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The Effect of a Supplemental, Web Based Program on Student Achievement in a Suburban New York State School District

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In a Suburban New York State School District

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Matthew Younghans has successfully defended and made the required modifications to the text of the doctoral dissertation for the **Ed.D.** during this **Spring Semester 2019**.

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Abstract

Since the inception of the Common Core, school districts have sought to implement effective and fiscally responsible ways to support underperforming general education students. The need for supplemental assistance for struggling learners has emerged, particularly when tied to high-stakes testing. To offer appropriate assistance, school districts analyzed the possible ways through which they could support students and boost achievement. One popular method for providing intervention services and supplemental instruction is web-based learning.

This study examined the effect of one particular supplemental web based program on student performance. It examined students who used the Castle Learning Online Program at a suburban high school in southern New York State, measured by Regents examinations and final course average. The study explores the explanatory valuables within the sample of students using Castle, such as gender and ethnicity.

The results indicated that the use of the Castle program had a statistically significant impact on student performance as measured by New York State Regents examination scores and student final course averages. Furthermore, the results indicate a statistically significant impact in academic performance when controlling for gender and ethnicity. The results and empirical evidence outlined in this study, as well as the recommendations for practice provided in this dissertation, can assist school districts and school administrators in their decision making process regarding web-based programs and interventions for students.

Acknowledgements

First and foremost, I would like to acknowledge the members of my dissertation committee for the support and guidance they have offered me throughout this lengthy yet fulfilling endeavor. My heartfelt gratitude specifically goes to Dr. Michael Kuchar, my dissertation mentor, who motivated me to make sense of what I was aiming to accomplish, and to be clear and intentioned with my writing. I also appreciate his friendly “nudge” when I became stagnant or was not working at the speed required to achieve our goal. I am grateful for his guidance, assistance, and friendship.

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I am grateful to my current Superintendent, Mr. Martin Cox, and the Clarkstown Central School District Board of Education for the permission and encouragement to conduct my research within their school district. I hope that the results of this study will assist our district and the students that it serves for years to come in a positive and supportive way.

Finally, I would like to express my deep appreciation for my colleagues. In 13 short years, I have learned more about being a good educator than I could have ever imagined possible. From P.S. 16 in the Bronx, Felix Festa Middle School, Clarkstown South High School to Little Tor Elementary School, I have worked with fantastic educators and even better people. You each have had a hand in helping me become successful for kids.

Dedication

This study, and every ounce of work and effort that went into beginning and ending it, is lovingly dedicated to my family – the best family in the world.

Thank you to my wife, Amanda, to my son, Jax, and to my son to be born shortly. Their support, understanding, and patience allowed this work to be done and to be completed successfully. I will be forever grateful to all of them for the opportunity to better myself and invest in our future. I hope you will always be as proud of me as I am of you.

To my parents, Edward and Grace Younghans, I am all that I am and all that I continue to be because of the both of you. Your love and caring for me have set the most powerful example of the parent I hope to be for my own children. Thank you for your unending guidance and support in all facets of life.

To Chief, I remember my name. I wish you were here to see what you have built and instilled in me and all of us.

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CHAPTER 1

INTRODUCTION

On July 19, 2010, the New York State Board of Regents adopted the Common Core State Standards (CCSS) for Mathematics and CCSS for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects, with the understanding that the New York State (NYS) could include additional expectations to the Common Core (NYS Education Department, 2011). The new standards presented many challenges for school districts and their stakeholder groups in all facets of the process, including but not limited to inadequate funding and insufficient or unclear guidance on the shifts (Kober & Rentner, 2011).

The new standards are designed to better prepare students for college and careers. Many parents acknowledge that these new standards sound good in theory. However, in practice, they say that the shifting educational tactics have left teachers frazzled, students stressed, and parents frustrated (Associated Press, 2013).

Academic Intervention Services (herein known as “AIS” or “AIS services”) were adopted by NYS in 2000, and were a means of supporting students during this shift. The New York State recognized that “children have a wide range of learning potential and many children will need additional time and assistance to reach these standards. The purpose of AIS is to provide that assistance” (New York State United Teachers [NYSUT], 2011). One such way through which school districts supported this cohort of student leaners was the development of a more stringent and inclusive AIS plan, as mentioned by the NYS Education Department. “Academic intervention services (AIS) are services designed to help students achieve the learning standards in English language arts and mathematics in grades K–12 and social studies and science in grades 4–12. These services include two components: additional instruction that supplements the general curriculum (regular classroom instruction); and/or student support services needed to address barriers to improved academic performance. The intensity of such services may vary, but must be designed to respond to student needs as indicated through State assessments results and/or the district-adopted or district-approved procedure that is consistent throughout the district at each grade level" (NYSED, 2000, pg. 4).

School districts need to be creative in the manner of addressing the needs of student learners. The demands of modern-day education (i.e., the common core, PARCC testing, and the 2% tax cap imposed on school district budgets) increase the need for schools to be fiscally efficient. The tax cap is of particular concern as districts adhere to mandates. "Enacted in 2011, the state tax cap law was designed to rein in out-of-control property taxes. Before the recession, annual school spending increased nearly 6 percent a year. In its first and second year, the cap limited tax levy growth to 2 percent. In the last two years, growth was constrained to 1.46 percent and 1.62 percent, respectively. Now that it has fallen to near zero, and with only a modest increase proposed in state aid, school officials say the cap creates a hardship for districts trying to meet student needs. In particular, districts with struggling schools — like Albany, Schenectady and Troy — point out it won't be so easy to boost proficiency or offer more services under such a strict cap" (Bump, 2016).

This has warranted the need for districts to explore cost effective methods, such as extended day and extended school year, to support students and boost or maintain achievement levels. Extended day is a before- or after-school program held at school as an attempt to increase instructional time. As a *Washington Post* article states, "The Department of Education has made extended learning time a centerpiece of its reform efforts. This could have been a breakthrough moment for our nation's education system, encouraging community partnerships to expand learning in ways that help students succeed and bring new resources into our schools. As decades of research on afterschool and summer learning programs show, community partners and innovative teaching approaches can help engage and excite students in learning, boosting achievement. Nevertheless, the extended day approach being implemented in many schools as a result of the department's push to increase instructional time falls short. It largely ignores the deep body of research on what makes effective expanded learning. Instead, too many schools are merely adding another hour or so of regular class time onto the school day. Not surprisingly, two very recent studies suggest we might not accomplish much with this approach to improving school" (Strauss, 2012).

Many school districts have selected another method to compete with the mandates, providing web-based, supplemental instruction to students. One such program is Castle Learning Online (herein known as "Castle"), which supports supplemental learning for students who qualify for AIS. Approximately 70% of public school districts in NYS make Castle Learning available to their teachers, students, parents, and administrators (School Administrators Association of New York State [SAANYS], 2016). The rationale for this implementation is to support AIS students and assist students in subsequently achieving at performance levels that are above passing and/or state-decided cut scores on newly developed, common core examinations.

This study investigates the effect of a supplemental online program on student performance with students using Castle at a suburban high school in southern New York by exploring student achievement on the NYS Regents examinations and through a review of final course averages. It also analyzes the difference in achievement between male and female students, as well as minority and non-minority students.

The hypotheses seek to determine whether supplying struggling students with online programming can equate to increasing student performance and achievement. Additionally, the study explores the explanatory valuables within the sample of students using Castle, such as gender and minority status.

Problem Statement

The adoption of the Common Core Standards in the New York State posed academic challenges for districts and students. The need for supplemental assistance for struggling learners emerged, particularly when tied to high-stakes testing. Given the mandate of Academic Intervention Services, qualifying general education students must receive academic support in their area(s) of need in accordance with NYS regulations. To offer appropriate assistance, school districts analyzed the possible ways through which they could support students and boost achievement.

One popular method for providing intervention services and supplementing instruction is web-based learning. Web-based learning programs such as Castle Learning Online are standards-based programs that provide targeted instruction in the four core subjects. Research on this topic is scarce; however, this study seeks to establish a correlation between student use of the Castle program and student achievement. Given the current focus on the accountability of school districts, the Common Core Standards, and student achievement, this study intends to promote a broader examination of web-based program effectiveness relative to student achievement.

Many districts' selection of the Castle Learning Online program to help ameliorate the achievement gap issues in NYS has prompted the necessity of assessing the efficiency of this program. This study seeks to verify whether the fiscal and time investment in the Castle Learning program is validated.

Purpose of the Study

The purpose of this study is to determine the effectiveness of a supplemental web-based program and evaluate program effectiveness, specifically in high schools. This dissertation and subsequent research examine the overall effectiveness of this supplemental program and its capacity to either positively or negatively affect student achievement. Data are analyzed to compare the following factors:

1. The effect of students using supplemental web-based instruction on final course averages and Regents exam scores in the four core content areas of English, Math, Social Studies, and Science
2. The differences among male and female students using supplemental, web-based instruction
3. The influence on the performance of minority and non-minority students using supplemental, web-based instruction

The data collected provide the opportunity to analyze the comparisons within the subgroups presented to ascertain whether the supplemental program is effective in assisting students with increasing their achievement. The scores for analysis are the final course averages in one or more of the four core subjects and/or achievement scores on the NYS Regents examinations. Dependent upon the student, the content area being supplemented is driven by previous achievement and AIS entrance qualifications. Student achievement can be assessed in any one of the four core subject areas of English Language Arts, Mathematics, Science, or Social Studies.

The program of note in this study, Castle Learning Online, was created in 1991, and it transitioned to a web-based resource in 2000. Without a vast amount of specific research referencing Castle, studies on both online and supplemental program effectiveness are used and analyzed. Understanding the effectiveness of recent online, supplemental programs provides an important contribution to the existing field of supplemental program research, as programs are relatively popular and widely used to support students at all levels in today's age of technology and accountability in education.

My decision is to study the Castle program usage and effectiveness. I additionally opted to expand the research by analyzing the subgroups of student learners and the ability of students to sustain their achievement over time. My intent in doing so is to provide statistical data to determine how the program affects student achievement in these areas for a greater body of outcome data to help improve academic achievement for all students.

Theoretical Framework

The theoretical basis for this study is technology-assisted learning. Technology-assisted learning refers to the use of information technology to support and enhance individuals' learning (Hu, Hui, Clark, Tam, & Milton, 2008). Seemingly everything in today's society is associated with technology; in education, however, some question the effectiveness associated with technology-assisted learning with the efficacy of face-to-face learning. Information technology provides potential advantages for educational provision in terms of flexible access, decreased need for on-site teaching accommodation, and enhanced explanations using special electronic effects (Hewitt-Taylor, 2003).

Empirical evidence suggests that technology-assisted learning effectiveness depends on the target knowledge category. Building on Kolb's experiential learning model, research indicates that technology-assisted learning improves students' acquisition of knowledge that demands abstract conceptualization and reflective observation but adversely affects their ability to obtain knowledge that requires concrete experience (Hu et al., 2008).

From a student's perspective, technology-assisted learning provides convenient access to interactive content in a multimedia environment that allows increased control over the pace and timing of the presented material. Previous research exploring the different aspects of technology-assisted learning has reported vague results concerning its effectiveness and outcomes. Data from this research are expected to improve the effectiveness and enhance the understanding of supplemental, technology-assisted programs.

The use of technology and technology tools in education can create considerable potential to support student learning and shifts in educational paradigms in various aspects. Stakeholders in education, such as school districts, school leaders, and policy makers, regularly search for ways to enhance and increase student learning. According to Penuel (2006), the use of technology in the classroom has an effect on student learning, and the purpose of such study is to expand the understanding and the investigation of the extensiveness of that effect. This study, and therefore, the use of a supplemental, web-based program, is driven by the belief that the usage of this type of technology affects student achievement.

An additional theoretical basis for this study is personalized instruction. Personalized instruction refers to a diverse variety of educational programs, learning experiences, instructional approaches, and academic-support strategies that are intended to address the distinct learning needs, interests, aspirations, or cultural backgrounds of individual students (Edglossary, 2015).

This approach by teachers deviates from the “one size fits all” mentality of traditional learning and aims to differentiate learning to obtain the best learning results for students. In more recent years, the educational paradigm has shifted from teacher-led to student-centered learning, with student engagement being the key factor in student growth and achievement. The individual needs of students become the “primary consideration in important educational and instructional decisions, rather than what might be preferred, more convenient, or logistically easier for teachers and schools” (Edglossary, 2015).

The term “personalized instruction” has become more broadly used by online or “virtual” schools and companies that sell and promote online learning programs. Since the advent of personal computers and their use in both homes and classrooms, computer-based instructional media (i.e., educational software and more recently, discussion boards, web sites, blogs, and other Internet-based tools) have been created to be used as instructional and learning supplements (Savio-Ramos, 2015). As terms and instructional methodologies such as “blended learning, project-based learning, and differentiation” evolve, personalized instruction becomes synonymous with the improvement of instruction to benefit every student. The present study aims to identify the effect of a program developed to provide personalized instruction to students and thus remediate their deficiencies in a specific content area and analyze any statistically significant effects that the program may have on student achievement.

Research Questions

This study is guided by the following three main research questions and hypotheses:

Research Question 1: To what degree does the Castle Learning Online program contribute to the academic success (NYS Regents exam scores and final course averages in the four core subjects) of high school students?

Research Question 2: What difference, if any, in academic outcomes is evident between male and female participants using the Castle Learning Online program?

Research Question 3: To what extent does participation in the Castle Learning Online Program differentially affect the performance of student subgroups as defined by the No Child Left Behind (NCLB) Act, namely Black or African-American, Hispanic or Latino, Asian or Native Hawaiian, and White?

Null Hypotheses

Null Hypothesis 1: No significant difference exists between high school students who use the Castle Learning Online program and those who do not in terms of achievement outcomes (NYS Regents exam scores and final course averages in the four core subjects).

Null Hypothesis 2: No significant difference exists between male and female high school students who use the Castle Learning Online program.

Null Hypothesis 3: No significant difference exists among high school students who use the Castle Learning Online program, regardless of student subgroup as defined by NCLB.

Research Design

This study represents a correlational/explanatory design, which is used to explicate the relationship between achievement levels when students use the Castle Learning Online program and when they do not use the program. This study utilized data from one academic school year, 2015–2016. A regression analysis is conducted to determine how the predictor variables influence student achievement. The predictor variables in this study are demographic variables such as gender and minority status. They are analyzed to verify any statistically significant relationship to the percentage of students who scored better on the NYS Regents exams than they did in the previous year.

The sample selected for this study consists of students from one high school in suburban southern New York State. The specific sample comprises students who qualified for Academic Intervention Services based on the previous year’s achievement and were therefore assigned a supplemental class in which they completed a web-based program in their content area of need as a means of intervention.

The unit of analysis for this study is student achievement relative to the NYS Regents examinations. The variables in the analysis are consequently controlled and included in the regression model, such as student gender and minority status. The NYS Regents exams are “high-stakes” tests administered to New York students in the four core content areas and which are subject-specific. These examinations are a requirement for graduation with a Regents diploma, which is the most common graduation pathway. Students must obtain a minimum score of 65 on any of the individual exams to receive a pass.

Significance of the Study

The significance of this study is in the results of whether the use of Castle Learning Online, an NYS-endorsed web-based program, affects student achievement at the high school level. Another significance of the study concerns the verification of any correlation between the use of the program and the case of controlling for gender and minority status. This aspect provides additional data for a furtherance of research.

The intent of this research is to contribute to the body of work relating to the effectiveness of web-based or supplemental online programs in relation to student achievement. The Castle program is apparently at the forefront of supplemental programs within NYS, providing standards-based instruction for any of the four core content areas at the middle and high school levels. Endorsed by the State Administrator's Association of New York, the Castle program is currently implemented in more than 70% of school districts within NYS (Castle, 2017).

The current study focuses on the question on the effectiveness of the program as measured by student achievement. Its results intend to demonstrate that the Castle program positively affects student achievement, and the program can therefore be classified as an effective resource at the high school level for students in need of academic support and service.

Limitations/Delimitations

At a suburban school district in southern NYS, the Castle program was adopted and implemented in the Achievement Center in school year 2014–2015. Software issues or glitches never emerged in this web-based program; however, the Castle program was new to all the school stakeholders during this period. Students and staff alike needed to familiarize themselves with the program and its functionality in the inaugural year of program implementation. Only two complete years of data were available at this time due to the more recent adoption.

Four teaching assistants staff the Achievement Center, within which the students complete the program. The intent of the center is for students to receive no more than one-on-five small group or independent instruction in their area of need. Students are therefore often left independently to complete the Castle program, while the teaching assistants work with other students on assignments, studying, or organizational skills. Therefore, students were loosely monitored in their completion of the program.

An additional limitation that emerged in the first year of implementation was student buy-in, particularly in the upper grades. Students who had been scheduled into the Achievement Center in previous years did not have to complete an online program, and some were particularly resistant to the new initiative/resource. A particular issue that needed to be addressed for some students initially concerned students clicking through assessments without reading or completing the lessons, therefore skewing their achievement data within the program. These cases were identified, deleted from the student data internally, and reassigned for proper completion.

Another limitation of this study pertained to the size and demographic of the sample. As the study included only one school and its students, its findings may not be generalized due to the evaluative nature of the specific program in a particular school. Instead, this case study is a non-generalizable one.

Finally, given the every-other-day nature of this course and therefore the Castle program implementation, the school calendar could be viewed as a limitation of this study. School absences, vacations, and weather-related closings, among other factors, could have altered the student's consistency in completing the work within the program throughout the course of the school year, and they should thus be considered.

Definition of Terms

Academic Intervention Services (AIS). Academic intervention services (AIS) are services designed to help students to achieve the learning standards in English Language Arts (ELA) and Mathematics in grades K–12 and Social studies and Science in grades 4–12 (NYSUT, 2011).

Castle Learning Online Program (Castle). Castle represents the supplemental online program being studied within this dissertation. Castle stands for Computer Assisted Student Teacher Learning Environment (Castle, 2017).

NYS Regents Examinations. These exams are mandatory assessments in the four core subjects (English Language Arts, Mathematics, Science, and Social Studies) that meet the testing requirements of the No Child Left Behind Act of 2001. Regents exams are administered to high school students following course completion, which is regularly in June (NYSED, 2011).

Personalized learning. This term refers to a diverse variety of educational programs, learning experiences, instructional approaches, and academic-support strategies that are intended to address the distinct learning needs, interests, aspirations, or cultural backgrounds of individual students (Edglossary, 2015).

SPSS. SPSS specifically pertains to SPSS Student Version 24.0. IBM SPSS Statistics is the world's leading statistical software used for solving business and research problems through ad-hoc analysis, hypothesis testing, geospatial analysis, and predictive analytics. Organizations use IBM SPSS Statistics to understand data, analyze trends, forecast and plan to validate assumptions, and derive accurate conclusions (IBM, n.d.).

Student achievement. Student achievement measures the amount of academic content that a student learns in a determined amount of time (Carter, 2018). In the current dissertation, student achievement refers to student achievement scores on the NYS Regents exams and/or final course averages in ELA, Mathematics, Science, and Social Studies.

CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

The use of technology in the classroom continues to be at the forefront of educational conversations and policy. The U.S. Department of Education's *Use of Technology in Teaching and Learning* webpage states the following: "Used to support both teaching and learning, technology infuses classrooms with digital learning tools, such as computers and hand held devices; expands course offerings, experiences, and learning materials; supports learning 24 hours a day, 7 days a week; builds 21st century skills; increases student engagement and motivation; and accelerates learning." Technology in education has developed and is now extensively incorporated into classrooms on a regular basis. Ample research is focused on the capacity of this software and technology to influence student achievement. In recent years, the need for a greater duration and a more cost effective means of instruction has emerged due to the demands of the Common Core, PARCC testing, and the 2% tax cap. Technology is a means through which school districts can be creative and efficient in supplying students with the support that they need.

In education, schools exist to provide all students with a supportive environment. Based on skill, intelligence level, and motivation, the accurate level of necessary support is determined on an individual basis. The best method of ensuring equality of opportunity is to "enable all children, regardless of their background characteristics, to leave school with skills that position them to compete fairly and productively in the nation's democratic governance and occupational structure" (Rothstein, 2004).

The intent to accomplish the monumental task of teaching all students is evidenced by the various reforms in education over the last century, all attempting to provide better supports for student learning. Beginning with the Elementary and Secondary Education Act (ESEA) of 1965, this legislation was part of Lyndon Johnson's "*War on Poverty*," which offered federal funds to help low-income students, resulting in the initiation of educational programs such as Title I and bilingual education. In replacement, 36 years later, the controversial No Child Left Behind (NCLB) Act was approved by Congress and signed into law by President George W. Bush on January 8, 2002. The law, which reauthorized the ESEA of 1965 and replaces the Bilingual Education Act of 1968, mandated high-stakes student testing, held schools accountable for student achievement levels, and provided penalties for schools that do not make adequate yearly progress toward meeting the goals of NCLB (Sass, 2009). More recently, on December 9, 2015, the U.S. Senate voted to approve the Every Student Succeeds Act, which was signed into law by then-President Barack Obama the next day. This latest version of the ESEA replaces NCLB and increases state control in judging school quality (Ed Resources). The historical context within which these major laws were formed was to support and aid students requiring assistance. Each law established a different groundwork on the level of assistance, the inclusion of funds and resources, and the specific category of learners toward which the support should be directed.

This chapter reviews the pertinent literature of topics related to this study and its components. These topics include a review of literature related to New York State Academic Intervention Services, the effectiveness of web-based program monitoring systems, teacher and student perceptions of the implementation of interventions, the effectiveness of technology-based interventions, and finally, an explanation of the Castle Learning Online program. The description of the Castle program aims to provide a complete history of the program and its features.

New York State Academic Intervention Services

The Commissioner of Education Regulations in New York State mandates that for grades 3–8, "[s]chools shall provide academic intervention services when students: score below the State designated performance level on one or more of the State elementary assessments in English language arts, mathematics or science" (100.2 (ee2i)); moreover, for grades 9–12, "the State designated [the] performance level on any one of the State examinations in English Language Arts, mathematics, social studies or science that are required for graduation" (100.2(ee3i)).

The NYS Education Department (NYSED) regulations also state the following:

> Beginning September 1, 2000, academic intervention instructional and/or student support services shall commence no later than the beginning of the semester following a determination that a student needs such services. Services shall continue until a student's performance: (a) meets or exceeds the State-designated performance level on the next State assessment; or (b) is shown to be likely to meet or exceed the State-designated performance level on the next State assessment through achievement on the district-selected assessments of the levels specified in the district description of academic intervention services pursuant to paragraph (4) of this subdivision. (100.2 ee)

The variety of support services offered to students requiring extra help is determined by each individual school district, and these support services can take on various forms both during the school day, or before or after the designated school time. The NYS Education Regulations stipulate that "the intensity of such services (AIS) may vary but must be designed to respond to student needs as indicated through state assessment results and/or the district-adopted or district-approved procedure" (100.1(g)) (NYSED, 2000, pg. 14).

At the inception of AIS in NYS (2000), a guidance document outlining the rationale and framework for the creation, implementation, and guidelines of AIS was published. The guidance document states, “Districts must adopt or approve a written procedure for identifying students for academic intervention services in those grades K–12 where there are no State assessments in English language arts or mathematics and in those grades 4–12 where there are no State assessments in social studies or science. This procedure shall apply across the district to all schools and students at the same grade level” (NYSED, 2000). School districts were charged with identifying such learners and creating targeted interventions aimed at strengthening student performance in identifiable subject areas. As NYSED claims, “Districts must also identify students at-risk of not meeting State standards. Therefore, the district must adopt or approve a uniform procedure that applies to all high schools across the district for identifying students in need of academic intervention services” (NYSED, 2000).

Particularly at the secondary level, these services aim to improve student achievement on Regents scores, which have a direct correlation to student graduation rates. The New York State indicates that “[a]cademic intervention services are not required in standards areas where there are no State assessments, even though students must earn one or more units of credit for graduation. They are only required in English language arts, mathematics, social studies, and science” (NYSED, 2000). The need for such regulations stems from a nationwide push to improve student performance and create consistent cohorts of students who are college- and career-ready in accordance with the Common Core.

The improvements of student graduation data are noticeable throughout the nearly two decades of AIS in NYS. According to NYSED, “the high school graduation rate hit a new high of 79.4 percent in 2016, an increase of 1.3 points from 2015 and more than 12 points from a decade ago" (Taylor, 2017).

Technology-assisted Learning

Since the birth of computers, technology has been transformed and adapted to meet the needs of students in the US and around the world. For reference, Molnar (1997) reports that in 1963, "only 1% of the nation's secondary schools used computers for classroom instructional purposes; but by 1975, 55% of the schools had some form of computer access, and 23% of them were using computers to assist and inform classroom instruction." The age of technology has since developed, and computers and technology have become a daily staple in today's society, inclusive of education in a classroom setting.

As educators and school districts consistently search for methods to improve and supplement instruction, the use of technology in classrooms is growing in popularity and volume within schools. As Davidson (1985, pg. 1) asserts, recent advances in instructional technology provide educators with "a range of exciting and versatile teaching tools. Today's microcomputer programs are capable of demonstrating intricate patterns of movement that can readily enhance a student's ability to visualize complex concepts. Because of this, computer-assisted instruction is gaining popularity as an effective and efficient method of teaching." Evmenova and King-Sears (2007) further explain that educators can use technology to increase the efficiency of the educational process.

Since the advent of computers and the creation of software, programs have aimed to aid in instruction and to be used as tools of efficiency and learning within the school setting. Programs are designed to target specific learners, areas of content, and learning styles.

Computers specifically enable students to be “actively involved in the learning process, individually or in groups of two or three. The computer allows students to progress at their own pace, an important implication for the gifted learners as well as for the low achievers” (Lazarowitz, Huppert, & Yaakobi, 1993). Many believe that computer-assisted learning via programs can be of benefit to all students at all levels.

The development of such programs, hardware, and software allows educators to interweave instruction with technology, creating a learning atmosphere that is engaging and interesting to students. Educators hope to obtain better results and higher levels of achievement through the usage of these tools, computers, and programs. Along with this merging of activities, many programs offer instant feedback on the performance of the student, and the need for delaying assessment feedback no longer exists (Kelman, 1990).

However, many argue that technology is simply a supplement to traditional instruction or a means of enhancing effective teaching methods. As Brooks-Young (2002) suggests, “technology is not the ‘magic pill’ that is needed to solve all of education’s problems, but it can be a powerful tool when used in conjunction with other powerful tools to improve instructional programs.”

Personalized Instruction

Personalized instruction dates back to the work of Helen Parkhurst and John Dewey in the 1920s. Parkhurst worked to create a balance between a child’s individual talents and the needs of the community, titled the Dalton Plan. Specifically, the Dalton Plan’s objective was to tailor the students’ program to their individual needs, interests, and abilities (Dewey, 1922) and to allow every schoolchild to have the opportunity to freely choose a series of activities, already predisposed by the teacher, to fully improve intellectual, social, and moral growth (Claparède & Meylan, 1967). As other theorists and researchers began to duplicate this work, some incorporated the various of forms of technology into the systems approach. These types of systems were considered to be adaptive in nature, adjusting as necessary to learners' needs in an effort to move toward a more student-centered approach to learning (Hwang, Sung, Hung, Huang, & Tsai, 2012).

Some of these other theorists such as Jean Piaget and Lev Vygotsky have published work on the philosophy of constructivism. According to Schulte (1996), constructivism states that learners bring their personal experiences into the classroom, and these experiences have a significant effect on students' views of how the world works. Learners construct understanding or meaning by making sense of their experiences and fitting their own ideas into reality. Piaget's work within his theory of cognitive development indicates that children are active learners who construct meaning throughout their stages of development. Within the realm of personalized instruction as it relates to constructivism, Tapscott (1998) suggests that with a constructivist approach to teaching, the student learns best by doing rather than by being passive listeners.

Vygotsky is another theorist whose research is important to understand and consider. His work highlights the influence of cognitive development on children's approach to learning new activities. Although some of Vygotsky's work parallels Piaget, Vygotsky believed that children's personal experiences could not be separated from their social interactions with others, and social and personal interactions could help create a child's knowledge (Berk & Winsler, 1995; Mooney, 2000). Vygotsky's work documents "zone of proximal development," a critical concept in learning development, and defines it as the distance between the most difficult task a child can do alone and the most difficult task a child can do with the assistance of an adult. Both Piaget and Vygotsky framed the theoretical groundwork for many of the subsequent learning theories we see today in education, and both speak to how students can learn and achieve given personalized instruction, in which students are able to construct meaning of their own learning.

In the early 1970s, Victor Garcia Hoz introduced and coined the term “personalization” in the context of educational science. Different in the aspect of personal connection and interaction, technology and computers specifically became more complex as technology evolved. This included programs that were created to provide instantaneous feedback to the user; something unimaginable until this time. Psotka, Massey, and Mutter (1988) mentioned the development of a system that provided immediate and customized feedback to learners, gave feedback based on user-inputted responses, and offered instant recommendations based on user responses. This system was named an “intelligent tutoring system” or ITS, and it was coined by Sleeman and Brown in 1982. The ITS was one of the first examples of a personalized learning tool because it adapted the material based on the needs dictated by the user response-dependent system. The capacity of ITS to provide personalized learning support and feedback to help individual learners to improve their learning performance based on personal information, profiles, or learning portfolios has played a major role in learning (Walonoski & Heffernan, 2006).

As time passed and technology improved, the development of computer- and technology-based programs has become commonplace. Many of these programs aim to achieve the personalized learning first established and created in its earliest forms, whereby the system, software, or program adapts to the student’s individual needs and provides instruction specific to that student. MacKenzie (2000) contends that teachers who rely on traditional teaching approaches “less likely make meaningful and frequent use of information technologies.” This type of learning is arguably the most effective in fostering both student growth and achievement. Personalized learning content is recognized as one of the most important features of educational systems (Tseng, Chu, Hwang, & Tsai, 2008). The personalized learning tool used in the current study is titled the Castle Learning Online program.

Effectiveness of Web-based Program Monitoring Systems

Schools and school districts constantly search for ways to identify the gaps in student achievement. Teachers need to obtain this type of data to properly differentiate instruction and work toward an individualized curriculum for students – one in which each student gains the interventions necessary for them to achieve or exceed the standards. Emphasis on school-wide screening and progress-monitoring models has also intensified as a result of the reauthorization of the Individuals with Disabilities Education Act, which allowed districts to use a Response to Intervention (RtI) process to identify students who are at risk academically (Deno et al., 2009).

As schools develop and complete the RtI process for students with academic needs, progress monitoring has become a beneficial and necessary factor in the success of the school RTI/IST teams. One of the foundational elements of RtI is a technically adequate system of screening and progress monitoring (Fuchs, Mock, Morgan, & Young, 2003). Given the need and increase in usage of these processes, coupled with the development of technology for educational purposes, web-based systems have become standard.

Web-based progress monitoring systems have provided assistance with necessary educational and student data as technology continues to develop. Publishers are producing “comprehensive technology-enhanced progress monitoring systems that provide teachers with the data they need to differentiate instruction, group students on the basis of comparable goals, and manage or adapt instruction based on student performance" (Edformation, 2004; Good & Kaminsky, 2002; McGraw-Hill Digital Learning, 2002; Renaissance Learning, 1998a).

Two previous studies focusing on the measurement of the effectiveness of progress monitoring systems provided a glimpse into the capacity of such programs to efficiently identify student deficiencies, allowing teachers to accordingly adopt a different instruction approach. In the first study, Ysseldyke and Bolt (2007) used Accelerated Math (AM), a continuous progress monitoring system, to enhance student performance by providing data to teachers to allow them to offer targeted instruction or differentiation. The study encompassed seven school districts in different states; it also covered 80 classrooms – 41 classrooms comprising the treatment group and 39 classrooms representing the control group. All the students were given the Renaissance Learning product STAR Mathematics Achievement Test as a pretest prior to implementation of the program near the beginning of the school year. Within the treatment group, teachers in those 41 classrooms received training in the use of the data from the pretest to assign students to instructional levels, and in the usage of the management system within the program to assign instruction and track student performance. Teachers in the experimental group, or the other 39 classes within the study, were asked to implement AM with their students but were not required to do so. This approach created a natural mix of high implementation, low implementation, and non-implementation among the teachers. All the students were posttested using the STAR Mathematics Achievement Test at the conclusion near the school year. The results indicated that students in the high implementation groups achieved consistently large and positive gains (Ysseldyke & Bolt, 2007). Therefore, the results implied that the more extensive the implementation of a web-based progress monitoring tool, coupled with an instructional management system, the greater the student achievement.

In the second study, Spicuzza et al. (2003) once again tested the use of AM, this time with a treatment group that used the program to supplement its core curriculum. In this instance, grades 4 and 5 students in one school district (N = 6,385) took the STAR Mathematics Achievement Test as a pretest in December, and a posttest in either May or June of the same school year. The results of this study indicated that students who participated in the AM supplemental instruction demonstrated a greater and more statistically significant growth than students in the control group that merely implemented the core curriculum but did not use the program (Ysseldyke, Kosciolek, Spicuzza, & Boys, 2003).

In Lembke et al.'s (2017) study of a different content area, sixth-grade students (N = 202) were administered a weekly vocabulary-matching curriculum-based measure (CBM) for 35 weeks in their Social Studies content. The curriculum-based measure, which is sometimes referred to as a "general outcomes measure," is a well-established, empirically based technology that can be used to monitor student performance across time; it has been shown to be reliable and valuable for enhancing the level of information that educators need to modify the individual instruction for students (Black & William, 1998; Deno, 1985; Fuchs & Fuchs, 1988). As additional measures, the students in Lembke et al.'s (2017) study were also administered the Scholastic Reading Inventory (SRI), along with the annual state-standardized test in Communication Arts. The CBM scores of students were analyzed to determine reliability, validity with criterion measures, and student growth over time. The results of this study indicated that the vocabulary-matching CBM was reliable and valid with the SRI but not with the state-standardized test. The results also demonstrated an overall growth trend, but one that provided flat results in the middle of the semester. The implementation of a progress monitoring tool together with supplemental instruction produced growth in student achievement within this additional study.

Effectiveness of Technology-based Interventions

A plethora of studies have investigated the effectiveness of web-based interventions across the content and at varying levels of education. For instance, Burns, Kanive, and DeGrande's (2012) study titled, "The effect of a computer-delivered math fact intervention as a supplemental intervention for math in third and fourth grades," examined the use of the Renaissance Learning program database. In this study, which comprised grades 3 and 4 students across 26 states (N = 442), the selected students were identified as "at risk" because they ranked below the 25th percentile on the Renaissance Star Math Assessment. A second group consisted of students scoring below the 15th percentile, or having a "severe deficit" on the same measure. The study's treatment group was a randomly selected group of students who had participated in the Math Facts in a Flash (MFF) program through Renaissance Learning at least thrice per week for a period of eight to 15 weeks. Meanwhile, the control group within this study was a second group of students who participated in the MFF program less than once a week for less than the minimum of eight weeks (Burns et al., 2012). MathFacts in a Flash is a computer software program that allows teachers to give students, at all levels, essential practice on their addition, subtraction, multiplication, and division facts, as well as other mental math skills such as squares and conversion of fractions, decimals, and percentages (Renaissance Learning, 2012).

The results of the study indicated that both the at-risk and severe-deficit experimental groups exhibited growth, but at the same rate. The researchers previously hypothesized that the severe-deficit subgroup would grow at a more substantial rate (Burns et al., 2012). Although this study based its research questions on the expected level of growth, the use of a web-based math intervention provided promising results for the students who were identified to participate in the study.

Another study investigated the use of a supplemental online tutoring program in the subject area of mathematics. In “The impact of an online tutoring program in mathematics,” Clark and Whetstone (2014) conducted a qualitative study on the perceptions and satisfaction levels of teachers regarding a program entitled “Math Whizz.” They additionally performed a quantitative study of 2,542 students in grades K–5 on five major data points: initial mathematics ability, improvement in math ability over a one-year period, average exercise score, average test score, and average weekly usage in minutes. The data from the qualitative component sampled 35 teachers from 15 different schools in terms of ease of use and overall satisfaction. The quantitative component of the study sampled 937 students in year 1,829 in year 2, and 776 in year 3 of the study (Clark & Whetstone, 2014).

The results from the qualitative survey provided data that were extremely positive. Ninety-four percent of teachers in the study reported being “satisfied” or “very satisfied” with the progress of students using the Math Whizz supplement program. Another interesting and positive result from the survey was the level of student enthusiasm when using the program, which was also reported as 94% (Clark & Whetstone, 2014). The results from the quantitative study yielded a strong positive correlation, indicating that the more students used the Math Whizz program, the greater their improvement, on average. Within this study, students consistently using the Math Whizz program for 50 minutes per week were predicted to result in approximately three quarters of a year's growth in mathematics (Clark & Whetstone, 2014). This aspect is another promising area of study for multiple reasons, specifically with regard to the satisfaction and efficacy topic discussed earlier, as well as a conclusive study of student achievement growth when employing a supplemental web-based program as an intervention for the identified students.

Other studies consider the use of technology assistance as an important supplement, particularly in the development of the foundations of learning in the primary years. Several programs presented evidence of improved learning outcomes (i.e., in terms of increased reading fluency) that combined the provision of eReaders and eBooks for students with TD programs on phonics-based literacy instruction (Murz, 2011; Worldreader, 2012, 2013). In addition to providing tailored examples or hints, technology-based learning systems can support the personalization of the learning experience of students by analyzing their performance on recent tasks and suggesting learning activities, resources, or approaches matched to each student's profile of skills and competencies (U.S. Department of Education, 2014). Independent learning through technology requires a set of "self-regulation" skills, including students' abilities to monitor their own understanding and progress, make decisions about their own learning (e.g., recognizing the need to review topics they do not yet fully understand), and control their own activities. Students who are self-regulating undertake tasks at appropriate levels of challenges, practice to proficiency, develop deep understandings, and wisely use their study time (Butler & Winne, 1995).

In a report from the U.S. Department of Education's (USDE) Office of Educational Technology in 2014, the USDE discusses the effectiveness of using technology to support learning; moreover, it even delineates specific examples of technologies that can improve learning across the content and certain studies that indicate their effectiveness in terms of student achievement. The first study was completed on the usage of the program SimCalc, which is learning tool that allows students to build the foundational concepts of advanced mathematics (algebra and calculus). In a randomized controlled trial across the diverse population of Texas and involving 95 teachers and 1,621 students, seventh-grade students in classrooms using SimCalc significantly outperformed students in classrooms using existing materials on a measure aligned both to Texas standards and to national and international achievement measures (Roschelle et al., 2010; USDE, 2014).

The next program, Technology-Enhanced Learning in Science (TELS), is a program out of the University of California at Berkeley. It is designed to support students' development of a profound understanding of core principles in the middle and high school science curriculum. The TELS modules offer interactive visualizations of scientific phenomena that are often impossible to directly observe, such as chemical reactions. Students explore these phenomena through the lens of current scientific issues such as treatment options for cancer. Through the software, students are guided to generate and test predictions, explain their understandings, and engage in discussions with peers (USDE, 2014). In a study of 26 teachers and 4,328 students using a time-delayed design, TELS students significantly outperformed their counterparts using traditional curricula in a measure of students' integrated understanding of scientific phenomena (Linn et al., 2006).

The final study references a program for literacy improvement named Intelligent Tutoring of the Structure Strategy (ITSS): Increasing Access to Successful Reading Strategies; this program is designed to support students' reading comprehension and recall of expository text. Furthermore, ITSS helps students to make the transition from reading narrative text to reading expository, content-rich text by learning to parse the structure of the text – for example, by learning to recognize signaling words that indicate that the writer is introducing an argument or comparison and using that structure to help organize more efficient mental representations of the text. The computer-based ITSS models this process and provides tailored feedback and scaffolding based on students' responses. A multisite cluster randomized trial was used to compare the once weekly use of ITSS as a partial curriculum replacement against the traditional language arts curriculum in 24 rural and suburban schools. Up to 131 fourth-grade classrooms were randomly assigned to treatment or control conditions within schools. Students in ITSS classrooms significantly outperformed the control students on the GRST (Gray Silent Reading Test, a standardized test of reading comprehension) and on researcher-developed measures of signaling, main idea quality, and overall content recall (USDE, 2014; Wijekumar, Meyer, & Lei, 2012).

Castle Learning Online Program Description

Castle Learning Online, a web-based supplement to classroom instruction, is both a program monitoring system and an instructional tool. It offers review assignments, practice sessions, and benchmark testing. It saves teachers time with automatic grading, assignment management, and instant progress reports. The core content areas for grades 3 through 12 are aligned to state standards.

In today's information age, "any student of history will recognize how far we have come from our roots as an agricultural society. The advances in technology can see this relatively rapid change, but a 1989 study by Gallagher and Pearson disclosed that from 1893 to 1979, instructional practices had remained traditional, resulting in a growing concern that schools would be unable to educate young people in America" (Davis & Sorrel, 1995).

Since the publication of that study, change has occurred as the State Education Departments moved toward the concept of mastery learning:

- Subject content is divided by units, with a set of objectives or expectations.
- Students work through units in either groups or alone.
- Students demonstrate mastery on unit exams, typically at the 80% level, before moving to new content.
- If mastery is not achieved, students receive remediation through tutoring, peer monitoring, small group discussions, or additional homework.
- Additional time for learning is offered for students who require remediation.
- The cycle of study and testing continues until the mastery level is reached.

Students have a higher level of achievement by using mastery learning techniques than those students being taught through traditional methods of instruction.

Castle Learning Online is uniquely designed to be used by educators who present content and raise academic proficiency by seeking a mastery level for students. The features found on the student review, testing, and assessment website, www.CastleLearning.com, or fully explained through the "Teacher Tour" on the home site of the company, www.castlelearning.com, employ the concept of mastery learning. The Castle Learning site provides the user with an extensive database of questions, hints, defined vocabulary and reasons, along with skill development and reading sets, where students can answer questions, learn where they are weakest, return to complete new assignments and then move forward after a teacher determines they have achieved mastery (Castle Software, Inc., 2017).

In its mission statement, Castle Learning Online strives to “provide high-quality content, authored by educators, so that you can focus your efforts on helping your students achieve academic success.” Castle Learning Online’s informational website further states that it offers a comprehensive instructional support platform for in-class, homework, review, and testing available both online and offline, and its system is designed “to help teachers be more efficient and effective while helping students achieve academic growth by providing access to thousands of content related questions. Teachers can easily search for content-related questions within Castle Learning to create their own assignments, or access pre-built, ‘ready-to-go’ activities and assessments. Instant grading, detailed assessment reports, and instructional feedback are benefits that save time and improve academic success. Questions are also aligned to topics, rigor and state or national standards so you can analyze assessment data to ensure positive progress and differentiate additional instruction as needed. One low per student cost can unleash the power of Castle Learning is one yearly, budget-friendly investment” (Castle Software, Inc., 2017).

Castle (“Computer Assisted Student Teacher Learning Environment”) Learning moved to a web-based resource in 2000. Students and teachers can access Castle Learning from any Internet-connected device. More than 70% of public school districts in New York currently use the NYS-based company’s Castle Learning (SAANYS, 2016). The participating districts have options for benefiting from their Castle Learning license. These features include Regents Preparation, Homework, Assessment Development, Delivery & Reporting, Student Growth & Differentiation, Credit Recovery, Class Elections, Parent Participation, and Flipped Classroom Delivery.

The Castle program has content and assessments at all levels, elementary through high school. It also offers SAT and ACT prep courses, and components for non-core courses such as Physical Education and Health. The program implementation and student criteria are further discussed in this dissertation.

Summary

The body of research on technology in the classroom, particularly web-based interventions and supplements, can be effective for student growth and achievement. The consistent and frequent implementation of a progress monitoring intervention brings greater gains as compared to students who only use a standard core curriculum (Ysseldyke et al., 2003). Various forms of technology and programs are available, and even more are currently being developed. The body of research on the effectiveness of these supplemental tools is likely to grow as schools continue to search for ways to provide meaningful, targeted interventions and progress monitoring of students.

Chapter 3 explains the methods of this study and investigates the use of the Castle Learning program to supplement core classroom instruction at the secondary level in the student's greatest area of need. Chapter 4 presents the results of the study. Finally, chapter 5 discusses the key findings and recommendations for future research on this topic.

CHAPTER 3

METHODOLOGY

Introduction

This quantitative research design explains the effect of a supplemental program on student achievement. Quantitative research on this topic is scant, that is, the effectiveness of the Castle or any other supplemental program on student achievement outcomes at the secondary level. This study measures the effect of the program on student achievement when controlling for student and school variables. Finally, this study adds to the existing literature by providing school district and building leaders with data and evidence to make informed decisions on the allocation of funding to support educational resources.

Chapter 3 includes sections on the research design, research setting and context, research questions and hypotheses, sample population, data collection, validity and reliability, data analysis, and a chapter summary. The subsequent chapters analyze the SPSS results of the data and discuss the results.

Research Design

This study predominantly used a correlational/explanatory design as a research method to explain the relationship between achievement levels when students use the Castle Learning Online program and when they do not use the program. General education students who did not obtain a passing score on the end-of-year New York State Regents exams in one of the four core subject were automatically placed into the sample and identified by the school as needing further Academic Intervention Services. The school provided such service by adding a supplemental, web-based program to the individual course of study, to be completed in a standalone every-other-day course titled Achievement Center. Students used this program in their greatest area of need for an entire year, two days per week.

The analysis and this study aim to uncover the effect of the use of this supplemental program on the students' NYS Regents exam scores having completed a full year of supplemental, personalized instruction in their previously failed content area. The study intends to determine any correlation between the two variables, that is, the use of the Castle program and student achievement. It also examines the variables of gender and minority status to ascertain if either gender or minority/non-minority groupings derive scores and data that are statistically significant.

The NYS Regents exam scores were assessed in the content areas of Math, English, Social Studies, and Science of the previously mentioned students within the sample. The school district data on these students' gender, minority status, and previous achievement were similarly evaluated. These comparisons were analyzed to investigate any statistically significant difference at the 0.05 level in the student performance measure outcomes, namely, NYS Regents examinations, of students using the Castle program for an entire school year when compared with the previous school year achievement. Within this study, the Castle program, or the use of such, functioned as the independent variable, whereas student achievement served as the dependent variable.

The students were included based on their involvement with the Castle program. Group 1 was composed of all students using the program during the school year. Group 2 included all females using the program, and Group 3 comprised all males using the program. Group 4 within this study consisted of all minority students, and Group 5 included students who were of non-minority status. This experimental design identified treatment groups and a control group. The outcome data of performance on the NYS Regents exams in the student's area of need represented the treatment effect.

Research Setting and Context

The research setting within which this study was conducted was a public high school in the southern sector of NYS. The school consists of approximately 1,450 students in grades 9–12, within a district of approximately 9,000 students. The affluent, suburban school district is approximately 25 miles northwest of New York City. Two high schools are located within this district, which represent students in grades 9–12. The proportion of high school students who are enrolled in the free or reduced lunch program is approximately 6% on a yearly basis. The average passing rate (proficiency) on the NYS English Language Arts exam at the high school, in which the study was conducted, for reference, is 95% of students, with 54% scoring at the mastery level.

Instrumentation and Procedures

The Castle Learning Online program was the instrument used as the basis for this study. Initiated in 1990, this program has evolved into an extensively used and acceptable web-based program that helps students to learn and prepare for NYS curriculum and standardized examinations. Approximately 70% of public school districts in NYS make Castle Learning available to their teachers, students, parents, and administrators (SAANYS, 2016), and more than one million students and thousands of teachers regularly use Castle Learning as part of their academic assets (Castle Learning Inc., 2017).

Castle Learning itself is a web-based program whereby students are assigned a course of study or program based on their area of need. Students then log into their profile and complete self-directed curricular readings and preparatory questions, which are all provided with hints and explanations. The system also generates progress monitoring reports and item analyses of question responses, which are all aligned with the NYS Common Core curriculum.

For the purposes of this study, general education students were assigned to an every-other-day course entitled Achievement Center, based on the previous year's achievement on the NYS Regents exams. Any student receiving 65 or less (failing grade) on an NYS Regents examination is automatically scheduled into this service course. With the supervision of teaching assistants, students completed their Castle Learning program via laptop computers two days a week for the duration of the school year as supplemental, personalized instruction to their current coursework in their area of greatest need. Oversight of the students and their progress was completed by a designated Achievement Center coordinator, who assigned content to the student's profiles, checked their progress, and printed quarterly progress reports for both home and the student's classroom teacher in the given area of need.

Research Questions

The following research questions guided this study:

Research Question 1: To what degree does the Castle Learning Online program contribute to the academic success (NYS Regents exam scores and final course averages in the four core subjects) of high school students?

Research Question 2: What difference, if any, in academic outcomes is evident between male and female participants using the Castle Learning Online program?

Research Question 3: To what extent does participation in the Castle Learning Online program differentially affect the performance of student subgroups as defined by the No Child Left Behind (NCLB) Act, namely Black or African-American, Hispanic or Latino, Asian or Native Hawaiian, and White?

Null Hypotheses

Null Hypothesis 1: No significant difference exists between high school students who use the Castle Learning Online program and those who do not in terms of achievement outcomes (NYS Regents exam scores and final course averages in the four core subjects).

Null Hypothesis 2: No significant difference exists between male and female high school students who use the Castle Learning Online program.

Null Hypothesis 3: No significant difference exists among high school students who use the Castle Learning Online program, regardless of student subgroup as defined by NCLB.

Sample Population/Data Source

The sample consisted of public high school students within NYS. The participants in this study were all the students using the Castle Learning Online program from school years 2014–2015 to 2016–2017, or during a three-year period. Student data were only reported, and students were dehumanized for the purposes of this study. The number of students that had complete data for each subject for grades 9–12 included the following:

- Grade 9 (n = 84)
- Grade 10 (n = 113)
- Grade 11 (n = 90)

Data Collection

The data for this study were retrieved from the New York State Information Repository System. The 2011 Microsoft Excel zipped files were downloaded, extracted, and saved to a data folder. This information becomes available to school districts yearly in June. Determining student involvement in the Castle program was derived from internal school records, and scheduling documents were obtained from the eSchool management system. The data were sorted, and incomplete data for any student were subsequently removed. The students were then sorted by grade level and content area in Microsoft Excel. The file was further broken down into separate workbooks for each grade level. Each workbook included four separate worksheets titled English Language Arts, Mathematics, Social Studies, and Science.

The results of the NYS Regents exams were added to the spreadsheet. For this study, the students’ current year exam scores were compared with their previous year’s scores. The data were consequently formatted and imported into IBM’s SPSS statistical analysis software. Data were categorized by grade level, content area, gender, and minority status.

Validity and Reliability

The goal of this study is to measure the effectiveness of a supplemental, web-based program on student achievement. The depth and significance of this relationship can apprise school leaders and school districts of the effect of these programs and can be used as a guide to inform future practice and resource allocation.

Validity and reliability are critically important when working with data and conducting a quantitative research of this nature. The New York State has offered a standard-setting technical report on the validity and reliability of Regents exams. In 2015, a new set of technical reports was published for examinations to align with the new Common Core standards. The NYS Regents exams are intended to quantify the level of proficiency demonstrated by students relative to their understanding of the NYS curriculum in the subject and content area of their enrollment. Dependent upon grade level and course of program, this differs by student.

The NYS Department of Education reviews all the assessments to ensure that data are accurately reported. The processes below are used for maintaining data reliability and validity.

1. All NYS assessments are aligned with state content standards published annually.
2. Controls for the scoring of open-ended or written questions are built into the assessment and grading processes. Examples of these controls are mandatory training for both site leaders and table leaders, read behinds, and rescoring when the scoring comes into question.
3. Student demographic data can be validated by the current district.
4. School administrators are required to complete an accountability verification process each year prior to a given date. This process is conducted through a state reporting system that verifies student scores and demographic information.
5. Appeal processes at the local and state levels are available at any step in the process. This uniform safeguard is allowed by the U.S. Department of Education to prevent errors in the data and reporting processes.

Data Analysis

The achievement data were analyzed using statistical measures to gain a deeper understanding of the effects of the variables in this study. Related samples and independent samples t-test were used to ensure the validity of this study and identify statistical significance. This approach was appropriate because each of the studied groups had a different sample of students. The t-tests determined whether a significant correlation emerged between students using the program after failing to perform at a proficient level the previous school year.

The dependent variable was student performance on the NYS Regents exams in the individual student's content area of deficiency, whereas the target variable was participation in the Castle program as a means of a supplemental, online program. The other independent variables included as control variables were gender and minority status, which are both identified in literature and research as having a significant influence on student achievement.

The study used only data from high school students in grades 9–11. The total number of students who were enrolled in the program was reported as 287.

Table 1: Variable Coding

Variable	**Measure**	**Coding**
Student's grade level	Categorical	9 = Grade 9 10 = Grade 10 11 = Grade 11
Student's gender	Nominal	0 = Female; 1 = Male
SES/economically disadvantaged	Nominal	0 = No; 1 = Yes
Attendance	Scale	Number indicated

Castle Learning participation	Nominal	0 = No; 1 = Yes
Student scores (Final course averages and Regents exams)	Scale	Scores indicated
Ethnicity	Categorical	1 = Asian 2 = African-American 3 = Hispanic 4 = White

Conclusion

The purpose of this study is to explain the relationship between a supplemental, web-based program and student achievement at the high school level. With the increasing need for interventions to boost student achievement, coupled with the intensified usage of technology in today's schools, this research can help inform future policy and practice in multiple areas of study.

Appendix

NYS AIS Eligibility Criteria

Students are eligible for Academic Intervention Services based on AT RISK performance on the following multiple measures:

NYS Grade 8 Assessments (in grade 9 only)

Interim Progress Reports/Quarterly Report Card

Applicable Regents examinations

Teacher Recommendation/Explanation of Services

The level of service provided is determined through the building's RtI Team and is based upon the level of student need in any given area of concern. The possible types of services include:

Tier 1: Classroom differentiation

Tier 2: Content Skills Lab, Achievement Center, Homework Center

Tier 3: Core Support Intensive Class, Social/Emotional Support Groups

Duration of services is dependent upon the level of student need, and the frequency and duration of service vary from:

1–5 times per week

30–40 minutes per session

Service may begin and end at any time during the school year.

Exit Criteria

Student progress is assessed through the re-administration of the multiple measures listed above. Students are considered to have reached the exit criteria for their area of need when they approach the grade-level benchmarks established across multiple measures.

The need for a comprehensive AIS plan is and was precipitated by the shift in the rigor of curriculum driven by the Common Core State Standards. Particularly at the secondary level, much of the criteria is derived from the passing rates of the NYS Regents exams. In NYS, graduation with a Regents diploma requires the completion of core courses and a certain number of credits and the achievement of a passing grade on certain Regents exams. The minimum criteria for obtaining a Regents Diploma are as follows:

Credits

- 4 credits in English Language Arts
- 4 credits in Social Studies, distributed as:
    - Global History and Geography (2)
    - U.S. History (1)
    - Participation in Government and Economics (1)
- 3 credits in Mathematics (minimum)
- 3 credits in Science, distributed as:
    - Living Environment (1)
    - Earth Science (1)
    - Life Science or Physical Science (1)
- 1 credit in Languages other than English (LOTE)
- 1 credit in Art, Music, Dance, or Theater
- 2 credits in Physical Education (participation required each semester)
- 0.5 credit in Health Education
- 3.5 credits of elective courses, as chosen by student

State Exams (Regents) (passing score reflected as 65 or above)

- 1 passing score on Regents in English Language Arts
- 1 passing score on Regents in Global History and Geography
- 1 passing score on Regents in United States History and Government
- 1 passing score on Regents in Mathematics (Algebra 1, Geometry, Algebra II/Trig)
- 1 passing score on Regents in Science (Living Environment, Earth Science, Chemistry, Physics)

Clarkstown South High School's purchase and inclusion of the Castle program aimed to provide a supplement to students who had not obtained or were in danger of not obtaining credits or passing the required Regents exams for graduation. Using the AIS plan as a guidance document, students were identified and scheduled into the school's Achievement Center.

Achievement Center is a general education service for students, which is scheduled into the student's program on an every-other-day basis, or on three of six cycle days. Staffed by teaching assistants within an eight-period day, the service is intended to provide a one-on-five instructional environment for a small group or even a one-on-one instruction in the student's area or areas of need. A complete cart (30) of student computers is also included within the physical environment of the Achievement Center. Prior to the start of school year 2014–2015, student licenses were obtained for the Castle program, and the curriculum was loaded into the students' individual accounts as determined by their area of need and current course within that content area. Furthermore, parents were notified via formal letter of their AIS qualification for services, a change in schedule to accommodate the Achievement Center as a resource, and the inclusion of the Castle program within the Achievement Center. A detailed explanation of the implementation of Castle and an overview of the program were additionally sent with this mailer.

CHAPTER 4
ANALYSIS OF DATA

This chapter provides the findings of the data analysis that investigated the effectiveness of the Castle Learning Online program on high school students' performance. The purpose of this study is to determine the effectiveness of a supplemental web-based program and evaluate program effectiveness, specifically in high schools. This chapter includes a review of the research questions and null hypotheses that have guided this specific research. Each question and hypothesis is addressed on an individual basis, and the results are reported based on the completed data analyses. Relevant conclusions are drawn and supported by both written analyses and accompanying data tables herein.

This chapter contains the research questions, description of data, and data analysis. The participants were 287 high school students in grades 9, 10, and 11 from one high school in the Clarkstown Central School District, located in West Nyack, which implemented the Castle Learning Online program in school years 2014–2015 and 2015–2016. Of the 287 participants, 129 were male and 158 were female (see Table 2). Eighty-four students were in grade 9, 113 in grade 10, and 90 in grade 11 (see Table 3). Of the 287 students, 20 were economically disadvantaged, whereas 267 were not economically disadvantaged (see Table 4). The student subgroups of the 287 participants, as defined by NCLB, were as follows: 39 Asian, 23 African-American, 63 Latino, and 162 White students (see Tables 5 and 6).

Table 2: Gender Data of the Sample

Student Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	129	44.9	44.9	44.9
	Female	158	55.1	55.1	100.0
	Total	287	100.0	100.0	

Table 3: Grade Level Data of the Sample

Student Grade Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	9.00	84	29.3	29.3	29.3
	10.00	113	39.4	39.4	68.6
	11.00	90	31.4	31.4	100.0
	Total	287	100.0	100.0	

Table 4: Economically Disadvantaged Data of the Sample

Economically Disadvantaged

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not ED	267	93.0	93.0	93.0
	ED	20	7.0	7.0	100.0
	Total	287	100.0	100.0	

Table 5: Ethnicity Data of the Sample

Ethnicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Asian	39	13.6	13.6	13.6
	AA	23	8.0	8.0	21.6
	Latino	63	22.0	22.0	43.6
	White	162	56.4	56.4	100.0
	Total	287	100.0	100.0	

Table 6: Ethnicity Histogram of the Sample

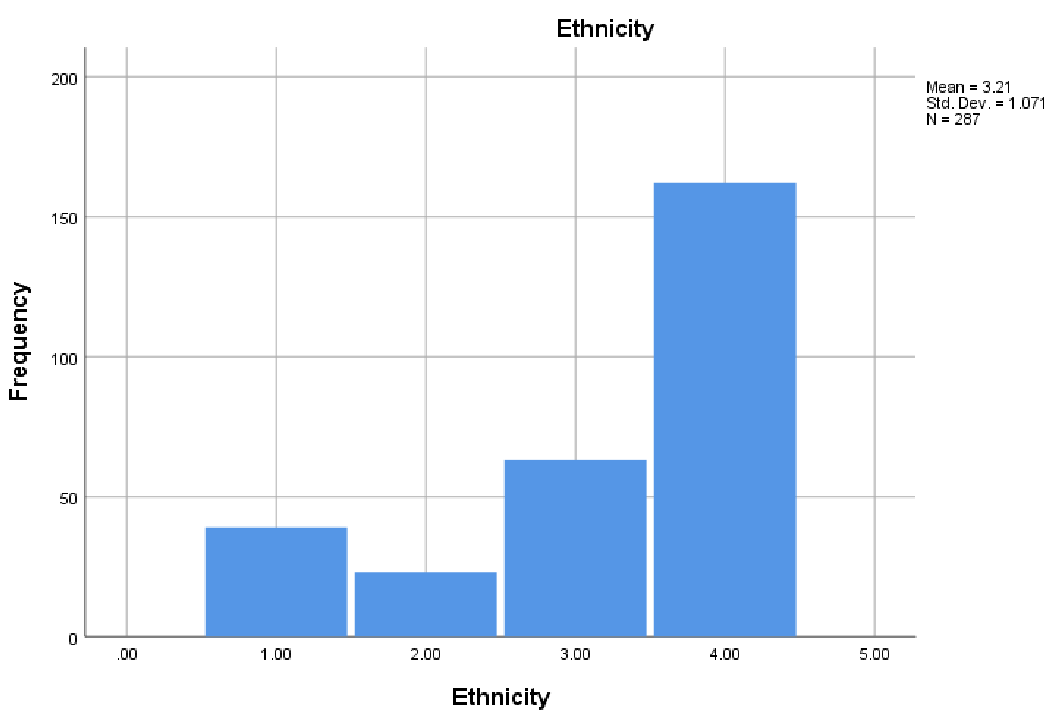

Table 7: Population Descriptive Statistics Data of the Sample

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Attendance	287	1.00	40.00	10.7317	7.11797	1.290	0.144
Eng.14_15	57	54.00	94.00	73.5439	7.12157	0.300	0.316
Eng.15_16	57	52.00	93.00	76.4912	7.66514	-0.776	0.316
Math.14_15	56	53.00	88.00	73.7857	8.02431	-0.385	0.319
Math.15_16	56	51.00	93.00	76.5357	9.34581	-0.420	0.319
Sci.14_15	41	59.00	87.00	72.9024	7.49268	0.215	0.369
Sci.15_16	41	52.00	91.00	77.2439	7.76138	-0.714	0.369
SS.14_15	69	50.00	91.00	71.7391	7.02444	0.211	0.289
SS.15_16	69	46.00	91.00	74.1594	8.57428	-0.298	0.289
RMath.14_15	8	69.00	80.00	74.5000	3.85450	0.090	0.752
RMath.15_16	8	55.00	86.00	75.5000	11.95229	-1.312	0.752
RSS.14_15	30	46.00	82.00	62.8333	8.90596	0.166	0.427
RSS.15_16	30	55.00	97.00	76.8667	10.07466	-0.187	0.427
RSci.14_15	26	54.00	88.00	66.5000	8.12034	1.077	0.456
RSci.15_16	26	24.00	85.00	63.4615	11.54550	-1.436	0.456

Research Questions and Null Hypotheses

Research Questions

Specific individual SPSS analyses were conducted to answer the following research questions:

Research Question 1: To what degree does the Castle Learning Online program contribute to the academic success (NYS Regents exam scores and final course averages in the four core subjects) of high school students?

Research Question 2: What difference, if any, in academic outcomes is evident between male and female participants using the Castle Learning Online program?

Research Question 3: To what extent does participation in the Castle Learning Online program differentially affect the performance of student subgroups as defined by the No Child Left Behind (NCLB) Act, namely Black or African-American, Hispanic or Latino, Asian or Native Hawaiian, and White?

Null Hypotheses

Null Hypothesis 1: No significant difference exists between high school students that use the Castle Learning Online program and those who do not in terms of achievement outcomes (NYS Regents exam scores and final course averages in the four core subjects).

Null Hypothesis 2: No significant difference exists between male and female high school students who use the Castle Learning Online program.

Null Hypothesis 3: No significant difference exists among high school students who use the Castle Learning Online program, regardless of student subgroup as defined by NCLB.

Analysis and Results

Research Question/Null Hypothesis 1

Research Question 1: To what degree does the Castle Learning Online program contribute to the academic success (NYS Regents exam scores and final course averages in the four core subjects) of high school students?

Null Hypothesis 1: No significant difference exists between high school students who use the Castle Learning Online program and those who do not in terms of achievement outcomes (NYS Regents exam scores and final course averages in the four core subjects).

To answer the first research question and the accompanying null hypothesis, seven different related samples t-tests were run to ascertain whether the Castle Learning Online program had a statistically significant effect on the final course average or the Regents scores of students within the sample. The results were determined as follows:

Null Hypothesis 1: English Final Course Average Results

A paired samples t-test was conducted to verify the effectiveness of the Castle Learning Online program relative to students' English final course averages. A significant interaction ($t(56) = -3.264$, $p = 0.002$) was found between the English final course averages of students after the implementation of the Castle Learning Online program in school year 2015–2016 ($n = 57$) (see Table 8). The effect size ($r = 0.43$) indicated that the program had a moderate effect on the students' English final course average scores, which increased, on average, 2.9 points from school years 2014–2015 to 2015–2016.

Table 8: Results of English Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Eng.14_15 - Eng.15_16	-2.94737	6.81757	0.90301	-4.75631	-1.13842	-3.264	56	0.002

Null Hypothesis 1: Math Final Course Average Results

A paired samples t-test was performed to confirm the effectiveness of the Castle Learning Online program relative to students' Math final course averages. A significant interaction ($t\ (55) = -2.346$, $p = 0.023$) was found between the Math final course averages of students after the implementation of the Castle Learning Online program in school year 2015–2016 ($n = 56$) (see Table 9). The effect size ($r = 0.31$) implied that the program had a small effect on students' Math final course average scores, which increased, on average, 2.75 points from school years 2014–2015 to 2015–2016.

Table 9: Results of Math Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Math.14_15 - Math.15_16	-2.75000	8.77030	1.17198	-5.09870	-0.40130	-2.346	55	0.023

Null Hypothesis 1: Science Final Course Average Results

A paired samples t-test was conducted to determine the effectiveness of the Castle Learning Online program relative to students' Science final course averages. A significant interaction ($t\ (40) = -3.478$, $p = 0.001$) was found between the Science final course averages of students after the implementation of the Castle Learning Online program in school year 2015–2016 ($n = 41$) (see Table 10). The effect size ($r = 0.54$) denoted that the program had a moderate effect on students' Science final course average scores, which increased, on average, 4.3 points from school years 2014–2015 to 2015–2016.

Table 10: Results of Science Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pair 1	Sci.14_15 - Sci.15_16	-4.34146	7.99253	1.24822	-6.86422	-1.81871	-3.478	40	0.001

Null Hypothesis 1: Social Studies Final Course Average Results

A paired samples t-test was performed to establish the effectiveness of the Castle Learning Online program relative to students' Social Studies final course averages. A significant interaction ($t(68) = -2.584$, $p = 0.012$) was found between the Social Studies final course averages of students after the implementation of the Castle Learning Online program in school year 2015–2016 ($n = 69$) (see Table 11). The effect size ($r = 0.31$) indicated that the program had a small effect on students' Social Studies final course average scores, which increased, on average, 1.0 points from school years 2014–2015 to 2015–2016.

Table 11: Results of Social Studies Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	SS.14_15 - SS.15_16	-2.42029	7.77894	0.93647	-4.28900	-0.55158	-2.584	68	0.012

Null Hypothesis 1: Social Studies Regents Exam Score Results

A paired samples t-test was conducted to confirm the effectiveness of the Castle Learning Online program relative to students' Social Studies Regents exam scores. A significant interaction (t (29) = -2.584, p = 0.000) was found between the Social Studies Regents scores of students after the implementation of the Castle Learning Online program in school year 2015–2016 (n = 30) (see Table 12). The effect size (r = 2.31) denoted that the program had an effect size larger than two standard deviations on students' Social Studies Regents exam scores, which increased, on average, 14.03 points from school years 2014–2015 to 2015–2016.

Table 12: Results of Social Studies Regents Exam Scores, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	RSS.14_15 - RSS.15_16	-14.03333	6.06564	1.10743	-16.29828	-11.76839	-12.672	29	0.000

Null Hypothesis 1: Math Regents Exam Score Results

A paired samples t-test was performed to determine the effectiveness of the Castle Learning Online program relative to students' Math Regents exam scores. No significant interaction ($t(7) = -0.273$, $p = 0.793$) was found between the Math Regents scores of students after the implementation of the Castle Learning Online program in school year 2015–2016 ($n = 8$) (see Table 13).

Table 13: Results of Math Regents Exam Scores, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pair 1	RMath.14_15 - RMath.15_16	-1.00000	10.36478	3.66450	-9.66517	7.66517	-0.273	7	0.793

Null Hypothesis 1: Science Regents Exam Score Results

A paired samples t-test was conducted to establish the effectiveness of the Castle Learning Online program relative to students' Science Regents exam scores. No significant interaction ($t(25) = 1.07$, $p = 0.293$) was found between the Science Regents scores of students after the implementation of the Castle Learning Online program in school year 2015–2016 ($n = 26$) (see Table 14).

Table 14: Results of Science Regents Exam Scores, 2014–2015 to 2015–2016

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pair 1 RSci.14_15 - RSci.15_16	3.03846	14.41799	2.82760	-2.78509	8.86201	1.075	25	0.293

Research Question/Null Hypothesis 2

Research Question 2: What difference, if any, in academic outcomes is evident between male and female participants using the Castle Learning Online program?

Null Hypothesis 2: No significant difference exists between male and female high school students who use the Castle Learning Online program.

To answer the second research question and the accompanying null hypothesis, seven different independent samples t-tests were conducted to determine whether the Castle Learning Online program had a statistically significant difference between male and female students on either final course averages or Regents exam scores of students within the sample. Additionally, to obtain a greater level of knowledge and analysis, seven paired samples t-tests for each student gender were performed to confirm any statistical significance among students of the same gender in any of the categories analyzed. The results were reported as follows:

Null Hypothesis 2: Regents Social Studies in School Year 2014–2015

An independent samples t-test was run to compare male and female students on Social Studies Regents exam scores in school year 2014–2015. A statistically significant difference was found between male (μ = 70.250, SD = 6.690) and female (μ = 57.890, SD = 6.452) students; (t (28) = 5.066, p = 0.000). These results suggested a statistically significant difference between male and female students on Social Studies Regents exam scores in school year 2014–2015 (see Table 15).

Table 15: Results of Social Studies Regents Exam Scores of Male, Female in 2014–2015

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
RSS.14_15	Equal variances assumed	0.220	0.643	5.066	28	0.000	12.36111	2.43978	7.36345	17.35877
	Equal variances not assumed			5.029	23.122	0.000	12.36111	2.45808	7.27766	17.44456

Null Hypothesis 2: Regents Social Studies in School Year 2015–2016

An independent samples t-test was conducted to compare male and female students on Social Studies Regents exam scores in school year 2015–2016. A statistically significant difference was found between male (μ = 82.583, SD = 9.01) and female (μ = 73.056, SD = 9.065) students; (t (28) = 2.827, p = 0.009). These results implied a statistically significant difference between male and female students on Social Studies Regents exam scores in school year 2015–2016 (see Table 16).

Table 16: Results of Social Studies Regents Exam Scores of Male, Female in 2015–2016

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
RSS.15_16	Equal variances assumed	0.021	0.886	2.827	28	0.009	9.52778	3.37023	2.62418	16.43138
	Equal variances not assumed			2.831	23.833	0.009	9.52778	3.36596	2.57820	16.47735

FEMALE RESULTS

Null Hypothesis 2: Female Students' English Final Course Average Results

A paired samples t-test was performed to establish the effectiveness of the Castle Learning Online program relative to female students' English final course average scores. A significant interaction ($t(26) = -2.742$, $p = 0.011$) was found between the English final course averages of female students from school years 2014–2015 to 2015–2016 ($n = 27$) (see Table 17). The effect size ($r = 0.53$) indicated that the program had a moderate effect size on female students' English final course averages, which increased, on average, 4.17 points from school years 2014–2015 to 2015–2016.

Table 17: Results of Female English Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Eng.14_15 - Eng.15_16	-4.07407	7.72073	1.48586	-7.12829	-1.01985	-2.742	26	0.011

Null Hypothesis 2: Female Students' Science Final Course Average Results

A paired samples t-test was conducted to ascertain the effectiveness of the Castle Learning Online program relative to female students' Science final course average scores. A significant interaction ($t(22) = -4.490$, $p = 0.000$) was found between the Science final course averages of female students from school years 2014–2015 to 2015–2016 ($n = 23$) (see Table 18). The effect size ($r = 0.94$) denoted that the program had a very large effect size on female students' Science final course averages, which increased, on average, 7.4 points from school years 2014–2015 to 2015–2016.

Table 18: Results of Female Science Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Sci.14_15 - Sci.15_16	-7.39130	7.89556	1.64634	-10.80560	-3.97701	-4.490	22	0.000

Null Hypothesis 2: Female Students' Social Studies Regents Exam Score Results

A paired samples t-test was run to verify the effectiveness of the Castle Learning Online program relative to female students' Social Studies Regents exam scores. A significant interaction (t (17) = -10.634, p = 0.000) was found between the Social Studies Regents exam scores of female students from school years 2014–2015 to 2015–2016 (n = 18) (see Table 19). The effect size (r = 2.50) indicated that the program had an effect size larger than two standard deviations on students' Social Studies Regents exam scores, which increased, on average, 15.2 points from school years 2014–2015 to 2015–2016.

Table 19: Results of Female Social Studies Regents Exam Scores, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	RSS.14_15 - RSS.15_16	-15.16667	6.05125	1.42629	-18.17588	-12.15745	-10.634	17	0.000

Null Hypothesis 2: Female Students' Math Final Course Average Results

A paired samples t-test was conducted to determine the effectiveness of the Castle Learning Online program relative to female students' Math final course average scores. No significant interaction (t (25) = -1.679, p = 0.106) was found between the Math final course averages of female students after the implementation of the Castle Learning Online program in school year 2015–2016 (n = 26) (see Table 20).

Table 20: Results of Female Math Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Math.14_15 - Math.15_16	-3.11538	9.45865	1.85499	-6.93582	0.70505	-1.679	25	0.106

Null Hypothesis 2: Female Students' Social Studies Final Course Average Results

A paired samples t-test was performed to confirm the effectiveness of the Castle Learning Online program relative to female students' Social Studies final course average scores. No significant interaction ($t(37) = -1.657$, $p = 0.106$) was found between the Social Studies final course averages of female students after the implementation of the Castle Learning Online program in school year 2015–2016 ($n = 38$) (see Table 21).

Table 21: Results of Female Social Studies Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	SS.14_15 - SS.15_16	-1.81579	6.75380	1.09561	-4.03571	.40413	-1.657	37	.106

Null Hypothesis 2: Female Math Regents Exam Score Results.

A paired samples t-test was conducted to establish the effectiveness of the Castle Learning Online program relative to female students' Math Regents exam scores. No significant interaction (t (4) = 0.322, p = 0.764) was found between the Math Regents exam scores of female students after the implementation of the Castle Learning Online program in school year 2015–2016 (n = 5) (see Table 22).

Table 22: Results of Female Math Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	RMath.14_15 - RMath.15_16	1.80000	12.51799	5.59821	-13.74313	17.34313	0.322	4	0.764

Null Hypothesis 2: Female Science Regents Exam Score Results

A paired samples t-test was run to determine the effectiveness of the Castle Learning Online program relative to female students' Science Regents exam scores. No significant interaction (t (20) = 0.066, p = 0.948) was found between the Science Regents exam scores of female students after the implementation of the Castle Learning Online program in school year 2015–2016 (n = 21) (see Table 23).

Table 23: Results of Female Science Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	RSci.14_15 - RSci.15_16	.14286	9.90599	2.16166	-4.36629	4.65201	.066	20	0.948

MALE RESULTS

Null Hypothesis 2: Male Students' Social Studies Regents Exam Score Results

A paired samples t-test was performed to confirm the effectiveness of the Castle Learning Online program relative to male students' Social Studies Regents exam scores. A significant interaction (t (11) = -7.206, p = 0.000) was found between the Social Studies Regents Exam scores of male students from school years 2014–2015 to 2015–2016 (n = 12) (see Table 24). The effect size (r = 2.08) indicated that the program had an effect size larger than two standard deviations on students' Social Studies Regents exam scores, which increased, on average, 12.3 points from school years 2014–2015 to 2015–2016.

Table 24: Results of Male Social Studies Regents Exam Scores, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	RSS.14_15 - RSS.15_16	-12.33333	5.92887	1.71152	-16.10036	-8.56631	-7.206	11	0.000

Null Hypothesis 2: Male Students' English Final Course Average Results

A paired samples t-test was conducted to ascertain the effectiveness of the Castle Learning Online program relative to male students' English final course average scores. No significant interaction ($t (29) = -1.814$, $p = 0.080$) was found between the English final course averages of male students after the implementation of the Castle Learning Online program in school year 2015–2016 ($n = 30$) (see Table 25).

Table 25: Results of Male English Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Eng.14_15 - Eng.15_16	-1.93333	5.83647	1.06559	-4.11271	.24604	-1.814	29	0.080

Null Hypothesis 2: Male Students' Math Final Course Average Results

A paired samples t-test was run to determine the effectiveness of the Castle Learning Online program relative to male students' Math final course average scores. No significant interaction ($t (29) = -1.610$, $p = 0.118$) was found between the Math final course averages of male students after the implementation of the Castle Learning Online program in school year 2015–2016 ($n = 30$) (see Table 26).

Table 26: Results of Male Math Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Math.14_15 - Math.15_16	-2.43333	8.27828	1.51140	-5.52449	.65783	-1.610	29	0.118

Null Hypothesis 2: Male Students' Science Final Course Average Results

A paired samples t-test was conducted to verify the effectiveness of the Castle Learning Online program relative to male students' Science final course average scores. No significant interaction (t (17) = -0.295, p = 0.772) was found between the Science final course averages of male students after the implementation of the Castle Learning Online program in school year 2015–2016 (n = 18) (see Table 27).

Table 27: Results of Male Science Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Sci.14_15 - Sci.15_16	-0.44444	6.40057	1.50863	-3.62737	2.73849	-0.295	17	0.772

Null Hypothesis 2: Male Students' Social Studies Final Course Average Results

A paired samples t-test was run to determine the effectiveness of the Castle Learning Online program relative to male students' Social Studies final course average scores. No significant interaction (t (30) = -1.969, p = 0.058) was found between the Social Studies final course averages of male students after the implementation of the Castle Learning Online program in school year 2015–2016 (n = 31) (see Table 28).

Table 28: Results of Male Social Studies Final Course Averages, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	SS.14_15 - SS.15_16	-3.16129	8.93718	1.60516	-6.43947	0.11689	-1.969	30	0.058

Null Hypothesis 2: Male Math Regents Exam Score Results

A paired samples t-test was performed to establish the effectiveness of the Castle Learning Online program relative to male students' Math Regents exam scores. No significant interaction (t (2) = -3.053, p = 0.093) was found between the Math Regents exam scores of male students after the implementation of the Castle Learning Online program in school year 2015–2016 (n = 3) (see Table 29).

Table 29: Results of Male Math Regents Exam Scores, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	RMath.14_15 - RMath.15_16	-5.66667	3.21455	1.85592	-13.65205	2.31872	-3.053	2	0.093

Null Hypothesis 2: Male Science Regents Exam Score Results

A paired samples t-test was conducted to determine the effectiveness of the Castle Learning Online program relative to male student's Science Regents exam scores. No significant interaction ($t(4) = 1.412$, $p = 0.231$) was found between the Science Regents exam scores of male students after the implementation of the Castle Learning Online program in school year 2015–2016 ($n = 5$) (see Table 30).

Table 30: Results of Male Science Regents Exam Scores, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pair 1	RSci.14_15 - RSci.15_16	15.20000	24.07696	10.76754	-14.69549	45.09549	1.412	4	0.231

Research Question/Null Hypothesis 3

Research Question 2: What difference, if any, in academic outcomes is evident between male and female participants using the Castle Learning Online program?

Null Hypothesis 3: No significant difference exists among high school students who use the Castle Learning Online program, regardless of student subgroup as defined by NCLB.

To answer the third research question and the accompanying null hypothesis, a one-way analysis of variance (ANOVA) test was run to determine whether the Castle Learning Online program had any statistically significant difference in performance between students of the various subgroups defined by NCLB on either final course averages or Regents exam scores of students within the sample. Additionally, to obtain a greater level of knowledge and analysis, seven paired samples t-tests for each student subgroup were performed to confirm any statistical significance among students of the same gender in any of the categories analyzed. The statistical levels of significance of the student subgroups are detailed below.

This one-way ANOVA assessed the effect of the Castle Learning Online program on the 2015–2016 performance on the English final course average of students in the various subgroups as defined by NCLB. Fifty-seven students participated in the study, of whom 10 are Asian, 5 are African-American, 11 are Latino, and 31 are White. The average 2015–2016 English final course average score for Asian students was 76.0 with a standard deviation of 6.70; for African-American students, 71.4 with a standard deviation of 11.50; for Latino students, 71.45 with a standard deviation of 7.57; and for White students, 79.26 with a standard deviation of 6.15.

In explaining the significant effect of student subgroup, a multiple comparison analysis was conducted. The findings from the multiple comparison table indicate the following:

1) The mean difference of -7.804 between the Latino and White students was found to be statistically significant ($p = 0.014$). The 2015–2016 English final course average score mean for White students was significantly higher than the average English final course average for Latino students.
2) No statistical difference was found between the 2015–2016 English final course average scores between Asian and African-American students.

On average, the White students outperformed the students of the Asian, African-American, and Latino subgroups.

Table 31: ANOVA Results for English Final Course Averages, 2015–2016

ANOVA

Eng.15_16

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	648.383	3	216.128	4.336	0.008
Within Groups	2641.863	53	49.846		
Total	3290.246	56			

Table 32: Multiple Comparisons of English Final Course Averages, 2015–2016

Multiple Comparisons

Dependent Variable: Eng.15_16

Tukey HSD

(I) Ethnicity	(J) Ethnicity	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Asian	AA	4.60000	3.86703	0.636	-5.6571	14.8571
	Latino	4.54545	3.08482	0.460	-3.6369	12.7278
	White	-3.25806	2.56761	0.586	-10.0685	3.5524
AA	Asian	-4.60000	3.86703	0.636	-14.8571	5.6571
	Latino	-0.05455	3.80799	1.000	-10.1551	10.0460
	White	-7.85806	3.40253	0.109	-16.8831	1.1670
Latino	Asian	-4.54545	3.08482	0.460	-12.7278	3.6369
	AA	0.05455	3.80799	1.000	-10.0460	10.1551
	White	-7.80352*	2.47779	0.014	-14.3758	-1.2313
White	Asian	3.25806	2.56761	0.586	-3.5524	10.0685
	AA	7.85806	3.40253	0.109	-1.1670	16.8831
	Latino	7.80352*	2.47779	0.014	1.2313	14.3758

* The mean difference is significant at the 0.05 level.

Null Hypothesis 3: Asian Students Social Studies Final Course Average Results

A paired samples t-test was performed to establish the effectiveness of the Castle Learning Online program relative to Asian students' Social Studies final course average scores. A significant interaction (t (8) = -2.684, p = 0.028) was found between the Social Studies final course averages of Asian students from school years 2014–2015 to 2015–2016 (n = 9) (see Table 33). The effect size (r = 0.89) denoted that the program had a large effect size on Asian students' Social Studies final course averages, which increased, on average, 4.1 points from school years 2014–2015 to 2015–2016.

Table 33: Results of Social Studies Final Course Averages of Asian Students, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	SS.14_15 - SS.15_16	-4.11111	4.59468	1.53156	-7.64290	-0.57933	-2.684	8	0.028

Null Hypothesis 3: Asian Students' Social Studies Regents Exam Results

A paired samples t-test was run to ascertain the effectiveness of the Castle Learning Online program relative to Asian students' Social Studies Regents exam scores. A significant interaction (t (5) = -6.306, p = 0.001) was found between the Social Studies Regents exam scores of Asian students from school years 2014–2015 to 2015–2016 (n = 6) (see Table 34). The effect size (r = 2.57) implied that the program had a very large effect size on Asian students' Social Studies

Regents exam scores, larger than two standard deviations, which increased, on average, 13.5 points from school years 2014–2015 to 2015–2016.

Table 34: Results of Social Studies Regents Exam Scores of Asian Students, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	RSS.14_15 - RSS.15_16	-13.50000	5.24404	2.14087	-19.00329	-7.99671	-6.306	5	0.001

Null Hypothesis 3: African-American Students Social Studies Regents Exam Results

A paired samples t-test was conducted to confirm the effectiveness of the Castle Learning Online program relative to African-American students' Social Studies Regents exam scores. A significant interaction ($t(2) = -16.000$, $p = 0.004$) was found between the Social Studies Regents exam scores of African-American students from school years 2014–2015 to 2015-2016 ($n = 3$) (see Table 35). The effect size ($r = 9.24$) indicated that the program had a very large effect size on African-American students' Social Studies Regents exam scores, larger than nine standard deviations, which increased, on average, 10.7 points from school years 2014–2015 to 2015–2016.

Table 35: Results of Social Studies Regents Exam Scores of African-American Students, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	RSS.14_15 - RSS.15_16	-10.66667	1.15470	0.66667	-13.53510	-7.79823	-16.000	2	0.004

Null Hypothesis 3: Latino Students' Math Final Course Average Results

A paired samples t-test was performed to determine the effectiveness of the Castle Learning Online program relative to Latino students' Math final course average scores. A significant interaction ($t\ (10) = -2.583$, $p = 0.027$) was found between the Math final course averages of Latino students from school years 2014–2015 to 2015–2016 ($n = 11$) (see Table 36). The effect size ($r = 0.78$) suggested that the program had a large effect size on Latino students' Math final course averages, which increased, on average, 6.4 points from school years 2014–2015 to 2015–2016.

Table 36: Results of Math Final Course Averages of Latino Students, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Math.14_15 - Math.15_16	-6.45455	8.28690	2.49859	-12.02176	-0.88733	-2.583	10	0.027

Null Hypothesis 3: Latino Students' Social Studies Final Course Average Results

A paired samples t-test was conducted to establish the effectiveness of the Castle Learning Online program relative to Latino students' Social Studies final course average scores. A significant interaction ($t(15) = -2.687$, $p = 0.017$) was found between the Social Studies final course averages of Latino students from school years 2014–2015 to 2015–2016 ($n = 16$) (see Table 37). The effect size ($r = 0.67$) implied that the program had a moderate to large effect size on Latino students' Social Studies final course averages, which increased, on average, 4.6 points from school years 2014–2015 to 2015–2016.

Table 37: Results of Social Studies Final Course Averages of Latino Students, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	SS.14_15 - SS.15_16	-4.56250	6.79185	1.69796	-8.18162	-0.94338	-2.687	15	0.017

Null Hypothesis 3: Latino Students' Social Studies Regents Exam Score Results

A paired samples t-test was performed to confirm the effectiveness of the Castle Learning Online program relative to Latino students' Social Studies Regents exam scores. A significant interaction ($t\ (7) = -6.859$, $p = 0.000$) was found between the Social Studies Regents exam scores of Latino students from school years 2014–2015 to 2015–2016 ($n = 8$) (see Table 38). The effect size ($r = 2.42$) indicated that the program had a very large effect size on Latino students' Social Studies Regents exam scores, larger than two standard deviations, which increased, on average, 15.5 points from school years 2014–2015 to 2015–2016.

Table 38: Results of Social Studies Regents Exam Scores of Latino Students, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pair 1	RSS.14_15 - RSS.15_16	-15.50000	6.39196	2.25990	-20.84381	-10.15619	-6.859	7	0.000

Null Hypothesis 3: White Students' English Final Course Averages Results

A paired samples t-test was conducted to determine the effectiveness of the Castle Learning Online program relative to White students' English final course average scores. A significant interaction ($t\ (30) = -4.278$, $p = 0.000$) was found between the English final course averages of White students from school years 2014–2015 to 2015–2016 ($n = 31$) (see Table 39). The effect size ($r = 0.77$) denoted that the program had a large effect size on White students' English final course averages, which increased, on average, 3.6 points from school years 2014–2015 to 2015–2016.

Table 39: Results of English Final Course Averages of White Students, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Eng.14_15 - Eng.15_16	-3.58065	4.66029	0.83701	-5.29005	-1.87124	-4.278	30	0.000

Null Hypothesis 3: White Students' Math Final Course Averages Results

A paired samples t-test was run to confirm the effectiveness of the Castle Learning Online program relative to White students' Math final course average scores. A significant interaction ($t(32) = -2.442$, $p = 0.020$) was found between the Math final course averages of White students from school years 2014–2015 to 2015–2016 ($n = 33$) (see Table 40). The effect size ($r = 0.42$) suggested that the program had a moderate effect size on White students' Math final course averages, which increased, on average, 3.3 points from school years 2014–2015 to 2015–2016.

Table 40: Results of Math Final Course Averages of White Students, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Math.14_15 - Math.15_16	-3.39394	7.98412	1.38986	-6.22499	-0.56289	-2.442	32	0.020

Null Hypothesis 3: White Students' Science Final Course Averages Results

A paired samples t-test was performed to verify the effectiveness of the Castle Learning Online program relative to White students' Science final course average scores. A significant interaction (t (25) = -3.219, p = 0.004) was found between the Science final course averages of White students from school years 2014–2015 to 2015–2016 (n=26) (see Table 41). The effect size (r = 0.47) implied that the program had a moderate effect size on White students' Science final course averages, which increased, on average, 4.3 points from school years 2014–2015 to 2015–2016.

Table 41: Results of Science Final Course Averages of White Students, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Sci.14_15 - Sci.15_16	-4.23077	6.70109	1.31419	-6.93740	-1.52414	-3.219	25	0.004

Null Hypothesis 3: White Students' Social Students Regents Exam Score Results

A paired samples t-test was conducted to establish the effectiveness of the Castle Learning Online program relative to White students' Social Studies Regents exam scores. A significant interaction ($t(12) = -7.292$, $p = 0.000$) was found between the Social Studies Regents exam scores of White students from school years 2014–2015 to 2015–2016 ($n = 13$) (see Table 42). The effect size ($r = 2.02$) indicated that the program had a very large effect on White students' Social Studies Regents exam scores, greater than two standard deviations, which increased, on average, 14.2 points from school years 2014–2015 to 2015–2016.

Table 42: Results of Social Studies Regents Exam Scores of White Students, 2014–2015 to 2015–2016

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	RSS.14_15 - RSS.15_16	-14.15385	6.99817	1.94094	-18.38280	-9.92490	-7.292	12	0.000

Summary

Three research questions were addressed in this study to investigate the effectiveness of a supplemental web-based program and evaluate program effectiveness, specifically in high schools. Student performance on two measures – final course averages in the four core subjects and Regents exam scores in the four core subjects – were used as a proxy for academic achievement and therefore as a means of measuring effectiveness given prior achievement compared with achievement after the administration of the Castle Learning Online program for one school year. The following three hypotheses were tested and were either retained or rejected:

Null Hypothesis 1: No significant difference exists between high school students who use the Castle Learning Online program and those who do not in terms of achievement outcomes (NYS Regents exam scores and final course averages in the four core subjects). This null hypothesis is rejected.

Null Hypothesis 2: No significant difference exists between male and female high school students who use the Castle Learning Online program. This null hypothesis is rejected.

Null Hypothesis 3: No significant difference exists among high school students who use the Castle Learning Online program, regardless of student subgroup as defined by NCLB. This null hypothesis is rejected.

The first research question sough to assess the overall effectiveness of the Castle Learning Online program as it is related to achievement in either the final course averages or Regents exam scores of high school students in the four core subjects of English, Math, Social Studies, and Science. The effectiveness of the Castle Learning Online program was found to be statistically significant on both the NYS Regents Social Studies exam performance and performance on the final course averages of all of the four core subjects. This significance indicated that students participating in the Castle Learning Online program tended to increase their performance in these five areas. Therefore, Null Hypothesis 1 was rejected.

The second research question sought to verify any difference between the two gender subgroups of students using the Castle Learning Online program. The difference in male and female performance was found to be statistically significant only on a single measure, that is, the Social Studies Regents exam. In both school years 2014–2015 and 2015–2016, a statistical significance emerged between males and females. This significance indicated the statistically significant difference of males taking the Social Studies Regents exam when compared with females. However, neither a statistical significance was found between males and females in the other two Regents exams within this study (Math, Science), nor a significance was identified in students' final course averages in any subject (English, Math, Social Studies, or Science).

The effect of the Castle Learning Online program as it relates to the individual performance of males and females was further evaluated. The analysis was completed to determine whether male and female students, separately, had a statistically significant change in performance after completing one year of the Castle Learning Online program. A statistical significance was found in the performance of female students in the following areas: English final course average, Social Studies final course average, and Social Studies Regents exam scores. However, a statistical significance was found in the performance of male students only in the Social Studies Regents exam scores. This significance suggested that female students participating in the Castle Learning Online program tended to increase their performance in these three areas, and males in this sole area. Therefore, Null Hypothesis 2 was rejected.

The third research question sought to establish any difference within the four ethnic subgroups defined by NCLB, namely Asian, African-American, Latino, and White students using the Castle Learning Online program. The difference in performance was found to be statistically significant on only a single measure, that is, the 2015–2016 English final course averages among Latino and White students. All the other comparisons within the one-way analysis of variance (ANOVA) did not contain statistical significance. This significance implied a statistically significant difference among White students' English final course averages when compared with Latino students. In this comparison, White students scored higher, on average, than Latino students in this area. Neither other statistical significances were found in any other ANOVAs conducted in either final course averages (Math, Social Studies Science), nor a significance was identified in any of the Regents exam scores analyzed (English, Math, Social Studies, or Science).

The effect of the Castle Learning Online program as it relates to the individual performance of each subgroup was further evaluated. The analysis was completed to confirm whether Asian, African-American, Latino, and White students, separately, had a statistically significant change in performance after completing one year of the Castle Learning Online program. A statistical significance was found in the performance of Asian students in the following areas: Social Studies final course average and Social Studies Regents exam scores. A statistical significance was found in the performance of African-American students only in Social Studies Regents exam scores. A statistical significance was found in the performance of Latino students in the following areas: Math final course average, Social Studies final course average, and Social Studies Regents exam scores. Statistical significance was found in the performance of White students in the following areas: English, Math, Social Studies, and Science final course average. These significances indicated that each ethnic subgroup of students who participated in the Castle Learning Online program tended to increase their performance in these aforementioned areas of final course average and Regents exam score. Therefore, Null Hypothesis 3 was rejected.

Chapter 5 presents a more in-depth discussion of the findings.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Personalized learning has become one of the major components of successful instruction and student learning in the 21st century. Research suggests that whether through supplemental programming or differentiated instruction, students achieve at a higher level when instruction is best fit to their specific learning style and cognitive ability level. Personalized learning content is one of the most critical features of educational systems (Tseng et al., 2008).

Technology is one method through which school systems seek to obtain this personalized approach, specific to struggling learners. Supplemental, web-based programs and software particularly provide a user experience that can be catered to the learners' needs and ability levels to maximize their learning in a target skill, content area, or curriculum. With a plethora of programs and software at a school district's purchasing disposal, research becomes increasingly important in determining whether these programs have a statistically significant effect on the performance of students they intend to support. As an increasing number of school districts dedicate time and funding to implement such programs in their daily practice and yearly budgets, further research is necessary to measure the effect on the academic achievement of students using the program. School districts across the nation would certainly benefit from research that provides insight into the connection and correlation between this type of program usage and student achievement.

The findings of this study suggest that the use of the Castle Learning Online program provides a statistically significant effect on student achievement in various areas. The students' final course averages in every content area demonstrated improvement, as did their performance scores on the Social Studies Regents exam. Additionally, when breaking down the research data by gender and student subgroup, the program exhibited an additional significant effect on various areas, which were highlighted in detail in chapter 4 and within this chapter under Research Questions and Answers.

Purpose

The purpose of this quantitative, correlational/explanatory design was to explore any effect of a supplemental web-based program on student achievement. This dissertation and subsequent research explored the overall effectiveness of this supplemental program and its capacity to either positively or negatively affect student achievement. The data were broken down to include the effect of students using supplemental web-based instruction, the differences among male and female students using supplemental, web-based instruction, and the effect on the performance of minority and non-minority students using supplemental, web-based instruction. The results can be used by educators, school administrators, and policy makers to guide decisions about future initiatives related to supplemental, web-based instruction, specifically the use of the Castle Learning Online program.

This study was conducted to determine whether the newly implemented Castle Learning Online program had a statistically significant effect on student achievement. In the era of supplemental programs used as remediation for Academic Intervention Services, this study sought to obtain information on the effect of this program after implementation. The study analyzed student achievement data within two school years: 2014–2015 and 2015–2016. The program was implemented in 2015–2016, and the results of the 2015–2016 student data therefore reflected the growth of students who used the program for a full year as a supplemental tool of typical instruction.

Organization of the Chapter

The three research questions are reiterated and answered in this chapter. The results are also discussed relative to the previously stated related research on this topic. From the findings of this study, conclusions are drawn and recommendations for current policy and practice are suggested. Finally, recommendations for future research on this topic are provided.

Research Questions and Answers

Research Question 1: To what degree does the Castle Learning Online program contribute to the academic success (NYS Regents exam scores and final course averages in the four core subjects) of high school students?

Null Hypothesis 1: No significant difference exists between high school students who use the Castle Learning Online program and those who do not in terms of achievement outcomes (NYS Regents exam scores and final course averages in the four core subjects).

Answer: Null Hypothesis 1 was rejected as evidenced by the results of the data analysis reported in chapter 4. The statistically significant effect of the Castle Learning Online program was found in the following areas of student performance: Regents Social Studies exam scores, English final course averages, Math final course averages, Science final course averages, and Social studies final course averages. Paired samples t-tests were run to determine the significance within these areas.

The areas in which the Castle Learning Online program lacked a statistical significance in student performance were also identified and reported in the analysis in chapter 4. These areas of student performance were Regents Math exam scores and Regents Science exam scores. According to this analysis, the use of the Castle Learning Online program for the purpose of supplemental instruction lacked a statistically significant effect on student academic performance in the aforementioned areas.

Research Question 2: What difference, if any, in academic outcomes is evident between male and female participants using the Castle Learning Online program?

Null Hypothesis 2: No significant difference exists between male and female high school students who use the Castle Learning Online program.

Answer: Null Hypothesis 2 was rejected as corroborated by the results of the data analysis reported in chapter 4. A statistically significant effect was found between male and female students using the Castle Learning Online program in one of the areas of student performance, that is, Regents Social Studies exam scores. Independent samples t-tests were performed to establish the significance in these areas.

The areas in which the Castle Learning Online program lacked a statistical significance in male and female student performance were also identified and reported in the analysis in chapter 4. These areas of student performance were English final course average, Math final course average, Science final course average, Science final course average, Math Regents exam scores, and Science Regents exam scores. According to this analysis, the usage of the Castle Learning Online program for the purpose of supplemental instruction had a statistically significant effect between male and female students on student academic performance, but only in the area of Social Studies Regents exam scores.

Additionally, paired samples t-tests were conducted to ascertain any level of significance among male and female students after the implementation of the Castle Learning Online program for one year.

As reported in chapter 4, a level of significance was identified for female students in English final course average, Social Studies final course average, and Social Studies Regents exam scores. This result suggested that the use of the Castle Learning Online program among female students had a significant effect on their performance after one year of the Castle Learning program in these areas.

Meanwhile, a level of significance was identified for male students, but only in their Social Studies Regents exam scores. This result implied that the use of the Castle Learning Online program among male students had a significant effect on their performance after one year of the Castle Learning program in this area.

Research Question 3: To what extent does participation in the Castle Learning Online program differentially affect the performance of student subgroups as defined by the No Child Left Behind (NCLB) Act, namely Black or African-American, Hispanic or Latino, Asian or Native Hawaiian, and White?

Null Hypothesis 3: No significant difference exists among high school students who use the Castle Learning Online program, regardless of student subgroup as defined by NCLB.

Answer: Null Hypothesis 3 was rejected as substantiated by the results of the data analysis reported in chapter 4. A statistically significant effect was found among the four subgroups of students who used the Castle Learning Online program in one major area, that is, English final course average. A one-way ANOVA was conducted to confirm the significance in these subgroups and content areas.

The areas in which the student subgroup variable lacked a statistical significance in student performance were also identified and reported in the analysis in chapter 4. These areas of student performance were English final course average, Math final course average, Science final course average, Science final course average, Math Regents exam scores, and Science Regents exam scores. According to this analysis, the use of the Castle Learning Online program for the purpose of supplemental instruction had a statistically significant effect between Latino and White students on student academic performance, but only in the area of English final course average scores.

Additionally, paired samples t-tests were run to determine any level of significance among the four student subgroups of students after the implementation of the Castle Learning Online program for one year on both final course averages and Regents exam scores in the four core subject areas.

A level of significance was identified for Asian students in Social Studies final course average and Social Studies Regents exam scores, as reported in chapter 4. This result suggested that the use of the Castle Learning Online program among Asian students had a significant effect on their performance after one year of the Castle Learning program in their performance within these areas.

Additionally, a level of significance was identified for African-American students only in Social Studies Regents exam scores, as reported in chapter 4. This result denoted that the use of the Castle Learning Online program among African-American students had a significant effect on their performance after one year of the Castle Learning Program in their performance within this area.

A level of significance was identified for Latino students in Math final course average, Social Studies final course average, and Social Studies Regents exam scores, as reported in chapter 4. This result implied that the use of the Castle Learning Online program among Latino students had a significant effect on their performance after one year of the Castle Learning Program in their performance within these areas.

Finally, a level of significance was identified for White students in English final course average, Math final course average, Social Studies final course average, and Science final course average, as reported in chapter 4. This result indicated that the use of the Castle Learning Online program among White students had a significant effect on their performance after one year of the Castle Learning Program in their performance within these areas.

Interpretations

The analysis of the study revealed that the use of the Castle Learning Online program for the purpose of supplemental academic instruction had, in some areas, a statistical significance in the academic achievement of students who participated in this program throughout a given school year. Specifically, a statistical significance was found to apply to student achievement in the area of Social Studies, both within the student final course averages and the Regents exams in this area.

Although this research demonstrated statistically significant results in certain areas, it had some delimitations. First, the demographic of the sample was narrowed to students who used the Castle Learning Online program in connection with student achievement in a suburban, southern New York State high school, and such a restricted scope should be specifically accounted for before using these results beyond this study. Second, the size of the sample population was on a small scale, particularly in the analysis of gender and student subgroup. In total, 287 students were included in the sample, or 129 males and 158 females. In terms of ethnicity, 39 Asian, 23 African-American, 63 Latino, and 162 White students comprised the sample. A larger sample, particularly in student subgroup, would have helped to strengthen the study and offset the existing size delimitation.

An additional limitation of the study, specifically its sample, was the lack of socioeconomically disadvantaged students. The small number of students within this sample neither yielded any relevant information about students who were economically disadvantaged nor provided a basis for comparison with those students who were not.

In the five overall instances in which a statistical significance in achievement on final course averages and Regents exam scores was identified, the mean scores reflected a positive, significant student achievement effect relative to the use of the Castle Learning Online program. In other words, the use of the Castle Learning Online program demonstrated a statistical significance related to how students performed after having used the program for one year. The data analysis revealed that student participation in the Castle Learning Online program had a significant effect on the final course averages of students within the sample in all four content areas of English, Math, Social Studies, and Science. The data analysis also denoted that student participation in the Castle Learning Online program had a significant effect on the Social Studies Regents exam scores.

Analysis of the scores of students relative to English final course average indicated that students scored, on average, 3.0 points higher after having used the Castle Learning Online program. Furthermore, analysis of the scores of students relative to Math final course average suggested that students scored, on average, 2.8 points higher after having used the Castle Learning Online program. Analysis of the scores of students relative to Science final course average denoted that students scored, on average, 4.3 points higher after having used the Castle Learning Online program. Additionally, analysis of the scores of students relative to Social

Studies final course average implied that students scored, on average, 2.4 points higher after having used the Castle Learning Online program. Finally, analysis of the scores of students relative to the Social Studies Regents exam indicated that students scored, on average, 14 points higher after having used the Castle Learning Online program. All the preceding data analyzed suggested an increase in student performance with statistical significance.

Further analysis of the sample by gender and student subgroup yielded additional statistically significant findings. Female student scores in English final course average (4.1 points higher, on average), Social Studies final course average (7.5 points higher, on average), and Social Studies Regents exam scores (15.2 points higher, on average) suggested that the Castle Learning Online program had a statistically significant effect on improving female student scores in these content areas and on these measures. Male student Social Studies Regents exam scores (12.3 points higher, on average) also denoted that the Castle Learning Online program had a statistically significant effect on improving male scores on this standardized examination.

In summary, a statistically significant effect on student achievement was found in the various areas within the study. The conclusive data yielded by the study suggested that when implemented in this setting and with this sample, the Castle Learning Online program had a statistically significant effect on student achievement on the following measures:

- The final course averages of all students in the content area of English
- The final course averages of all students in the content area of Math
- The final course averages of all students in the content area of Social Studies
- The final course averages of all students in the content area of Science
- The Regents exam score performance of all students in the area of Social Studies

- The Regents exam score performance of male students, but only in the area of Social Studies
- The final course averages of female students, but only in the content area of English
- The final course averages of female students, but only in the content area of Social Studies
- The Regents exam score performance of female students, but only in the area of Social Studies
- The final course averages of Asian students as an individual subgroup, in the content area of Social Studies
- The Regents exam score performance of Asian students as an individual subgroup, in the area of Social Studies
- The Regents exam score performance of African-American students as an individual subgroup, in the content area of Social Studies
- The final course averages of Latino students as an individual subgroup, in the content area of Math
- The final course averages of Latino students as an individual subgroup, in the content area of Social Studies
- The Regents exam score performance of Latino students as an individual subgroup, in the area of Social Studies
- The final course averages of White students as an individual subgroup, in the content area of English
- The final course averages of White students as an individual subgroup, in the content area of Math

- The final course averages of White students as an individual subgroup, in the content area of Social Studies
- The final course averages of White students as an individual subgroup, in the content area of Science

However, caution should be exercised when drawing conclusions from the analysis of the data because certain variables must be considered and justified, including the size of the sample population. Furthermore, as the population was drawn from one high school in suburban, southern New York State, the results of this research may not be generalized to other areas of the country or student populations, as this case study is a non-generalized one.

The evaluation of the results of this study within the context of the larger research base does confirm that although research has investigated the use of supplemental, web-based programs to boost student achievement, the use of such programs can have a significant effect on student achievement. Notwithstanding the large variety of program types and ample research, previous studies, coupled with this research, reveal the clear positive effect of the usage of supplemental programs such as Castle Learning Online. Student achievement, as it relates to the use of supplemental programming, should be continuously evaluated to enhance the understanding of the effect of supplemental programs on student achievement in various content areas.

Recommendations for Administrative Policy and Practice

The findings from this study may be shared with school district and school building leaders to broaden their understanding of the effect of the Castle Learning Online program on student achievement. The research specifically investigating the supplemental, academic effect of web-based programming, especially as the plethora of options in terms of programs becomes prevalent, should provide school districts and school superintendents with the opportunity to obtain this valuable information before dedicating fiscal resources to supplemental online programs. As school budgets become increasingly difficult to manage due to the tax caps and other constraints, and as resources become stretched within school districts, the cost of acquiring such requisite programs for implementation should be weighed. Professional development, in-house training, and allocation of full time employees should also be considerations in the purchase of such programs. A debate may ensue about whether the potential cost of a supplemental, web based-program is justified, recognizing that schools already allocate money to technology purchases and classroom resources designed to differentiate for students. In consideration of a web-based program, especially with new programs available each year, administrators and policy makers should be highly concerned about the merit of purchasing and implementing a supplemental, web-based program. The critical question that school districts should ask is how they intend to support struggling general education students given the mandates of Academic Intervention Services.

This study, with its narrow scope, small sample size, and delimitations, should not be interpreted by school leaders as being conclusive in its findings. Rather, it should be viewed as a piece of research that contributes to the entire body of research on this topic – one that educational leaders and policy makers can use for assessing the benefits and potential purchase of a supplemental online program for the students they serve. District leaders are encouraged to investigate not only the growing quantity of programs such as this but also the increasing volume of studies on these programs.

In addition, district leaders, curriculum developers, and classroom teachers should evaluate these programs within the larger context of their adopted curricula and teaching practices within their districts. District leadership should make curriculum and fiscal decisions with the best interest and foremost need of their student population in mind. Policy makers and school district leaders should also complete their own data analysis to assess their own experiences with any supplemental programs being used in their district and thus to determine effectiveness and subsequent continuation. Failing to undertake this approach on a yearly basis would be irresponsible. Given the recommendations within this section, school district leadership can ascertain the most effective use of their funding and potentially implement a program that has the capacity to significantly affect student performance and achievement.

Recommendations for Future Research

The body of research on the effect of supplemental, web-based programs is insufficient to date, and the results have been largely inconclusive. This study offers findings to add to the existing body of research; however, any single study, especially one with a limited sample and delimitations, should not be intended as a singular source of answers or conclusions. Additional studies on this theme and related topics and programs, especially with larger cohorts and longer time spans, could assist an analysis within the existing body of research of the effect of supplemental, web-based programs on student achievement.

Given the singular study within this dissertation and the lack of investigation on this topic in the field of education, further research is necessary to allow for an expansive and significant body of research on supplemental, web-based programs and how these programs affect student achievement. Recommendations for future research include the following:

1. Complete a replication study with data from an additional school year and expand the scope of the study to include a larger student demographic of students who participate in the Castle Learning Online program. The scope of this particular study and the small sample size can easily be enlarged, and they should be expanded to include all grade levels and students using the program.

2. Design a similar study that assesses student performance and progress while using the Castle Learning Online system at benchmark points throughout the school year. Evaluate student performance on course averages at the conclusion of each quarter and semester.

3. Design a study that analyzes other numerous variables of student performance, and correlate these variables to student performance in final course average and Regents exam scores. Analyze and test for student attendance, teacher variable, and socioeconomic status.

4. Conduct a study of a neighboring school district in the same capacity. Replicate the study in these high schools given the same data sources. Compare the results with the findings of this study and assess the similarities and differences in results.

5. Increase the number of days that students are required to use the program in their area(s) of need. Conduct a study that measures the same effect of the Castle Learning Online program given the change in frequency and consequently evaluate the results.

6. Obtain a sample with a greater volume of economically disadvantaged students to allow for the assessment of the significance of this variable. Compare economically disadvantaged students with those who are not economically disadvantaged to determine any

need to further explore this student variable or ascertain whether the program can positively influence this subgroup of students.

7. Examine the achievement gap of the four core content areas to establish any significant gap in the passing of certain subjects when compared with others. This information can further aid studies regarding the use of the program in specific subject areas, and it can add to the data that this study provides relative to the larger collective gains in Social Studies versus those in English, Math, or Science.

8. Conduct a qualitative study on the student user experience of Castle Learning Online or other supplemental, web-based programs to gain information regarding efficacy, buy-in, and comfortability with the program for both students and teachers.

Conclusion

The adoption and implementation of supplemental programming and personalized learning has become increasingly prevalent in recent years given the demands of the Common Core curriculum. The results of this study on the effect of a supplemental, web-based program on student achievement are intended to contribute to the body of research on this topic. They also serve to reinforce the necessity for a significant amount of further research to provide educators, policy makers, and school districts with the proper information, research, and data to make informed decisions on fiscal spending in this area. Moreover, the results of the effect of this program on student achievement denote a necessity for further studies on various programs, including Castle Learning Online, to analyze the effectiveness of such programs in the experience and achievement of students. With a greater body of research, additional and replicative studies, and larger samples of student usage and analysis, a bigger picture of the actual significant effect of these programs is expected to emerge.

School districts' understanding that programs supplementing instruction are one small piece of the larger puzzle in terms of student achievement remains critically important. Differentiated, personalized supports for students are also essential for students to achieve their best personal learning and therefore attain to their capabilities. These programs aim to assist in that journey, and this study has identified certain areas that need to be used positively and significantly in this regard.

This study was designed and intended to determine the effect of the Castle Learning Online program on student achievement. The core takeaway from this study and subsequent research suggests that if implemented properly and with fidelity, supplemental instruction has the capacity to boost the achievement of students by reinforcing the content and skills in which they have been deficient in the previous year. As a direct result of this study, the utilization of supplemental programs such as Castle Learning Online is a recommended and useful resource for implementation relative to supporting and aiding student achievement. As additional research is completed, students are expected to continue to utilize the supports that can help them to best learn and create personalized instruction and hence grow and achieve at the state-mandated baseline level.

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APPENDICES

Appendix A: Request Letter to School Superintendent to Conduct Research

LITTLE TOR ELEMENTARY SCHOOL

56 Gregory Street · New City · NY 10956 · Tel: (845) 624-3471 · Fax: (845) 638-0807 · www.ccsd.edu/littletor

Mr. Matthew Younghans
Principal
myounghans@ccsd.edu

Success Shines on Everyone at Little Tor.

April 30, 2018

Dear Mr. Cox,

As a doctoral candidate at Seton Hall University, I am conducting research as part of the requirements for the fulfillment of the Ed. D. degree program. The title of my research project *is "The Effect of a Supplemental, Web-Based Program on Student Achievement in a Suburban New York State School District,"* and the purpose of my research is to better understand the impact of the Castle Learning Online Program on student achievement at the secondary level. As you are aware, we utilize this program at both of our district high schools.

I am writing to request permission to use desensitized, de-identified, and anonymous student data from school year 2015-2016 as it related to student's final course averages and New York State Regents exam scores. Per the Family Educational Rights and Privacy Act (FERPA) 34CFR Part 99.31 (A)(6), this data can be released to me via the exception that covers the following:

(6)(i) The disclosure is to organizations conducting studies for, or on behalf of, educational agencies or institutions, to: (C) improve instruction.

Pursuant to the exception found in FERPA, my research will require no direct contact with students, nor will the identity of the students be known to anyone involved with this study at any time. If you would grant me permission to use this data, it will be supplied de-identified to me by our district data manager. All data will be managed and secured using all applicable data management strategies and protocols. Following the data analysis, all identifiable records will be destroyed in accordance with the previously stated regulations.

Thank you for your consideration given to this request. If you could please let me know of your decision in writing, we can discuss further details and logistics regarding how I will carefully obtain the data.

Sincerely,

Matthew Younghans

Matthew Younghans
Principal

Clarkstown Central School District · 62 Old Middletown Road · New City · NY 10956 · Tel: (845) 639-6300 · www.ccsd.edu

Appendix B: School Superintendent Permission to Conduct Research

CLARKSTOWN CENTRAL SCHOOL DISTRICT

Martin D. Cox
Superintendent of Schools

62 Old Middletown Road · New City · NY 10956
Tel: (845) 639-6418 · Fax: (845) 639-6488
mcox@ccsd.edu · www.ccsd.edu

May 2, 2018

Seton Hall University

Re: Matthew Younghans

Dear Institutional Review Board:

The purpose of this letter is to inform you that I give Matthew Younghans permission to conduct the research titled "The Effect of a Supplemental Web Based Program on Student Achievement in a Suburban New York State School District" at Seton Hall University. This also serves as assurance that this school complies with requirements of the Family Educational Rights and Privacy Act (FERPA) and the Protection of Pupil Rights Amendment (PPRA) and will ensure that these requirements are followed in the conduct of this research.

Sincerely,

Martin D. Cox

Martin D. Cox
Superintendent of Schools

Appendix C: Seton Hall IRB Response Letter

SETON HALL UNIVERSITY
1856

June 27, 2018

Matthew Younghans
[redacted]

Dear Mr. Younghans,

This letter is a formal statement that your study "The Effect of Supplemental, Web-Based Program on Student Achievement in a Suburban New York State School District" does not fall under the purview of the IRB. This is because, as you describe it in your IRB Application, the study is a program evaluation in the format of a non-generalizable case study on a web based program on student achievement in Clarkstown Central School District only.

Sincerely,

Mary F. Ruzicka, Ph.D.

Mary F. Ruzicka, Ph.D.
Professor
Director, Institutional Review Board

cc: Dr. Michael Kuchar

Appendix D: Approval for Dissertation Proposal

SETON HALL UNIVERSITY
1856

COLLEGE OF EDUCATION & HUMAN SERVICES
DEPARTMENT OF EDUCATION LEADERSHIP MANAGEMENT & POLICY

APPROVAL FOR DISSERTATION PROPOSAL

Candidate, Matthew Yanghans, has successfully completed all requisite requirements. This candidate's proposal has been reviewed and the candidate may proceed to collect data according to the approved proposal for dissertation under the direction of the mentor and the candidate's dissertation committee.

If there are substantive differences between what has been approved and the actual study, the final dissertation should indicate, on separate pages in the Appendix, the approval of the committee for those changes.

Title of Proposed Dissertation:

The Effect of a Supplemental, Web Based Program on Student Achievement In a Suburban New York State School District

Dissertation Committee:

Michael D Kuchar PhD	[signature] PhD 4/30/18
Mentor (Print Name)	**Signature/Date**
JAN A. FURMAN EdD	[signature] 5/3/18
Committee Member (Print Name)	**Signature/Date**
J. Thomas Morton EdD	[signature] 4-30-18
Committee Member (Print Name)	**Signature/Date**
Committee Member (Print Name)	**Signature/Date**
Committee Member (Print Name)	**Signature/Date**

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