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Examining the Overall Impact of Computer-Based Mathematics Instruction on Math Achievement in an Alternative High School

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EXAMINING THE OVERALL IMPACT OF COMPUTER-BASED MATHEMATICS INSTRUCTION ON MATH ACHIEVEMENT IN AN ALTERNATIVE HIGH SCHOOL

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DEDICATION

This dissertation is dedicated to my husband, Jonah Gilyard, and my sons, Jonah Gilyard, Jr., and Christian Gilyard, who have been my biggest supporters. Thank you all for encouraging me to never give up and to accomplish my biggest dream.

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ABSTRACT

Over the past decade, the United States has witnessed a remarkable surge in computer-based instruction, revolutionizing how students learn and educators teach. This action research study aimed to investigate the overall impact of computer-based instruction on mathematics achievement in the alternative high school setting. The research design incorporated both quantitative and qualitative methods to gather comprehensive data for twenty high school students enrolled in an alternative high school setting. The quantitative data analysis involved examining pre-and post-test scores, graduation data, and final course grades to assess the effect of computer-based instruction on mathematics achievement. All the students showed some improvement in scores from pre- to post-test. The results of the paired-t test for the pretest and post-test indicated that there is a significant difference between the mean and the standard deviation of the Apex Learning pretest ($M = 44.2$, $SD = 18.5$) and the posttest ($M = 64.9$, $SD = 8.4$), $t(19) = 6.9$, $p < .001$. The average mean increased by 20.7 points. The standard deviation of the posttest showed that the scores were more tightly clustered than the scores of the pretest. The scores of all twenty students exhibited a positive increase from the pretest to the posttest. The results provided insights into the improvement in students' performance after engaging with the Apex Learning program. Qualitative methods, such as semi-structured interviews and a survey, were used to gain a deeper understanding of the students' experiences with computer-based instruction. The findings have implications for educators and district policymakers in designing and implementing effective

strategies to enhance mathematics learning for students enrolled in alternative educational environments.

Keywords: Apex Learning mathematics program, online learning, alternative learning environment, college readiness, math achievement

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CHAPTER 1

INTRODUCTION

There are times when high school students in the Cayland County School District (CCSD) (pseudonym) are suspended, expelled, or voluntarily withdrawn from traditional high schools. As a result, these students are given an opportunity to enroll in CCSD's alternative school, The Alternative Center (TAC) (pseudonym). The district's alternative school setting is designed to foster the academic, social, and physiological needs of these students while away from the traditional high school (*K12 EDUCATION Information on How States Assess Alternative School Performance Accessible Version United States Government Accountability Office,* 2020). Alternative schools offer a curriculum and learning environment that diverges from the mainstream of a traditional high school in order to meet the needs of students enrolled in its programs (Porowski, 2014).

Some alternative schools offer the choice of computer-based instruction or face-to-face instruction for courses in classroom settings. Regardless of the instructional delivery method for courses offered, the rigor of the curriculum at alternative schools must be aligned with the state's curriculum standards (Hadley et al., 2021). Appropriately, courses at TAC are aligned with the state's curriculum standards for the state of South Carolina. High school students enroll in the designated coursework based on their academic needs toward graduation.

As it relates to the core subject area of mathematics, South Carolina has two high school mathematics course pathways: pathway 1 and pathway 2. The most common mathematics course pathway for high school students who attend TAC is South Carolina's high school mathematics course pathway 2 (See Table 1.2). SC high school mathematics course pathway 2 recommends students take Foundations in Algebra 1 (part 1) during their first year of high school and Intermediate Algebra 1 (part 2) during the second year. During the third year, students will enroll in Geometry, and complete Probability & Statistics during year four of high school. TAC currently offers Foundations in Algebra (part I), Intermediate Algebra (part II), Algebra 1, Geometry, Algebra 2, and Probability & Statistics. All high school students enrolled in TAC are enrolled in computer-based mathematics courses regardless of the mathematics course they are currently taking.

TAC does not enroll many students who require the South Carolina high school mathematics course pathway 1 (See Table 1.1). Pathway 1 is designed for students who take Algebra 1 during their eighth-grade year or during their first year of high school. The table below shows the computer-based courses offered to any student who enrolls at TAC on an advanced math pathway in each year of high school.

Table 1.1 SC High School Mathematics Course Pathway 1

Year 1 8th or 9th grade	Year 2 9th or 10th grade	Year 3 10th or 11th grade	Year 4 11th or 12th grade	Year 5 12th grade
Algebra 1	Algebra 2 or Geometry	Geometry or Algebra 2	Probability & Statistics or Pre-calculus	Probability & Statistics or Pre-calculus

Adapted from Instructional Resources, 2022

Table 1.2 SC High School Mathematics Course Pathway 2

9th grade	10th grade	11th grade	12th grade
Foundations in Algebra (Part 1)	Intermediate Algebra (Part 2)	Geometry	Algebra 2 or Probability and Statistics

Adapted from Instructional Resources, 2022

The computer-based courses are offered through Apex Learning, which offers high-quality, standards-based education, and scaffolds and supports that expose students to grade-level courses (Apex Learning, 2018). Apex Learning is a system built on mastery where students must demonstrate effective completion of each unit. To advance in Apex Learning, students must achieve a minimum score of 60% on quizzes and tests. To receive credit for the course, students must have a minimum overall passing score of 60% (Apex Learning, 2018).

Computer-based courses provide a critical area of support to alternative schools and ensure that students are able to register for the courses that they need for graduation. Whether students experience a computer-based or traditional learning experience, high school students exiting alternative school programs are expected to be college-ready and eligible to enroll in colleges or universities if they meet college entry requirements set forth by the state of South Carolina (Hadley et al., 2021).

Problem of Practice

Students who attend alternative school learning environments are sometimes stereotyped and labeled as the "bad kids" (Clayton, 2019, p. 39). These are the students who have unique challenges such as academic deficiencies, behavioral problems, attendance issues, or want to get back on track to graduate. These students are assigned

to TAC because they could no longer attend their traditional homeschool where an alternative school learning environment proved to be a better fit. The problem of practice guiding this study centers on the lack of examination or evaluation of mathematics achievement for at-risk high school students using computer-based instruction (CBI) attending an alternative school learning environment.

The computer-based instruction (CBI) provided to the high school students at TAC gave them an opportunity to learn at their own pace within a semester. The high school students enrolled at TAC utilized the Apex Learning computer-based mathematics program. Even though many of the students who attended the alternative school program were deemed at-risk students, the goal was to equip them to enter college or the workforce after they graduate from high school. Because some students will leave the alternative high school and go directly to a post-secondary institution or directly into the workplace, we must utilize instructional methods and resources that will ensure the best academic results for these students (Jacobson, 2017).

Despite the increasing utilization of computer-based instruction (CBI) in alternative school learning environments, there is a notable lack of examination and evaluation of mathematics achievement specifically for at-risk high school students. This shortage of comprehensive assessment practices impedes the ability to identify the effectiveness of CBI and the impact it has on the mathematics learning outcomes of at-risk students (Robinson, 2020). Consequently, there is a pressing need to investigate and address this gap in knowledge to ensure that educational interventions are evidence-based and tailored to the unique needs of at-risk students in alternative school settings.

Research Questions

This research study was designed to examine the overall impact of computer--based mathematics instruction for high school students in an alternative school with regards to math achievement. The following research questions guided the study:

Research Question: What is the overall impact of the Apex Learning mathematics online program on mathematics achievement and college readiness for high school students enrolled in an alternative high school?

Sub-Research Question #1: How do students who are enrolled in an alternative high school program perceive their academic success and college readiness as it relates to mathematics achievement utilizing the Apex Learning mathematics program?

Sub-Research Question #2: What supports do high school students recommend for the learning environment within the alternative school to foster their success with the Apex Learning mathematics program?

Theoretical Framework

The theoretical framework that undergirds this action research study was the constructivist and behaviorist theories. In recent years, the integration of technology in educational settings has gained significant attention. Computer-based instruction, in

particular, has emerged as a viable approach for enhancing learning experiences in various subjects, including mathematics (Keller, 1979). Understanding the theoretical underpinnings behind the use of computer-based math instruction is crucial for effective implementation and positive learning outcomes. This theoretical framework explores the application of behaviorist and constructivist theories to support the use of computer-based math instruction.

Constructivism

Constructivism is a learning theory that describes the process of constructing knowledge. According to Jazim et al. (2017), the constructivist learning theory is a process for students where knowledge is stored in the minds of students. Constructivism posited that learners actively construct knowledge and meaning through their experiences and interactions with the environment (Piaget, 1977). According to constructivist theory, learners actively engage in the process of knowledge construction by relating new information to their existing mental frameworks. Computer-based math instruction can facilitate constructivist learning by providing interactive simulations, problem-solving activities, and opportunities for exploration and discovery (Jonassen, 1991). Through these activities, learners can actively construct their understanding of mathematical concepts, test hypotheses, and engage in reflective thinking.

Piaget (1973) is known as one of the first theorists of constructivism. His theories indicate that humans create knowledge through the interaction between their experiences and ideas. Piaget's (1973) view of constructivism is the inspiration for radical constructivism due to his idea that the individual is at the center of the knowledge creation and acquisition process. Throughout the learning process, the learner is expected to consider the information being taught and construct an interpretation. The interpretation is constructed based on past experiences, personal views, and cultural background (DiSessa, 2018; Jazim et al., 2017).

The constructivist theory involves understanding the importance of the social dimension during the learning process through observation, treatment, interpretation, and adaptation of information on building a cognitive structure (Brau, 2018). Constructivism

involves constructing, creating, and inventing for students to develop their knowledge and meaning (DiSessa, 2018). According to Faris (2017), as cited in Akpan and Beard (2016), it is important that instruction be student-oriented allowing students to make meaning at individual levels to connect with existing knowledge.

In the majority of educational institutions around the world, general education lessons are advised to be taught according to the constructionist approach (Faris, 2017). For this study, high school math students used the constructivist theory because students used the Apex Learning program as computer-based instruction. The computer-based instruction is designed to allow students to work independently as they make sense of their learning.

Behaviorism

Behaviorism, rooted in the work of psychologists such as B.F. Skinner, emphasizes the role of external stimuli and reinforcement in shaping human behavior (Skinner, 1953). Applied to education, behaviorist theory suggests that learning is a result of stimulus-response associations and subsequent reinforcement or punishment. Computer-based math instruction aligns with behaviorist principles by providing immediate feedback, rewards, and reinforcements for correct responses (Keller, 1979). By utilizing interactive features like gamification and virtual rewards, computer-based math instruction promotes engagement, motivation, and repetition, all of which are central to behaviorist learning principles.

The behaviorist theory is a learning theory that can be used as a basis for computer-based instruction. According to Skinner (1965), within the realm of behaviorism, learning is seen as the acquisition of new behavior based on environmental

conditions. Since the behaviorist theory relies on observable behavior, it is simple to implement in the classroom using reinforcement techniques. According to Skinner (1965), good consequences would produce more probable actions. Students would continue their behaviors if positive feedback was given.

With computer-based instruction, students often receive feedback while completing lessons. This immediate feedback shapes student behavior during computer-based instruction (Gilmore, 2018). According to Staddon (2016), students' behaviors can be changed by using both selection and variations of reinforcements. If a teacher chooses to increase the attention span of a student and decrease the amount of fidgeting during instruction, then select to reinforce the behavior to increase the student's attention span and decrease the amount of fidgeting (Staddon, 2016).

In order to improve student learning using the behaviorist theory, teachers could break down learning activities into smaller parts or sections and each is taught at a time; model or illustrate every step in a process or activity; or provide immediate feedback to the student during teaching and learning (Faris, 2017; Staddon, 2016). Computer-based instruction provides immediate feedback to students during instruction which provides a basis for the behaviorist theory.

The theoretical framework presented here highlights the potential benefits of using computer-based math instruction by integrating behaviorist and constructivist theories. By leveraging behaviorist principles, learners can receive immediate feedback and reinforcement, while constructivist principles encourage active engagement and knowledge construction. The integration of these theories in computer-based math

instruction has the potential to enhance learning outcomes and promote a deeper understanding of mathematical concepts.

Purpose of Study

The purpose of this action research study was to determine if there was an impact of computer-based mathematics instruction on math achievement in an alternative high school for students who attend The Alternative Center (TAC) (pseudonym). This research study aimed to examine the effectiveness of the Apex Learning program in preparing high school students in an alternative environment to be prepared for college. This research sought to contribute to the existing body of knowledge on the impact of computer-based mathematics instruction on math achievement for high school students in alternative school settings.

Methodology Overview

This action research study utilized a mixed-methods research design (Efron & Ravid, 2020; Herr & Anderson, 2015). Action research is conducted for the "purpose of improving the practice of classroom teachers and their students' learning…" (Efron and Ravid, 2020, p. 11). Efron and Ravid (2020) stated that John Dewey encouraged teachers to become reflective practitioners. Action research allows teachers to examine problems or weaknesses in teaching and learning and develop practical solutions to address them quickly and efficiently (Herr & Anderson, 2015). Mixed methods allowed the researcher to use sequential steps between qualitative and quantitative methods (Kimmons, 2022). The quantitative data consisted of pretest/posttest scores, final course grades, data from surveys, and data from student reports. The qualitative data within the study came from the researcher’s surveys and semi-structured interviews.

The participants for this research study were drawn using a convenience sample. The researcher sampled the high school students enrolled in TAC taking computer-based instruction in mathematics. Participants for this research study were identified using the roster of high school students enrolled in the Apex Learning program taking a mathematics course via computer-based instruction. Participants were selected from students enrolled in either of the following mathematics courses: Foundations of Algebra, Intermediate Algebra, Algebra 1, Algebra 2, Geometry, Discrete Math, Probability & Statistics, or Pre-Calculus.

The basic interpretive approach using qualitative data (Dana & Yendol-Hoppey, 2020; Efron & Ravid, 2020; Herr & Anderson, 2015) was chosen for a part of this study because the researcher was interested in learning about ways students perceive academic success and college readiness as it relates to mathematics achievement utilizing the Apex Learning in mathematics computer-based instruction (Apex Learning, 2018). The researcher wanted to find out the types of support high school students would recommend so that the alternative learning environment could foster their success with Apex Learning computer-based mathematics courses. This research study was designed to examine data that would yield results to show the overall impact of computer-based mathematics instruction for high school students in an alternative school on the math course's final grade.

Positionality

As the only high school math teacher at TAC, the researcher was unequivocally an insider to the research study as the teacher-researcher and deeply wanted to make sure that each student was successful. Every student does not experience success using

computer-based instruction; therefore, I searched for solutions to improve mathematics achievement for these students. Additionally, I used this information to help make informed decisions with the math supervisors in the district to locate resources to help students become more successful with computer-based instruction.

Currently, I serve as a teacher-facilitator for the participants who were enrolled in the Apex Learning math courses. During the time of the research study, my classes included high school Foundations of Algebra 1, Intermediate Algebra 1, Algebra 1, Algebra 2, Geometry, Probability & Statistics, and Pre-Calculus. As the math teacher for the participants, I was in the classroom with the students as they completed computer-based instruction. As the teacher-facilitator for the computer-based math lessons, I was aware of the lived experiences that the participants were encountering day-to-day at the alternative school while working on the Apex Learning program. This research study was strengthened by my position because I was on-site to conduct member checks and validate the data.

As an African American female veteran educator, I share gender and race/ethnicity with some of the participants in the research study. I did not want these commonalities to interfere with the research study and its collected data from these participants. The first ethical guideline that researchers should prioritize when conducting interviews with study participants of the same gender or race/ethnicity is obtaining informed consent (Henrickson et al., 2020). It is crucial to ensure that participants fully understand the purpose of the study, the nature of their involvement, and any potential risks or benefits associated with their participation. By obtaining informed consent, I was able to demonstrate respect for the participants' autonomy and provide them with the

necessary information to make an informed decision about their involvement in the study. Additionally, I fostered an inclusive and respectful environment, allowing participants to express their unique viewpoints and experiences without undue influence.

Additionally, I have worked on committees with some of the parents or relatives of some of the participants because we attend the same church. As a researcher, I wanted the participants to give honest responses on the surveys and during the interviews. I did not want my position as a church member to influence how the participants answered interview questions. My presence needed to be non-intimidating to the participant; therefore, the surveys were given to the participants so that they can complete them individually and on their own time.

I would like to acknowledge that I held an assumption regarding the academic performance of students who were expelled from the alternative school and subsequently enrolled in the geometry course for the second or third time. Initially, I had the preconceived notion that these students might not perform well using the Apex Learning course due to their previous negative behaviors, excessive absences, or expulsions. This assumption may have influenced my expectations before beginning the research process.

I wanted to make sure that the method for collecting data was valid and trustworthy. To ensure that the research study was conducted without bias, I collected data from multiple sources to validate findings. I was also able to involve the study participants in the research process by sharing the findings with them and seeking their input. The practice of member checking allowed the study participants to verify and provide feedback on the accuracy and interpretation of the data, reducing potential biases in the analysis. The research study was strengthened by my position as a teacher-

researcher because I was onsite to the conduct member checks and validate the data.

Limitations

The limitations of this research study were partly influenced by two key factors: time and sample size. The research was conducted over an 18-week period within one semester, focusing on a computer-based geometry course using the Apex Learning program. As the research site was an alternative learning environment, generalizations cannot be made due to the small sample size of 20 participants. The generalizations from this study are restricted and cannot be extended to other instructors, students, classrooms, or higher education institutions. Additionally, the researcher played dual roles as both the researcher and facilitator of the geometry course. Apart from the classroom setting, the researcher also took on the role such as one of TAC's afterschool program teachers and worked with some of the students in the afterschool program before they were enrolled in the day program at TAC. These various roles involved prior interactions with some of the students before they enrolled in the geometry course. However, the researcher's previous experiences with some of the students from TAC's afterschool program in the course posed a limitation, as there could be implicit bias towards certain students based on these past interactions.

Significance of Study

This research study provided insights into the effectiveness of mathematics programs that use computer-based instruction for high school students attending alternative learning environments. Mathematics achievement has always been an area

of weakness for high school students in the district. Additionally, this research study was significant because it addressed the overall impact of computer-based

mathematics instruction in an alternative school learning environment for students attending an alternative school where the student's standardized assessment scores such as SAT or ACT are often used to assess career- and college-readiness.

In 2021, the South Carolina School Report data showed that students in the CCSD had an average benchmark score of 16.5 out of 22 on the ACT. Meanwhile, only 8.2 percent of the high school students met the benchmark score of 22 on the ACT. ACT benchmarks are scores on the ACT subject-area tests that represent the level of achievement required for students to have a 50% chance of obtaining a B or higher or about a 75% chance of obtaining a C or higher in corresponding credit-bearing first-year college courses (Career Readiness Assessments - SC School Report Card, 2021). For future purposes, educators needed to know the overall impact of relationships that occurred between college readiness, computer-based instruction, mathematics achievement, and whether the results accounted for gender and ethnicity/race.

As students transition from middle to high school, they are asked whether or not they plan to attend college, enter the military, or go directly into the workplace. Students are asked this because they are required to take high school courses to complete their path to graduation. This decision might seem like an easy one, but it is not when the states are experiencing a teacher shortage and students are faced with classrooms that do not have a certified teacher to prepare them for their path to graduation. Teacher shortages have increased since the pandemic (Carver-Thomas, 2022). There are thousands of classrooms across the United States that do not have a certified teacher delivering instruction to high school students (Carver-Thomas, 2022).

According to McKenna (2018) and Carver-Thomas (2022), Teacher turnover and shortages are two of the most important problems in education. Teachers have the most impact on how well students do in school, and research shows that poor-quality teaching makes it harder for students to be ready for college when they graduate (Carver-Thomas, 2022).

Dissertation Overview

The dissertation is structured into five key chapters that collectively form a cohesive narrative. Chapter 1 introduces the research topic, establishes its significance, and outlines the research questions. Chapter 2 conducts a thorough review of relevant literature, providing a foundation for the study. In Chapter 3, the methodology employed in the research is detailed, including the research design and data collection methods. The findings from data analysis are enumerated in Chapter 4 offering insights into the research outcomes. Finally, Chapter 5 synthesizes the findings, discusses their implications, and concludes the dissertation by tying together the research journey and offering recommendations for future exploration in the field to better serve students enrolled in alternative learning environments accounting for gender and race/ethnicity.

Definition of Terms

Academic Performance – Academic performance is defined as the students' reported performance on school courses or a standardized test (Define Academic Performance, 2018; Ravitch, 1999).

Academic Achievement – Academic achievement refers to how far a student or institution has progressed toward short or long-term educational objectives. Students' grade point averages can be used to assess accomplishment, while graduation rates can be

used to gauge achievement for institutions (Academic Achievement Definition and Meaning, 2022).

Alternative Education programs – Alternative Education programs refer to those specifically tailored to meet the needs of students who may be struggling with poverty, substance abuse, family dysfunction, or psychological or physical trauma (Porowski et al., 2014; Quinn & Poirer, 2006).

Alternative High School Students – Alternative high school students refer to those at-risk for high school failure for various reasons, including academic deficiency, behavioral difficulties, excessive absences, pregnancy or parenting, adjustment problems, or juvenile justice involvement. For this study, the alternative high school students will be ninth, tenth, eleventh, and twelfth graders from an alternative school (Fuller & Sabatino,1998).

American College Testing (ACT) – ACT is a curriculum and standards-based educational and career planning tool that assesses students' academic readiness for college in math, science, reading, and writing. The test includes 215 multiple-choice questions and a score of 36 is the highest possible score. The test is offered six times per year in the U.S. and is usually taken during a junior or senior year of high school (Allen & Sconing, 2005).

Apex Learning - The Apex Learning Online Learning is an academic curriculum that provides standards-based courses in math, science, English, social studies, world languages, electives, and advanced placement for grades 7 through 12. Apex Learning courses are semester-long courses. They require the same dedication of learning time as a classroom course. Students will spend nearly 90 hours, plus homework time, in a course (Apex Learning, 2018).

At-Risk Students – At-risk students are individuals who possess a present or a predictable status (economic, social-cultural, academic, or health), indicating that they might fail to complete their secondary education and acquire essential life skills necessary for higher education and employment (Fuller and Sabatino, 1998).

College Preparatory Course – A college preparatory course of studies is designed to qualify students for admission to a college (Hadley et al., 2021).

College Readiness – College readiness is defined as the level of preparation a student needs to enroll and succeed in a credit course at a trade school, a technical college, two-year or four-year institution (Conley, 2008; College and Career Readiness – SC Report Card, (2022); Division of College & Career Readiness, 2022).

Comparison of Math Courses – The comparison of math courses is defined as online math course academic performance compared to traditional classroom math course academic performance. The math courses will be college preparatory courses including but are not limited to Algebra, Geometry, Discrete Math, Probability and Statistics, Pre-calculus, or Calculus.

Computer-based Instruction (CBI) –computer-based instruction is when students interact with a computer as a key element of the learning process. An instructor is almost always present to organize and monitor student activities. Students will complete exercises and view materials on a computer screen rather than receiving the information from written material or an instructor's presentation (What Is Computer Based Instruction in Education, 2012).

Ethnicity – Ethnicity is a characteristic of a human group with racial, religious, linguistic, and other traits in common (Dunning-Lozano, 2016).

Gender - Gender will refer to males and females in some research offered within the text (Pryzgoda & Chrisler, 2000).

Grade Point Average (GPA) – GPA is defined as a measure of academic attainment computed by dividing the total number of grade points received by the total number of credits or hours of coursework taken by the student. The GPA scores will be reported for 11th, 12th, or graduate students from an alternative high school (Division of College & Career Readiness, 2022).

National Assessment of Educational Progress (NAEP), also known as the *Nation's Report Card*, was first administered in 1969 and is the largest continuing and nationally representative assessment of what our nation's students know and can do in subjects such as mathematics, reading, science, and writing. Standard administration practices are implemented to provide a common measure of student achievement (National Assessment of Educational Progress (NAEP), 2022).

Online Learning - Online learning is defined as a learning experience delivered through a computer and the Internet (Kearsley, 2000; Keegan, 1996; Shin & Chan, 2004).

Online Math Course - an online math course is defined as a high school math course in which the curriculum and instruction of the course are delivered through the use of a computer and the Internet (Kearsley, 2000).

Scholastic Aptitude Test (SAT) – SAT is defined as a standardized test published by College Board that measures attained knowledge in Critical Reading, Writing, and Math. The current test consists of three 800-point sections (Kobrin et al., 2016; Preston, 2017).

Traditional Classroom Learning – Traditional classroom learning refers to students meeting face-to-face for direct instruction from a teacher (Neufeld, 2015).

Traditional Math Course - Traditional math course is defined as a high school math course in which the curriculum and instruction of the course are delivered in a regular classroom with a face-to-face instructor (Neufeld, 2015).

CHAPTER 2

LITERATURE REVIEW

To increase a student's chances of graduating from high school, Cayland County School District (CCSD) (pseudonym) offers opportunities for high school students to attend the district's alternative school, The Alternative Center (TAC) (pseudonym). TAC utilizes computer-based instruction for all high school courses. The researcher was concerned about students being ready to enter college after using computer-based instruction for high school math courses. The problem of practice addressed in this research study was a lack of effective evaluation of computer-based instruction to determine whether or not it helped students enrolled in alternative high school learning environments to be ready to enter college upon graduation.

Students enrolled at TAC are only offered courses using computer-based instruction. Students complete their path to high school graduation by enrolling in alternative school computer-based instruction for math courses. The Alternative Center (TAC) offers high school courses for credit recovery or original credit. Original credit courses are for those students who are taking a course for the first time, failed the course with a grade of 49 or less, or want to take the entire course over to replace the original course's final grade. Credit recovery courses are taken by students who fail the original course with a grade that falls between 50-59.

Even though, high school students are eligible to complete their graduation requirements and graduate from The Alternative Center (TAC); there is not enough data to determine whether students are ready to enter college. The researcher conducted this action research study to examine the overall impact of computer-based instruction on math achievement in an alternative high school mathematics program using the Apex Learning program, accounting for gender and race/ethnicity. Also, the researcher searched for evidence to show whether students who use computer-based instruction for math courses in an alternative school learning environment are ready to enter the workforce or college upon graduation.

The following electronic resources databases were used to search and retrieve articles for this study: Google Scholar, Journal Storage (JSTOR), Educational Resources Information Center (ERIC), and the University of South Carolina's library of databases. The searches to reveal studies were done by using the following topics: the history of alternative schools and education, constructivist and behaviorist theoretical framework, online learning, college-readiness, assessing math achievement, and computer-based instruction and achievement. The beginning of the literature review contains a brief history and context of alternative schools. The remaining literature review includes research relevant to alternative schools and education, constructivist and behaviorist theoretical framework, early history and context of alternative schools, online learning, impact of Covid-19 on online learning, assessing math achievement, college readiness, and the impact of computer-based instruction on student academic achievement.

The purpose of this action research study was to examine the overall impact of computer-based mathematics instruction for high school students in an alternative school regarding mathematics achievement. The following research questions will guide the study:

Research Question: What is the overall impact of the Apex Learning mathematics online program on mathematics achievement for high school students enrolled in an alternative high school?

Sub-Research Question #1: How do students perceive their academic success and college readiness as it relates to mathematics achievement utilizing the Apex Learning mathematics program?

Sub-Research Question #2: What supports do high school students recommend for the learning environment within the alternative school to foster their success with the computer-based Apex Learning mathematics program?

This chapter presented a review of scholarly literature that begins with the historical and theoretical contexts for the problem, purpose of the study, and content of the research study. The sections of this literature review chapter addressed the theoretical framework, the historical context of alternative schools, alternative schools and education, online learning, impact of COVID19 on online learning, assessing math achievement, college readiness, and the impact of computer-based instruction on student achievement.

Theoretical Framework

This action research encompassed constructivist and behavioral theories as the theoretical framework that defined this body of work. Student learning is different for each student, but there is a time when students personalize learning by making associations and connections between their lives and what they are learning. The constructivist theory is a basic understanding that a learner's knowledge is acquired by connecting their own experiences to new knowledge (Brau, 2018). As students learn, educators observe the 'ah ha' moments when student learning is taking place. The behaviorist theory allows teachers to observe students as they are constructing their knowledge. The behaviorist learning theory emphasizes how learners interact with their environment (Faris, 2017).

Constructivist Theory

Constructivism was the work of several education theorists, Jean Piaget, John Dewey, and Lev Vygotsky. They focused on explaining teaching and learning as an interaction between the teacher and students. Dewey (1938) described constructivism as where the learner depended on acquiring knowledge drawn from experiences and actions that had meaning to the learner. Dewey believed that learning for students had to occur in a classroom in an environment where interactions occurred (Dewey, 1938). Piaget had a notion that constructivism was built upon discovery where teachers had to understand the development of the mind of a child (Piaget, 1973). In Piaget's work, he focused on how humans create meaning when they interact with their experiences and their ideas (Piaget,

1973). Lev Vygotsky emphasized social etiquette; how interactions with adults, peers, and cognitive tools are incorporated by learners to form mental constructs through the zone of proximal development. Vygotsky described the proximal development in stages in which a learner can do with aid, without aid, or cannot do at all (Brau, 2018; Faris, 2017; Wachira & Mburu, 2019). Several factors and principles of constructivism influence how the theory works and how it applies to students. According to (Brau, 2018), Some principles of constructivism are as follows:

- Knowledge is built upon other knowledge (previous experiences).
- Learning involves building meaning from experiences.
- Learning is active; the learner needs to do something to learn something.
- Learning is directly related to associations and connections with other people.
- Learning does not need to be isolated facts but connected to things that the learner already knows.
- Constructivism is based on a learner's own experiences and beliefs. Knowledge is personal.
- Motivation is key to learning. Learners need to be motivated to be able to learn.

According to research by Evendi (2022), constructivist principles allow learners to engage in meaningful mathematical experiences, fostering conceptual understanding and critical thinking skills There were several principles from the theory of constructivism that were used to frame the study and they were: the learner needs to do something to learn something, knowledge is built upon other knowledge and learning involves building meaning from experiences.

In the constructivist theory, the learner interacts with his or her environment learning through problem-solving making sense of the environment to establish a basis for understanding the educational context of computer-based learning (Dewey, 1938). According to Dewey (1938), the learner depended on acquiring knowledge drawn from experiences and actions that had meaning. The meaningful experiences and actions in a computer-based learning environment, which are rooted in the constructivist theory, need to take place in a classroom setting that fosters an environment conducive to learning. This learning environment should facilitate interactions between students and the computer-based instructional intervention as noted by Dewey (1938). Piaget had a notion that constructivism was built upon discovery where teachers had to understand the development of a child's mind (Piaget, 1973).

The research study searched the data for evidence establishing where interactions and problem-solving took place during online learning experiences. The researcher sought to understand the experiences of online learning from the perspective of the student based on the interactions that took place during online sessions. Since the theory of constructivism is framed on learner interactions with his or her environment while problem-solving and making sense of the learning, then the researcher's research questions, and interpretive approach served as guiding tools to investigate and understand the theory of constructivism (Faris, 2017).

Behaviorist Theory

Behaviorism was formally established by John B. Watson who claimed that behavior could be conditioned to act in any particular manner given the right conditioning (Faris, 2017). From 1920 to the mid-1950s, behaviorism became dominant,

and its popularity grew as part of behavioral psychology (Faris, 2017). In education, behaviorism examines how students behave while learning (Brau, 2018). The development of behaviorism is associated with Ivan Pavlov and his experiments with dogs, food, and the sound of a bell (Pavlov, 1927). Dogs learned to associate feeding time with the sound of a bell which induced salivation. Pavlov conducted these experiences in the 1900s and these experiments were repeated throughout the 20th century (Faris, 2017). Pavlov's experiments demonstrated three major tenets of the field of behaviorism:

- Behavior is learned from the environment. This was demonstrated when Pavlov observed that the dogs salivated at the sound of a bell along with food over time Pavlov (1927).
- Behavior must be observable. Pavlov (1927) concluded that the dogs were learning because they salivated at the sound of the bell with or without food.
- All behaviors are a product of the formula stimulus-response. The sound of a bell did not cause a response until it was associated with the food in which the dogs responded with increased salivation (Pavlov,1927).

The behaviorist learning theory emphasizes how learners interact with their environment. Some of the tenets used for the framework of the study were: behavior is learning from the environment, behavior must be observable, and all behaviors are a product of a stimulus-response.

Behaviorist B.F. Skinner described operant conditioning as the process in which learning can occur using reinforcement and punishment (Faris, 2017; Skinner, 1965). All actions are learned by conditioning, and conditioning takes place through contact with

the environment, according to the behaviorist theory of learning (Skinner, 1965). While the Behaviorist school of learning may help students understand what they are doing, educators need to know what students are thinking and how to enhance what they think. According to Skinner (1965), immediate feedback reinforces the behavior of the student and the student's behavior is conditioned to do. Constructivism is where the learner interacts with his or her environment thus learning through problem-solving and making sense of the environment to establish a basis for understanding the educational context of computer-based learning. Both Pavlov and Skinner promoted repetitive behavior which leads to forming habits (Brau, 2018; Skinner, 1965).

The integration of behaviorist and constructivist theories within computer-based math instruction offers a comprehensive approach to learning. By incorporating behaviorist principles, learners receive immediate feedback and reinforcement, enabling them to develop procedural fluency and accuracy. Simultaneously, constructivist principles allow learners to engage in meaningful mathematical experiences, fostering conceptual understanding and critical thinking skills (Evendi et al., 2022). The combination of these theories promotes a balanced approach that addresses both the procedural and conceptual aspects of mathematics.

Early History and Context of Alternative Schools

The diminishing perceptions of students regarding the institution of public education have become a national concern and must be redirected immediately (Kober, 2020). Educational problems and performance gaps are most acute among students from low-income families, particularly minority families, who are much weaker and whose homes and communities are less likely to provide resources such as museums, libraries,

books, and healthy recreational activities, in a culture of success based on educational achievement (Garcia & Weiss, 2017). One must first understand the institution's history to fully understand what is occurring within the public education system. Public education in the United States today is far different from what the framers envisioned when they promoted the concept of public education (O'Neill, 2001). Today, the infusion of religion into the public education system is something that is not permitted. Furthermore, situations arise where school systems are found in violation, and severe punitive consequences may result from this violation (O'Neill, 2001).

The mainstream public education system of the late 1950s and early 1960s was highly criticized for being racist and exclusively designed for the success of the few (Butts, 1978). As Raywid (1981) described, these schools were cold, dehumanizing, irrelevant institutions, mainly indifferent to those they were designed to serve. Those critical of the public school system argued that the system possessed a definition for excellence that was narrow in cognitive terms at the expense of equity (Kliebard, 2004; Young, 1990). In 1965, President Johnson named the public school system the front line of attack as America declared war on poverty. The emphasis on excellence was replaced by the humanistic goal of equity (Olivia, 2009; Young, 1990).

With government backing and funding, a new wave of alternatives was spawned that was meant to offer equal and meaningful education to disadvantaged and minority students (Lee, 2012; Oliva, 2009; Young, 1990). During the 1960s and 1970s, Oliva (2009) stated that school districts were involved in efforts to provide accommodations for those students who could not perform well in traditional public schools by offering options either within or outside the school. The more common alternatives outside the

established schools were free schools, storefront schools, and schools without walls (Oliva, 2009).

An alternative free school is a type of educational institution that operates independently, without charging tuition fees and is often managed by the students, parents, and teachers collectively (Gribble & Mulford, 2018). On the other hand, an alternative store-front school refers to a school that is located in a non-traditional setting, such as a community center or a commercial space, and offers a flexible and personalized learning environment for students (Johnson, 2016). Lastly, an alternative school without walls is a concept where learning takes place outside of a traditional school building, often through experiential learning, field trips, and community-based projects (Ravitch, 2019). Individuals, organizations, and businesses in the community participated in youth education (Oliva, 2009). School systems took advantage of the human and material resources available in the community and offered students practical instruction in a setting less structured than the established school.

Alternative schools are divided into three categories according to what they are trying to change: the student, the school, or the educational system (Franklin et al., 2018). Alternative schools that change the student or their academic or behavioral performance use a corrective orientation (Adams, 2022). Raywid (1998) stated that the alternative schools that focus on changing the school are considered innovative. These alternative schools possessed novel curricular and instructional approaches and positive school climates (Franklin et al., 2018). They also show positive effects in increased graduation rates and college readiness. Alternative schools geared toward changing the educational system are often small and created as school-within-schools. It remains to be seen if

these small alternative schools can survive in larger school systems to support their innovation (Robertson et al., 2016).

Saunders and Saunders (2001) completed a study comparing alternative school students' perceptions of past (traditional) and current (alternative) school environments. The traditional school referred to their past home school in which they enrolled before being enrolled in an alternative school environment in which the student is currently registered. Saunders and Saunders (2001) referenced a study by De La Rosa (1998) that found that caring teachers are vital to any successful program. Students in these programs feel the staff is genuinely concerned about them. In a study by Sergiovanni (1996), Saunders and Saunders (2001) noted that because of the small size, alternative schools could produce what they call community, which results in more active student participation, a sense of belonging, and greater academic and social success.

In their comparative findings, Saunders and Saunders (2001) found that eighty-seven percent of the sixty-two students in the study attended alternative schools during the day and 13% attended the evening program. The researchers reported that fifty-five percent of the students were female, and forty-five percent were male. The mean and median age was 16.5 years. The average grade was ninth grade, and the median grade was 10th grade. The average grade is accurate with the evaluative report from South Carolina (Tenenbaum, 2000). Sixty-two percent of the students completed the grade they had been attending. Students felt much more positively about the teachers, caseworkers, and administrators at the alternative school than their feelings about the teachers at their traditional schools. Overall, these students characterized their school experience before coming to the alternative school as "fair." Their school experiences at the alternative

school were rated “very good.” Eighty-nine percent of the sixty-two students indicated that their experience has improved. Saunders and Saunders’ (2001) study revealed that students placed in an alternative school have positive school experiences because the school is a smaller setting in size, the students feel that time spent with the teachers, caseworkers, and administrators is better because they are given more individual attention, and their individual needs are met. This study showed that more females have enrolled in the alternative school, but it did not mention the ethnicity of the students being studied.

Poyrazli et al. (2008) conducted a cross-sectional study to explore associations between academic achievement, employment, gender, and age concerning students’ sense of school membership and perception of adults in school. The sample used for this study consisted of 102 alternative school students. This research study noted that students who are sent to alternative schools sometimes involuntarily develop a resistance toward the new school. Therefore, the new school, TAC, must anticipate and intervene with this resistance to keep it from interfering with students’ achievement of their educational goals. A positive alternative school experience may help students attain a higher level of academic achievement (Poyrazli et al., 2008; Saunders & Saunders, 2001).

Poyrazli et al. (2008) studied students referred to an alternative school due to classroom behavior problems, aggression, poor attendance, academic difficulties, and poverty. These characteristics are very similar to those of at-risk students in alternative schools as defined by (Clayton, 2019; Fuller and Sabatino, 1998). The research study results indicated that students who had a more positive perception of their teachers, counselors, and administrators had a greater sense of school membership. Therefore, the

researchers noted that students' perceived relationships with school personnel seem to be vital in defining a positive alternative school environment. The results matched the conclusion that Saunders and Saunders (2001) made in their study as they reviewed students' school experiences in their research. Other vital results indicated that students that worked outside of school had higher performed better academically. The researchers implied that students that had structured time outside of school, such as a job, are more successful. Thus, providing students with opportunities for extracurricular activities or volunteer work may help them achieve a higher level of academic success.

In contrast with previous literature (Gold & Mann, 1982), this study found no relation between academic achievement and a sense of membership. Since the study sample was primarily African American students, comparisons could not be made among different races or ethnic groups. Regarding race-ethnicity, 70% were African American, 12% bi-racial, 7% Latino/a, 4% White, and 7% noted as 'other.' Forty-two percent were female, and 58% were male. While the results of this study offer many important implications, they should be approached cautiously. The generalizability may be limited to secondary alternative school students in semi-urban school settings.

Castleberry and Enger (1998) conducted a study to learn more about alternative school students' success concepts. The study sample consisted of 173 high school students from 21 alternative school programs in Arkansas. Ninety-four percent of the students were 9-12, and 91 percent were 15-18 years old. Eighty-two of the students were working toward graduation or a GED. In terms of the demographic characteristics of the students: 58 percent were male, and 42 percent were female; 67 percent were White, 27 percent were African American, and 6 percent were of another race. The

students were asked to compare the characteristics of their alternative school and their regular school program. The student favored many attributes of the alternative school, such as one-to-one interaction with the teachers at the alternative school and the smaller class sizes. The smaller class sizes and interactions with teachers were also noted in the previous study by Saunders and Saunders (2001). The students were asked how they knew when they had been successful in the alternative school. Most of the students responded that measures such as grades, diploma, or general educational development test (GED), course credits, and returning to their regular school would indicate success. Other responses included improved personal behavior, teachers telling them they had improved or were successful, and college. The implications of this study show that the students in the alternative schools in Arkansas benefit from alternative education. The alternative educational option provided the students with a means to be successful. Arkansas has framed its educational system to provide social justice for all students by allowing students who need an alternative education option to be successful.

Online Learning

Online learning is the process of acquiring knowledge through the internet (Smith, 2020b). It provides educational materials, resources, and assistance to students, enabling valuable interaction and knowledge creation (Gonzalez & St. Louis, 2018). The National Center for Education Statistics (NCES) predicted that the total number of students attending public schools in grades K through 12 in distance education grew some 65 percent in two years starting in 2002. It is estimated that more than 30% of American students are enrolled in at least one online course (Palvia, et al., 2018). From the presented literature, the facts about the growing population regarding online learning

were attention-grabbing. Online learning is on the rise in educational uses of technology (Li & Lalani, 2020). In addition, enrollment figures for courses or high school programs that provide computer-based learning increased to 1.6 million in 2021 (Online Education Statistics, 2021).

Based on additional literature, the researcher was aware of the findings that the evaluation of online programs and their efficiency must be seen as an instrument to support administrators and decision-making about future uses of online learning programs in high schools. Students who received identical quality instruction while learning online usually achieve levels equivalent to their peers in classroom-based classes (Means & Haertel, 2004; Writers, 2019). A significant attribute that sets successful online learners apart from their classroom-based counterparts is self-sufficiency and greater conscientiousness (Keegan, 1996; Wedemeyer, 1981; Writers, 2019). According to Jones and Sharma (2020), online education has demonstrated its potential to become the primary form of national education.

Online learning presents challenges for instructors and non-digital-native students, as teachers who excel in physical classrooms may not immediately adapt to online teaching (Jones & Sharma, 2020). Students often experience a lack of motivation, isolation, time management issues, excessive distractions, and technical difficulties (Gillett-Swan, 2017). In order to alleviate the challenges for students and have them make sense of the material and gain conceptual and epistemic understanding, online learning significantly depends on their agency, multimodal communication, and active engagement with digital resources (Hartnett, 2016).

Online learning, also known as distance education, has become increasingly popular in recent years. It allows students to access educational materials and participate in classes remotely, using internet-based technologies (Smith & Johnson, 2019). Online learning offers several advantages, such as flexibility in scheduling and location, which allows students to learn at their own pace and from the comfort of their own homes (Allen & Seaman, 2017; Smith & Johnson, 2019). Additionally, online learning provides a wide range of resources and multimedia tools that enhance the learning experience (Johnson, 2018). For example, students can access interactive simulations, videos, and online forums that promote engagement and collaboration (Hollister et al., 2022).

One of the key benefits of online learning is its flexibility. Students can access course materials and lectures at any time, allowing them to balance their studies with other commitments, such as work or family responsibilities (Allen & Seaman, 2017; Smith & Johnson, 2019). This flexibility is particularly beneficial for non-traditional students, such as adult learners or those with disabilities, who may face barriers to attending traditional classroom settings (Johnson, 2018). Online learning also eliminates geographical barriers, as students can access courses from anywhere in the world, expanding educational opportunities for individuals in remote areas or those who cannot relocate (Smith & Johnson, 2019).

In addition to flexibility, online learning offers a wealth of resources and multimedia tools that enhance the learning experience. For instance, students can access a variety of digital resources, such as e-books, interactive simulations, and multimedia presentations, which cater to different learning styles (Hollister et al., 2022). These resources provide students with the opportunity to engage with the content in a more

interactive and dynamic way, promoting deeper understanding and retention of the material (Johnson, 2019). Furthermore, online learning platforms often incorporate discussion forums and collaborative tools, enabling students to interact with their peers and instructors, fostering a sense of community and support (Allen & Seaman, 2017).

Online learning has revolutionized education by providing flexible and accessible learning opportunities. It offers students the ability to learn at their own pace, regardless of their geographical location or personal circumstances. The abundance of resources and multimedia tools available in online learning platforms enhances the learning experience and promotes active engagement and collaboration (Hollister et al., 2022). As technology continues to advance, online learning is likely to become an increasingly integral part of education, providing students with innovative and convenient ways to acquire knowledge and skills.

Impact of Covid-19 on Online Learning

In March 2020, the coronavirus epidemic drove schools to close their doors and transfer classes online, effectively forcing all students to become online learners (Hess, 2021). In 2007, twenty-eight states had online virtual high school programs (Tucker, 2007), but by the end of 2021, thirty-eight states had approved permanent online learning programs (Gile, 2021). With the advent of the internet, online education has become a viable option, and regular classroom teachers are incorporating online teaching and learning activities into their instruction. Even though all recent publications praise online education, academics doubt its effectiveness. The usefulness of computer-assisted instruction is still being studied (Paul & Jefferson, 2019). In the spring of 2020, a significant number of public schools (77%) and private schools (73%) shifted to online distance-learning formats. Public schools primarily utilized self-paced or real-time

learning, while private schools (48%) relied more on paper materials sent home with students (41%) in public schools (National Center for Education Statistics, 2022).

The rapid rise of the online learning population has been attention-grabbing (Li & Lalani, 2020). Online courses have quickly grown in popularity, and they have the potential to improve many students' educational prospects, particularly those who are underserved by traditional educational institutions (Bettinger and Loeb, 2017). In 2019, over 375,000 K-12 students in the United States attended an online school full-time. There are undoubtedly more students who are pursuing their education entirely online (Guide to Online School, 2020).

According to Pokhrel and Chhetri (2021), Covid-19 caused the largest disruption of education systems in human history. This disruption affected nearly 1.6 billion learners in more than 200 countries. About 94% of the world's student population was impacted. Educators shifted to delivering education using various online platforms. The education systems and the educators adopted "Education in Emergency" (Pokhrel and Chhetri, 2021, p. 134) using various online platforms to deliver education during Covid-19. Schools all over the world were searching for platforms to use to assist educators with teaching and learning. In doing so, the Covid-19 pandemic paved a way for innovations to implement alternative educational strategies (Dhawan, 2020).

There were benefits to online education for students which allowed students to continue their learning during the Covid-19 pandemic. Without regard to location, technology enables students to learn and access on-demand knowledge whenever they are interested in a subject. As a benefit, students were able to access their instruction from

any location using different forms of technology. Another benefit of online learning is that instructional materials were more profitable with some reduction, allowing educational institutions to save money by using mobile platforms and resources (Suresh et al., 2022). Mobile technology devices and computers made it simple to access online learning platforms and improve the efficacy of mobile learning (Yu, 2021).

At the same time, there were challenges and limitations to using online education during Covid-19. It should come as no surprise that Covid-19 forced government officials to take substantial steps to make online learning practical and possible for students (Suresh et al., 2022). Challenges with online education include accessibility, affordability, flexibility, learning pedagogy, life-long learning, and policy (Murgatrotd, 2020). In contrast to students who are weak learners, the vulnerable group of students is relatively unaffected by their learning since they require little monitoring and direction (Murgatrotd, 2020). Some academically gifted students from underprivileged backgrounds are unable to access or finance online education (Sintema, 2020). Due to the decreased amount of contact time for students and the lack of teacher advice when encountering learning/understanding challenges, the level of academic performance of the students is expected to decline for the classes held for both the year-end assessment and internal examination (Sintema, 2020).

Access to digital gadgets and a stable Internet connection are major problems in many nations. While poor children in many developing nations are unable to buy online learning gadgets, the risk of increasing screen time for the learner exists with online

education (Pokhrel & Chhetri, 2021). It is now crucial for students to participate in offline activities and self-directed learning. Another issue is that both parents work, making it difficult for young students to receive adequate parental guidance (Murgatrotd, 2020; Pokhrel & Chhetri, 2021).

Due to the COVID-19 epidemic and nationwide lockdown, numerous state-level board exams, recruitment exams, university-level exams, and entrance exams were postponed throughout countries. There have also been several admission exams postponed or rescheduled such as SAT2020, GMAT2020, and ACT2020. The ongoing situation has had a significant impact on the educational system in schools, colleges, and universities across the nation (United Nations, 2020). Many colleges and universities waived their admission exam requirement during the COVID-19 pandemic (Reich et al., 2020).

Despite the fact that multiple studies have shown that online learning is more successful than traditional learning, there are disadvantages in student engagement, academic success, and time consumption (Yu, 2021; Alsammak et al., 2022). Without a doubt, online learning affects education, particularly student academic growth (Suresh et al., 2022). Many educators continued to oppose the use of online learning because they thought it might lower student engagement and result in less positive academic outcomes than traditional face-to-face training (Yu, 2021; Alsammak et al., 2022; Suresh et al., 2022). The world saw an outbreak of COVID-19 across countries in 2019 which met schools with technological challenges (Chandasiri, 2020). While the pandemic put the world in survival mode, it also threw the educational systems across the world scrambling to create online education to reach each student as best as possible (Chandasiri, 2020; Yu,

2021). Even though schools offered online learning to their students, there were benefits to using technological devices to reach students in areas that would have been otherwise impossible to reach. Numerous households located in remote and rural areas still met issues when students could not access the learning platforms due to little or no Internet or Wi-Fi service (Yu, 2021).

Assessing Math Achievement

Assessing math achievement is important for assessing high school students' proficiency in mathematics and their readiness for college and future careers. Various assessment tools and methods are utilized to evaluate students' math skills and knowledge. There are different approaches to assessing math achievement. Also, it is important to accurately assess math achievement in order to promote educational improvement and provide equitable opportunities for students (Ran, 2021).

One commonly used method for assessing math achievement is standardized testing. Standardized tests, such as the SAT and ACT, provide a standardized measure of students' math skills and knowledge. These tests assess students' abilities in areas such as algebra, geometry, and data analysis. According to Smith and Jones (2018), standardized tests offer a reliable and objective way to compare students' math achievement across different schools and districts.

In addition to standardized tests, classroom assessments play a significant role in assessing math achievement. Teachers often use quizzes, tests, and homework assignments to evaluate students' understanding of mathematical concepts and problem-solving skills (Johnson, 2019). These assessments provide valuable information about individual students' progress and help guide instructional decisions.

Formative assessments are another approach used to measure math achievement.

These assessments are ongoing and provide feedback to students and teachers throughout the learning process (Wiggins, 2018). Examples of formative assessments in math include exit tickets, quick checks, and in-class activities that allow teachers to gauge students' understanding and adjust instruction accordingly.

Another method for assessing math achievement is through performance-based assessments. These assessments require students to apply their mathematical knowledge and skills to real-world contexts or complex problem-solving tasks (Darling-Hammond, 2017). Performance-based assessments assess students' ability to think critically, reason mathematically, and communicate their mathematical thinking effectively.

To ensure accurate measurement of math achievement, it is important to consider the validity and reliability of assessment instruments. Validity refers to the extent to which an assessment measures what it is intended to measure, while reliability refers to the consistency and stability of the assessment scores (American Educational Research Association, 2014). Assessments should undergo rigorous validation processes to ensure that they provide accurate and meaningful information about students' math achievement.

College-Readiness

College readiness refers to the preparedness of high school students for the academic, social, and emotional challenges they will encounter in college (Brown, 2019). It encompasses a range of skills and knowledge that students need to succeed in higher education (Hanson, 2019). This topic is of great importance because college readiness has a direct impact on students' ability to thrive and complete their degrees. According to Johnson (2021), college readiness encompasses the academic, social, and emotional preparedness of students for the challenges they will face in higher education. Students who are adequately prepared for college are more likely to thrive academically, engage in

campus life, and persist to graduation. Johnson's research highlights the significance of ensuring that students are equipped with the necessary skills and attributes to navigate the complexities of college life and achieve their academic goals. Students will face the challenge of the transition from high school to college, in which the change can affect their future careers. If students are not successful in college, they often drop out during their first year of college noting academic difficulty as a primary reason (Hanson, 2019).

One aspect of college readiness is academic preparedness. Students who are academically prepared for college have a solid foundation in core subjects such as math, science, English, and social sciences (Dalton & St. John, 2017). According to Smith (2020a), academic preparedness involves proficiency in key disciplines such as mathematics, science, English, and social sciences. Students who excel in these core subjects are more likely to adapt to the rigorous academic demands of college, engage effectively with course materials, and achieve academic success. Smith's research underscores the importance of academic readiness in equipping students with the necessary knowledge and skills to thrive in the college environment. They possess strong critical thinking and problem-solving skills, as well as the ability to effectively communicate their ideas both orally and in writing. According to the National Association for College Admission Counseling (NACAC), "college readiness means having the academic knowledge and skills necessary to succeed in college-level courses" (NACAC, 2017, p. 2).

Another important component of college readiness is social preparedness. College life involves interacting with a diverse group of peers, faculty, and staff. Students who are socially prepared have strong interpersonal skills, the ability to work collaboratively,

and a sense of self-efficacy. They are also aware of the resources available on campus and how to access them. A study by Perna and Titus (2016) found that social preparedness is positively associated with college persistence and graduation rates.

Emotional preparedness is equally crucial for college success. The transition from high school to college can be overwhelming for many students, as they navigate a new environment and face increased independence. Emotionally prepared students have the resilience to manage stress, adapt to new situations, and seek support when needed. Emotional preparedness is a vital component of college success, as highlighted by Adams (2019). The transition from high school to college can be a challenging period for many students, characterized by increased independence and the need to adapt to a new environment.

According to Adams (2019), emotionally prepared students demonstrate resilience in managing stress, coping with new situations, and accessing support when necessary. These students are better equipped to navigate the emotional demands of college life, maintain mental well-being, and effectively handle the pressures associated with academic and social transitions. They possess a growth mindset and are open to learning from their failures. According to the American Psychological Association (APA), emotional preparedness includes "the ability to regulate emotions, manage stress, and maintain a positive outlook" (APA, 2019, p. 4).

To improve college readiness, various strategies can be implemented at both the high school and college levels. High schools can offer rigorous coursework, such as Advanced Placement (AP) or International Baccalaureate (IB) programs, to challenge students academically (Hanson, 2019). They can also provide counseling services that

help students explore career options, set goals, and develop a plan for college enrollment. Additionally, high schools can collaborate with colleges and universities to establish dual enrollment programs, allowing students to earn college credits while still in high school.

Colleges and universities play a vital role in supporting college readiness. They can offer pre-college programs that provide students with a taste of college life and academic expectations. These programs can include academic workshops, mentoring, and opportunities for students to connect with current college students (NACAC, 2017). Colleges can also provide comprehensive support services, such as tutoring centers, counseling services, and career development programs, to assist students in their transition and ensure their success (NACAC, 2017).

In conclusion, college readiness is a multifaceted concept that encompasses academic, social, and emotional preparedness. It is crucial for students to be equipped with the necessary skills and knowledge to succeed in higher education. By implementing strategies such as rigorous coursework, counseling services, and pre-college programs, we can enhance college readiness and ultimately improve college completion rates (Adams, 2019; NACAC, 2017). As educators, policymakers, and stakeholders, it is our collective responsibility to ensure that all students have an equal opportunity to thrive in college and beyond (APA, 2019).

Impact of Computer-based Instruction on Student Academic Achievement

Several research studies were found comparing the impact of computer-based instruction on academic achievement. According to Renshaw and Taylor (2010), computer-based instruction is effective for enhancing rote memorization but the impact on critical thinking skills is less clear. Studies have used various methods to evaluate the

educational effectiveness of computer-based instruction on achievement using surveys, quizzes, and pre-and post-interviews, but may not be effective for evaluating the impact on critical thinking skills (Renshaw and Taylor, 2010).

Chirco (2018) completed a research study to determine whether computer-based instruction impacted student achievement and attitudes towards using technology in the classroom. The quantitative research study analyzed pre-and post-tests and student surveys. The sample consisted of twenty-eight third-grade students. The students were taught a lesson on fractions over a three-weeks. The students were randomly assigned to two groups: one with computer-based instruction and one group with teacher-led instruction. The findings indicated that the use of computer-based instruction positively impacted student academic achievement. However, the results from the data showed that computer-based instruction was not as effective on student achievement as teacher-led instruction. The extended use of computer-based instruction also improved the attitudes toward learning and technology (Chirco, 2018).

Gilmore (2018) investigated the impact of computer-based learning on middle school math achievement of at-risk students. The convenience sample consisted of 83 middle school students in Georgia. These students were failing to meet local and state proficiency levels. Computer-based instruction was implemented as an intervention to increase math achievement. The research study used a pre-and post-test design. The results indicated that the computer-based instruction, Math 180, did not show a statistically significant increase in achievement for the students. The observed power for the null hypothesis was very low indicating a type II error; therefore, there may have been an effect of Math 180 on student achievement. The sample size was too small to

detect it. Gilmore (2018) recommends that further research continue on other computer-based programs.

"The United States ranks in the middle of other nations participating in the Program for International Student Assessment, and secondary education has not seen growth in mathematics achievement since the 1970s" (Robinson, 2020, p.3). Since computer-assisted mathematics offers new opportunities to increase math achievement with students, Robinson (2020) conducted a study using a computer-assisted program, Math XL, for secondary math students for Algebra I and Geometry in an online intervention program. The sample of students was taken from high school students enrolled online in Algebra I or Geometry. Performance is measured using an end-of-course examination. A comparison group was created from students who chose not to participate in the math intervention program. An analysis of variance was used to test for statistically significant differences in the end-of-course test scores in those students enrolled in the math intervention program and those students who are not enrolled in the computer-assisted math intervention program. The analysis found no significant difference in the mean between the group enrolled in the computer-assisted intervention and those not enrolled.

Gaps in Research

The gaps in this research included determining what factors impacted math achievement for high school students enrolled in computer-based instruction at an alternative school. There were gaps in knowing what specifically caused an increase in student achievement for the research studies that showed positive results. Based on the results of research studies conducted to evaluate the impact of computer-based

instruction on student achievement, there was a need to conduct further studies on high school students and alternative school learning environments. The action research study conducted by the researcher will add to the body of literature already conducted on computer-based instruction, alternative schools, and mathematics achievement of high school students.

Summary

The literature review indicated that students with high poverty levels or labeled as at-risk and enrolled in online or computer-based math courses may not achieve college readiness due to a lack of support or access to technological resources. A significant amount of research is available on online learning, assessing math achievement and computer-based instruction in statistical data, reports, and studies. The literature review also indicates sufficient and reliable measures for college readiness (NACAC, 2017) for high school students, whether they enroll in online math courses or traditional math courses. The was little literature on the relationship between high school students and online math courses compared to undergraduate college students taking online college courses at universities.

Further studies are needed on high school computer-based instruction and academic success. There was no literature on the impact on mathematics achievement for high school students enrolled in computer-based math courses at alternative schools accounting for gender and ethnicity. The researcher used the results from this study to add to the body of literature on computer-based instruction and its impact on math achievement for high school students enrolled in an alternative school learning environment and created implications for further research on the relationship between

high school students enrolled in alternative schools using computer-based instruction. In addition, the study accounted for gender and ethnicity, which will also create implications for further research studies on alternative schools, gender, and ethnicity.

Chapter three discussed the research design and approach, setting and sample, data collection, instrumentation and materials, data analysis, and ethical safeguards. Chapter Three provided information on the description, justification, and logical derivation of the research design and approach, the research setting, and the sample. Following these descriptions, information on instrumentation and materials are provided to ensure equality of math courses and validity of the testing instrument examined. The chapter will be completed with data collection, data analysis, and ethical safeguards.

CHAPTER 3

METHODOLOGY

Alternative schools are designed to offer students another pathway to graduation. The CCSD offers several methods of instructional delivery to students including computer-based instruction. Many students graduate from high school after attending alternative learning environments where computer-based instruction serves as an option for receiving various course credits. Over the last 19 years, the CCSD's alternative school has followed this trend and offered computer-based math instruction to its high school students. The primary computer-based courses include Foundations in Algebra, Intermediate Algebra, Algebra 1, Geometry, and Probability & Statistics.

While searching for research studies on evaluating the effectiveness of computer-based instruction, it was determined that there was a lack of information or research studies to show the impact of computer-based instruction on math achievement for high school students who attended an alternative school before graduation. Scholars must continue to research in this area, as many of the at-risk students who enroll in alternative schools are students who are typically underrepresented in education and/or students who are at a higher risk of dropping out of high school. Many at-risk students who enroll in alternative schools belong to underrepresented groups in education and are at a higher risk of dropping out of high school (Dupéré, 2018). Dupéré (2018) stated the importance of understanding the unique challenges faced by these students and developing tailored interventions to support their academic success. By investigating the factors contributing

to the enrollment of at-risk students in high schools, scholars can contribute to the development of targeted strategies that address the needs of marginalized student populations and mitigate the risk of dropout (Dupéré, 2018).

According to Dunning-Lozano (2016), at-risk students are removed from the school district's traditional high school and placed in substandard alternative schools lacking in material and intellectual resources. Couple this with the fact that nearly fifty percent of Hispanics, African Americans, and Native Americans do not graduate on time with their classmates (Darling-Hammond et al., 2014; Bransberger et al., 2020). The disparity in on-time graduation rates among Hispanics, African Americans, and Native Americans underscores the need for targeted interventions and support mechanisms in education, as highlighted by Howard (2019).

Factors contributing to the delayed graduation of these student groups include systemic inequalities, socioeconomic barriers, inadequate access to educational resources, and cultural differences in educational experiences (Smith & Brown, 2018). Howard (2019) emphasized the importance of addressing these multifaceted challenges through culturally responsive teaching practices, targeted academic support programs, and community partnerships that promote educational equity and inclusivity. By exploring the underlying causes of delayed graduation for Hispanic, African American, and Native American students, educators and policymakers can develop evidence-based interventions to improve graduation outcomes and reduce disparities in educational attainment.

Problem of Practice

The problem of practice addressed in this study was centered on evaluating the overall effectiveness of the Apex Learning mathematics program on mathematics achievement. It was further derived from the lack of data available on the impact of computer-based instruction on the math achievement of high school students who attend alternative school learning environments. According to a study by Williams et al. (2021), the integration of computer-based instruction in mathematics education has been associated with enhanced problem-solving skills and increased motivation among learners. The aim of this action research study sought to add to the body of literature related to the impact of computer-based instruction on mathematics achievement for at-risk high school students attending an alternative learning environment. Computer-based instruction has been found to positively influence math achievement by providing personalized learning experiences and immediate feedback to students (Johnson & Smith, 2018).

Purpose of the Study

The purpose of this action research study was to evaluate the impact of high school computer-based math instruction and the academic success of high school students enrolled in alternative learning environments. The research study focused on the impact of CBI on mathematics achievement.

Research Questions

The following research questions guided the research study:

Research Question: What is the overall impact of the Apex Learning mathematics online program on mathematics achievement for high school students enrolled in an alternative high school?

Sub-Research Question #1: How do students perceive their academic success and college readiness as it relates to mathematics achievement utilizing the Apex Learning mathematics program?

Sub-Research Question #2: What supports, if any, do high school students recommend for the learning environment within the alternative school to foster their success with the Apex Learning mathematics program?

Research Design

This action research study utilized a mixed-methods design to search for and collect data that fit the definition of qualitative and quantitative research on examining the overall impact of computer-based math instruction on math achievement in an alternative high school, accounting for student gender and race/ethnicity from a review of student data. According to Messikh (2020), action research provides an opportunity for teachers to develop critical thinking skills while becoming problem-solvers for the challenges faced in their classrooms. According to Herr and Anderson (2015), "Most practitioners or communities hope that action research will solve pressing problems or improve their practice" (p. 4). Mixed methods design tends to add a strong methodological foundation by creating an integrated approach for addressing practical problems in action research (Ivankova & Wingo, 2018). The quantitative data consists of pre-/post-tests, final course grades, and surveys, accounting for the number of students by

gender and race/ethnicity. The qualitative data will come from semi-structured interviews and surveys.

The basic interpretive approach using qualitative data (Dana & Yendol-Hoppey, 2020; Efron & Ravid, 2020; Herr & Anderson, 2015) was chosen for a part of this study because the researcher was interested in learning about ways students perceive academic success and college readiness as it relates to mathematics achievement utilizing the Apex Learning mathematics computer-based instruction (Apex Learning, 2018). The researcher wanted to find out the types of support high school students would recommend, if any, to ensure that the alternative learning environment undergirded their success with the Apex Learning mathematics computer-based program.

Apex Learning Intervention

The teacher-researcher implemented the Apex Learning program in a mathematics course to give students an opportunity to discover and make meaning of their own learning. With Apex Learning, students are able to learn at their own pace. The Apex Learning program allowed students to follow a one-semester pacing guide as they worked through their assigned mathematics course.

Apex Learning Activity Types

Students were given a sequenced plan of activities for math lessons using interactive features that gave immediate feedback on shaping student behavior during computer-based learning (Gilmore, 2018). Each mathematics course is divided into the following activities (Apex Learning, 2018):

- **Study** – The study consisted of course concepts using text, images, multimedia, and active learning opportunities. Study guides were available and helped with organizing notes and checking for understanding.
- **Discussion** – The discussion consisted of open-ended prompts that promoted class discussions. Students who take part in the discussion activities might construct knowledge and make sense of their learning (Faris, 2017; Jazim et al., 2017).
- **Quizzes** – The quizzes were computerized, lesson-level assessments that were scored by the computer.
- **Computer-Scored Test (CST)** – This was a computerized, summative unit-level assessment that was scored by the computer.
- **Final Exam** – These exams were computerized, summative, semester-level assessments scored by the computer.

As each student progressed through their assigned mathematics courses, they had to complete several computer-scored activities. The most common of these are computer-scored quizzes at the end of lessons, and computer-scored tests at the end of units and semesters.

Apex Learning Course Settings

Course settings promoted academic integrity in computer-scored assessments. The teacher-researcher adjusted the course settings for individual classrooms at the beginning of each semester. The following Mastery-Based Learning (MBL) course setting is described below and used for each Apex Learning mathematics course (Apex Learning, 2018):

Mastery-Based Learning (MBL) – The MBL allowed students to work through course content sequentially and are required to earn a minimum score (60%) on the computer-scored assessments to move to the next set of activities. MBL attempts were set to the number of times (2) a student may attempt mastery before being blocked from the quiz.

Apex Learning has other settings that provided support to students who might have needed additional support. The Apex Learning program has a Text-to-Speech (TTS) and Translation feature that provided support for students who needed additional resources for language and reading, particularly English Language Learners (ELL) and below-proficient readers (Apex Learning, 2018). The MBL setting was determined to be the appropriate setting for students to progress at their own pace and ensure a deeper understanding of the material before advancing further.

Prescriptive Pretests

The prescriptive pretests are only available for content recovery courses. The following settings are available for prescriptive pretests (Apex Learning, 2018):

- **Pretest Test-out Level (PTO)** – If the pretest score (60%) is above this level, scored activities in the unit were assigned the earned percentage.
- **Allow Unit Test-out (UTO)** – This setting permitted test-out of all scored activities in a unit if the pretest was above the Pretest test-out level (60%).
- **Require Pretest (RP)** – This setting locked student access to unit activities until the pretest was complete.

Monitoring Students

The teacher-researcher monitored each student's progress as they navigated through their assigned mathematics course. The Course Activity Scores Report was used to monitor each student's progress. The Course Activity Scores Report is a report that allows the viewing of individual performance data including all scored activity due dates, completion dates, and scores (Apex Learning, 2018).

The Apex Learning program used as an intervention allowed students to work independently on their assigned mathematics computer-based course. The students were able to navigate the computer-based program after having a thorough introduction and tutorial on how to use the features available for each mathematics course. The students watched a tutorial and were able to ask questions about various features offered by Apex Learning. The teacher-researcher was available to assist with features of the Apex Learning computer-based learning program as well as assisted with any technical difficulties that might have occurred during student use. The teacher-researcher was also available to reset quizzes or unlock proctored quizzes or tests for the students.

Setting and Context

The research study took place at The Alternative Center (TAC) (pseudonym). The Alternative Center is the only alternative school learning environment in the Cayland County School District (pseudonym). It houses students in grades sixth through twelfth. Students in this study have a homeschool in one of the three high schools in the district. Cayland is a rural county located in South Carolina. During the 2022-2023 school year, TAC had 50 students enrolled in grades sixth through twelfth. The enrollment as of spring 2024 is 65 students in grades sixth through twelfth.

The Alternative Center serves students who are all receiving free lunches through the school district's free lunch program. For the 2023-2024 school year, the student population serves students who are African American, Caucasian, and Hispanic. The students in the high school classrooms are separated by grade levels; 9th and 10th grade are in the same class and 11th and 12th grade are in the same classroom for mathematics. The research study focused on 20 high school students enrolled in a computer-based mathematics course.

The students used the Apex Learning computer-based program (Apex Learning, 2018). The students were enrolled in one or more of the following computer-based mathematics courses: Foundations of Mathematics, Intermediate Algebra, Algebra I, Algebra II, Geometry, Pre-Calculus, Discrete Mathematics, or Probability and Statistics. Each course is a semester-long course; therefore, the timeframe for the research study took place over which is equivalent to eighteen weeks.

Role of the Researcher

The teacher-researcher for this action research study is an African-American veteran female math teacher. The primary role of the researcher as a teacher is to act as a facilitator for the high school students using the Apex Learning mathematics computer-based learning program in the classroom. As the facilitator, the teacher-researcher unlocked and monitored students as they completed quizzes, tests, and exams in the classroom. Another responsibility was to print grade reports from the Apex Learning program and file them in each student's folder in the classroom. The teacher role also required the researcher to maintain folders on each student that contained personal information, Apex Learning grade reports, and documentation of communication with

parents. The teacher-researcher maintained all responsibilities required by the administration at TAC (e.g., morning duty, monitoring the restrooms, lunch duty, faculty meetings, math department meetings, and professional learning community meetings).

For purposes of data collection in the research study, the teacher-researcher collected data using surveys, Pre-/Post-tests, Apex Learning final course grades, and semi-structured interviews. As a teacher working at TAC, the researcher had perceptions about the effectiveness of its academic program. This bias had to be addressed in order to gather, analyze, and interpret data validly and truthfully. The teacher-practitioner had to set aside the teacher role and use the researcher role to conduct semi-structured interviews. The researcher used member checks to ensure that the data was valid and reliable, (Efron & Ravid, 2020). According to Herr and Anderson (2015), "most practitioners or communities hope that action research will solve pressing problems or improve their practice…" (p. 4). The researcher hopes that this action research study will help find personal insights to improve teaching and learning for the teacher-practitioner role.

Study Participants

To protect the identity of the participants and setting, pseudonyms were used throughout the study. The participants for this research study were drawn using a convenience sample. The researcher sampled the high school students enrolled in the alternative school program taking computer-based instruction in mathematics. Home schools are the high schools in which the high school students are enrolled based on their location in the county; there are three high schools in the school district.

A purposeful, non-random sample method was used to choose students for this study. Heppner and Heppner (2004) and Merriam and Tisdall (2016) indicated that when choosing to conduct non-random sampling, researchers should attend to both race/ethnicity and gender in sampling whenever possible. Purposive sampling allowed the researcher to use judgment to select a sample believed to be representative of the larger population (Heppner and Heppner, 2004; Merriam and Tisdall, 2016). The sample size depended on the number of high school students enrolled in the district's high school alternative school and who agreed to participate in the research study.

Participants for this research study were further identified using the roster of high school students enrolled at TAC taking a mathematics course via computer-based instruction including the seniors who will be graduating after attending TAC for the 2023-2024 school year. South Carolina requires all high school students to complete at least four high school math courses to meet high school mathematics graduation requirements. Participants were selected from students enrolled in either of the following mathematics courses: Foundations of Algebra, Intermediate Algebra, Algebra 1, Algebra 2, Geometry, Discrete Math, Probability & Statistics, or Pre-Calculus.

The participants included in this research study were 20 high school students who are currently attending TAC. There were 15 males and 5 females participating in this research study with 10% sophomores, 50% juniors, and 40% seniors. Demographically, 65% were African American, 30% were Caucasian, and 5% Hispanic. All of the students qualified for a free lunch program because the district participated in a free lunch program. Of the 20 students, 15% were served by Individualized Educational Plans (IEP).

The demographic makeup of the participants in the study is shown in Figure 3.1. Figure 3.1 compares the number of females to males for African American, Caucasian, and Hispanic students. There was a total of 20 students in the study in grades 10 – 12.

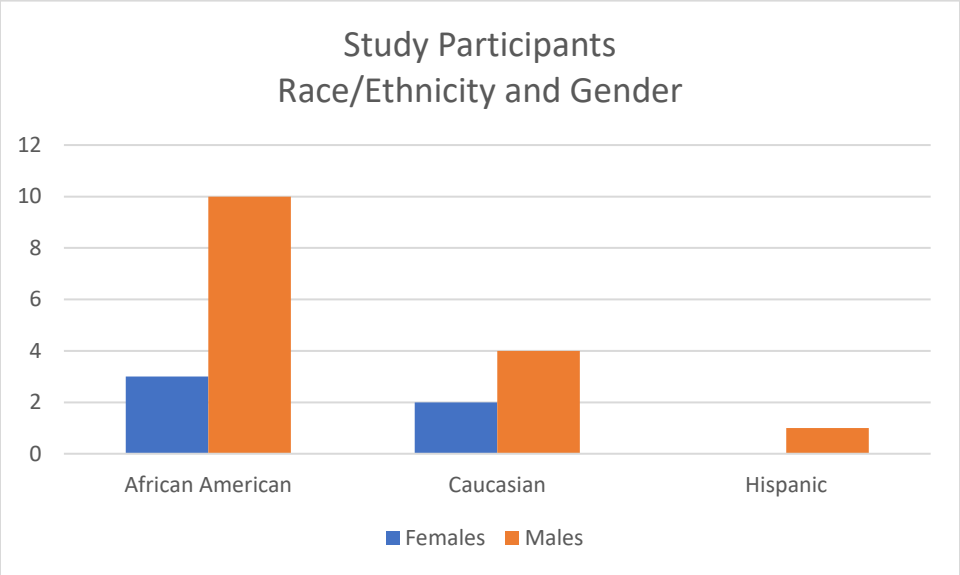

Figure 3.1 Study Participants by Race/Ethnicity and Gender

The names of the twenty high school students were placed in alphabetical order and assigned numbers for anonymity. The assigned numbers were used to identify each student in the reports. The students were numbered from Student 1 to Student 20.

Students 1, 2, 12, 13, 14, 15, 18, and 20 all of whom were fast-track high school seniors, were selected to take part in the semi-structured interviews for data collection purposes. They are considered fast track because they only needed 1-2 math courses and no more than 6 other courses to graduate in the spring of 2024; therefore, they might need to take one more math course during the 2024 spring semester. All of these students were repeating geometry and were supposed to graduate in 2023 but did not graduate due to some unforeseen circumstances. Some of the students were truant, expelled for the remainder of the spring 2023 semester, or failed to complete their assigned Apex Learning courses. These students were assigned to TAC's afterschool program during the

spring 2023 semester before being reassigned to the day program for the 2023 fall semester. The primary goal was to work with these seniors on a fast-track to help them graduate in the spring of 2024. Fast-track allows the students to work at a fast pace to complete the required courses needed to meet graduation requirements. Fast-tracking works for those students who focus and complete the courses needed to graduate.

Student Participants

- Student 1 was an African American male retaking geometry. The year prior, Ahmad took geometry and failed due to poor attendance. He had an individualized education plan (IEP) and received academic support from the special education teacher, Mrs. Brand (pseudonym). His learning disability allowed him to have accommodations such as additional time to complete assignments, preferential seating, and assistance from his special education teacher. He worked well in class and got along well with his classmates. He worked very hard and sometimes required his quizzes to be reset more than once. He also needed to use headphones to use the Apex Learning program reading feature. He often went to the special education teacher's classroom for additional support. has already found a job at Bojangles and is an assistant manager.
- Student 2 was a Caucasian male who is quiet and preferred to sit away from the other students. This student had an IEP filed with special education. I had one table that was at the back of the classroom so, he sat there daily. He was an average student because he maintained a C average in geometry. If he passed a quiz or test with a minimum score of 60%, then he did not want to do it again. This student plans on becoming a firefighter.

- Student 12 was a Hispanic male. He had an IEP. English was his second language, but he spoke fluent English. He read and comprehended literature at grade level. He wanted to become a cosmetologist and own his own salon. He worked slowly but managed to complete all of his work by the end of the semester.
- Student 13 was a Caucasian male who was truant. He had excessive absences. He has been referred to our district's truancy officer. He was scheduled to graduate in 2023 but he did not complete the courses in which he was supposed to complete. He returned to TAC this year to complete the rest of his high school coursework so that he can graduate in 2024. He wanted to be a long-distance truck driver.
- Student 14 was an African American male. Noah was a student at TAC when he was in the 7th grade. He returned to TAC because he felt that he could get more work completed in TAC. Noah often worked quietly but worked at a fast pace. He completed his course before the final due date.
- Student 15 was an African American male who loved sports. He wanted to play basketball in college. When he worked in Apex Learning, he wrote thorough notes and worked through all of the practice problems. He was very competitive so he challenged his classmates to see who would get the highest quiz or test score.
- Student 18 was an African American male. He had a desire to attend college. He worked and if his quiz or test score was not up to par, then he will do it over. He tries to get grades of 'A' on his assignments.

- Student 20 was an African American male. He maintained a ‘C’ average. He worked to make sure that each one of his assignments was his best work. He kept a math notebook in which he kept his notes and/or handouts
- Student 6 was a Caucasian male. He to worked alone and preferred not to have anyone sitting beside or behind him. He never worked ahead of his Apex Learning calendar of assignments. He was 18 years old and lived in a small travel trailer in his parents' backyard because he did not get along with his stepmother.
- Student 9 was a Caucasian female who requested to attend TAC because she was truant at her homeschool. Her brother attended TAC during the year before the pandemic. He was killed in a car accident. She worked at a fast pace.
- Student 17 was a Caucasian female who was pregnant. Her main goal was to graduate to get a job to take care of her baby. She planned to have her baby and return during the summer to complete the remaining courses she needed to get her diploma. She came from a single-parent home where she lived with her father. She wanted to be a receptionist.
- Student 5 was a Caucasian male who was an athlete. He was the oldest of three children. He lived with his father. His mother was not in his life. He was very organized and took notes during class. He asked questions about math problems in his study plan while navigating through his lessons. He said that he liked math. He wanted to own a lawn care business when he finished school.

- Student 3 was an African American male who had a 2-year-old son. He was truant and was trying to regain visitation with his son. His attention span was short, and he daydreamed a lot. He had to be refocused quite a lot. He wanted to earn his diploma. He had a job working at a fast-food restaurant. He planned to open a pressure-washing business.
- Student 7 was an African American female. She worked independently on her math. She was in the gifted and talented program in middle school. She said that her residential placement in foster care caused her grades to decline starting in 6th grade. She still hoped to find a forever home and family. She planned to open a home daycare one day.
- Student 11 was an African American male. This student had been enrolled in two other alternative schools this year. He said that he was bullied at his old high school. He always completed his math assignments. He kept a notebook and wrote down math notes. He plans to become a construction worker in his uncle's business.
- Student 16 was an African American male. He was truant. He met with the district's attendance clerk several times about his attendance. He completed his math assignments when he was present at school. He took math notes during his lessons. He did not ask questions about his study plan's math problems. He did not know what he wanted to do after he finished high school.
- Student 19 was an African American female. This student had missed a lot of days from TAC. She did average work in math. She wanted to be a cosmetologist after graduation.

- Student 10 was an African American female. She enjoyed doing hair. She had been in several fights and struggles to communicate her feelings to others. She does work hard academically. She said that she liked using Apex Learning.
- Student 4 was an African American male. He had an older brother who taught line dancing classes. He planned to start a dance studio after he graduated high school. He said that he was on the debate team when he was in middle school.
- Student 8 was an African American male. He was extremely quiet in class. He was always talking about the universe and following the numbers of the universe. He was the father of a baby girl. He was looking for a job so that he could help provide for his child financially. He talked about dropping out of traditional school and enrolling in adult education. He planned to be a security guard when he completed high school.

Table 3.1 shows the projected graduation years for the student participants. This information helped the researcher identify the seniors who are planning to graduate this 2023-2024 school year. Figure 3.2 shows the graduation years in graphical form.

Table 3.1 Participants Proposed Graduation Year

Name	Race/Ethnicity	Gender	Proposed Grad Year
Student 12	Hispanic	Male	2024
Student 6	Caucasian	Male	2025
Student 9	Caucasian	Female	2025
Student 17	Caucasian	Female	2025
Student 13	Caucasian	Male	2024
Student 5	Caucasian	Male	2026
Student 3	African American	Male	2025
Student 20	African American	Male	2024
Student 2	Caucasian	Male	2024
Student 7	African American	Female	2025
Student 11	African American	Male	2025
Student 14	African American	Male	2024
Student 16	African American	Male	2025
Student 19	African American	Female	2024
Student 4	African American	Male	2025
Student 15	African American	Male	2024
Student 8	African American	Male	2025
Student 1	African American	Male	2024
Student 10	African American	Female	2026
Student 18	African American	Male	2025

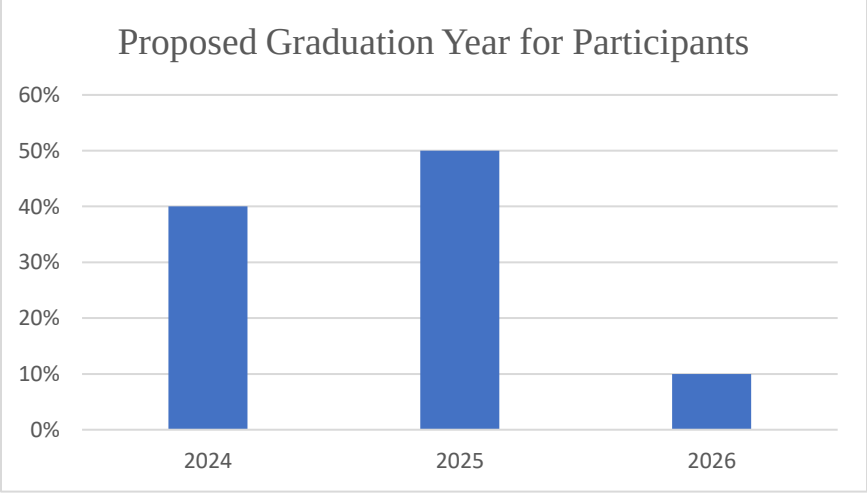

Figure 3.2 Proposed Graduation Dates

The student record data was reviewed to gather data on the proposed graduation year for each of the participants. Figure 3.2 has the percentages of proposed graduates by year. There were 8 seniors (40%) who plan to graduate in 2024, ten participants who are juniors (50%) and plan to graduate in 2025, and two sophomores (10%) who plan to graduate in 2026. The 40% of participants will finish their senior year at TAC. Further questions were asked about college readiness in the semi-structured interviews. The students' answers will be discussed in the qualitative data analysis section. These students were enrolled in geometry first and then scheduled to take the Probability and Statistics course as their last math course in spring 2024. These students are following the South Carolina High School Mathematics Course Pathway 2 (Table 1.2).

Data Collection

Upon approval from the IRB and securing consent from the parent/guardian of the participants and meeting with the participants, the following data collection methods were used in the research study: survey, Apex Learning reports, and semi-structured interviews.

Table 3.2 Data Collection Methods

Research Question: What is the overall impact of the Apex Learning mathematics online program on mathematics achievement for high school students enrolled in an alternative high school program?	**Quantitative Data** • Pre-/Post-tests • Apex Final Course Grade • Survey
Sub-Research Question #1: How do students perceive their academic success and college	**Qualitative Data**

readiness as it relates to mathematics achievement utilizing the Apex Learning mathematics program?	• Semi-structured Interviews • Survey
Sub-Research Question #2: What supports do high school students recommend for the learning environment within the alternative school to foster their success with the Apex Learning mathematics program?	**Qualitative Data** • Survey • Semi-structured Interviews

Survey Questions

The researcher used a survey (APPENDIX E.1) which was developed to allow students to anonymously share their feelings and experiences (Dana & Yendol-Hoppey, 2014). The researcher created a survey to pair with semi-structured interview questions to have participants provide answers to various factors, such as the number of hours spent on the computer in a math course, the number of times retaking a quiz or test, and their final course grade. The surveys were also used to measure some perceptions of students to help answer research questions (Creswell and Plano Clark, 2013, as cited in, Merriam & Tisdall, 2016). According to Efron and Ravid (2020), surveys are one of the "most common and efficient ways to gather information" (p. 113).

Other factors were reviewed based on the answers to the surveys. The surveys provided data on the number of times a student had to retake quizzes or tests, math course final grades, and the amount of time spent working on the computer-based math course at school.

Assessment Data

The researcher collected data from Apex Learning reports and student records. The Apex Learning reports contained the name of the Apex Learning math course, time on task for each lesson, lesson quiz scores, unit test scores, and math course final scores for students who were enrolled in The Alternative Center. The quantitative data also consisted of math course pretests and posttests (Table 4.1), and final course grades (Table 4.2) taken from the Apex Learning program. The review of assessment grades from Apex Learning reports rendered data that was classified as quantitative research. The researcher reviewed assessment grades from Apex Learning program reports and student profiles accounting for gender and race/ethnicity. The researcher used the collected student data to account for gender and race/ethnicity.

Semi-Structured Interviews

Semi-structured interviews (APPENDIX F.1) are defined as the process in which a researcher and participant engage in a conversation using questions focused on the research topic (DeMarrais, 2004, as cited in, Merriam & Tisdall, 2016). The conversation that the researcher used with the participants had a flexible, set of questions; therefore, the researcher had person-to-person, semi-structured interviews. The semi-structured interviews allowed the researcher to gain knowledge about the perceptions of students.

The researcher took notes during the semi-structured interviews. Reflective notes will include very detailed and "descriptive writing" (Merriam & Tisdall, 2016, p.149). Field notes can also be written as "reflective notes" (Efron & Ravid, 2020, p. 95). For the purpose of the research study, descriptive notes were used (Efron and Ravid, 2020):

- to note the comments of the participants, and
- to write tentative interpretations supported by data.

The interview responses were recorded to “create videos of the interviews” to help with transcribing the interviews (Herr & Anderson, 2015, p. 108). The interview questions were structured to get as much information as possible related to the research questions that were designed for this research study. “Different types of questions” helped gather different types of information (Merriam & Tisdall, 2016, p. 117). There are six different types of questions that were used to get information from participants.

Various types of questions were used to gather in-depth data from each participant. The researcher used semi-structured interview questions to learn about experience and behavior, opinion and value, feelings, knowledge, sensory, and background/demographic based on the research questions (Merriam & Tisdall, 2016). At this point, Merriam & Tisdall (2016) suggested that the researcher sit down at a table with the transcript from the first interview or the data from the assessment reports collected and review the purpose of the research study. After doing this, the researcher made notes in the margins commenting on the data collected.

Research Procedures and Timeline

Weeks 1-9

Upon approval from the IRB, the research study began during the fall semester of the school year for the 2023-2024 school year. Students were given the classroom procedures and expectations of the TAC program and instructions on how to use the Apex Learning computer-based learning program for mathematics. Students were informed that a research study was going to be conducted during the semester and all consent forms were distributed and collected as they were signed and returned. After receiving all of the signed consent forms from each of the participants of the study, a

meeting was held with all of the participants. The survey was distributed via the computer using Microsoft Forms. The data from the surveys were reviewed at the end of the week and used to create additional questions for individual semi-structured interviews. Student data was collected and analyzed from reports containing student grades, Apex Learning reports, and pre- and posttest scores, and the number of seniors who will enter college, accounting for gender, and race/ethnicity.

Weeks 10-18

By the beginning of Week 10, students were accustomed to expectations in their Apex Learning mathematics course. Semi-structured interviews were continued, and notes were written and reviewed the same day. Student math course final grades from Apex Learning were collected at the end of Week 18. The researcher continued to collect data from Apex Learning reports and student records showing Apex Learning final course grades.

Data Analysis

Qualitative Data Analysis

The data from the surveys and the semi-structured interviews were analyzed as the data collection occurred to look for patterns, themes, or categories that might lead to the next data collection session using some form of "coding" (Merriam & Tisdall, 2016, p.199). Inductive coding is a valuable approach for researchers to analyze qualitative data (Creswell, 2013; Thomas, 2006). Inductive coding involves systematically categorizing and labeling data to identify patterns and themes (Efron & Ravid, 2020). This process allowed for the identification of emergent themes and concepts that may not have been anticipated beforehand. The themes that emerged from the survey and semi-interview

responses were benefits of computer-based instruction, covid-19 and online learning, face-to-face instruction and computer-based instruction, computer-based instruction and college readiness, and recommendations for computer-based instruction. To ensure rigor and transparency in the analysis process, it was essential to document coding decisions and maintain an audit trail (Saldaña, 2021). By employing inductive coding, the researcher was able to uncover new insights and contribute to the advancement of knowledge within the educational field.

Quantitative Data Analysis

For the quantitative data, the researcher gathered information from the pre-/post-tests, surveys, and Apex Learning final grade reports. The researcher utilized descriptive statistics to analyze the number of students who passed the computer-based course. Microsoft Excel and GraphPad were used to analyze the collected data for the study. The data analysis results were written descriptively using reports generated from Microsoft Excel. Some of the variables measured using the Microsoft Excel software were Apex Learning pre-and post-test scores, final course grades, and quantitative survey data. All results from the data analysis were written using a descriptive analysis based on the results from the Microsoft and GraphPad reports and/or from other analysis methods.

Summary

This research study took place in a high school alternative school learning environment. The participants were high school students in grades 10 – 12. Chapter Three provided information on the description, justification, and logical derivation of the research design and approach, the research setting, and the participants. Following these descriptions, information on instrumentation and materials were provided to ensure the

equality of computer-based math courses, and the validity of the testing instrument examined. The chapter was completed with data collection, data analysis, and ethical safeguards.

The research study examined overall the relationship between college readiness for high school students enrolled in alternative school learning environments enrolled in computer-based math courses using Apex Learning accounting for gender and ethnicity in South Carolina. The research study is a mixed methods research design. The participants for the study were selected in a purposeful, non-random sampling method. Excel and GraphPad were used to analyze the collected data for the study. The data analysis results were written descriptively using reports generated from the Microsoft Excel and GraphPad. Furthermore, Chapter Three provided information regarding how the data was organized and grouped within the identified areas for reporting. Chapter Four shared research results and presented the findings as determined by the researcher. Finally, in Chapter Five, the researcher discussed the findings and draws conclusions based on the information obtained. Recommendations were made, and information was provided on how future researchers can conduct future research to serve all students enrolled in alternative schools within the public education system.

CHAPTER 4

FINDINGS

The primary objective of the research study was to determine whether computer-based instruction would impact math achievement scores for students attending an alternative high school. According to Smith and Johnson (2016), action research allows teachers to identify areas of concern within their own classrooms and collaboratively develop and implement interventions to address these concerns. The purpose of this chapter is to present the findings of a research study that aimed to examine the impact of computer-based mathematics instruction on math achievement in an alternative high school setting. The study utilized a mixed-methods research design with 20 students enrolled in Geometry from an alternative high school who were assigned to use computer-based math instruction called Apex Learning.

Purpose of the Study

The action research study aimed to assess the impact of computer-based math instruction on math achievement at an alternative high school, specifically The Alternative Center (TAC). It sought to evaluate the effectiveness of the Apex Learning program in preparing students in this setting for college readiness. The study aimed to contribute to the existing knowledge on the influence of computer-based math instruction on math achievement in alternative school environments.

Significance of the Study

The research study explored the impact of a computer-based mathematics program, Apex Learning, on mathematics achievement for high school students in an alternative learning environment. It highlighted the historical weakness in mathematics achievement among district's high school students enrolled in TAC. The study's significance lies in contributing to the understanding of the impact of computer-based math instruction on math achievement in alternative school setting.

Research Question: What is the overall impact of the Apex Learning mathematics online program on mathematics achievement and college readiness for high school students enrolled in an alternative high school?

Sub-Research Question #1: How do students who are enrolled in an alternative high school program perceive their academic success and college readiness as it relates to mathematics achievement utilizing the Apex Learning mathematics program?

Sub-Research Question #2: What supports do high school students recommend for the learning environment within the alternative school to foster their success with the Apex Learning mathematics program?

Action research serves as a powerful tool for educators to continuously improve their instructional practices and contribute to the ongoing development of the field of education (Smith & Johnson, 2016). Hence, the overarching Research Question aimed to investigate the overall impact of the Apex Learning mathematics online program on mathematics achievement and college readiness for high school students enrolled in an alternative high school program. The study considered the factors of gender and race/ethnicity to understand any potential variations in the program's impact.

Findings

Quantitative

Results from Survey Question #2: How much time do you spend working on your computer-based math course at school? The average number of hours worked on Apex Learning each day for students was 5.1 hours per day. Students are enrolled in 5 class blocks each day. Four of the blocks are dedicated to working on math, science, English, social studies, or electives. The fifth block is used as a character education class or study hall. Each class period is approximately 80 minutes per day. Figure 4.1 shows the average amount of time that students spend on Apex Learning per day at school.

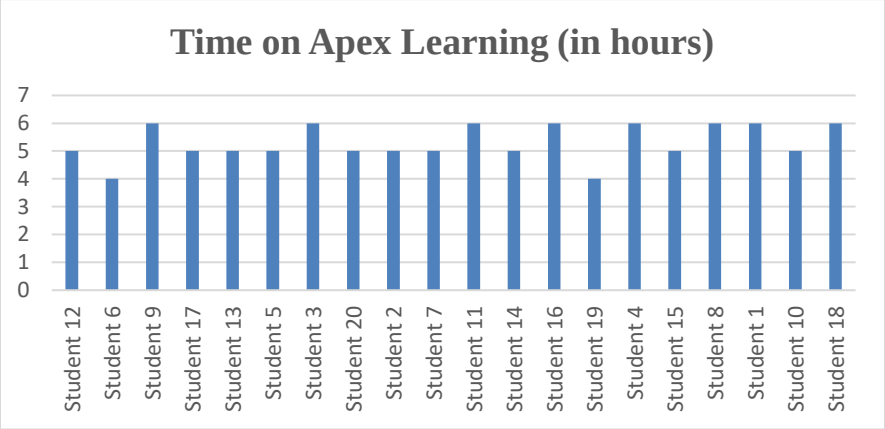

Figure 4.1 Time on Apex Learning Per Day

Results of the Pretest and Posttest. Apex Learning was used as the computer-based math instruction for the action research study. For the purpose of this study, students were administered an online pretest and a unit test (posttest) to measure mathematics achievement. The students were assigned a 45-item, multiple choice pretest. The pretest was designed by Apex Learning to assess the students' prior knowledge of the math concepts addressed in the instructional unit on foundations of geometry. The pretests in Apex Learning are designed to assess prior knowledge and create a personal

study plan for each student based on the pretest results. The study plan included unit activities for each student to complete for each student (Apex Learning, 2018). Each students' study plan included lessons for math concepts that were (did not test out of math concept with a minimum grade of 60) not mastered based on the score from the pretest. The student completed the study plan lessons and took the unit test (posttest) after completing the required study plan lessons. After each student completed the Apex Learning study plan lessons, they completed their posttest for the instructional unit on triangles. The unit test (posttest) consisted of 25 multiple choice questions which assessed each student's knowledge after the student had completed the computer-based learning in Apex Learning. The posttest was the same test for all students.

Table 4.1 displays each student's Apex Learning pretest, posttest, and the change between the two tests. The pretest and posttest were both worth 100 points. The column entitled change provided the difference between the pre- and post-test. The change in scores is shown in the change column using a plus sign to indicate an increase between the pretests and the posttests. Students who made a score equal to 60 points or higher are considered passing the unit and those scores are labeled with an asterisk.

Table 4.1 Apex Learning Pretest and Posttest

Name	Pretest	Posttest	Change
Student 12	62*	68*	+6
Student 6	56	68*	+12
Student 9	62*	64*	+2
Student 17	56	72*	+16
Student 13	60*	70*	+10
Student 5	53	68*	+15
Student 3	58	60*	+2
Student 20	53	64*	+11
Student 2	47	60*	+13
Student 7	47	72*	+25
Student 11	58	72*	+14

Student 14	62*	80*	+18
Student 16	49	64*	+15
Student 19	49	68*	+19
Student 4	33	56	+23
Student 15	11	56	+45
Student 8	29	72*	+43
Student 1	11	40	+29
Student 10	16	64*	+48
Student 18	11	60*	+49

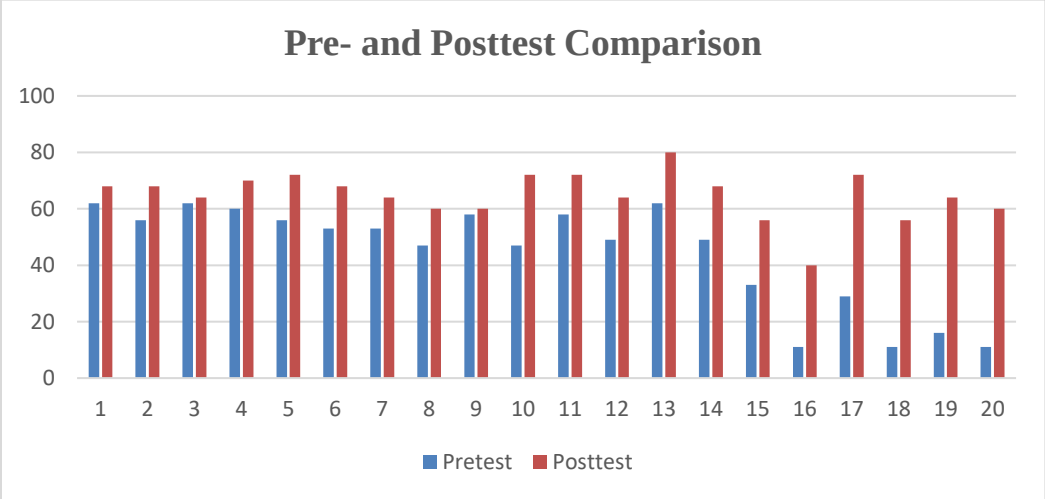

Figure 4.2 Pre- and Posttest Comparison

On the pretest, sixteen of twenty students (80%) scored below the 60% passing score. Four of the students scored 60% or above to pass the pretest. All students showed an increase in scores from the pretest score to the posttest score. Seventeen students scored 60% or above to pass the posttest (85%). Three students did not score a passing score of 60% on the posttest. The lowest change in scores was an increase of 6 points while the highest change in scores was an increase of 49 (Figure 4.2). The students who had the lowest pretest scores showed the highest growth.

The pretest scores had an average score of 44.2 points. However, the posttest had an average score of 64.9 points. Ten students scored above the posttest average score. The growth between the pretest and the posttest showed that all of the students learned

math concepts using their individualized study plans in Apex Learning indicative by the increase in points between the pretest and posttest scores. The lowest score on the posttest was 40% and the highest score was 80% and only one student made this score. The results of the paired-t test for the pretest and posttest indicated that there is a significant difference between the means of the Pretest (M = 44.2, SD = 18.5) and the Posttest (M = 64.9, SD = 8.4), t (19) = 6.9, p < .001. According to the standard deviation (SD) of the pretest, the scores were more spread out, but the SD of the posttest indicated that the scores were tightly clustered.

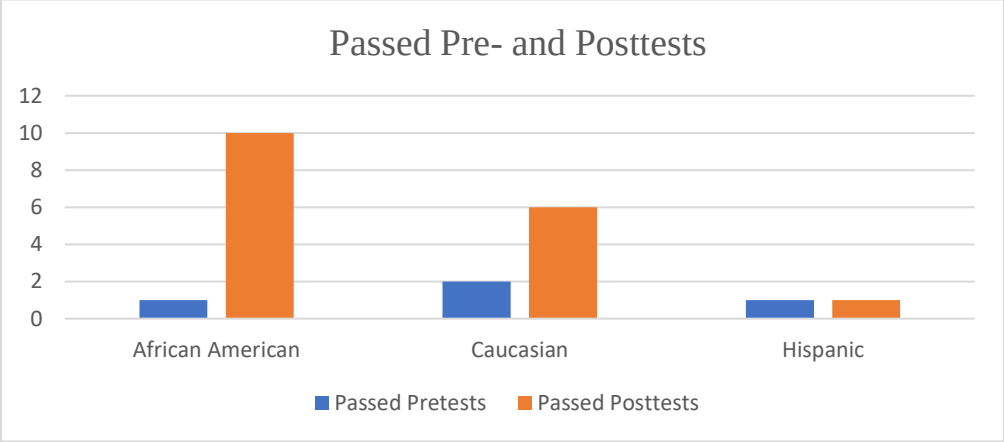

Figure 4.3 Passed Posttests by Race/Ethnicity

Figure 4.3 shows the analysis for students who passed the pretest and posttest by race/ethnicity. In Figure 4.3, the data shows that 2 Caucasian students, 1 African American student, and 1 Hispanic student passed the pretest with a grade of 60% or higher. The table shows that 10 African American students, 6 Caucasian students, and 1 Hispanic student passed the posttest after completing the Apex Learning instructional unit. The results of this table showed that 4 students (20%) passed the pretest and 17 students (85%) passed the posttest in Apex Learning. This concludes that students did better after completing the computer-based math instruction using Apex Learning.

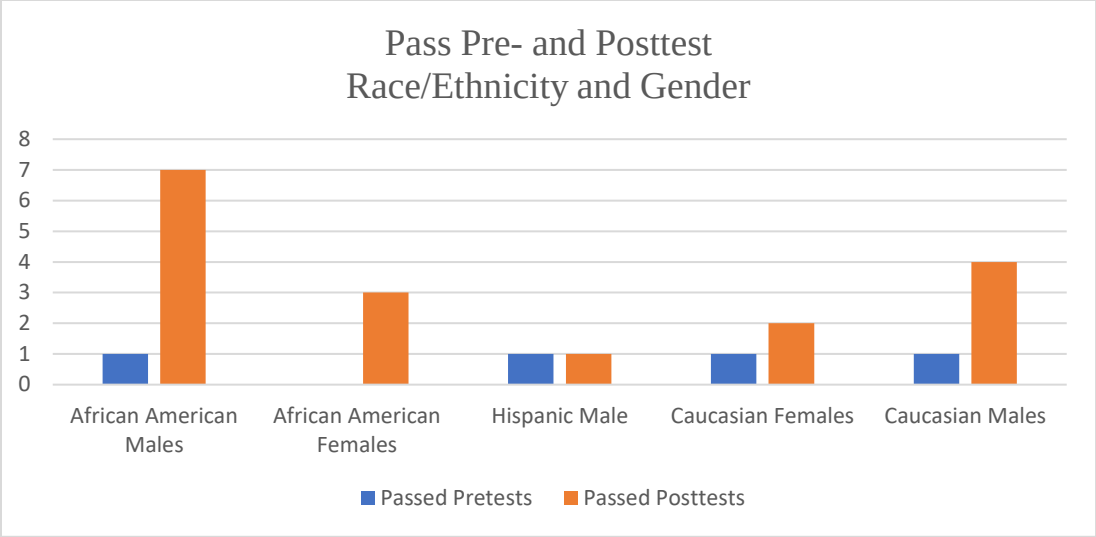

Figure 4.4 Pre- and Posttest by Race/Ethnicity and Gender

Figure 4.4 shows the number of students who passed the pretests and posttests by race/ethnicity and gender. There was 1 African American male, 1 Hispanic male, 1 Caucasian female, and 1 Caucasian male who passed the pretest. There were 7 African American males, 3 African American females, 1 Hispanic male, 2 Caucasian females, and 4 Caucasian males who passed the posttest. Only twenty percent of the students passed the pretest with a 60% or higher while eighty-five percent of the students passed the posttest. Of the twenty percent who passed the pretest, none were African American females.

Results for Apex Learning Final Course Grades

The Apex Learning program provided the researcher with reports that showed the student's final course grades, the amount of time they spent on each lesson, and the dates that assignments were completed. For this Apex Learning geometry course, students had to complete 11 units in geometry to earn their geometry final grade. The final grade was chosen as part of data collection from each students' Apex Learning grade report.

Table 4.2 Final Geometry Course Grades from Apex Learning Report

Name	Race/Ethnicity	Gender	Course Final Grade
Student 12	Hispanic	Male	60
Student 6	Caucasian	Male	62
Student 9	Caucasian	Female	62
Student 17	Caucasian	Female	64
Student 13	Caucasian	Male	64
Student 5	Caucasian	Male	66
Student 3	African American	Male	70
Student 20	African American	Male	70
Student 2	Caucasian	Male	70
Student 7	African American	Female	72
Student 11	African American	Male	74
Student 14	African American	Male	74
Student 16	African American	Male	74
Student 19	African American	Female	75
Student 4	African American	Male	75
Student 15	African American	Male	76
Student 8	African American	Male	76
Student 1	African American	Male	76
Student 10	African American	Female	80
Student 18	African American	Male	88

This data was collected as quantitative data because it is being used to address the research question examining the overall impact of the Apex Learning online math program on mathematics achievement for high school students enrolled in an alternative high school program. Table 4.2 shows twenty students who took geometry as their computer-based instruction using Apex Learning. Table 4.2 arranged the final course grades in ascending order to make it easier to view the scores from least to greatest. In Table 4.2, all students passed the geometry course with a grade of 60% or higher. The lowest final course grade was 60% which had only 1 student scoring at this level. The highest grade was 88% and only one student scored 88% for the final course grade. The average for the final course grades was 71.4% and 11 students earned a grade at or above

71.4% for their final course grade. Sixty-five percent of the students scoring 70% or higher were African Americans.

Qualitative Data Analysis

Results from Semi-Structured Interviews

In the qualitative data analysis section of this dissertation, a deep exploration of the rich narratives and experiences shared by participants unfolds. The technique of constant comparison was used to refine the data analysis, ultimately leading to the identification of meaningful themes (Figure 4.5). Through careful examination and interpretation of these qualitative data, valuable insights and themes emerge, shedding light on the complexities of the research topic. Analysis and subsequent coding of the interview transcripts revealed the following themes: theme 1: benefits of computer-based instruction, theme 2: COVID-19 prepared for future use of online learning, theme 3: face-to-face versus computer-based math instruction, theme 4: computer-based instruction and college readiness, and theme 5: recommendations for computer-based math instruction.

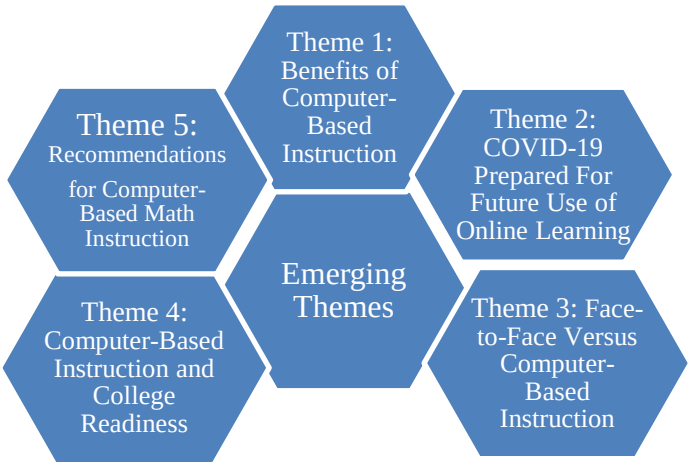

Figure 4.5 Emerging Themes from Interview Data

Theme 1: Benefits of computer-based math instruction. As the teacher-researcher for this action research, talking to the participants as their teacher and the interviewer was exciting to them. The students seemed calm and did not hesitate to answer interview questions. The students mentioned that computer-based instruction offered several benefits for them in their high school math classrooms at TAC. They all agreed that it provided a personalized learning experience for them. With computer-based instruction, students mentioned that they could progress at their own pace, allowing for individualized instruction and the ability to review material as needed. Students were asked about the number of times that they retake quizzes or tests to earn a passing score and the average for the students was 2 times that they needed to either retake a quiz or a test.

The semi-structured interview data provided evidence that computer-based instruction positively impacted the students. They said things like "I feel like working out the math on the computer is easy for me because I work at my own pace" (Student 2) and "I don't have to wait on other people when I am working on Apex Learning. I can work faster and can take my time if I need to when something is hard to me" (Student 14). Student 14 explained how Apex Learning benefited him: "I like the way we can skip some lessons if we pass some parts of the pretest." Through multimedia resources, simulations, and various features of Apex Learning, students could actively participate in their learning, "making it more interesting and enjoyable" (Student 18). Computer-based instruction offered interactive and engaging learning opportunities (Gilmore, 2018). Student 12 said, "I like that I can look at the lessons over and over again." Computer-based instruction also enhanced digital literacy skills, which are increasingly essential in

today's technology-driven world (Gilmore, 2018). When students were asked about learning using computer-based instruction; Student 12 had this to say:

School Work:

I am happy that we get to work at school because I have to work too much with my mom after school. I like the part of Apex Learning when I can make it read to me. That helps me a lot.

English Skills:

I speak English way better than my mom but sometimes I don't pronounce the words right. I like that I can have Apex Learning read the definition for the hard math words (Student 12, personal communication, September 7, 2023).

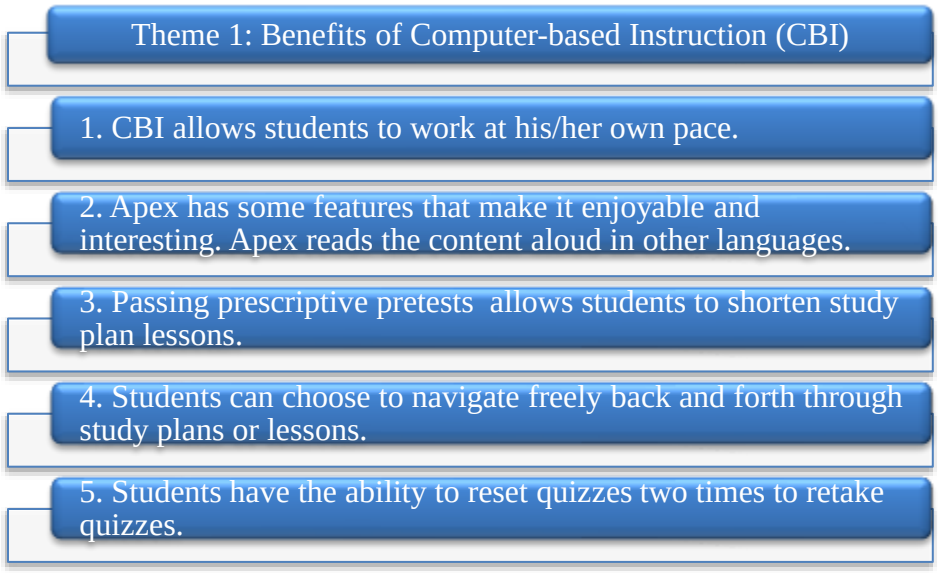

Figure 4.6 Theme 1: Benefits of Computer-based Instruction

While computer-based instruction offers numerous benefits expanding access to educational resources and enhancing student engagement, the global pandemic has also accelerated the adoption of online learning platforms. The challenges faced during the pandemic have not only highlighted the importance of digital tools but have also

equipped students with valuable skills for navigating and succeeding in virtual learning environments.

Theme 2: The pandemic prepared students for future use of online learning.

The pandemic has accelerated the adoption of computer-based math instruction in schools, preparing students for future use of technology (Franchi, 2020; Sintema, 2020). Our school district is a one-to-one technology district. We have assigned every student a laptop for school use. During the pandemic, all of our schools shifted to remote learning at one point, and students had to rely on online platforms and digital resources to continue their math education. While being isolated at home, students were able to learn to navigate virtual classrooms, submit assignments online, and communicate with their teachers and peers through digital platforms (Caldwell & Gedeon, 2019). This is what some of the students had to say about using the computer-based instruction during the pandemic:

According to Student 15, "using Apex Learning while we were out of school during the pandemic helped me learn to work harder. I had to listen to the teacher teach the lesson and then still use the Apex Learning study to help me. My mama couldn't help me. Student 15 also said, "I liked that we worked in Microsoft Teams because I could go back and rewatch the lesson video and I could send messages to my teacher for help."

Student 14 said this about how he felt during the pandemic, "I liked using Apex Learning because my teacher let us work by ourselves if we wanted to. We just had to have our work turned in by Friday. That taught me to keep a calendar of stuff due."

Student 12 said, "I like working on the computer now, but I did not like it during the pandemic. It was too hard for me because my Kajeet (district-issued mobile hotspot)

would not work right. I hated it. I did learn how to do my schoolwork on the computer so now it is not that hard."

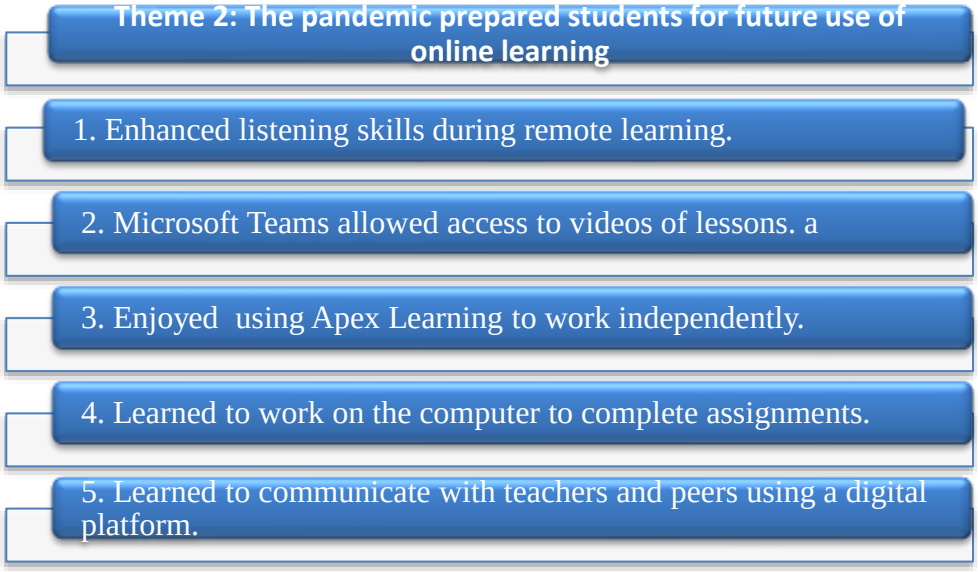

Figure 4.7 Theme 2: Pandemic Preparedness and Online Learning

As students adapt to the increasing prevalence of online learning, the comparison between face-to-face instruction and computer-based instruction becomes a pertinent consideration period while the pandemic has underscored the benefits of virtual learning, exploring the unique advantages and limitations of face-to-face instruction versus computer-based instruction is essential for effective educational decision-making.

Theme 3: Face-to-face instruction versus computer-based math instruction.

Face-to-face instruction and computer-based math instruction both have their advantages and are valuable approaches for these high school geometry students. There were times when the teacher had to teach mini one-on-one lessons to help students who needed the individual assistance with geometry topics. Face-to-face instruction provided immediate feedback and interaction with the teacher, allowing for real-time clarification of concepts and personalized guidance (Singh et al., 2021). At the same time, Apex

Learning is also designed to give immediate feedback to students as they acquire learning through using the lessons (Apex Learning, 2018). Apex Learning also promoted peer collaboration and discussion, enabling students to learn from each other's perspectives and build social connections. In the **Apex Learning Survey question #4, the students were asked: "Do you feel that your grade would be lower or higher if this math course was taken in a traditional (face-to-face classroom setting? Why?"** Some of the students responded with the following statements:

Student 1 said**, "**My grade would be higher face to face because I would be in a class and able to ask more questions."

"My grade maybe lower due to no help available because of class size in a face-to-face class" stated Student 2.

Student 13 stated, "I feel that my grade would be lower or about the same in a traditional classroom setting, but I would not be able to work as fast as I can work on Apex Learning".

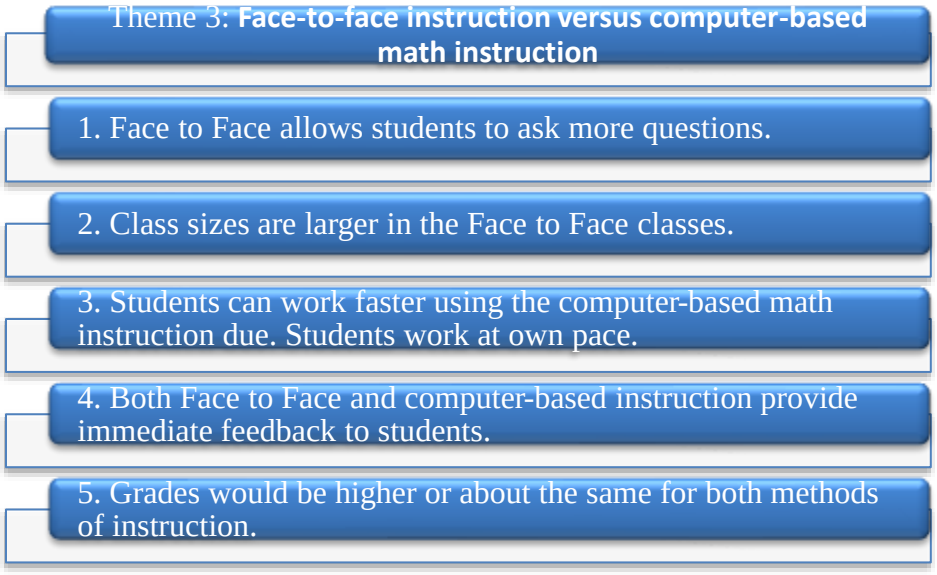

Figure 4.8 Theme 3: Face-to-Face Versus Computer-based Instruction

As the debate between face-to-face instruction and computer-based instruction continues, the impact of computer-based instruction on college readiness emerges as a crucial aspect to consider. Exploring how proficiency in navigating online educational tools can enhance students' preparedness for higher education sheds light on the evolving landscape of academic readiness in the digital age.

Theme 4: Computer-based instruction and college readiness. The researcher asked students if they felt that they would be ready to enter college upon graduation as it relates to taking math courses using computer-based instruction called Apex Learning. The students made these statements:

Student 1 said, **"**I think that I will be ready for college after taking math courses online because these courses make me think hard. I am finishing geometry, and I will be taking probability and statistics next. I don't think I will go to college right away. I have a good job for my age." I asked Student 1 where he worked and what was his responsibilities. He said that he worked at a store named Big Lots and he was in charge of others who stocked items on the shelves. I asked him if he would consider attending college or training to become a manager. He said he would love to be trained as a manager. I printed out literature to show him the salaries of managers in stores similar to his place of employment with an associate degree. It inspired him to research technical colleges in the area.

"I hope that I do not have to take college math online unless I have a teacher like you, Mrs. G. I know I will need math to do people's hair. I have to measure and mix chemicals a lot. I do think this Apex Learning class helped me so I can do college work" stated Student 12**.**

"I know that it [Apex Learning] helps me get ready for college cause I have to read and figure out hard problems. I have learned to take good notes too" stated Student 15.

Student 14 shared that he was ready for college because he is good at working online and he said, "I can work as fast as I want to. I also know how to research online to find extra problems to help me sometimes."

Student 13 mentioned that he wants to be a truck driver and does not want to go to a college, but he said, "I know the class gets me ready for college…I know I will have to take tests to get my truck driver license."

Student 18 said he is ready for college after taking online classes. He also said, "…I know how to organize and get work turned in on time. I know to ask questions and ask for help too."

"I will do good in college. Taking this Apex Learning class helped me learn to take notes and write down everything. Some of the work is hard but I don't give up" stated Student 20.

The Apex Learning program is designed to prepare high school students to enter college after graduating by equipping them with essential skills and knowledge necessary for higher education (Apex Learning, 2018). By providing a comprehensive and well-rounded educational experience, Apex Learning effectively prepares high school students for the challenges and demands of college life (Apex Learning, 2018).

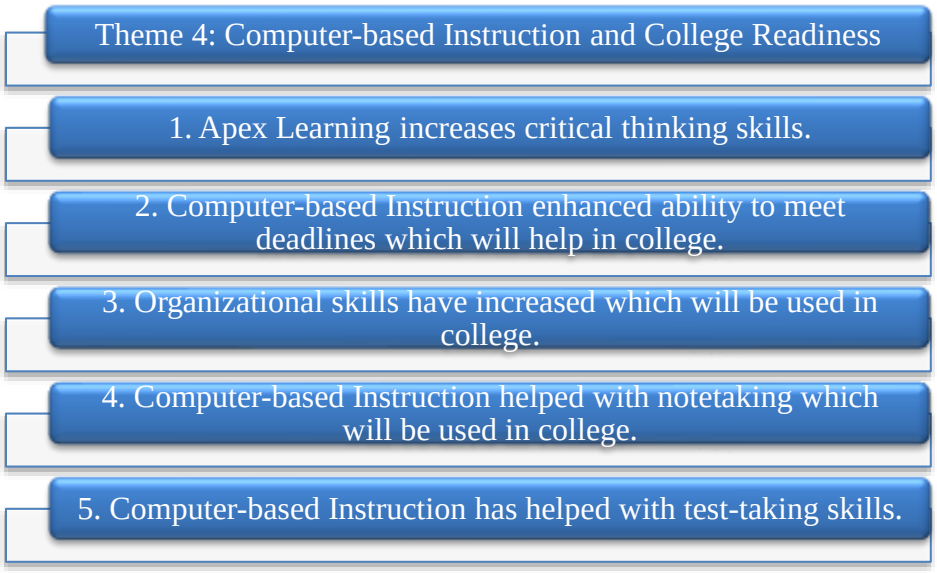

Figure 4.9 Theme 4: Computer-based Instruction and College Readiness

Theme 5: Recommendations for computer-based math instruction. To support high school students taking Apex Learning computer-based instruction in an alternative school setting, students offered several recommendations. Students felt that it was very important that each class provide a structured and supportive environment that fostered focus and engagement. Students were asked in the semi-structured interview to make a recommendation to improve their experience with completing a computer-based math course using Apex Learning in the classroom (APPENDIX F). Some of the recommendations that emerged from the data were as follows: More instructional videos added to the lessons, more step-by-step examples are needed in the Apex Learning program, TAC should offer tutoring sessions afterschool, incorporate collaboration time for students, and provide classroom printers so that students might print out study guides as needed. The students who were interviewed gave the following statements about recommendations to improve computer-based instruction at TAC:

Student 20 said that he would like to have extra assistance with challenging problems on Apex Learning.

"I would like to see more videos added to the lesson" stated Student 12. Student 14 mentioned that "Apex Learning needs more step-by-step examples."

"The alternative school should offer tutoring sessions at some point" was mentioned by Student 20.

Student 15 stated that, "the school should have a printer available just in case students want to print their study guides instead of saving everything on their computer. I like to have my study guide in front of me."

Student 12 mentioned, "Sometimes, I would like to discuss my study notes with others. We should have time if we are working on the same lesson to discuss notes with each other. I also need a little more time for the teacher to check on me. I know that the teacher always gives me support but I just need more."

The last recommendation that was suggested was to have celebrations for students to help foster positive school culture while celebrating students' achievements.

Student 15 said, "I would like to have a program like other schools to get a certificate when we do good stuff like make honor roll or good attendance."

"We need an award's day program so that our parents can be proud of us. We work hard in school too like the other schools" stated Student 18.

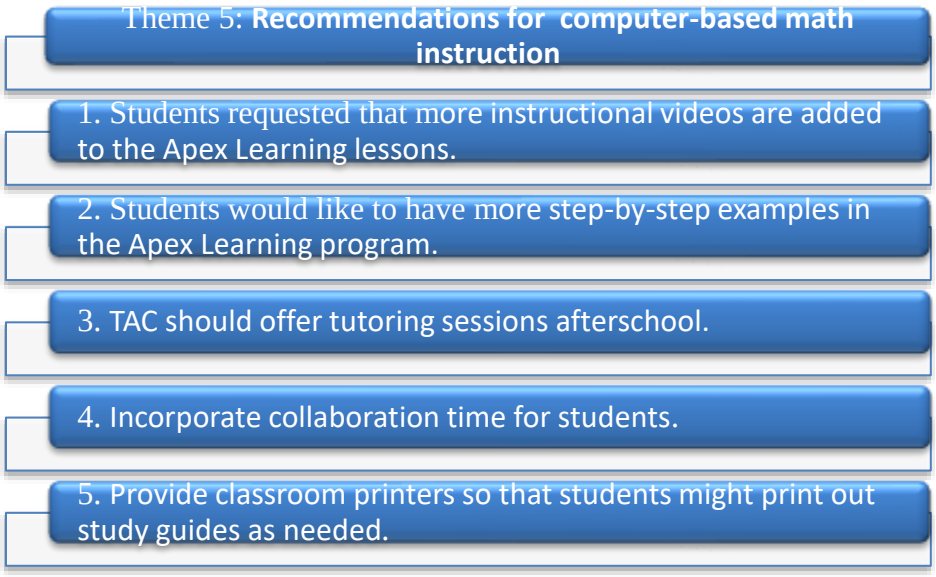

Figure 4.10 Theme 5: Recommendation for Computer-based Instruction

These recommendations from the students would create a sense of belonging that can further enhance their experience with Apex Learning computer-based instruction in an alternative school setting. Some of the recommendations can be addressed at the school level while a couple would have to be requested from the curriculum department at the district level.

Addressing the Research Questions

In this section, the mixed method approach was used to interpret the results from the data that was collected. The researcher collected and analyzed a combination of quantitative and qualitative data to answer each research question.

Research question, "What is the overall impact of the Apex Learning mathematics online program on mathematics achievement and college readiness for high school students enrolled in an alternative high school program?" was answered using data collected using the Apex Learning pre- and posttests, Apex Learning final course grades, and the Apex Learning survey. A comparison of pre- and posttest from a geometry unit

showed growth from 6 points to 49 points, with an overall average change of approximately 20.7 points. All students demonstrated growth on the posttest scores where 85% of the participants exceeded a score of 60%, which is the lowest passing grade in the state of South Carolina.

This was corroborated by Apex Learning course final grades, data from surveys and semi-structured interviews. All of the participants passed the Apex Learning geometry course with final grades that ranged from 60% to 88%. The average score for the Apex Learning course final grade was 71.4%. There were 11 students (55%) who scored above the average score of 71.4%. The graduation data taken from student records showed that 40% of participants were set to graduate in 2024, 50% in 2025, and 10% in 2026.

Of the 8 seniors participating in the study, semi-structured interviews revealed that 50% are planning to attend college. 100% of the seniors felt that the computer-based instruction in which they are enrolled is preparing them for college by completing challenging math problems using computer-based instruction which required them to use critical thinking skills, organizational skills were acquired when students had to meet due dates, some students learned how to use outside resources to assist with additional examples of math problems, learned to navigate through the Apex Learning program utilizing all of its features, and learned to work on individualized coursework.

Sub-research question 1: “How do students who are enrolled in an alternative high school program perceive their academic success and college readiness as it relates to mathematics achievement utilizing the Apex Learning mathematics program?” was answered using semi-structured interviews and surveys. Overall, the students had positive responses about their academic success and being ready for college. Of the 8 seniors who

were interviewed and surveyed, 50% of them planned to attend a two-year or four-year college or university. Three students planned to attend a four-year university and one student plans to attend a technical college. One student planned to attend training at a beauty training school to become a cosmetologist. One plans to get training to become a truck driver. Of the 8 seniors, 5 are African American males and 80% of these African American males planned to attend some form of college. Students felt that they had been prepared to be successful academically beyond high school. Many of the students felt that their experiences with computer-based instruction have prepared them to be successful in college.

Students felt that they became more proficient using the computer-based instruction while navigating digital platforms in Apex Learning, and effectively utilized online resources, preparing them for future academic and professional endeavors (Apex Learning, 2018).

Sub-research question 2: "What supports do high school students recommend for the learning environment within the alternative school to foster their success with the Apex Learning mathematics program?" was answered using the semi-structured interviews and surveys. Students wanted to be recognized with celebratory programs for making the honor roll. They suggested that more projects that are available in the Apex Learning program be completed by students to replace some of the tests. A student recommended that more collaborative time for students to work together if they are working on the same lesson. They would like to have their work on display after completing projects. They wanted teachers to do regular check-ins and make sure that students are getting the academic support they need. They wanted the computer-based instruction for math to have more instructional videos. Students wanedt dedicated spaces

just for computer-based instruction throughout the building. Students gave recommendations where most of them can be done at TAC. The study participants were informed that some of their recommendations would have to be approved by the curriculum department at the district level.

Summary

In this action research study, the researcher sought to find out how students who are enrolled in an alternative high school program perceived their academic success and college readiness as it related to impacting mathematics achievement utilizing the Apex Learning mathematics program accounting for gender and race/ethnicity. A mixed methods research design was utilized to conduct the eighteen-week study. The study findings included a 20.7-point average increase between the Apex Learning pre-test average and the Apex Learning posttest average in mathematics achievement. There were positive perceptions from students about the use of the Apex Learning mathematics program as it related to students who felt that they were being prepared to enter college with academic success regardless of their gender and race/ethnicity. Chapter 5 detailed the recommendations and implications stemming from this action research.

CHAPTER 5

IMPLICATIONS AND RECOMMENDATIONS

According to Efron & Ravid (2020), action research is conducted by insiders who are involved in the context and want to improve practice. This action research study aimed to address the effectiveness of computer-based math instruction on math achievement in alternative high school settings and provide insights for educators, administrators, and policymakers. It also provided implications and recommendations for future research and decision-making in alternative high schools to improve math achievement outcomes for students.

In recent years, the researcher's focus has focused on high school students who are taught in an alternative school setting. The students who attend TAC (pseudonym) are usually underachieving students who lack the necessary credits to graduate or to be in the same grade as their peers (*National Dropout Prevention Center*, 2022). The Alternative Center (TAC) offered students computer-based instruction in various courses. After carefully observing the high school students at TAC, the teacher-researcher began to wonder what happens to the students after they graduate from high school. The researcher wanted to know if students were acquiring the skills that they would need to be successful in college. The researcher also wanted to know if students felt that they were academically ready to attend college after graduating from TAC. Thinking about the future of our students who attend TAC gave birth to my problem of practice. The lack of

examination or evaluation of mathematics achievement for at-risk high school students using computer-based instruction while attending an alternative learning environment.

This action research study was set at The Alternative Center (pseudonym) in a small, rural city in South Carolina. The Alternative Center serves between 36-60 middle and high school students at any given time. The high school students are enrolled at TAC for one - two semesters. The Alternative Center has had students who were assigned in middle school and returned during their high school years. At TAC, my role was the high school mathematics teacher while serving as the teacher and insider-researcher in the mixed methods research design. The action research study was conducted in the researcher's classroom using a convenience sample of 20 participants. The study participants were students enrolled in a geometry course and were using the Apex Learning mathematics program.

The purpose of the action research study was to assess the impact of computer-based instruction in high schools on the academic performance of students in alternative learning environments. Specifically, the researcher analyzed the overall impact of the Apex Learning computer-based mathematics program on student success in an alternative high school. This action research was guided by the following research questions:

Research Question: What is the overall impact of the Apex Learning mathematics online program on mathematics achievement and college readiness for high school students enrolled in an alternative high school program?

Sub-Research Question #1: How do students who are enrolled in an alternative high school program perceive their academic success and college readiness as it relates to mathematics achievement utilizing the Apex Learning mathematics program?

Sub-Research Question #2: What supports do high school students recommend for the learning environment within the alternative school to foster their success with the Apex Learning mathematics program?

The researcher answered the research questions using a mixed methods research design using quantitative and qualitative methods. The quantitative data collection instruments included an Apex Learning Pretest/Posttest, Apex Learning final course grade, and an Apex Learning survey. The qualitative data collection instruments included a semi-structured interview and an Apex Learning survey.

At the beginning of the action research study, the researcher informed the study participants about what action research would require and explained the purpose of the action research study to the high school students. The students were provided an overview of how the study would be conducted. After gaining consent from the students and parents of the students, the participants were given a tutorial of Apex Learning 'getting started guide' to learn to navigate the features of Apex Learning without problems. The data collection began with administering the Apex Learning Pretest to the twenty students who consented to participate in the study (Table 4.1). Apex Learning features were discussed and modeled and an explanation of how each participant would be working on an individualized unit in geometry based on their Apex Learning pretest results was conveyed to the participants. The Apex Learning pretest results were used as baseline data which Apex Learning used to generate their study plans. The study plans included an overview of the objectives for the lesson, the study which is where the actual lesson is learned, a check-up, a lesson quiz, and a test.

The participants used the Apex Learning mathematics program as the intervention after taking the Apex Learning pretest. The participants used the 80-minute class period to work on their intervention which was the Apex Learning individualized study plans in math class every day of the week. Purposeful sampling was used to choose participants to be interviewed. The selected participants who were all seniors completed an Apex Learning survey and participated in the semi-structured interviews to gather data to address the overall research question and the two sub-research questions. After each participant completed their intervention, the Apex Learning posttest was administered.

Findings

The findings from the action research indicated that computer-based instruction, specifically the Apex Learning mathematics program, had a significant impact on math achievement for high school students. The intervention of the Apex Learning program resulted in an average increase of 20.7 points between the pretests and post-tests administered to the students. According to a study by Brown et al., (2019), high school students who participated in the Apex Learning mathematics program demonstrated a significant increase in math achievement. This improvement demonstrated the effectiveness of the program in enhancing students' math skills and understanding. The results of the paired-t test for the pretest and post-test indicated that there is a significant difference between the Pretest ($M = 44.2$, $SD = 18.5$) and the Posttest ($M = 64.9$, $SD = 8.4$), $t(19) = 6.9$, $p < .001$. The pretest scores were more spread out based on the large SD as compared to the lower SD for the posttest where the scores were less spread out.

In terms of college readiness, the action research findings indicated that Apex Learning effectively prepared high school students for higher education. By enhancing

math achievement, the Apex Learning mathematics program equipped students with the necessary skills and knowledge required for success in college-level mathematics courses. This preparation in math achievement is crucial as it lays a solid foundation for students' academic and career pathways. The perceptions of high school seniors indicated that the high school students planned to attend college and felt that Apex Learning prepared them by strengthening their thinking skills, helping them to navigate a computer-based instructional program, manage time, take assessments online and stay organized which would be skills that they transfer to college.

The action research study revealed positive student perceptions regarding the Apex Learning mathematics program. Students appreciated the flexibility provided by Apex Learning, allowing them to work at their own pace. This personalized approach to learning catered to individual student needs and preferences, leading to increased engagement and motivation. Additionally, the immediate feedback provided by Apex Learning enabled students to track their progress and identify areas that required further attention. This timely feedback of Apex Learning played a crucial role in facilitating student learning and growth. The positive student perceptions regarding Apex Learning, such as the ability to work at their own pace and receive immediate feedback, were highlighted in the research conducted by Smith and Johnson (2020). These features of Apex Learning contributed to enhanced math learning experiences.

Apex Learning allowed students to be in control of their learning. This sense of autonomy empowered students and fostered a sense of responsibility for their education. By allowing students to take charge of their learning journey, Apex Learning promoted student agency and ownership, resulting in improved outcomes. Thompson and Williams

(2018) conducted research affirming that Apex Learning effectively prepared high school students for college readiness, particularly in terms of math achievement. The study emphasized the role of Apex Learning in equipping students with the necessary math skills and knowledge required for success in higher education.

Insights from the Teacher-Researcher

The research study on the impact of Apex Learning math instruction on math achievement in an alternative high school provided valuable takeaways for teacher-researcher. Firstly, the study revealed a 20.7-point increase in the means between the pretest and posttest scores, indicating the effectiveness of Apex Learning in improving math achievement among students. The researcher felt that this finding highlighted the potential of computer-based instruction to enhance learning outcomes in alternative high school settings. Additionally, the study reported a remarkable 100% passage rate for final geometry course grades, showcasing the positive impact of Apex Learning on student success and mastery of the subject. This result suggested that Apex Learning could effectively support students in meeting the required academic standards. Moreover, the study uncovered positive perceptions among the students about using Apex Learning to prepare students for college readiness. This insight indicated that Apex Learning could be a valuable tool in equipping students with the necessary skills and knowledge for higher education.

Considering these results, the researcher felt a sense of accomplishment and satisfaction. The significant increase in the means between the pretest and posttest scores demonstrated the effectiveness of Apex Learning in improving math achievement and validated the researcher's choice of instructional approach. The 100% passage rate for

final geometry course grades further reinforced the researcher's belief in the positive impact of Apex Learning on student success and academic mastery. Moreover, the positive perceptions about using Apex Learning to prepare students for college readiness indicated that the researcher's efforts in implementing this program have been well-received and have the potential to support students in their future educational endeavors. Overall, the researcher felt encouraged and motivated to continue exploring the potential of Apex Learning and computer-based instruction in enhancing student outcomes and promoting academic success.

The researcher assumed that expelled high school students would not perform well in the Apex Learning geometry course. This assumption was based on the belief that their prior behavior and disciplinary issues would negatively impact their academic performance. However, the researcher's assumption was proven wrong when the expelled students achieved passing grades in the geometry course.

Despite the initial expectation that the student’s past behavior would hinder their academic progress, the expelled students demonstrated their ability to succeed in the Apex Learning geometry course. This unexpected outcome challenged the researcher's assumption and highlighted the students' resilience and potential for academic success. The students' passing grades in the Apex Learning geometry course revealed that their previous disciplinary actions did not define their academic capabilities.

The research study results emphasized the importance of giving students a fair opportunity to learn and succeed, regardless of their past behavior or circumstances. The research study was also a model of the significance of avoiding preconceived notions and biases when conducting research. It served as a reminder to the researcher that individual

potential should not be underestimated based on external factors, and that each student should be given an equal chance to excel academically.

Theoretical Framework: Understanding the Underlying Concepts

The action research study findings suggested that the Apex Learning mathematics program utilized a constructivist theory to impact math achievement among high school students. A study by Anderson and Smith (2019) supported the use of constructivist principles in the Apex Learning mathematics program. The researchers found that the Apex Learning program emphasized the importance of students' prior knowledge and experiences, allowing them to connect new information to existing mental frameworks. This process of constructing meaning and building upon prior knowledge has been shown to enhance students' conceptual understanding and retention of mathematical concepts. The research study also highlighted the program's focus on real-world applications of math, helping students understand the relevance and practicality of what they are learning. This constructivist approach has been found to increase students' motivation and engagement in math, leading to improved math achievement (Anderson & Smith, 2019).

The behaviorist approach employed by the Apex Learning mathematics program contributed to improvements in math achievement among high school students through several key mechanisms. First, the program emphasized explicit instruction and structured lessons in the study plan for each student, breaking down complex mathematical concepts into smaller, more manageable steps (Apex Learning, 2018). This approach allowed students to build a solid foundation of knowledge and skills, enabling them to tackle more advanced math topics with confidence (Johnson & Thompson, 2020).

The Apex Learning program utilized frequent quizzes, assessments, and immediate feedback to reinforce math behaviors. Students received timely feedback on their performance, allowing them to identify areas of weakness and make necessary adjustments. By providing feedback and reinforcement for correct answers and guiding students toward the correct solution, the behaviorist approach helped students develop a deeper understanding of mathematical concepts and problem-solving strategies (Smith & Johnson, 2019). This was confirmed by the perceptions that students gave in their semi-structured interviews.

The Apex Learning mathematics program employed the use of external stimuli, rewards, and punishments to motivate students and shape their math behaviors. For instance, the Apex Learning program may offer virtual badges, certificates, or other incentives to recognize and reward student achievement. This reinforcement encouraged students to stay engaged, apply themselves, and strive for continuous improvement in their math skills (Johnson & Thompson, 2020).

The behaviorist approach adopted by the Apex Learning mathematics program contributed to improvements in math achievement among high school students by providing clear learning objectives, breaking down complex concepts, offering immediate feedback, and employing motivational strategies. Through these mechanisms, students are able to develop strong mathematical foundations, enhance problem-solving skills, and experience increased confidence and success in their math learning (Smith & Johnson, 2019).

Action Plan

This action plan is aimed at improving college readiness and math achievement for high school students attending The Alternative Center. This action plan is based on the results of the action research study conducted, which gathered valuable feedback and recommendations from our students. The study highlighted the need for several key improvements, including:

- More interactive lessons in the Apex Learning
- Increased availability of instructional videos in Apex Learning
- Offering tutoring sessions
- Providing an accessible printer in each classroom
- More step-by-step math examples in the Apex Learning program.
- Expanding project-based assessments through the Apex Learning program.

To address these recommendations and improve college readiness and math achievement, the researcher proposed that TAC conduct a more comprehensive needs assessment to evaluate the current math proficiency levels of our students and assess the availability of resources, including technology, teacher support, and learning materials. This assessment provided a baseline understanding of our students' needs and enable us to align our action plan accordingly. Additional feedback was gathered from students, teachers, and parents to ensure their perspectives were considered in the development and implementation of the action plan.

Next, TAC requested that the district curriculum representative scheduled a meeting to collaborate with Apex Learning, a renowned provider of educational resources. This partnership allowed us to integrate their computer-based interactive

lessons into our math curriculum, ensuring alignment with curriculum standards and addressing the specific needs of our students. The administrator worked closely with Apex Learning experts to provide professional development opportunities for our teachers, focusing on effectively utilizing the program and integrating it into their teaching strategies.

To enhance student learning, we developed a comprehensive, digital library of instructional videos covering various math concepts and problem-solving strategies. These digital videos were made accessible to students at any time, enabling them to review the material independently. Additionally, we encouraged our teachers to create their instructional videos to supplement the existing content and cater to the specific needs of our students.

To provide additional support outside of regular class hours, the teachers at TAC created a schedule of tutoring sessions for teachers and students. Qualified math tutors were arranged for both in-person and online sessions, accommodating different learning preferences, and ensuring that students had access to personalized help when needed. We actively promoted these tutoring sessions to ensure students are aware of their availability and the benefits they offered.

Recognizing the importance of resources, we provided an available printer for students to print necessary materials, worksheets, and assignments. Clear guidelines were established to manage resources effectively and ensure fair access for all students. To improve the Apex Learning program, TAC focused on incorporating more step-by-step math examples that demonstrated problem-solving strategies. This helped enhance students' understanding and confidence in tackling complex math problems.

The teachers expanded the use of project-based assessments within the Apex Learning program. By increasing the number of such assessments, the researcher aimed to encourage critical thinking, problem-solving, and collaboration skills among our students. These assessments required students to apply math concepts in real-world scenarios, promoted the practical application of knowledge. Clear guidelines and rubrics were provided to assess students' performance and provided constructive feedback.

Throughout the implementation of this action plan, we continuously monitored and evaluated students' progress. This allowed us to make data-driven decisions and adjusted instructional strategies as needed. The researcher actively sought feedback from students, teachers, and parents to ensure ongoing improvement and alignment with their needs and expectations.

The implementation of this comprehensive action plan would significantly enhance college readiness and math achievement among TAC's high school students. The action plan was revised after the researcher met with the principal at TAC to discuss the students' recommendations. After collaborating on actions that were addressed at the building level, the researcher revised the action plan to include recommendations and requests that needed approval from the district level. The revised action plan was written and forwarded to the principal for his approval. Next, the action plan was forwarded to the district's curriculum department for approval, and gained support to implement this action plan, as it was aligned with the recommendations provided by the students.

Implications for Future Research

The action research findings on the impact of the computer-based program, Apex Learning, on math achievement among high school students enrolled at TAC provided

valuable insights for future research endeavors. Building on these findings, there were implications to dive deeper into the specific instructional strategies and features within Apex Learning that contributed to such positive outcomes. The study's implications included a need to investigate the long-term impact of implementing the Apex Learning mathematics program in an alternative high school using a larger and more diverse sample, examine the college success of graduates of the Alternative Center in a longitudinal study, investigate the impact of Apex Learning on math achievement by measuring standardized test scores and to investigate graduation rates of alternative high school students and the long-term impact on graduation data. Exploring the mechanisms through which the program influences math achievement, considering factors such as personalized learning paths, adaptive feedback, and gamification elements, could provide a more nuanced understanding of how computer-based interventions can support student learning in more diverse educational contexts.

Using an asset-based framework in a study examining the impact of computer-based math instruction on math achievement in an alternative high school brings important implications. This framework focuses on identifying and leveraging the strengths and resources of individuals and communities, rather than solely focusing on deficits. By adopting this approach, the study can highlight the existing assets and potentials of students in the alternative high school setting. It allows for a more holistic understanding of how computer-based math instruction can build upon the strengths of students, enhance their learning experiences, and ultimately improve math achievement. This asset-based perspective encourages a positive and empowering narrative that can

inform educational practices and policies to better support students in alternative high schools.

Recommendations

Future research could extend the investigation to examine the differential impact of Apex Learning on math achievement across various demographic groups, particularly concerning gender and race/ethnicity using a larger sample size. By conducting subgroup analyses and exploring potential disparities in program effectiveness based on these factors, researchers can gain a more comprehensive understanding of how computer-based interventions like Apex Learning can address educational equity and support the academic success of all students. Additionally, investigating the perceptions and experiences of students from different demographic backgrounds regarding their engagement with Apex Learning and its impact on their math learning could offer valuable insights for designing more inclusive and culturally responsive educational computer-based programs in the future.

According to Coghlan and Brannick (2021), action research typically follows a cyclical process that includes planning, acting, observing, and reflecting. There exist implications to evaluate the long-term impacts of implementing the Apex Learning mathematics program in an alternative high school. One potential long-term impact that could be evaluated is the impact on math achievement by measuring improvements in standardized test scores, grades, and overall math proficiency over multiple years. Researchers can assess the long-term effects of the recommended changes on students' math achievement. Longitudinal studies can provide insights into whether the recommended changes lead to sustained improvements in students' math skills and

knowledge.

Graduation rates can be evaluated as a long-term impact. Further researchers can examine whether students who have been exposed to the Apex Learning program and the recommended changes are more likely to graduate on time from high school compared to their peers who have not had access to these interventions. This evaluation can provide insights into the program's effectiveness in supporting students' overall academic success and progression.

Also, further studies can assess the impact of the recommended changes on students' college readiness in the field of mathematics. The researcher used semi-interview questions to collect data about the participants who planned to attend college after graduation, but more research can be done to find out how many of the students actually attend college. Understanding the long-term impact on college readiness is essential for determining the effectiveness of the Apex Learning program in preparing students for further educational and professional opportunities.

Long-term impacts should be evaluated by researchers in terms of equity and achievement gaps. Again, researchers can examine whether the recommended changes help reduce disparities in math achievement among different student populations, such as students from low-income backgrounds, English language learners, or students with learning disabilities. Action research involves systematic inquiry and intervention to bring about practical and meaningful changes in specific settings or contexts (Stringer, 2014). This evaluation can provide insights into TAC’s effectiveness in promoting equitable outcomes for all students.

In conclusion, further studies on implementing recommended changes in school

districts using the Apex Learning mathematics program can evaluate various long-term impacts. These include math achievement, student engagement, graduation rates, college and career readiness, and equity and achievement gaps. By considering these factors, researchers can gain a comprehensive understanding of the effectiveness and sustainability of the recommended changes in improving math education in school districts.

Summary of the Study

Many of the high school students attending The Alternative Center seemed to be retaking courses using the Apex Learning program. The number of students repeating high school courses due to various reasons was a deep concern for the researcher. This led to an examination of the Apex Learning mathematics program, attitudes of the students, and grades of students at TAC. The researcher decided to plan to use an action research study to find out as much as possible to be able to assist our students especially in mathematics since it is the subject area that the teacher-researcher teaches. The decision to explore the Apex Learning program which is grounded in the constructivist and theory of behaviorism frameworks as the intervention in the mixed methods research study to answer the following research questions: What is the overall impact of the Apex Learning mathematics online program on mathematics achievement for high school students enrolled in an alternative high school program?, How do students perceive their academic success and college readiness as it relates to mathematics achievement utilizing the Apex Learning mathematics program, accounting for gender and race/ethnicity?, and What supports do high school students recommend for the learning environment within the alternative school to foster their success with the Apex Learning mathematics

program? To answer these questions, the researcher used an Apex Learning pretest and (unit test) post-test, an Apex Learning survey (APPENDIX E), and semi-structured interviews (APPENDIX F).

From an analysis of the research study's findings, a conclusion that semi-structured interviews were conclusive and revealed that the high school students felt that Apex Learning prepared them to be academically successful as well as prepared them to enter college. The student data reports revealed that seniors were on track to graduate. The students also gave recommendations that would render them support at TAC to foster their success with Apex Learning. The results revealed that Apex Learning is a viable means to use to increase math achievement for high school students in an alternative setting no matter the race/ethnicity or gender. The pretest and posttest results showed an average increase of 20.7 points between the scores. The t-test confirmed that there was a significant difference in the average between the pretest and posttest scores.

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APPENDIX A: QUESTIONNAIRE/SURVEY PROTOCOL

Table A. 1 QUESTIONNAIRE/SURVEY PROTOCOL

Protocol Title:	Electronic Questionnaire/Survey
Institution/Affiliation:	University of South Carolina College of Education Instruction and Teacher Education, EdD Curriculum Studies
Principal Investigator Name/Contact Information:	Jacqueline L. Gilyard 803-374-4470 gilyardj@email.sc.edu or jackiegilyard@yahoo.com
Research Study Location(s):	Chester County School District/The Learning Center 1014 McCandless Road Chester, SC 29706 803-581-9362
Background/Rationale:	The action research study is being conducted to determine if computer-based instruction impacts math achievement for high school students who attend the alternative school. There is no research showing the impact of computer-based instruction on high school students who attend alternative school learning environments. The data from this research study can be used by the district to determine the appropriate resources needed to improve the success of high school students who attend the alternative school ensuring that they graduate and are career- or college-ready.
Primary Objectives:	The questionnaire data will be used to help answer the **Research Question**: What is the overall impact of the Apex Learning mathematics computer-based program on math achievement for high school students enrolled in an alternative high school program accounting for gender and ethnicity? and the **Sub-Research Question:** What supports do high school students recommend for the learning environment within the alternative school to foster their success with the Apex Learning mathematics program?
Primary Endpoint:	The questionnaires will occur at the beginning and end of the research study. The questionnaires will begin after IRB

	approval has been granted and consent forms have been properly signed. This will begin during week 2 and will end by week 16. The study will span over an 18-week period which is equivalent to one semester of the 2023-2024 school year.
Study Design:	1. Upon IRB review of protocol design, the appropriate method of obtaining consent will be provided. 2. Upon student agreement to participate, parental/student consent forms will be distributed for the appropriate signatures. 3. Questionnaires will be administered and completed electronically using Microsoft Form during the first 9 weeks of an 18-week semester. 4. The study will last for 18 weeks which is equivalent to one semester of the 2023-2024 school year. 5. As potential participants return properly signed consent forms are returned, their names will be added to the participant list in a database on a secure file. 6. Only students who want to participate in the questionnaire portion will have their data included in the results of the research study. 7. Participants who do not complete the questionnaire will be sent reminders to participate.
Inclusion Criteria:	Students who attend the alternative school will be invited to participate in the research study. Participants must be in grades 9 – 12.
Exclusion Criteria:	Students who are enrolled in middle school but are taking a high school course will not be invited to participate in the study.
Number of Subjects:	Approximately 10-25 students will be included in the study.
Rationale for Number of Subjects:	For the 2023-2024 school year, CCSD will start the year with at least 10 students returning from the 2022-2023 school year. The number will increase as the semester moves forward.
Study Duration:	Students can enroll in the study during the first 4 weeks of the semester. The study will end after the 18th week of the semester.
Risks:	The participants will not have any potential risks. For the study, pseudonyms for the participants and school will be used for privacy and protection.
Risk Mitigation:	Subjects may skip any question they do not wish to answer and/or may withdraw consent from the study at any time without repercussion.

Statistics:	All data will be analyzed and placed in presentation form using charts and graphs. Microsoft Excel and GraphPad will be used to organize data.
Reference:	Dr. Yasha Jones Becton, Clinical Assistant Professor University of South Carolina College of Education Curriculum Studies 820 Main Street Wardlaw College Columbia, SC 29208 YYJONES@mailbox.sc.edu

APPENDIX B: STUDENT DATA REPORTS PROTOCOL

Table B.1 STUDENT DATA REPORTS PROTOCOL

Protocol Title:	STUDENT DATA REPORTS
Institution/Affiliation:	University of South Carolina College of Education Instruction and Teacher Education, EdD Curriculum Studies
Principal Investigator Name/Contact Information:	Jacqueline L. Gilyard 803-374-4470 gilyardj@email.sc.edu or jackiegilyard@yahoo.com
Research Study Location(s):	Chester County School District/The Learning Center 1014 McCandless Road Chester, SC 29706 803-581-9362
Background/Rationale:	The action research study is being conducted to determine if computer-based instruction impacts math achievement for high school students who attend the alternative school. There is no research showing the impact of computer-based instruction on high school students who attend alternative school learning environments. The data from this research study can be used by the district to determine the appropriate resources needed to improve the success of high school students who attend the alternative school ensuring that they graduate and are career- or college-ready.
Primary Objectives:	The Apex Learning Reports will be used to collect data to assist with answering the following **Research Question**: What is the overall impact of the Apex Learning mathematics online program on mathematics achievement for high school students enrolled in an alternate high school program accounting for gender and race/ethnicity?
Primary Endpoint:	The data collection will occur throughout the research study. The study will span over an 18-week period which is equivalent to one semester of the 2023-2024 school year.
Study Design:	1. Upon IRB review of protocol design, the appropriate method of obtaining consent will be provided.

	2. Upon student agreement to participate, parental/student consent forms will be distributed for the appropriate signatures. 3. As potential participants return properly signed consent forms are returned, their names will be added to the participant list in a database on a secure file. 4. Upon receipt of the consent forms with appropriate signatures, the researcher will begin collecting student data starting the same or the following day. Student data will include quiz scores, unit tests, mid-course exams, and final exam scores from Apex Learning, graduation data for former TAC students, and ACT College and Career Readiness scores. 5. The study will last for approximately 18 weeks which is equivalent to one semester of the 2023-2024 school year. 6. All students who want to participate in assessment data collection will have their data included in the results of the research study. 7. Data collection will occur daily.
Inclusion Criteria:	Students who attend the alternative school will be invited to participate in the research study. Participants must be in grades 9 – 12.
Exclusion Criteria:	Students who are enrolled in middle school but are taking a high school course will not be invited to participate in the study.
Number of Subjects:	Approximately 10-25 students will be included in the study.
Rationale for Number of Subjects:	For the 2023-2024 school year, CCSD will start the year with at least 10 students returning from the 2022-2023 school year. The number will increase as the semester moves forward.
Study Duration:	Students can enroll in the study during the beginning of the fall semester. The study will end after the 18th week of the semester. Each class block is 80 minutes.
Risks:	The participants will not have any potential risks. For the study, pseudonyms for the participants and school will be used for privacy and protection.
Risk Mitigation:	Participants might be absent on some days and/or may withdraw consent from the study at any time without repercussion.
Statistics:	All data will be analyzed and placed in presentation form using charts and graphs. Microsoft Excel and GraphPad will be used to organize data.

Reference:	Dr. Yasha Jones Becton, Clinical Assistant Professor University of South Carolina College of Education Curriculum Studies 820 Main Street Wardlaw College Columbia, SC 29208 YYJONES@mailbox.sc.edu

APPENDIX C: SEMI-STRUCTURED INTERVIEW PROTOCOL

Table C.1 SEMI-STRUCTURED INTERVIEW PROTOCOL

Protocol Title:	Semi-Structured Interview
Institution/Affiliation:	University of South Carolina College of Education Instruction and Teacher Education, EdD Curriculum Studies
Principal Investigator Name/Contact Information:	Jacqueline L. Gilyard 803-374-4470 gilyardj@email.sc.edu or jackiegilyard@yahoo.com
Research Study Location(s):	Chester County School District/The Learning Center 1014 McCandless Road Chester, SC 29706 803-581-9362
Background/Rationale:	The action research study is being conducted to determine if computer-based instruction impacts math achievement for high school students who attend the alternative school. There is no research showing the impact of computer-based instruction on high school students who attend alternative school learning environments. The data from this research study can be used by the district to determine the appropriate resources needed to improve the success of high school students who attend the alternative school ensuring that they graduate and are career- or college-ready.
Primary Objectives:	The semi-structured interviews will be used to collect data to assist with answering the following: **Sub-Research Question #1**: How do students perceive their academic success and college readiness as it relates to mathematics achievement utilizing the Apex Learning mathematics program? **Sub-Research Question #2:** What supports do high school students recommend for the learning environment within

	the alternative school to foster their success with the Apex Learning mathematics program?
Primary Endpoint:	Semi-structured interviews will occur throughout the research study. The semi-structured interviews will begin after IRB approval has been granted and consent forms have been properly signed. This will begin during week 2 and will end by week 16. The study will span over an 18-week period which is equivalent to one semester of the 2023-2024 school year.
Study Design:	1. Upon IRB review of protocol design, the appropriate method of obtaining consent will be provided. 2. Upon student agreement to participate, parental/student consent forms will be distributed for the appropriate signatures. 3. As potential participants return properly signed consent forms are returned, their names will be added to the participant list in a database on a secure file. 4. Upon receipt of the consent forms with appropriate signatures, semi-structured interviews will begin after observations are conducted and questionnaires have been submitted. Interviews will be conducted and field notes will be written approximately 2-5 weeks into the study. The semi-structured interviews will be scheduled and completed during my planning period. 5. The study will last for approximately 18 weeks which is equivalent to one semester of the 2023-2024 school year. 6. All students who want to participate in the interview portion will have their data included in the results of the research study. 7. Semi-structured interviews will occur every other day until all participants have been interviewed.
Inclusion Criteria:	Students who attend the alternative school will be invited to participate in the research study. Participants must be in grades 9 – 12.
Exclusion Criteria:	Students who are enrolled in middle school but are taking a high school course will not be invited to participate in the study.
Number of Subjects:	Approximately 10-25 students will be included in the study.

Rationale for Number of Subjects:	For the 2023-2024 school year, CCSD will start the year with at least 10 students returning from the 2022-2023 school year. The number will increase as the semester moves forward.
Study Duration:	Students can enroll in the study at the beginning of the 2023 fall semester. The semi-structured interviews will begin after IRB approval has been granted and consent forms have been properly signed. This will begin during week 2 and will end by week 16. The study will end after the 18th week of the semester. Each class block is 80 minutes.
Risks:	The participants will not have any potential risks. For the study, pseudonyms for the participants and the school will be used for privacy and protection.
Risk Mitigation:	Participants might be absent on some days and/or may withdraw consent from the study at any time without repercussion.
Statistics:	All data will be analyzed and placed in presentation form using charts and graphs. Microsoft Excel and GraphPad will be used to organize data.
Reference:	Dr. Yasha Jones Becton, Clinical Assistant Professor University of South Carolina College of Education Curriculum Studies 820 Main Street Wardlaw College Columbia, SC 29208 YYJONES@mailbox.sc.edu

APPENDIX D: PRETEST/POSTTEST PROTOCOL

Table D. 1 PRETEST/POSTTEST PROTOCOL

Protocol Title:	Pretests/Posttests
Institution/Affiliation:	University of South Carolina College of Education Instruction and Teacher Education, EdD Curriculum Studies
Principal Investigator Name/Contact Information:	Jacqueline L. Gilyard 803-374-4470 gilyardj@email.sc.edu or jackiegilyard@yahoo.com
Research Study Location(s):	Chester County School District/The Learning Center 1014 McCandless Road Chester, SC 29706 803-581-9362
Background/Rationale:	The action research study is being conducted to determine if computer-based instruction impacts math achievement for high school students who attend the alternative school. There is no research showing the impact of computer-based instruction on high school students who attend alternative school learning environments. The data from this research study can be used by the district to determine the appropriate resources needed to improve the success of high school students who attend the alternative school ensuring that they graduate and are career- or college-ready.
Primary Objectives:	The pretests and posttests will be used to collect data to assist with answering the following: **Research Question**: What is the overall impact of the Apex Learning mathematics online program on mathematics achievement for high school students enrolled in an alternate high school program accounting for gender and race/ethnicity?
Primary Endpoint:	The Pretests will occur at the beginning of the research study. The Pretests will be administered after IRB approval has been granted and consent forms have been properly signed. This will begin during week 2 and will end by week

	16. The study will span over an 18-week period which is equivalent to one semester of the 2023-2024 school year. The post-tests will be administered after the Intervention has taken place using the Apex Learning computer-based program.
Study Design:	1. Upon IRB review of the protocol design, the appropriate method of obtaining consent will be provided. 2. Upon student agreement to participate, parental/student consent forms will be distributed for the appropriate signatures. 3. As potential participants return properly signed consent forms are returned, their names will be added to the participant list in a database on a secure file. 4. Upon receipt of the consent forms with appropriate signatures, Pretests will begin. Interviews will be conducted, and surveys will be written approximately 2-9 weeks into the study. The semi-structured interviews will be scheduled and completed during my planning period. 5. The study will last for approximately 18 weeks which is equivalent to one semester of the 2023-2024 school year. 6. All students who want to participate in the pretests and posttests will have their data included in the results of the research study. 7. Semi-structured interviews will occur every other day until all participants have been interviewed.
Inclusion Criteria:	Students who attend the alternative school will be invited to participate in the research study. Participants must be in grades 9 – 12.
Exclusion Criteria:	Students who are enrolled in middle school but are taking a high school course will not be invited to participate in the study.
Number of Subjects:	Approximately 10-25 students will be included in the study.
Rationale for Number of Subjects:	For the 2023-2024 school year, CCSD will start the year with at least 10 of students returning from the 2022-2023 school year. The number will increase as the semester moves forward.
Study Duration:	Students can enroll in the study at the beginning of the 2022 fall semester. The semi-structured interviews will begin after IRB approval has been granted and consent forms have been properly signed. This will begin during week 2

	and will end by week 16. The study will end after the 18th week of the semester. Each class block is 80 minutes.
Risks:	The participants will not have any potential risks. For the study, pseudonyms for the participants and the school will be used for privacy and protection.
Risk Mitigation:	Participants might be absent on some days and/or may withdraw consent from the study at any time without repercussion.
Statistics:	All data will be analyzed and placed in presentation form using charts and graphs. Microsoft Excel and GraphPad will be used to organize data.
Reference:	Dr. Yasha Jones Becton, Clinical Assistant Professor University of South Carolina College of Education Curriculum Studies 820 Main Street Wardlaw College Columbia, SC 29208 YYJONES@mailbox.sc.edu

APPENDIX E

APEX LEARNING SURVEY QUESTIONS

Survey Questions

Student: _____

Today, I am going to have you complete a survey about Apex Learning. There are no wrong answers. Just do your best to answer the questions.

1. What is the average number of times that you are re-taking quizzes per lesson to pass? Tests per unit?
2. How much time do you spend working on your computer-based math course at school?
3. What is your current grade on this computer-based math course for this quarter?
4. Do you feel that your grade would be lower or higher if this math course was taken in a traditional (face-to-face) classroom setting? Why?

APPENDIX F

SEMI-STRUCTURED INTERVIEW QUESTIONS

Student: _____

Today, I am going to ask you some questions about the action research project we are completing in class. Just do your best to answer the questions.

1. What is your gender?
2. What is your race/ethnicity?
3. What is the projected year of your graduation?
4. Which computer-based math course are you taking on Apex Learning this semester?
5. Tell me about your background and experiences using computer-based instruction.
6. If you could make a recommendation to improve your experience with completing a computer-based math course using Apex Learning in the classroom, then what would you recommend?
7. Are you planning to enroll in college upon graduation? Technical or University?
8. In what ways do you feel that this Apex Learning computer-based math course is preparing you to be ready to enter college upon graduation?
9. Describe the role that The Alternative Center plays in the success of your computer-based instruction learning experience.