra time, (b) a small group testing environment with less than 15 students, (c) explanation or repetition of instructions, and (d) the exam was read to the student. The state approved other accommodations, but those were not used as frequently at the sites in this study.

Administration guidelines for the EOCTs were provided in an examiner’s manual provided by the DOE (GADOE, 2013). These guidelines required the use of a proctor along with a certified educator for testing groups with more than 30 students. For groups under 30 students, only a certified educator was required in the testing room. Also, the administrative guidelines required test security procedures so that testing materials were never unattended or in an unlocked location. Directions for testing were provided in the examiner’s manual and were to be followed as written. Also, the testing administrator read instructions to students verbatim from the manual. During the exam, the administrators and proctors kept the official time for the EOCT and were not permitted to answer questions from the students. If any testing irregularities occurred such as a mistiming, incorrect administration of accommodations, or students not following directions, the proctor and examiner were required to report this to the school testing coordinator immediately. The building or district testing coordinator then reported this irregularity to the Georgia DOE. After an investigation, the DOE determined whether it was necessary to re-administer the test or scored with the irregularity noted.
Procedures

Prior to the conduct of this study, the researcher received approval from her dissertation committee chair and committee members and also the assigned research consultant. After those approvals were granted, permission was requested from the school system where the study took place and from the members of the Liberty University Institutional Review Board (IRB). Slight changes to the study were made based on questions from the IRB committee and in response to legal requirements communicated by the school system. After amendment of both applications, they were resubmitted and the research study received approval. During the collection of data, the researcher realized that 1 additional year of data was necessary in order to increase the power and effect size of the analysis. The researcher submitted the change in the research protocol form to the IRB after the receipt of additional approval from the local school system for this change. The IRB approved this change in the study, and the researcher resumed data collection and analysis with the extra year of data. See Appendix B for a copy of the IRB exception letter, Appendix C for a copy of the approved change in protocol form, and Appendix D for a copy of the approved research application from the school system used as the site of the study.

Since the study was ex-post facto, the researcher used archival data between the 2009/2010 and 2012/2013 school years. This data included: (a) the setting in which each student repeated a Mathematics I course, (b) the pretest and posttest grades for the Mathematics I courses, (c) demographic information for each student, and (d) each student’s housing status at the time of when they repeated Mathematics I. Over the summer, before the start of each school year, the student information system was used to randomly placed students in their requested classes through the use of the schedule wizard function. Students and parents were not allowed to select a blended online or traditional classroom setting in this scheduling process. However,
students, parents, and staff members may have made requests for changes, and schedules were changed at the discretion of guidance counselors at each site.

Students, who took Mathematics I during the school year, attended the repeated course during the block of time and the semester noted on their schedules. Students with the blended online class met in the computer lab with their teacher. Students in the traditional class reported to a traditional classroom during the assigned block and were mixed with students, who took the course for the first time. Since the schools in the study were on a block schedule, students’ schedules changed to different classes during each of the 2 semesters. Therefore, some students, who participated in the study, may have taken the Mathematics I course first semester, while other students took the class second semester. Additionally, some students may have had the opportunity to take the class across both semesters because of a need to slow down the pace of the course. This option was available in both settings. Students, who took the EOCT after 15 weeks and the students who took the EOCT after 33 weeks, were treated the same in data analysis.

Teachers in both settings were provided training in terms of instructional strategies as part of the school district strategic plan for improvement. Additionally, teachers were given training on the Mathematics I curriculum from the Georgia DOE and school district staff. The same credit repair guidelines were used at all three research sites (CCSS, 2010). Administrators at each site for this study provided training for Education2020 to teachers (CCSS, 2010). Training was provided each semester, so that all staff members, who worked with the program, were aware of county guidelines and expectations. Also, training was provided to all staff members, who administered the EOCT, per GADOE guidelines.

Students, who took the course in summer school met for 4 hours a day, 5 days a week,
and for 4 consecutive weeks. Students in summer school could also receive extra instruction, up to an additional 4 hours a day if needed. During the first year of data collection for this study, the traditional model was used during summer school. Students who failed Mathematics I, and retook the course in summer school during June of 2011, 2012, and 2013, were in the blended online classroom. Students took the EOCT at the end of summer school, and guidelines for course instruction remained the same as those during the school year. Therefore, summer instruction was considered comparable to the instruction offered during the regular school day. Due to a small sample size within subgroups, students from summer school were included to increase the power and effect size of the study (Gall et al., 2007; Howell, 2008).

To determine the sample for this study, the researcher created an ad-hoc query in Infinite Campus for each school and for each year in the study to include the following parameters: (a) student last name, (b) student first name, (c) student GTID number, (d) student date of birth, (e) student gender, (f) student federal race/ethnicity, (g) address line 1, (h) address line 2, (i) guardian name, (j) class = Mathematics I, (k) grading task = semester average, and (l) grade < 70. Once this report was populated with students from each school who met the requirements, the information was exported into an Excel spreadsheet. The researcher then looked at individual student transcripts in Infinite Campus. Student results, which did not represent a first attempt at the course, were removed from the list.

The researcher audited each student’s report card for numerous years to note the year and semester: (a) the student repeated the course, (b) mode of instruction for the second attempt based on course number, (c) the pretest score, and (d) the posttest score. Based on this information, students, who did not repeat Mathematics I while enrolled at one of these three schools or did not take the EOCT, were excluded from the study. The researcher then verified the
data regarding mode of instruction, pretest scores, and posttest scores through the use of SLDS records, transcripts, and assessment data in Infinite Campus. For mode of instruction, students, who repeated the course in the blended online setting, were coded as 1 and students, who repeated the course in the traditional classroom, were coded as 2. This process was repeated for each school in the study for each year of the study between July 2009 and June 2013; thus, there were nine separate spreadsheets.

Once the population was narrowed down to only the students, who repeated the course while enrolled at one of the three high schools in the study and with an EOCT score for the pretest and posttest, the researcher verified homeownership status for the student participants. For each student, at least one address and guardian was listed on the spreadsheet. Several students had multiple addresses listed and more than one guardian listed. The researcher used the available county tax records online to search for property owner information by address. Tax records indicated not only current ownership of the home, but a history of homeownership dating back to 1980. By opening a tax property record, a history of homeownership by name and date could be viewed.

The researcher entered each student’s address, or addresses in cases of multiple entries, individually into the search engine on the tax records website to query results. The name of the homeowner during the time period the student repeated Mathematics I was compared to the guardian name(s) listed in the student information system. If the guardian owned the home during the time period the student repeated the course, the student was noted as being from a home owning family and a code of 1 was entered on the spreadsheet. If the homeowner during that time period was not listed as a guardian of that student, the student was noted as from a non-home owning family and a code of 2 was entered on the spreadsheet. If an address did not
appear in tax records, as in cases of apartment complexes with individual apartment addresses and government housing, the researcher searched tax records by guardian name(s) in addition to the address. If no results appeared as a result of each search, the student was listed as having non-homeowner family standing. At times, the name in the tax record was close to the name of the guardian, but not exact. Those cases were evaluated in Infinite Campus by looking at guardian middle names, nicknames, and the names of other relatives for each student, and decisions on status were made on a case-by-case basis. This process was also repeated for each school in the study for each year of the study between July 2009 and July 2013 and noted on the nine separate spreadsheets.

Once the population was determined for the study, the researcher moved all complete spreadsheet records to one central spreadsheet, and eliminated student identification information in the process. The only remaining information on the spreadsheet was: (a) GTID number, (b) pretest score, (c) posttest score, (d) the code for mode of instruction, and (e) the code for homeownership status. Of the 448 students in the population, 398 participants were randomly chosen for participation in this study. The researcher used systematic random sampling procedures to determine the samples. Based on a minimum sample size of 30 participants per subgroup for each independent variable, the researcher decided to eliminate approximately 10% of the population in the creation of the sample (Rovai et al., 2013).

To randomly select a sample for this study, the researcher organized the population by GTID number from smallest to largest in an Excel spreadsheet. Systematic random sampling was used to create a sample based on the GTID numbers already assigned to all students in the population (Gall et al., 2007). Since the GTID number was randomly assigned to students by the Georgia Department of Education, it could be used to randomly select participants without the
risk of periodicity in the list (Aspy, 2015). The researcher randomly selected a number between 2 and 449 (i.e., the rows in the Excel spreadsheet) as a starting point for the sampling process with use of a random number generator (Urbaniak & Plous, 2015). The researcher then selected every 10th entry to be excluded from the sample starting with the randomly selected number 282 and moving up and down the list from that starting point.

After the sample was created, the researcher created a boxplot for the data in SPSS to identify any outliers that could influence the results, since ANCOVA can be very sensitive to outliers (Gall et al., 2007). The researcher located 5 outliers that influenced the normal distribution for both independent variables, mode of instruction and homeownership status. One outlier was on the high side of pretest scores and posttest scores, and the other four outliers were at the low end of posttest scores. With use of the GTID numbers of these outliers, the researcher looked at factors in SLDS to understand why the student’s score was noted as an outlier. For the four outliers on the low end of the posttest, excessive absences were present, meaning the student did not fully participate in the course. Since these four outliers were all attributed to incorrectly measured data, they were eliminated from the data set (Gall et al., 2007; Howell, 2008; Osborne & Overbay, 2004). For the one outlier at the high end of scores, the researcher concluded that the student exceeded the expectations with a pretest score of 90 and did not have much room for improvement on the posttest. Also, this student was the only student in the entire population with a pretest score in the exceeded expectations range. This score was eliminated as an extreme value for the pretest and an outlier for both the population and the sample (Gall et al.; Howell, 2008; Osborne & Overbay, 2004). Displayed in Figure 1 is the summary of the participant selection, as well as the distribution of students across each independent variable in addition to the demographic information for each group.
Figure 1

Procedures for Selection and Distribution of Samples

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Description</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students repeating Mathematics I for the first time</td>
<td>(N = 448)</td>
<td></td>
</tr>
<tr>
<td>Random selection by eliminating every tenth student</td>
<td>(n = 403 students)</td>
<td></td>
</tr>
<tr>
<td>Group assignment through student scheduling process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Re-enrolled in Mathematics I in a blended online</td>
<td>(n = 74 students)</td>
<td></td>
</tr>
<tr>
<td>classroom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homeowner</td>
<td>(n = 35)</td>
<td></td>
</tr>
<tr>
<td>Non-Homeowner</td>
<td>(n = 39)</td>
<td></td>
</tr>
<tr>
<td>Boys n = 46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls n = 28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White n = 40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black n = 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other race n = 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Re-enrolled in Mathematics I in a traditional classroom</td>
<td>(n = 329 students)</td>
<td></td>
</tr>
<tr>
<td>Elimination of Outliers based on box and whisker plots</td>
<td>(n = 324)</td>
<td></td>
</tr>
<tr>
<td>Homeowner</td>
<td>(n = 143)</td>
<td></td>
</tr>
<tr>
<td>Non-Homeowner</td>
<td>(n = 181)</td>
<td></td>
</tr>
<tr>
<td>Boys n = 197</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls n = 132</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White n = 194</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black n = 105</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other race n = 30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Throughout the research process, the researcher took great care to protect individual student information by the elimination of student names whenever possible throughout the data collection and analysis process; all identifiable data was kept in a secure location. After the data were collected, reports from the student information system and any printed materials and
spreadsheets were stored in a locked filing cabinet located in the home office of the researcher. Any information, which was saved in an electronic format, did not include student names or GTID numbers after the data collection analysis phase was complete. Throughout the process, all electronic documents were password protected.

**Data Analysis**

Statistical data were analyzed with use of two-way ANCOVA to examine each null hypothesis, as recommended by Rovai et al. (2013). According to Dimitrov and Rumrill (2003), since the classes were already intact, ANCOVA would be better than an Analysis of Variance in order to adjust the posttest means based on pretest differences. This procedure helped to increase the reliability of the research study. The data were analyzed through SPSS, more specifically, SPSS Statistics Version 23. Throughout the analysis of data, the researcher verified the accuracy of all data entered. In line with statistical power analysis, the sample size remained as large as possible. This assisted in the decision whether to reject or fail to reject each null hypothesis (Gall et al., 2007; Rovai et al.; Salkind, 2011).

There were several assumptions and requirements that had to be met before statistical analysis with ANCOVA could be run to ensure the validity and reliability of the results (Green & Salkind, 2014). If any of these tests had failed, adjustments would have been made to ensure quality results. First, there had to be a linear relationship between the covariate and the dependent variable for each independent variable (Rovai et al., 2013; The RMUoHP, 2013a). The researcher used a scatterplot to test for a linear relationship for each independent variable to include: (a) mode of instruction, (b) homeownership status, and (c) each subgroup therein.

Another assumption of ANCOVA is the presence of normal distribution of data for the pretest and posttest across all independent variables and within subgroups for those independent
variables. The researcher used the absolute values of skew and kurtosis to evaluate whether the scores for the pretest and posttest were normally distributed for: (a) sample sizes larger than 300, (b) mode of instruction, and (c) homeownership status (Kim, 2013). For sample sizes smaller than 300, online learners, traditional classroom learners, homeowners, and non-homeowners, the researcher used z-scores based on a ratio of skew or kurtosis and corresponding standard errors to determine whether the pretest and posttest scores were normally distributed for all subgroups (Rovai et al., 2013). The researcher considered use of the Shapiro-Wilk test or the Kolmogorov-Smirnov test for normality, but these methods are not recommended for samples over 300, and the researcher wanted to maintain consistency in the method used across all groups (Kim, 2013).

Levene’s test was used to satisfy another assumption for the use of ANCOVA. This test of homogeneity of variance was conducted in SPSS. The purpose of this test was to determine whether there were differences in the variability of scores between subgroups (Gall et al., 2007; RMUoHP, 2013a). The null hypothesis of Levene’s test was that the variance was equal across groups. Therefore, it was the goal of the researcher to fail to reject this null hypothesis. If the significance level was less than or equal to the alpha set for each independent variable, the researcher would have concluded that the variation in pretest and posttest scores were statistically significant and would have been unable to continue with ANCOVA (Rovai et al., 2013).

A test of homogeneity of regression slopes was the last assumption that had to be met before the use of ANCOVA (Rovai et al., 2013; The RMUoHP, 2013a). This assumption evaluated the possibility of the presence of a significant interaction between the covariate and each independent variable (Rovai et al., 2013). If a significant interaction existed, differences on the dependent variable could be a function of the covariate and not the independent variable.
However, if the relationship between the covariate and the dependent variable was the same across all groups, then the researcher could conclude that there was homogeneity of the regression slopes. The researcher ran this analysis for each null hypothesis in SPSS. If the significance level was greater than .05, the researcher could determine that there was not a statistically significant interaction between the pretest score and each independent variable.

Once all assumptions were met, the researcher used two-way ANCOVA to evaluate a possible interaction between the independent variables after adjusting for the effect of the pretest (RMUoHP, 2013b). The researcher used Type II Sums of Squares in SPSS to test for a main effect for each independent variable and an interaction between the two variables (Rovai et al., 2013; RMUoHP, 2013a; RMUoHP). Use of the Type II Sums of Squares also helped to address the differences in the sample sizes for the online group and the traditional group, which were in proportion to differences in the population (Lane, 2015). After running the ANCOVA, the researcher used the reported group means and standard deviations to calculate a Cohen’s D value for each independent variable to determine the effect size (Breaugh, 2003; Howell, 2008; McGough & Faraone, 2009). Based on the value for Cohen’s D, the alpha level set for each group, and the sample size for each group, the researcher calculated the post-hoc statistical power for two-tailed hypotheses for each independent variable (Soper, 2015).

To further determine an interaction between the independent variables and the dependent variable, the researcher conducted main effect tests. The main effect tests evaluated differences in groups, based on one level of the first independent variable and both levels of the other independent variable (Green & Salkind, 2014). Since all assumptions were also met for these subgroup comparisons, the researcher was able to conduct a simple main effect analysis to further evaluate any statistically significant results from the two-way ANCOVA. In addition,
Cohen’s D values were calculated to correspond with the main effect tests to report the effect size of the results (Breaugh, 2003; Howell, 2008; McGough & Faraone, 2009). Again, the researcher used these Cohen’s D values, alpha levels, and sample sizes for each subgroup to calculate the statistical power of each analysis (Soper, 2015).
CHAPTER FOUR: FINDINGS

Research Question

The research question that guided this study was:

**RQ1:** Is there a difference in Mathematics I EOCT scores between students taking blended online classes and students taking traditional face-to-face classes that is connected with parental homeownership status?

Null Hypotheses

The null hypotheses for this study were:

**H₀₁:** There is not a significant difference between Mathematics I EOCT scores of students who participate in blended online classes and those of students who participate in traditional face-to-face classes while controlling for pretest EOCT scores.

**H₀₂:** There is not a significant difference between Mathematics I EOCT scores of students whose parents’ homeownership status is either homeowner or non-homeowner while controlling for pretest EOCT scores.

**H₀₃:** There is not a significant interaction among Mathematics I EOCT scores of students who participate in blended online classes and students who participate in traditional face-to-face classes in connection with their parents’ homeownership status being either homeowner or non-homeowner while controlling for pretest EOCT scores.

Results

Assumptions

As the first test of assumption, the researcher tested for a linear relationship between the pretest and the posttest for students in the different settings, and for students from different home environments. The scatterplot created for each group in this study indicated linear relationships
between the pretest scores and posttest scores for both the online learning group and the traditional learning group. The researcher also looked at groups represented in the sample in regard to each of the independent variables to create scatter plots for: (a) students from home owning families in the online learning environment, (b) students from families who are not homeowners in the online learning environment, (c) students from home owning families in the traditional classroom, and (d) students from families who were not homeowners in the traditional classroom. Each of these scatterplots indicated a linear relationship between the pretest and the posttest.

To test for normality, the researcher used absolute values of skew and kurtosis measures for groups larger than 300 participants. For groups smaller than 300 participants, the researcher used the z-scores calculated by dividing the skew or kurtosis measurement by the standard measure for each measurement. All groups matched requirements of skew or kurtosis numbers between negative 1 and positive 1. All subgroups matched requirements for z scores between negative 2 and positive 2. The results of normality testing are displayed in Table 7.

The assumption of homogeneity of variance was examined using Levene’s Test where $F(3, 394) = 1.508, p = .212$. The assumption of equal variance was met. The Assumption of Homogeneity of Slopes was examined to look at an interaction. No interaction was detected. Therefore, the Assumption of Homogeneity of Slopes was met ($p = .712$). With all assumptions met, the researcher was able to continue data analysis with use of ANCOVA.
Table 7

*Results for Tests of Normality*

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Skew</th>
<th>Kurtosis</th>
<th>$z$-score based on skew</th>
<th>$z$-score based on kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest - Online Learners</td>
<td>-</td>
<td>-</td>
<td>1.38</td>
<td>-1.64</td>
</tr>
<tr>
<td>Pretest - Traditional Learners</td>
<td>.071</td>
<td>-.044</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pretest - Homeowners</td>
<td>-</td>
<td>-</td>
<td>.70</td>
<td>-.78</td>
</tr>
<tr>
<td>Pretest – Non-Homeowners</td>
<td>-</td>
<td>-</td>
<td>.55</td>
<td>-.02</td>
</tr>
<tr>
<td>Posttest – Online Learners</td>
<td>-</td>
<td>-</td>
<td>.91</td>
<td>-.39</td>
</tr>
<tr>
<td>Posttest – Traditional Learners</td>
<td>.067</td>
<td>-.293</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Posttest – Homeowners</td>
<td>-</td>
<td>-</td>
<td>.54</td>
<td>-.89</td>
</tr>
<tr>
<td>Posttest – Non-Homeowners</td>
<td>-</td>
<td>-</td>
<td>.67</td>
<td>-.97</td>
</tr>
</tbody>
</table>

**Null Hypothesis One**

The first null hypothesis compared the methods of online learning and traditional classroom learning for all participants in the study. Through the use of Two-way ANCOVA, a pretest was used to adjust the means for the posttest. Displayed in Table 8 are the ANCOVA results based on adjusted pretest scores. The results indicated a significant difference in content mastery between participants in the online learning setting and participants in the traditional classroom setting after controlling for pretest scores based on the adjusted mean on the posttest for online learning and the adjusted mean on the posttest for traditional classroom learning where
\( F(1, 393) = 7.925, p = .005 \). The null was rejected at a 95% confidence level as the participants in the traditional classroom (\( M = 69.153, SE = .411 \)) demonstrated content mastery at a higher level than participants in the blended online setting (\( M = 66.442, SE = .856 \)).

Table 8

**ANCOVA Results for Online Learning Compared to Traditional Learning**

<table>
<thead>
<tr>
<th></th>
<th>Adjusted Means</th>
<th>( Df )</th>
<th>( F )</th>
<th>( P )</th>
<th>Cohen’s d</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posttest</td>
<td>66.442</td>
<td>69.153</td>
<td>1</td>
<td>7.925</td>
<td>.005</td>
<td>.418</td>
</tr>
</tbody>
</table>

**Null Hypothesis Two**

The second null hypothesis compared the homeownership status of participants to determine whether this status affected content mastery as measured by the posttest. Through the use of Two-way ANCOVA, a pretest was used to adjust the means for the posttest. The results did not indicate a significant difference in content mastery between students from families owning homes and those who did not own homes after controlling for pretest scores based on the adjusted mean on the posttest for homeowners and the adjusted mean on the posttest for non-homeowners where \( F(1, 393) = 1.462, p = .227 \). The researcher failed to reject the null hypothesis, as students from home owning families (\( M = 68.053, SE = .692 \)) did not perform significantly different from students from families who did not own homes (\( M = 67.542, SE = .649 \)) on the posttest after controlling for pretest scores. Displayed in Table 9 are the statistical results of the second null hypothesis.
Table 9

*ANCOVA Results for Homeownership Compared to Non-Homeownership*

<table>
<thead>
<tr>
<th></th>
<th>Adjusted Means</th>
<th>Df</th>
<th>F</th>
<th>P</th>
<th>Cohen’s d</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Homeowners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-Homeowners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>68.053</td>
<td>1</td>
<td>1.462</td>
<td>.227</td>
<td>.1972</td>
<td>.50</td>
</tr>
</tbody>
</table>

**Null Hypothesis Three**

The last null hypothesis compared the combination of mode of instruction and homeownership status of participants to determine whether there was an interaction between these two independent variables, which could explain any significant results for the first two null hypotheses. The results of two-way ANCOVA did not indicate a significant interaction between mode of instruction and homeownership status after controlling for pretest scores based on the adjusted mean on the posttest where $F(1, 393) = .433, p = .511$ with an observed power of .172. The researcher failed to reject the null hypothesis, as there was not a statistically significant interaction between mode of instruction and online learning.
CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

The purpose of this study was to compare the effects of online learning and traditional classroom learning as they related to content mastery for students from differing home environments, who repeated a mathematics course at the high school level. The researcher hypothesized that there would not be a statistically significant difference in content mastery in the comparison of students in the blended online learning environment with students in the traditional classroom after controlling for the effects of the pretest. Also, the researcher hypothesized that there would not be a statistically significant difference in content mastery between students whose parents or guardians were homeowners and students whose parents or guardians were not homeowners after controlling for the effects of the pretest. In regard to the last hypothesis, the researcher tested for a significant interaction between mode of instruction and homeownership status in terms of content mastery after controlling for the covariate. The researcher hypothesized that there would not be a significant interaction between variables when measuring content mastery on the posttest.

Hypothesis One

The results of this study supported the first hypothesis and indicated that students in the traditional classroom performed better than students in the online classroom after controlling for the effects of the pretest. Given the population of this study, students who previously failed a mathematics course and were repeating the course, the results indicated that students who lacked the skills to successfully pass courses on the first attempt may have also lacked some of the self-regulation skills that were necessary in the online environment (Murphy et al., 2014). While Artino (2008) and Thiele (2003) argue that situations which require students to take
responsibility for their learning will support the activation of self-regulation skills. However, students who lack these skills may not be able to master these skills within the blended online setting (Seckel, 2007). Given the correlation between student levels of self-regulation and achievement in blended online courses, it makes sense that a lack of success in this setting could be due to a lack of self-regulation skills (Lynch & Dembo, 2004).

Also, it may be that students to lack the necessary level of maturity or motivation to fully participate in a student-centered learning environment or manage self-regulation in learning (Schunk et al., 2008). In Keller’s (2008) theory of motivational design of instruction, the five areas, which led to increased motivation, are: (a) attention, (b) relevance, (c) confidence, (d) satisfaction, and (e) self-regulation. As previously discussed, a lack of self-regulation skills can be a factor in a student’s success in the blended online environment. Also, a lack of self-regulation can lead to a decrease in motivation. The population, who the subject of this study, may have also lacked confidence in their mathematics skills, and lacked knowledge at the start of the course, which may have led to yet another factor for decreased student motivation (Marino, 2010; Weiner, 1974). These factors for decreased motivation in the online learning environment may outweigh the positive effects of attention, relevance, and satisfaction in the online setting noted in previous research (Edwards & Rule, 2013; Roschelle, et al., 2000; Seng & Mohamad, 2002; Sun et al., 2008; Watson & Gemin, 2008).

Cognitive load theory may have been a factor in the results of this study, as students, who previously failed the Mathematics I course, may have felt overwhelmed by the increased demands for self-regulation while they learned mathematics content in the blended online setting (Chandler & Sweller, 1991; Pass, Tuovinen, et al., 2003). Basham and Marino (2013) maintained that students who struggle with mathematics in high school, lack pre-requisite skills
or number sense, which results in a greater need for a student-centered design and the use of Universal Design for Learning (UDL). It may be possible that, in the process, these students were not able to implement their own learning supports. This level of difficulty in the blended online learning environment may explain why students in the traditional classroom setting performed significantly better on the posttest than students in the online setting. In the traditional classroom, it was the teacher’s responsibility to notice when the students needed extra support or motivation, and he or she was trained in facilitating supports such as UDL and differentiation (Courey et al., 2013).

The focus of the literature, which pertains to at-risk high school students’ participation in online learning, is only on the qualitative experience for the student (Aronson & Timms, 2004; Cavanaugh et al., 2009; Dexter, 2011; Eduviews, 2009; iNACOL, 2012; Lawrence, 2012; Picciano & Seaman, 2009; USDOE, 2010; USDOE, 2012; Watson & Gemin, 2008). While an examination of satisfaction with the online learning experience was not a part of this study, Watson and Gemin (2008) indicated that students, who were at-risk of not passing courses or graduating from high school, were highly satisfied with the online learning environment and at-risk students were more successful in this setting in terms of passing classes and earning credits. Satisfaction plays an important role in student motivation, which can lead to greater confidence, higher levels of self-regulation, and an increase in student-centered learning (Keller, 2008; Schunk et al., 2008). Although these previous studies indicated a high level of student satisfaction with online learning, it cannot be determined from this study whether student satisfaction within the online course had an impact on content mastery, as that was not part of the research design.
The results, in regard to this hypothesis are also consistent with a 2014 study completed in different learning environments across several charter schools. In that study, conducted by Murphy et al. in 2014 and funded by The Michael & Susan Dell Foundation, the results from two different high schools indicated that Algebra I students performed significantly better in the traditional setting, in comparison to students in a blended online setting. The blended online setting in that study was different from the model used in this study, and the population included all students taking the course, not just students, who repeated the course. Also, it is important to note that the students, who took ninth grade courses in the Murphy et al. study, performed better in the traditional setting for English Language Arts as well. However, in the tenth grade year, students performed better in the blended online learning environment for English Language Arts. This supports previous research and the findings from this current study. Students in ninth grade classes or at-risk students may lack brain maturity, self-regulation skills, or motivation to succeed in an online learning environment (Geary et al., 2004; Jensen, 2005; Kesler et al., 2011).

Hypothesis Two

The second hypothesis, which was focused on the effects of homeownership status in content mastery, did not show a statistically significant difference in the content mastery of students of homeowners and students of non-homeowners when the effects of the pretest were controlled. Previous researchers (Aaronson, 2000; Currie & Yelowitz, 2000; Green & White, 1997; Haurin et al., 2001; Vandiver et al., 2006) indicated that students of non-homeowners are at a greater risk of failure in school in comparison to students of homeowners. However, without significant differences for the posttest, while controlling for the effects of the pretest, the results from this study did not support the previous findings in regard to homeownership status and academic success in school. Based on a county homeownership rate of 74.5% between 2009 and
2013 and almost equal numbers of students of homeowners and non-homeowners in the population, and in the sample of this study, there appeared to be a disproportionate number of students, from families who did not own homes, who failed the course on the first attempt (U.S. Census Bureau, 2015). In comparison to other students, who were determined at-risk because they had previously failed Mathematics I, students of non-homeowners performed comparably with students of homeowners, an indication that one at-risk factor for all students may reduce the effect of other at-risk factors between the groups.

Without knowing the history of homeownership for all students in the study, it may be possible that the children of homeowners, at the time of the posttest, may have previously had high rates of mobility, which may have affected achievement years later. According to staff of the Center for Housing Policy (2007), mobility early in a student’s schooling may have a greater impact than mobility in the high school years. Also, turbulence is negatively correlated with a student’s success in school, and the correlation becomes stronger as the student becomes older. While homeownership status is not directly linked to turbulence, these factors can relate to one another in situations of frequent mobility or in situations where students are homeless (Moore et al., 2000). This is yet another risk factor related to homeownership status that could explain outcomes of academic failure (Vandivere et al., 2006).

**Hypothesis Three**

The researcher tested for an interaction between mode of instruction and homeownership status. The results did not indicate a significant interaction between mode of instruction and homeownership status. This lack of further interaction supported the fact that students in the traditional classroom performed better than students in the online classroom, and that parents’ home ownership may have less to do with student performance than the mode of instruction.
Conclusions

The results from this current study indicated that the mode of instruction was a predictor of student achievement, but that parental homeownership status was not a predictor of student achievement. Murphy et al. (2014) compared of online learning to traditional learning, and attributed a lack of comparable academic achievement in the online setting to a deficit in self-regulation skills. Self-regulation skills and motivation are essential elements in the implementation of an online class (Artino, 2007; Lynch & Dembo, 2004). Since the sample in this study included only students, who repeated the course, students’ levels of self-regulation and motivation may have been lower than the average student. This could explain the significant difference in performance between the students these two settings. It is important for school leaders to be mindful of this difference when they select interventions for at-risk students. While online programs for credit recovery may increase pass rates and assist students to quickly earning additional credits toward graduation, they do not provide comparable results in student content mastery in comparison to traditional classroom instruction for Mathematics I (DiRienzo & Lilly, 2014; USDOE, 2010).

While most of the literature correlates parental non-homeownership to lower rates of student achievement and higher rates of school problems, the results from this current study indicated that there is no statistically significant difference in student achievement in the comparison of students of homeowners to students of non-homeowners (Currie & Yelowitz, 2000; Haurin et al., 2001). Students of non-homeowners may have performed comparably with students of homeowners due to self-regulation learning skills, which they may have learned as coping strategies through several moves from school to school (Roy, McCoy, & Raver, 2014). They may have had to learn how to help themselves more than students of homeowners who
have had consistent experiences in school. The students of non-homeowners may also have more coping skills in terms of overcoming failure and maintaining confidence, as they may have been exposed to more situations in which they had to exhibit resiliency and determination (Svetina, 2014). While, often, many students from at-risk situations have difficulty in school, the study skills that back up successful learning may be present. It may be that gaps in content knowledge are the largest obstacles for these students, not a lack of preparedness for the school environment (Montoya, Horton, & Kirchner, 2008).

The content itself may have led to more difficulties with learning in the blended online learning environment. In a study completed by Murphy et al. in 2014, students performed better on the ninth grade mathematics assessment when they were exposed to the traditional model of instruction as opposed to the blended online model of instruction. While there is not enough evidence to support a conclusion being drawn, the concepts in this level of mathematics may be too difficult for struggling students to master within the blended online setting (Barnes & Raghubar, 2014; Susac & Braeutigam, 2014). When this result is combined with research outcomes from brain development, it may be possible that students, who have previously struggled in mathematics, do not have the brain maturity and development needed during their ninth grade year to fully learn difficult mathematics content in the blended online setting (Benton, 2008; Bower, 2012; Boylan, 2011; Jensen, 2005; Ratey, 2002). Also, it is possible that students may not have had the pre-requisite skills of numeracy needed to complete the more difficult mathematics tasks required with the Mathematics I curriculum, as suggested by other researchers (Barnes & Raghubar, 2014; Kesler et al., 2011). Had the focus of this current study been on another content area such as social studies, literature, or science, the results may have been
different, as those subject areas do not require as many neurocognitive processes (Barnes & Raghubar, 2014).

**Implications**

The use of blended online learning is growing at a rapid pace, and will continue to grow after being named as a one of six key trends in educational technology for 2016 and 2017 (Johnson et al., 2015). While staff of The New Media Consortium recognized blended online learning as a promising technology practice, there is insufficient quantitative research to support such claims. The findings from this current study help to close a gap in the research related to blended online learning and content mastery in mathematics at the high school level. While there are a few studies (i.e., two at last count), in which the effects on blended online learning are compared to traditional classroom learning for high school mathematics mastery, none of these focus on students, who previously failed a course in that subject area, or students from different home environments. Qualitative studies of online learning with high school students are abundant. However, this is the first study to focus on content mastery for students identified as at-risk based on previous failure of the course and based on parental homeownership status. The results of this study will support future research on effective practices and uses of blended online learning in schools by providing resource information. While blended online learning may be a successful practice with some groups of students, more research in this area is needed to study overall effects and impact on different populations within the high school environment. This study adds to the small volume of quantitative literature, which pertains to the effectiveness of blended online learning.

For the school sites, which were used for this study, the comparable academic performance for students of homeowners and students of non-homeowners indicated that
research in the area of student achievement and student mobility may be incomplete in its scope. In most cases, students considered at-risk in regard to mobility were compared with average peers and not peers who were also at-risk based on other factors. In this research study, all students were already at-risk based on previous failure of the Mathematics I course. The results from this study may support further research in the relationship between academic achievement and parental homeownership status for high school students, who exhibit one or more factors, which place them at-risk for low academic achievement. Also, the findings from this study may lead to further research in regard to the current effects of parental homeownership status on academic achievement, as much of the research in this area is over a decade old. Several factors of community, school, and social supports have changed over the last 10 years and may impact the results of future studies in this area.

**Limitations**

Some of the major limitations in this study were dictated by the researcher’s use of the ex-post facto design of this study and the resulting sample size. Since the design was ex-post facto, the researcher was unable to randomly assign participants to groups (Gall et al., 2007). The researcher had to account for this by randomly selecting a sample from the population. Although the researcher used all years of available data from 2009 through 2013, it was not possible to create a sample size large enough to support conclusions in two subgroup comparisons: (a) students from home owning and from non-home owning families in the online learning environment and (b) online learning and traditional learning with children from families who did not own homes. The strength of the findings would have been greatly increased if the researcher had at least 50 more participants in the non-homeowner group and 196 more
participants in the blended online setting to reach the sample size recommended for a small effect size (Gall et al., 2007).

Other limitations of this study include the interpretation of the results to only the settings and populations within the study. Since these results are from within one school district in suburban Georgia, schools in different parts of the country or in urban or rural areas may have different results. The demographics of this district are not representative of other schools within the state of Georgia or within in the U.S. in terms of race and academic achievement (GADOE, 2012a; U.S. Census Bureau, 2015). Additionally, these results cannot be generalized to other groups of students, as only students identified as at-risk, based on previous course failure and homeownership status, were included in this population. Students identified as at-risk based on different contributing factors may respond differently to the two types of instruction.

Also, the practices within the blended online setting and traditional classroom setting may be unique to the school system and schools in which this study took place. Blended online programs in different districts may follow a different schedule or different guidelines than the schools within this study. Blended online programs in other schools may also use a different online learning provider. This study is limited in the use of only one online program, Education 2020, in the blended online learning environment. The use of a different program could yield different results.

While other subject areas are also present in online course offerings, the focus of this study was exclusively on mathematics instruction. Therefore, the results of this study could not be applied to instruction in other academic subject areas or elective and vocational areas. This study is limited further by the Mathematics I curriculum unique to the state of Georgia for first
year high school students. The mathematics curriculum in other states may vary and therefore may not be comparable to that of the state of Georgia.

The setting in which students repeated the course also presented some limitations to this study. Since students, who repeated the course in the traditional classroom, were mixed with students, who took the course for the first time, participants in that setting may have been positively influenced by the learning behaviors of other students in the class. Had students in the online course been mixed with students, who were taking the course for the first time, they too may have started to implement learning behaviors modeled by more successful students in the classroom environment.

Student and teacher preparedness for their roles in the learning process may have also impacted the results of this study. Students in the traditional classroom environment may have received more support from the teacher to make up for gaps in self-regulation skills. Whereas gaps in self-regulation skills in the online classroom may have led to greater frustration and a reduction in motivation. Teacher training specifically prepares teachers to implement learning supports, such as UDL and differentiation, to keep students engaged and motivated in relevant instruction in the traditional classroom setting. Teachers are also prepared to address areas of student weakness, including gaps in self-regulation skills. However, teachers are not trained to transfer those skills into other educational settings. In addition, these students were more accustomed to traditional learning models, and therefore knew how to function in that setting when they did not understand the assignments or required extra assistance. The results from this study may have differed if the students in the online setting had received more direct instruction and training in the building and use of self-regulation skills for a blended online setting.
The difference in roles of the teachers in the two settings may also have impacted the results of the study. In the traditional classroom, teachers were more attuned to areas of student failure and were encouraged to use these failures as opportunities to remediate skills to increase content mastery. However, in the blended online setting, the responsibility for addressing student failure was shared between the teacher/facilitator and students. The expected role of the student in the blended online setting may have placed too high of an expectation on the student, given the current levels of mathematics understanding and possible lack of previous experience in a student-centered learning environment. Whereas the expected role of the teacher in the blended online setting was to support students when needed, the instructors were not expected to initiate assistance and extra instruction as much as the teachers in the traditional classroom setting.

**Recommendations for Future Research**

Based on a lack of available quantitative research on the effectiveness of blended online learning for high school students, it is clear that more research is needed in this area to support the growth of this practice in the K-12 setting (Barbour & Reeves, 2009; iNACOL, 2012; Murphy et al., 2014; O’Dwyer et al., 2007; USDOE, 2010). Because many areas of online learning for high school students have not been examined carefully and in depth, it is difficult to determine priorities for future researchers. Yet with such rapid growth of online learning in the high school setting, it is important for future researchers to continue with the questions posed in this study. Before researchers can start to evaluate effective practices within online learning, it is only prudent to determine whether online learning is superior to or equivalent to traditional instruction for different high school populations.
Within the realm of quantitative research in K-12 online learning, the current body of knowledge could be greatly improved by a focus on different populations of students. Student differences such as gender, previous experience with online courses, and socioeconomic status could be a starting point for further research to compare online learning to traditional learning in the K-12 setting. Researchers could also look at students, who are identified as gifted or have disabilities, in terms of content mastery in the online setting and the traditional setting. In addition, research should be continued in regard to homeownership status and content mastery, as evaluated in this study.

In consideration of the setting used for online learning, a variety of online learning models and programs are currently used in the K-12 setting (Cavanaugh et al., 2009). Blended online learning, used as the model in this study, can take on a variety of formats as evidenced by the different models studied by Murphy et al. (2014) and defined by Johnson et al. (2015). Also, online learning can take the form of a distance learning format, such as that used by Georgia Virtual School and other online schools across the nation (AdvancED, 2012; Picciano & Seaman, 2009; Wicks, 2010). Within each setting, different online learning platforms are used to provide student instruction and, in some cases, connect students with teachers and other students. With such a variety of models available to study, the empirical research findings must support the findings from practice, in order to conclude whether these models of instruction are comparable to traditional classroom instruction.

In addition, the use of online learning should also be compared to traditional classroom instruction in term of content mastery, after one has taken into account several factors, which contribute to student readiness. One area that should be assessed is student satisfaction within each learning environment as a contributing factor to content mastery. Since self-regulation may
have been a factor in the results of this study, further attention should also be given to research in terms of student self-regulation throughout the learning process and the impact this factor can have on content mastery in both the online and traditional settings. Also, student motivation throughout the learning process should be studied in terms of content mastery across both settings, since motivation is a key to student success in school. Self-rating scales and questionnaires are available for student satisfaction, self-regulation, and student motivation, so measurements in this area would be available for future research.

The effectiveness of online programs and traditional instructional programs should be compared for different purposes in the education of K-12 students. One purpose is for student remediation of previously un-mastered skills and content over short periods of time. This is often referred to as intersession and involves the remediation of specific skills or knowledge across 1 or 2 days. Another use for online learning, which should be studied for effectiveness, is its use as a test preparation tool for university and technical college bound students. Effectiveness should be studied as it relates to growth in self-regulation skills across both online and traditional classroom settings. Future researchers should continue to focus on instruction for students, who repeat a course, but they should also focus on students, who take a course for initial credit. Future researchers could also focus on a variety of subject areas such as mathematics, language arts, science, social studies, and elective courses, as each of these subjects requires different mental processes.

Since there is a lack of available research to compare the effectiveness of online learning to traditional classroom learning in terms of content mastery for students in the K-12 setting, any research in this area will add to a growing body of knowledge (Murphy et al., 2014; USDOE, 2010). The results from this study indicate that traditional instruction is more effective than
blended online learning for students, who repeat Mathematics I at the ninth grade high school level. Given the importance of quality instruction for current students and our future workforce, this topic deserves more attention and further analysis in the realm of educational research.
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APPENDICES

Appendix A

Georgia Performance Standards for Mathematics I

<table>
<thead>
<tr>
<th>Content</th>
<th>Strand and Indicators</th>
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| Algebra | **MM1A1. Students will explore and interpret the characteristics of functions, using graphs, tables, and simple algebraic techniques.**  
  a. Represent functions using function notation.  
  b. Graph the basic functions $f(x)=x^n$, where $n=1$ to 3, $f(x)=x$, $f(x)=|x|$, and $f(x)=1x$.  
  c. Graph transformations of basic functions including vertical shifts, stretches, and shrinks, as well as reflections across the $x$- and $y$-axes.  
  d. Investigate and explain the characteristics of a function: domain, range, zeros, intercepts, intervals of increase and decrease, maximum and minimum values, and end behavior.  
  e. Relate to a given context the characteristics of a function, and use graphs and tables to investigate its behavior.  
  f. Recognize sequences as functions with domains that are whole numbers.  
  g. Explore rates of change, comparing constant rates of change (i.e., slope) versus variable rates of change. Compare rates of change of linear, quadratic, square root, and other function families.  
  h. Determine graphically and algebraically whether a function has symmetry and whether it is even, odd, or neither.  
  i. Understand that any equation in $x$ can be interpreted as the equation $f(x) = g(x)$, and interpret the solutions of the equation as the $x$-value(s) of the intersection point(s) of the graphs of $y = f(x)$ and $y = g(x)$. |
| | **MM1A2. Students will simplify and operate with radical expressions, polynomials, and rational expressions.**  
  a. Simplify algebraic and numeric expressions involving square root.  
  b. Perform operations with square roots.  
  c. Add, subtract, multiply, and divide polynomials.  
  d. Expand binomials using the Binomial Theorem.  
  e. Add, subtract, multiply, and divide rational expressions.  
  f. Factor expressions by greatest common factor, grouping, trial and error, and special products limited to the formulas below.  
  $(x + y)^2 = x^2 + 2xy + y^2$  
  $(x - y)^2 = x^2 - 2xy + y^2$  
  $(x + y)(x - y) = x^2 - y^2$  
  $(x + a)(x + b) = x^2 + (a + b)x + ab$  
  $(x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$  
  $(x - y)^3 = x^3 - 3x^2y + 3xy^2 - y^3$  
  g. Use area and volume models for polynomial arithmetic. |
MM1A3. **Students will solve simple equations.**
a. Solve quadratic equations in the form \(ax^2 + bx + c = 0\), where \(a = 1\), by using factorization and finding square roots where applicable.
b. Solve equations involving radicals such as \(x + b = c\), using algebraic techniques.
c. Use a variety of techniques, including technology, tables, and graphs to solve equations resulting from the investigation of \(x^2 + bx + c = 0\).
d. Solve simple rational equations that result in linear equations or quadratic equations with leading coefficient of 1.

**Geometry**

MM1G1. **Students will investigate properties of geometric figures in the coordinate plane.**
a. Determine the distance between two points.
b. Determine the distance between a point and a line.
c. Determine the midpoint of a segment.
d. Understand the distance formula as an application of the Pythagorean theorem.
e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

MM1G2. **Students will understand and use the language of mathematical argument and justification.**
a. Use conjecture, inductive reasoning, deductive reasoning, counterexamples, and indirect proof as appropriate.
b. Understand and use the relationships among a statement and its converse, inverse, and contrapositive.

MM1G3. **Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.**
a. Determine the sum of interior and exterior angles in a polygon.
b. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
c. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
d. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
e. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

**Data Analysis and Probability**

MM1D1. **Students will determine the number of outcomes related to a given event.**
a. Apply the addition and multiplication principles of counting.
b. Calculate and use simple permutations and combinations.
**MM1D2. Students will use the basic laws of probability.**

a. Find the probabilities of mutually exclusive events.
b. Find the probabilities of dependent events.
c. Calculate conditional probabilities.
d. Use expected value to predict outcomes.

**MM1D3. Students will relate samples to a population.**

a. Compare summary statistics (mean, median, quartiles, and interquartile range) from one sample data distribution to another sample data distribution in describing center and variability of the data distributions.
b. Compare the averages of the summary statistics from a large number of samples to the corresponding population parameters.
c. Understand that a random sample is used to improve the chance of selecting a representative sample.

**MM1D4. Students will explore variability of data by determining the mean absolute deviation (the average of the absolute values of the deviations).**

**Process Standards** 

**MM1P1. Students will solve problems (using appropriate technology).**

a. Build new mathematical knowledge through problem solving.
b. Solve problems that arise in mathematics and in other contexts.
c. Apply and adapt a variety of appropriate strategies to solve problems.
d. Monitor and reflect on the process of mathematical problem solving.

**MM1P2. Students will reason and evaluate mathematical arguments.**

a. Recognize reasoning and proof as fundamental aspects of mathematics.
b. Make and investigate mathematical conjecture.
c. Develop and evaluate mathematical arguments and proofs.
d. Select and use various types of reasoning and methods of proof.

**MM1P3. Students will communicate mathematically.**

a. Organize and consolidate their mathematical thinking through communication.
b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
c. Analyze and evaluate the mathematical thinking and strategies of others.
d. Use the language of mathematics to express mathematical ideas precisely.

**MM1P4. Students will make connections among mathematical ideas and to other disciplines.**

a. Recognize and use connections among mathematical ideas.
b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
c. Recognize and apply mathematics in contexts outside of mathematics.

MM1P5. **Students will represent mathematics in multiple ways.**

a. Create and use representations to organize, record, and communicate mathematical ideas.

b. Select, apply, and translate among mathematical representations to solve problems.

c. Use representations to model and interpret physical, social, and mathematical phenomena.

(GADOE, 2012b)
Appendix B

IRB Exemption Letter

March 12, 2015

Jeannette Hallam
IRB Exemption 2112.031215: Mathematics Content Mastery for High School Students: Homeownership Status and Blended Online Learning Versus Traditional Classroom Instruction for Credit Recovery

Dear Jeannette,

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 to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application and no further IRB oversight is required.

Your study falls under exemption category 46.101(b)(4), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:101(b):

(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Please note that this exemption only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

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

Sincerely,

Fernando Garzon, Psy.D.
Professor, IRB Chair
Counseling

(434) 592-4054

Liberty University | Training Champions for Christ since 1971
Good Afternoon Jeannette,

This email is to inform you that your request to include an additional year of archival data (2012-2013) to your study has been approved. Thank you for submitting documentation of permission to use the data.

Thank you for complying with the IRB’s requirements for making changes to your approved study. Please do not hesitate to contact us with any questions.

We wish you well as you continue with your research.

Best,

G. Michele Baker, MA, CIP
Institutional Review Board Coordinator
The Graduate School    (434) 592-5530

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Appendix D

Research Approval from School System

School System
Georgia

Schools Research Application
(Revised 05/07)

I. RESEARCHER INFORMATION

Name of researcher: Jeannette Hallam
Home Phone:

Address: 

Employer: School System

Business Phone:

College or institution sponsoring project: Liberty University
Name of Individual sponsoring project: Dissertation Chair – Dr. Jerry Woodbridge-Cornell

Address: NA

Phone number:

II. PROJECT INFORMATION

Beginning & ending dates of study: Archival data is being used from January 2009, through June 2012.

Synopsis of research:
The purpose of this causal-comparative study is to compare the methods of traditional face-to-face classroom instruction and blended online instruction for students from differing home environments repeating a Mathematics I course at the high school level. This quantitative study, conducted at three high schools in Georgia, uses the theories of self-regulated learning, student-centered learning, Keller’s ARCS (Attention, Relevance, Confidence, and Satisfaction) model of motivational design of instruction, and cognitive load theory to compare the two approaches to learning. The participants in this study will consist of approximately 250 high school students taking a Mathematics I class in either a traditional classroom setting or a blended online setting for the second time from January 2009 through June 2012. Archival data will be collected regarding demographic information and student outcomes on Georgia’s End of Course Test (EOCT) from each school’s student information system. Archival data will also be collected regarding student addresses at each of the schools in this study and will be compared to tax records to determine homeownership status. A pretest/posttest causal comparative design will be used. The pretest will consist of each student’s previous EOCT score while the posttest will consist of each student’s End of Course Test score after repeating the course. Two-
way Analysis of Covariance (ANCOVA) will be used to analyze the archival data in the study.

**Schools Research Application, page 2**

**III. POPULATION INFORMATION, continued**

**Population involved:** The population for this study consists of high school students participating in credit recovery in the subject of Mathematics I in three City Schools public schools; specifically, [School 1], [School 2], and [School 3].

**Identify characteristics of participants:** The participants in the study will be those students that failed the first attempt at Mathematics I. Students will vary in terms of housing status: parents own home or parents do not own home.

**Specify amount of time needed:** Since the data is archival, the data collection part of the study will only take two weeks.

**Schools:** [School 1] High School, [School 2] High School, and [School 3] High School

**Will you need access to students’ permanent records?** Yes, I will need access to student’s grades, transcripts, and schedules as well as access to their address records. I already have access to the information in Infinite Campus for the three high schools used in the study, so no rights would need to be added in Infinite Campus.
Schools Research Application, page 3

I understand that no individual participant(s) or school(s) will be identifiable through this research project. I recognize that the research is not complete until a copy of the results is sent to the Director of Testing and Research for the School System.

Due to the system's comprehensive academic program, research activities will be conducted during the following months unless special arrangements have been made:

October-November AND January-March

Please attach a copy of all correspondence (cover letter, questionnaires(s), etc. that you intend to send to School System staff.

Will students be surveyed as a part of this study? YES NO

If "YES", please attach a copy of your proposed survey instrument.

I realize that I will be notified in writing concerning the status of this research project within three weeks after the application has been received.

Signature of Applicant: 2/19/15

Please send this completed application with requested materials to:

Lead Psychologist/SST Coord.
School System

For System Use Only

Date Application received: 2/10/15
Date Applicant notified: 2/10/15
Approved: 
Not Approved: 

Authorized Signature: 2/10/15
Date: 
