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The effectiveness of a digital iPad curriculum in the classroom

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THE EFFECTIVENESS OF A DIGITAL IPAD CURRICULUM IN THE CLASSROOM

by

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Dedications

I would like to dedicate this thesis to Toby. You were by my side throughout this entire process. Your constant support helped me reach this point. Thank you for believing in me and helping me through the tough times when I wanted to quit. You have been my number one fan and have helped me persevere and complete this journey.

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Abstract

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The purpose of this study was to determine if utilizing a digital iPad curriculum increases academic achievement in students in a middle school inclusive mathematics classroom. Twenty eighth-grade students participated in the study. The research was conducted using a group design methodology. Ten students in the experimental group used the digital iPad curriculum throughout instruction. The remaining ten students in the control group used traditional paper materials. A baseline was found prior to instruction using pre-tests. While the instruction was the same for all students, the methods of note-taking, practice of skills, and assignment completion and submission varied between the experimental and control groups. The students were assessed after instruction using post-tests. A comparison between pre- and post-test scores was calculated to determine the students' academic achievement and growth. Results demonstrated that the group using the digital iPad curriculum showed slightly more improvement than the group using traditional paper materials. Results also showed that a student with learning difficulties using the iPad was more successful than another student with learning difficulties using traditional paper materials. The results suggest that using a digital iPad curriculum in the classroom can lead to increased academic achievement for general education students and those with learning difficulties.

Table of Contents

Table of Contents (continued)

List of Tables

Chapter 1

Introduction

Technology has had a huge impact on society, improving the quality of life in many fields including data and task processing, the efficiency of healthcare, and education (Di Giacomo, Ranieri, & Lacasa, 2017). Within the past decades, there have been so many technological advances. The field of education is moving towards using more technology. Schools have moved from a traditional textbook and paper approach using very little technology to completely digital curriculums. In recent years, school districts began implementing Bring Your Own Device policies (BYOD), where students brought their own technology to the classroom to use throughout instruction. Many schools are now implementing 1:1 initiatives, in which each student has his or her own device throughout the school day to utilize for learning purposes. Research by Ferguson (2016) supports that many education professionals are hopeful that the use of technology will increase student engagement and learning. New technology has provided a variety of instructional strategies that help students overcome many educational barriers in the classroom (Chang, Reisman, & Tovar, 2017). With the integration of the technology in the classroom, students will be engaged and learn in innovative ways.

Statement of the Problem

The Apple iPad has provided schools with user-friendly, personal devices to promote learning (Hui, 2016). The device can be easily transported due to its small, light-weight size. The iPad's touch-screen feature makes it easy for students of all ages and ability levels to use. Attachable keyboards can also be utilized. Across the United States, 1:1 iPad initiatives are being implemented in many districts (Riley, 2013). Each

student receives an iPad that he or she can utilize within the classroom and outside of school. The usage within the classroom is monitored by the teachers. Findings from a study by Liu and Gong (2014) demonstrate the advantages the iPad has on teaching and learning. These advantages include access to educational applications, immediate feedback, access to information, and collaboration between peers and teachers.

Through the use of the iPads, some districts are going paperless. Many schools are no longer providing students with hard copies of textbooks, but using digital materials instead. While some schools are making use of e-books, other schools have created completely digital curriculum, eliminating textbooks. These schools are utilizing applications, such as *iTunes University*, *Google Classroom*, and others, to provide students with instructional materials. iTunes University allows a district or an individual teacher to create a course, enroll their students, and upload lecture presentations and assignments. The students can then access all of the course materials, complete their assignments on the iPad, and submit their work to the instructor via Wi-Fi. This eliminates the need for teachers to make hundreds of copies of assignments for their students. Students can no longer misplace their assignments, since they are all on the iPad. This could potentially increase rates of homework completion.

The iPad can also support students with unique learning needs. Many of these students are classified for special education services under the Individuals with Disabilities Act. Students who are classified for special education services have an Individualized Education Program (IEP) to meet their specific learning needs. The iPad provides opportunities for teachers to differentiate instruction and assignments, making the classroom more conducive to its diverse learners. The iPad can be considered

assistive technology because it can allow students to participate in activities, access the curriculum, and succeed. With the push for a more inclusive education for students with disabilities, teachers must find ways to meet the needs of a diverse group of learners in their classroom. iPads provide an opportunity for teachers to reach all learners (Chambers et al., 2017).

Significance of the Study

In the current world of education, teachers are held to high standards and are expected to instruct students using evidence-based practices. The instructional strategies they use in their classrooms must be previously used and studied, to evaluate their effectiveness. As technology is advancing, and being utilized for learning and instruction, the teaching methods must be studied and evaluated.

The significance of this study is to measure if middle school students using iPads to learn through a digital curriculum are achieving at a higher rate academically. The goal for implementing technology is to engage students and help them learn. This study will provide evidence of the students' academic achievement.

This study will also provide data on the effects of a digital iPad curriculum on middle school students with exceptional learning needs. In order to meet the needs of these students in an inclusive classroom, teachers must provide a variety of accommodations, differentiate instruction and assignment materials, and continually assess their students. This study will evaluate the digital iPad curriculum to see if it is effective for middle school students with disabilities.

Purpose of the Study

The purpose of this study is to investigate the effect of an all-digital curriculum and the implementation of iPads on academic performance of students in mathematics.

Research Questions

1. Will the use of iPad instruction and a paperless curriculum increase the academic achievement of students in an eighth-grade inclusive mathematics classroom?
2. Will the use of iPad instruction and a paperless curriculum increase student engagement in an eighth-grade inclusive mathematics classroom?
3. Will the ability to submit homework assignments digitally through the use of an iPad increase homework submission rates in an eighth-grade inclusive mathematics classroom?
4. Will students in an eighth-grade inclusive mathematics classroom be satisfied with a digital mathematics curriculum?

Hypothesis

Receiving instruction using iPads and the digital curriculum will increase the academic achievement, engagement, homework submission rates, and satisfaction of students in an eighth-grade inclusive mathematics classroom.

Key Terms

For the purposes of this study, these terms will be defined as follows:

1. Digital curriculum: a classroom learning program that is not based on textbooks and paper assignments, allowing teachers to design their own interactive materials using a variety of e-resources (Pepin, Gueudet, & Trouche, 2017).

2. Evidence-based practice: data has been collected through testing and research in support of a particular approach (Di Giacomo et al., 2017). In the field of education, evidence-based practices are teaching strategies and educational tools that have evidenced student achievement.
3. Differentiation: methods of instruction and tools used to meet the needs of a diverse classroom with students at varying ability levels (Hui, 2016).

Chapter 2

Review of the Literature

Today's students are considered to be "digital natives" because they grew up with technology readily available to them. The increased technology available in schools has caused teachers and other education professionals to rethink teaching modalities to incorporate these resources in the classroom (Jahnke et al., 2017). The use of technology in classrooms to enhance learning has increased with the use of iPads (Ferguson, 2016). The internet provides students with easy access to information and learning materials. With the click of a few buttons, students can search for information on any topic. Technology has become an increasingly important tool in the field of education, to increase students' learning and prepare them for their future. Apple's iPad offers students educational support and access to curriculum (Hui, 2016).

Technology keeps students engaged and will help them with achievement. Using technology in the classroom, specifically iPads, students have found that learning is more intriguing and enjoyable (Ferguson, 2017). The Apple iPad allows students to interact with learning materials, keeping them engaged. The iPad also provides teachers and students with immediate feedback, allowing them to be more successful, academically (Lui & Gong, 2014). The move from a paper and textbook-based curriculum to a digital curriculum has allowed teachers to utilize more interactive materials, designing learning experiences unique to their students' needs (Pepin et al., 2017). Being able to individualize students' learning experiences is especially important for students with learning disabilities. The iPad is being used in the classroom to support the diverse needs of students with learning difficulties and disabilities (Chambers et al., 2017).

This chapter provides a review of the research related to the impact of a digital curriculum using iPads for instruction, a strategy that incorporates technology in the classroom and eliminates paper assignments, and its implications for students with learning disabilities.

Technology in Instruction

Jahnke et al. (2017) report that the incorporation of technology in the classroom allows teachers to implement student learning-centered pedagogies where students can gain a deeper understanding of concepts. Integrating iPads in education makes learning more student-driven, enabling students to construct meaning using higher-order thinking skills. Within this study, iPads were used to create and enhance a learning design used in the classroom encompassing five characteristics deemed important for students to successfully gain a deep understanding of concepts. The five elements include: (1) communicating learning goals and outcomes to the students, (2) learning activities that support the students' achievement of learning outcomes, (3) assessment, including feedback and reflection throughout the learning process, (4) multiple social roles, where students consume information, but also produce information and design their own learning, and (5) web-enabled media tablets that support learning activities by allowing students to access information, communicate, and demonstrate their learning.

To evaluate the effectiveness of technology in the classroom, the digital framework using the iPad was implemented in 64 different classrooms, ranging from preschool through grade 11. The researchers used classroom observations, interviews, and surveys to collect data. The classes were placed into three different groups, each integrating technology differently. In group 1, the technology was fully integrated into

the teaching framework, with students utilizing iPads throughout learning activities for multiple purposes. In group 2, the students only utilized technology as a word processing tool. Group 3, the control group, did not utilize any technology in the classroom. Findings indicated that students from Group 1, with full technology integration, were the most successful in meeting the learning goals with a deep understanding. Utilizing the iPad fostered new possibilities for learning, providing students with a multitude of options for investigating concepts and exhibiting what they have learned (Ibid.).

Hui (2016) also believes that the use of technology in the field of education has resulted in a change in classroom activities and learning. This study researched the impact of the iPad in education. The researcher focused on students, ages 13 through 16, utilizing iPads for learning, over a three-year period. As in the last study discussed, this researcher also evaluated the students' ability to achieve a deeper understanding of concepts, but also evaluated the students' collaboration using the iPads as well as the learning that occurred outside of the formal class time. The study used surveys and interviews of students and teachers involved in the research, classroom observations, and the students' academic results to collect data.

The students' perception of the impact of the iPad on their learning was analyzed. Many students saw the benefit of the iPad for research purposes. They were able to quickly look up information that was not available in their regular textbooks. Students also saw the benefit of the many different applications available to enhance learning. Findings also supported that students were more independent, requiring less direct instruction from the teacher, also enhancing collaboration between peers. Teachers' perceptions were also analyzed. While they found many of the same

benefits as the students, they also noted the benefit of using the iPad as an assessment tool. Students receive immediate feedback through different applications and can also use it for self-reflection. The findings from this study supported that lesson structure and activities changed with the use of technology. Because learning was more self-directed and students could use the iPads to research information needed to achieve a deep understanding of concepts, the teachers spent less time on direct instruction. Teachers did not need to repeat information as frequently because students could use a variety of available resources on the iPad to clarify any information they were unsure of. Throughout class time, there was more class discussions where students collaborated. Class discussions were not only oral, but also utilized online discussion forums and other applications where students could demonstrate their understanding of learning goals (Ibid.).

Student Engagement and Achievement

Ferguson (2017) conducted a study to analyze the reactions of middle school students using a one to one technology program in their classes. Students responded to survey questions about their attitude towards using the iPad for their education. Most students took the survey eight months after receiving the iPads to use in class. The seventh-grade students had been using the iPads for a year and eight months. Results showed that most students found the iPads beneficial for their engagement and achievement. For example, most students said that they learn better using an iPad, are more productive when using the iPad, and learning is more interesting and fun. In response to the survey, 72% of students stated that they were less distracted when completing assignments using the iPad than when they are completing assignments on

paper. Many students also stated that their grades improved since using the iPads. The research did note that the seventh-grade students had the most positive responses to the survey questions. These students had been using the iPads for the longest period and had adjusted to using the technology. For iPads to be effective in engaging students and improving student achievement, there must be time for the students to learn to use the technology effectively and adjust to the new learning methods.

Research conducted by Lui and Gong (2014) also supports increased student engagement when using iPads for learning. Students can interact with the iPad, keeping students engaged throughout the learning process. Students also receive immediate feedback using the iPad. Based on a student's performance, a variety of applications can provide individualized tutoring and practice to improve his or her overall achievement. In this study, elementary school teachers and students utilized iPads for four weeks of instruction to analyze its advantages for teaching and learning. Data was collected through interviews of teachers and students and through classroom observations.

The results of the study demonstrated the increased engagement and achievement of students using iPads in the classroom. For example, a teacher found free applications that helped the students meet the learning goals. One application allowed the students to work on a specific skill, at different difficulty levels, so that each of her students were working at the appropriate level, which is necessary for keeping students engaged. Through observations, it was noticeable that the students enjoyed interacting with the different digital applications for learning. To increase student achievement, the iPads provided students and teachers with immediate feedback. Students could see what they answered correctly, or incorrectly. Teachers could adjust their teaching methods

when students are unsuccessful, based on the feedback, so they could help the students meet the learning goals (Ibid.).

Another study found similar results for student engagement and achievement when using iPads for instruction. Students were engaged throughout the learning process, continued to learn outside of the regular class time, and collaborated more frequently. For data analysis, students were grouped based on their ability level. Students in the high and low ability groups showed a significant difference in their learning outcomes, performing better when utilizing the iPads for learning (Hui, 2016).

Mathematics Learning Disabilities

Mathematics Learning Disability (MLD), also known as dyscalculia, causes challenges for some students. Students with dyscalculia often have difficulty with counting, number facts, calculations, measurement, telling time, counting money, estimation, mental math, and problem solving (Cortiella & Horowitz, 2014). Students with learning disabilities require individualized instruction to meet their specific learning needs.

Chambers et al. (2017) conducted a study to explore the uses of the iPad in the classroom to support students with exceptional learning needs. The researchers used an online survey to gather information from 427 teachers and other education professionals in the United States, Canada, the UK, and Australia. Survey results showed that teachers across these countries were using iPads to teach academic, functional, and social skills, as well as communication. For a student receiving special education services, the iPad can be an important component of his or her academic success and would be included in the Individualized Education Program (IEP). Approximately one-third of the study's

participants noted that their students' IEP included the use of an iPad. If included in a student's IEP, the school would be required to provide the student with the device, since the IEP is a legally binding document.

In a study conducted by Ok and Bryant (2016), the iPad was used to support fifth-grade students with mathematics learning disabilities to learn multiplication facts. Utilizing technology in mathematics education provides students with additional practice of skills, which is especially important for students with learning disabilities. The computer-based instruction (CBI) provides teachers with opportunities to adjust and individualize instruction, adapting difficulty levels and pacing, record and track a student's progress, and set specific learning goals. Because of its potential to support basic math skills, CBI can be beneficial to students with mathematics learning disabilities who typically struggle in this area.

The study tracked four fifth-grade students' multiplication fact fluency. Prior to the study, the students were taught how to use the iPad. Throughout the study, the students received systematic and explicit instruction from a teacher as intervention. Then the students used the iPad application for independent practice. The application was set up in a game format. It allowed teachers to customize settings based on individual student needs, gives immediate feedback, allows students to correct mistakes, and tracks data. At the end of each session, the students were administered a 2-minute probe to assess their progress. All four students in the study showed positive results from this intervention. Students were also reevaluated to see if they maintained the skill after a period of time. Again, the four students were successful. The data indicates that this intervention was successful for students with mathematics learning disabilities in

increasing their multiplication fact fluency. The computer-based instruction allowed the students to practice the skill, at the appropriate difficulty level, individualized to their needs, until they reached mastery (Ibid).

Digital Curriculum and Paperless Assignments

While there is extensive research on technology integration in classrooms, the research on the implementation and effectiveness of an exclusively digital curriculum is limited. A study conducted by Pepin et al. (2017) analyzed a completely digital mathematics program used in France created by a collection of teachers. The program *Sésamath* has resources available for grades five through twelve. The program is comprised of a variety of online resources including practice exercises, a geometry software, an e-textbook, and a website offering additional resources. The mathematical topics were organized into chapters based on the national standards for the grade level. While creating the digital program, the teachers involved in the design considered the importance of adaptability of the content. The digital textbook was created in a format that could be edited by the teacher who was using it. Any teacher using the *Sésamath* program, including someone not involved in the development of the program, could individualize lessons and practice exercises to meet the needs of his or her students. This differs from a traditional textbook where teachers do not always have access to a variety of online materials and do not have the ability to easily adapt materials.

In observing a teacher utilizing the *Sésamath* program in the classroom, the researchers were able to collect data about the program and the different aspects of teacher design in the classroom when using a digital curriculum. The teacher from the study was able to adapt her lessons based on the needs of her students. The digital

resources available through the *Sésamath* program supported her students so they could meet the learning goals (Ibid.).

Hallatt et al. (2017) conducted a study to compare the rates of homework submission when assigned digitally in comparison to traditional paper assignments. The researchers analyzed homework assignments in social studies and language arts classes, grades six through twelve. Homework submission rates were tracked throughout the course of the school year. Information was gathered for each assignment about how the assignment was to be completed and submitted. Paperless assignments were submitted through a variety of programs including *Moodle*, *Gaggle*, and *Google Drive*. Unlike the hypothesis of this thesis paper, the researchers found that there was a 13.55% drop in submissions of paperless assignments in comparison to traditional paper assignments. In this study, the researchers also used a survey of the students to determine whether students preferred digital homework or traditional paper assignments. Most students who responded to the survey preferred the traditional paper submission of homework assignments.

Conclusion

This review of the literature details the uses of technology for academic instruction, the effect of iPads on student engagement and achievement, the difficulties of students with mathematics learning disabilities and how technology can support those needs, and the limited data related to digital curriculums and paperless assignments. Results from these studies demonstrated positive effects overall for incorporating technology in instruction. As previously stated, the data on the effectiveness of an entirely digital curriculum is limited. The goal of this study is to add

to the research on utilizing iPads and digital resources in a mathematics classroom by investigating the effectiveness of a paperless curriculum with eighth-grade students. After completing this review of the literature, I will narrow down the topic of this study to the academic achievement of students utilizing iPads for a paperless curriculum in an eighth-grade inclusive mathematics classroom.

Chapter 3

Methodology

Setting

School. The study was conducted in a Central New Jersey public school district. The school district consists of three high schools, five middle schools, and 17 elementary schools, serving students from kindergarten through twelfth grade. One of the five middle schools was selected for this study. This middle school has students in grades six through eight and is considered to be a Title I school. The school operates on a four period block schedule, with each block lasting 84 minutes. Mathematics and language arts courses meet daily for a full block, whereas other courses alternate, meeting every other day. The district started a 1:1 technology initiative in the 2016-2017 school year and this has continued into the current school year. All eighth-grade students have received an Apple iPad.

According to the New Jersey Performance Report (New Jersey Department of Education, 2017), the school had a total of 522 students in the 2016-2017 school year. Approximately 14% of the students have disabilities and receive special education services. The school has a significant number of students, 44% who come from economically disadvantaged families. The school has a diverse student population. In the 2016-2017 school year, 42% of the students were Caucasian, 32.8% of students were Hispanic, 13.4% were African American, 10.5% were Asian, and 1.3% of the students were 2 or more races. A significant change in population has not occurred since the time of this report and the demographics are similar to the population at the time the current study was conducted.

Classroom. The classroom where the study took place was on the main floor of the building. Health classes are taught in the classroom for a majority of the day, but it is used for an eighth-grade mathematics class for one block each day. The classroom has of 25 student desks and one teacher desk. There is one additional desk in the back corner of the room used to hold supplies, including crayons, scrap paper, calculators, and hand sanitizer. There is also a bookshelf on the side of the room used to hold health textbooks. There is one computer in the classroom that is connected to a LED projector that is used to display lessons and notes. Each student has his or her own iPad to utilize throughout class.

The study was conducted in the eighth-grade mathematics class taught during block 3, in an 84-minute instructional block. The class begins at 11:37AM and goes until 12:19PM, when the students have a break for lunch. The students then return to mathematics class at 12:54 until 1:36. There are a total of 25 students in the class with one teacher.

Participants

Students. The study included 20 participants from the 8th grade class. Five students from the class were excluded from the study. Three of those students did not receive parental consent to participate in the study. The other two students were randomly excluded from the study. From the class attendance list, every third student was included until there was a total of 20 students participating in the study. Participating students were randomly numbered using a random number generator. Participants numbered 1 through 10 made up the control group, and 11 through 20 made up the experimental group. Although all of the students in the study

were members of the general education population, there were two students who were identified as possibly needing special education services. Those students were receiving educational accommodations within the classroom which were recommended by the intervention and referral services (I&RS) team prior to being evaluated by child study team.

The students were 13 or 14 years of age, 11 were male and 9 were female. Two students had accommodations recommended by the I&RS Team, participants 7 and 19. Both students were given extended time to complete academic tasks. An additional accommodation for participant 7 was frequent communication with parents through email and a signed assignment notebook. Participant 19 was allowed to use a calculator on all assignments. He also received modified homework assignments, with 25% of problems eliminated.

Teacher. The mathematics class was instructed by a K-12 certified mathematics teacher for the entire 84 minutes of instruction each day throughout the duration of the study. The teacher had four years of experience as a middle school mathematics teacher. She was responsible for engaging students in mathematics lessons that follow the district curriculum for eighth-grade mathematics students and encompass the New Jersey Student Learning Standards.

Materials

An Apple iPad was needed for all students in the experimental group. Each iPad had access to the following applications that were utilized throughout the study: Notability, IXL, iTunes University, and Prodigy. Notability was used for notetaking and to complete assignments digitally. IXL was used for additional practice of skills. All

assignments were uploaded by the teacher to iTunes University for the students to complete. Students were able to turn in their assignments digitally to iTunes University. Prodigy was used for additional practice of skills in a game format. The students had access to a digital copy of the class textbook. Students in the control group used a traditional printed version of the class textbook. Some worksheets from the corresponding workbook were used as well (Larson et al., 2012).

Students in both groups completed four independent assignments each week to practice the skills they were learning, a total of 12 independent practice assignments used throughout the study. Some of the assignments were completed in class and some were completed after school for homework. Students in the experimental group completed the assignments digitally using iTunes University and Notability. Students in the control group completed the assignments on paper.

Students were assessed using Pre- and Post-Tests during the study. Throughout the unit, there were four assessments were used. The first was a pre-test on the information that would be covered in the first section of the unit. The second was a post-test, that would be used after instruction of that material. The third assessment was another pre-test on the material to be covered during the second section of the unit. After instruction, the final assessment, a post-test that covered the information from the second section of the unit, was used. All students had access to a scientific calculator throughout the second section of the unit.

Research Design

A group design was used for this study. The participants were split into two groups, the experimental group receiving the intervention, and the control group who did

not receive the intervention. Baseline data was collected from each group using a pre-test, prior to any instruction on the topics to be covered in the unit. Students in the experimental group received instruction using the digital iPad curriculum, taking notes using iPad applications and completing assignments digitally. The control group received traditional instruction, taking notes in a notebook and completing assignments on paper. After the students received instruction and completed independent practice assignments, data was collected again using a post-assessment.

Procedures

The research was implemented over a 3-week period. Students received instruction for 84 minutes each day, five days a week. Prior to the intervention, students received instruction on how to use the iPad and the different applications used throughout the intervention. Students had been working with the iPad and the applications for approximately six months prior to the intervention.

Pre-tests were given to students in both groups to determine a baseline. After the students completed the pre-test, instruction was provided by the teacher for the class. Students in the experimental and the control groups received the same instruction. Students in the experimental group took notes and completed assignments using the iPad. Students in the control groups took notes using a notebook and pencil, and completed assignments on paper. Students completed four independent assignments each week to practice the skills learned from the instruction. Some assignments were completed in class, and others were done for homework. At the conclusion of the instruction of the pre-test topics, the students completed the post-test.

Measurement Procedures

Pre-tests. Prior to any instruction on the topics being covered, the students in both groups took a pre-test to find a baseline. There was one pre-test that covered the material from the first section of the unit. Five different topics were tested on this assessment. A second pre-test was given approximately half way through the study that covered the second section of the unit. Four different skills were covered on this assessment. Each question on the pre-tests was assigned a point value, and students earned points for answering the question correctly. Tables 1 and 2 give more detail about the skills assessed on each pre-test.

Post-tests. After receiving instruction on the topics, the students were assessed using post-assessments. The students took two post-tests throughout the study, one on topics covered in the first section of the unit, and a second covering material from the second section of the unit. The post-tests used were the exact same assessments used for the pre-tests. After learning the skills, the students will be able to apply the knowledge learned throughout instruction to answer the questions correctly. Each question on the post-tests were assigned a point value, and students earned points for answering the question correctly. Partial credit was available if the student answered the question partially correct. The point system used to score the post-tests matched the point system used for the pre-tests.

Table 1

Pre- and Post-Test Part 1 Information

Skill	Topic	Number of Questions	Total Possible Points
A	Evaluating Square Roots	3	15
B	Evaluating Cube Roots	4	20
C	Approximating Square Roots to the Nearest Integer	6	30
D	Approximating Square Roots to the Nearest Hundredth	2	10
E	Simplifying Square Roots	5	25

Table 2

Pre- and Post-Test Part 2 Information

Skill	Topic	Number of Questions	Total Possible Points
F	Finding the Missing Side Length of Right Triangles	6	30
G	Determining if a Triangle is a Right Triangle	4	20
H	Finding the Distance Between Two Points from Coordinates	6	30
I	Finding the Distance Between Two Points from a Graph	4	20

Data Analysis

Data points were collected at four different times throughout the three-week study. Pre-test data was collected at the beginning of the study on information to be covered in the first section of the unit. Approximately half way through the study, post-test data was collected on the first section of the unit. A second set of pre-test data was

collected for the information to be covered during the second section of the unit. Finally, data was collected at the end of the study on the second section of the unit. Data was broken down from the tests based on each skill taught. A composite score was calculated. All data was recorded in a spreadsheet. A pre- post comparison was used to indicate growth differences between the control and experimental groups. This will determine whether a change has taken place between the pre- and post-tests, within the control and experimental groups. It will allow us to draw a conclusion about the cause-and-effect relationship of receiving the digital curriculum intervention (Leedy, Omrod, & Johnson, 2019). Comparisons were made between the section 1 pre- and post-tests, the section 2 pre- and post-tests, and the overall results from the pre- and post-tests. No further analyses were used due to the limited sample size. Results were displayed in tables for visual analysis. The comparison of results helped assess the effectiveness of a digital iPad curriculum on student achievement.

Chapter 4

Results

This study utilized a group design with a control group and an experimental group to evaluate the effectiveness of a digital iPad curriculum in an eighth-grade inclusive mathematics class. Specifically, it aimed to assess student achievement while using the tools available through the digital iPad curriculum. Twenty eighth-grade students were randomly placed into two groups. Two of the twenty students had learning difficulties, one student was in the experimental group, and the other in the control group. The experimental group received the iPad intervention, and the control group completed academic tasks traditionally, using a textbook, papers, and pencils. Prior to instruction, a baseline was obtained through pre-tests. Students in both groups received the same instruction throughout the study, but utilized different tools to take notes, practice skills, and complete and submit assignments. After instruction, the students took post-tests to assess their academic achievement. A pre- post comparison was used to indicate growth differences between the control and experimental groups. No further analyses were used due to the small sample size.

Academic Achievement

To assess if students were achieving academically, pre- and post-test data was collected and analyzed. A baseline was obtained for each student using pre-tests. The Part 1 pre-test assessed material to be covered during the first section of the unit. For this part, students did not have access to a calculator. The Part 2 pre-test assessed material to be covered during the second section of the unit. Students had access to a calculator for this pre-test. To find an overall pre-test score, the scores from Part 1 and Part 2 were

added. For this unit of study, most students did not have any prior knowledge, so pre-test scores were low. Individual students' pre-test scores can be viewed in Appendix A. Mean scores were calculated from the pre-test composite scores for the control group and experimental group. Scores were broken down by Part 1, Part 2, and the overall pre-test score. The mean scores for both the control and experimental groups on the Part 1 pre-test were greater than the mean scores for part 2 of the pre-test in both groups, despite having equivalent total points available. The experimental group scored higher than the control group on both parts, giving them a overall mean pre-test score 1 point higher than the control group. These mean scores are presented in Table 3.

Table 3

Pre-Test Group Means

Group	Part 1	Part 2	Overall
Control	6	2	8
Experimental	6.5	2.5	9

Post-tests assessed if the students had met the learning goals. After instruction, students in both groups took the post-test. For the Part 1 post-test, students did not have access to a calculator, except for the one student receiving accommodations set by the I&RS committee. For the Part 2 post-test, all students were allowed to use a calculator. The overall post-test score was found by adding the scores from Part 1 and Part 2. Individual students' scores can be found in Appendix B. Mean scores were calculated from the post-test composite scores for the control group and experimental group. Scores were broken down by Part 1, Part 2, and the overall post-test score. Scores on Part 2

were higher than Part 1 in both groups, despite having equivalent total points available. The experimental group scored higher than the control group on both parts of the post-test, giving them an overall score 5.8 points higher than the control group. These mean scores are presented in Table 4.

Table 4

Post-Test Group Means

Group	Part 1	Part 2	Overall
Control	88.1	90	178.1
Experimental	89.5	94.4	183.9

A pre- post comparison was used to indicate growth differences between the control and experimental groups. All participants showed significant growth between the pre- and post-tests. To calculate growth differences, each students' scores on the pre- and post-tests were subtracted to find the change. Scores were broken down into Part 1, Part 2, and the overall score. Individual students' pre- post differences can be found in Appendix C. Mean differences were calculated for the control and experimental groups. The differences in both groups were greater in Part 1 than Part 2. The experimental group differences in both parts were greater than the control group differences. The mean differences between the pre- and post-tests are presented in Table 5.

Table 5

Pre- Post Comparison

Group	Part 1 Difference	Part 2 Difference	Overall Difference
Control	88	82.1	170.1
Experimental	91.9	83	174.9

Students with Learning Difficulties

Participants 7 and 19 were identified as having learning difficulties and received educational accommodations recommended by the I&RS team throughout instruction and assessments. Participant 7 was in the control group and participant 19 was in the experimental group. Table 6 displays the students' overall post-test scores and pre- post differences.

Table 6

Students with Learning Difficulties

Participant	Group	Post-Test Overall	Pre- Post Difference
7	Control	152	132
19	Experimental	160	160

As seen in Table 6, both students showed growth between the pre- and post-tests. The student in the experimental group scored higher on the post-test and had a greater difference between pre- and post-test scores. In comparison with the group mean scores on the post-test, both students scored lower than their respective groups. Participant 7 was 26.1 points below the control group post-test mean. Participant 19 was 23.9 points below the experimental group post-test mean. In comparison with the mean

group differences, both students scored lower than their respective groups. Participant 7 was 38.1 points below the control group mean difference. Participant 19 was 14.9 points below the experimental group mean difference. Despite performing lower than the means, the student in the experimental group scored closer to the means than the student in the control group.

Chapter 5

Discussion

The purpose of the present study was to investigate the effectiveness of a digital iPad curriculum. Academic progress was monitored determine if the intervention increased achievement. Participants were eighth-grade students in an inclusive mathematics classroom.

Findings

The results of this study showed that the digital iPad curriculum was effective for increasing student academic achievement in an eighth-grade inclusive mathematics classroom. All students in the experimental group showed significant academic growth between the pre- and post-tests. The mean pre- post differences for the experimental group (part 1 M=91.9, part 2 M=83, overall M=174.9) were greater than the mean pre-post differences for the control group (part 1 M=88, part 2 M=82.1, overall M=170.1), who did not use the digital iPad curriculum. These results corroborate the results of Ferguson (2017), Lui and Gong (2014), and Hui (2016) finding that incorporating iPads in instruction is effective for increasing student academic achievement.

The results of this study also show that the digital iPad curriculum was effective for increasing academic achievement for students with learning difficulties. There was one student in the experimental group and one student in the control group who were identified as needing additional educational supports due to learning difficulties. For the overall post-test scores, the student in the experimental group (160) scored higher than the student in the control group (152). The student in the experimental group (160) also showed more growth between the pre- and post-tests than the student in the control group

(132). The finding of the present study, that utilizing iPads for instruction increases academic achievement for students with learning difficulties, supports the finding of Chambers et al. (2017) that incorporating iPads in instruction is effective for teaching students with learning disabilities. Previous research also suggests that utilizing the iPad as an intervention for students with learning disabilities will improve student learning outcomes (Ok and Bryant, 2016). The results of the present study, from the two participants with learning difficulties, corroborates those results.

Limitations

One major limitation of this study was a small sample size. The study was conducted with only one class of students because it was the only class the researcher taught in which every student had an iPad. Also, some students in the class did not receive parental consent, limiting the available sample size. The small sample size limited the statistical analysis of the data. Only a pre- post comparison was used because other methods of analysis would have been invalid. A larger sample size may lead to more conclusive evidence of the effectiveness of a digital iPad curriculum on student academic achievement. Also, only two students participating in the study were identified as having learning difficulties. The results of these two participants cannot be generalized to all students with learning difficulties, including those classified for special education services, without further research.

Another limitation was the availability of technology for both the experimental and control group throughout the study. While the students in the control group utilized the traditional printed textbook, notebooks, papers, and pencils, they still had access to their iPads throughout the study. All students in the class had been using the iPads for

instruction throughout the first five months of the school year, prior to the study. Although the students were monitored during instruction, to ensure the students in the experimental group were utilizing the iPads and the students in the control group were not using technology, many of the students in the control group were using their iPads outside of the classroom. Students in the control group were still using the Prodigy application on the iPad for additional practice of skills. While outside of the classroom, some of the students in the control group completed and submitted assignments digitally. More conclusive results may be found if students in the control group did not have any access to iPads prior to, or during the length of the study.

A third limitation of this study was the time frame. The study was implemented over a 3-week period. The data collected from the study may have been stronger if collected over a period of time longer than 3 weeks. Due to the time limitations, the study only collected data from one instructional unit with related mathematical topics and skills. Further research would be needed to generalize the effectiveness of a digital iPad curriculum on student achievement across other mathematical topics and skills.

Implications and Recommendations

This study adds to the research on incorporating technology, specifically the Apple iPad, in the classroom. The implementation of a digital iPad curriculum in the mathematics classroom researched through this study may lead educators to consider alternative methods of instruction, incorporating iPads and a digital curriculum. The findings of this study imply that using iPads for notetaking, practicing skills, and completing assignments can lead to increased academic achievement.

Although this study had limitations, the data does suggest that using a digital iPad

curriculum increases student academic achievement. Prior studies, such as the research conducted by Lui and Gong (2014), Hui (2016), and Ferguson (2017) have yielded more encouraging results demonstrating increased academic achievement when iPads are utilized throughout instruction. Studies conducted by Chambers et al. (2017) and Ok and Bryant (2016) evidenced the benefit of using iPads to support students with exceptional learning needs. There is a demand for research to continue on the use of digital iPad curriculums in classrooms to further understand its effectiveness for increasing academic achievement for all students, including those in the special education population.

In this study, all students utilizing the digital iPad curriculum showed academic growth between the pre- and post-tests. The student with learning difficulties receiving the iPad intervention showed progress between the pre- and post-tests. Future studies should be conducted with a larger sample size, including members of the special education population with a variety of classifications, to determine if these findings can be generalized to all learners. Future studies should be conducted over a longer time frame, assessing a variety of skills, to determine if these findings can be generalized across other content.

Conclusions

In conclusion, it appears that using the digital iPad curriculum increased academic achievement. While there does not seem to be a significant difference overall, the experimental group did show slightly more improvement than the control group. In addition, the student with learning difficulties in the experimental group showed more improvement than the student with learning difficulties in the control group. Further research is needed to generalize these findings to a more widespread student population,

including students with significant learning difficulties and disabilities. While this study attempted to demonstrate the effectiveness of a digital iPad curriculum in an eighth-grade mathematics classroom on student academic achievement, future research should utilize a larger number of participants across a longer period to draw more conclusive findings.

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Appendix A

Individual Student Pre-Test Scores

Table A1

Control Group Pre-Test Scores

Control Participant	Part 1 Score	Part 2 Score	Overall Score
1	0	0	0
2	0	0	0
3	0	0	0
4	5	0	5
5	15	0	15
6	0	0	0
7	15	5	20
8	10	10	20
9	5	5	10
10	10	0	10

Table A2

Experimental Group Pre-Test Scores

Experimental Participant	Part 1 Score	Part 2 Score	Overall Score
11	0	0	0
12	0	0	0
13	15	10	25
14	10	0	10
15	0	0	0
16	30	0	30
17	0	0	0
18	0	0	0
19	0	0	0
20	10	15	25

Appendix B

Individual Student Post-Test Scores

Table B1

Control Group Post-Test Scores

Control Participant	Part 1 Score	Part 2 Score	Overall Score
1	96	94	190
2	86	98	184
3	94	86	180
4	85	94	179
5	95	94	189
6	93	95	188
7	88	64	152
8	82	92	174
9	77	89	166
10	85	94	179

Table B2

Experimental Group Post-Test Scores

Experimental Participant	Part 1 Score	Part 2 Score	Overall Score
11	100	95	195
12	90	94	184
13	99	93	192
14	100	100	200
15	83	96	179
16	74	95	169
17	94	95	189
18	87	86	173
19	68	92	160
20	100	98	198

Appendix C

Individual Student Part 1 Pre- Post Comparison

Table C1

Control Group Part 1 Pre- Post Comparison

Participant	Pre-Test Score	Post-Test Score	Difference
1	0	96	96
2	0	86	86
3	0	94	94
4	5	85	80
5	15	95	80
6	0	93	93
7	15	88	73
8	10	82	72
9	5	77	72
10	10	85	75

Table C2

Experimental Group Part 1 Pre- Post Comparison

Participant	Pre-Test Score	Post-Test Score	Difference
11	0	100	100
12	0	90	90
13	15	99	84
14	10	100	90
15	0	83	83
16	30	74	44
17	0	94	94
18	0	87	87
19	0	68	68
20	10	100	90

Appendix D

Individual Student Part 2 Pre- Post Comparison

Table D1

Control Group Part 2 Pre- Post Comparison

Participant	Pre-Test Score	Post-Test Score	Difference
1	0	94	94
2	0	98	98
3	0	86	86
4	0	94	94
5	0	94	94
6	0	95	95
7	5	64	59
8	10	92	82
9	5	89	84
10	0	94	94

Table D2

Experimental Group Part 2 Pre- Post Comparison

Participant	Pre-Test Score	Post-Test Score	Difference
11	0	95	95
12	0	94	94
13	10	93	83
14	0	100	100
15	0	96	96
16	0	95	95
17	0	95	95
18	0	86	86
19	0	92	92
20	15	98	83

Appendix E

Individual Student Overall Pre- Post Comparison

Table E1

Control Group Overall Pre-Post Comparison

Participant	Pre-Test Score	Post-Test Score	Difference
1	0	190	190
2	0	184	184
3	0	180	180
4	5	179	174
5	15	189	174
6	0	188	188
7	20	152	132
8	20	174	154
9	10	166	156
10	10	179	169

Table E2

Experimental Group Overall Pre-Post Comparison

Participant	Pre-Test Score	Post-Test Score	Difference
11	0	195	195
12	0	184	184
13	25	192	167
14	10	200	190
15	0	179	179
16	30	169	139
17	0	189	189
18	0	173	173
19	0	160	160
20	25	198	173