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An investigation of the use of the iPad and textbooks on the achievement of students with special needs in algebra

Ahmet Kilic

AN INVESTIGATION OF THE USE OF THE iPAD AND TEXTBOOKS ON THE ACHIEVEMENT OF STUDENTS WITH SPECIAL NEEDS IN ALGEBRA

by
Ahmet Kilic

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Abstract

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Educational leaders and policy-makers assume that replacing the technological tools currently used in schools with new, portable ones will result in widespread usage of the device for educational purposes by students and teacher, and an increase in student achievement. This study examines these assumptions with twenty students taking an Algebra-2 course in a northern New Jersey charter school. The mixed methodology used in this study included classroom observations and assessments, surveys for both students and teachers, and interviews with parents through home visits. Findings show that iPad integration in an Algebra-2 class led to a slight increase in student achievement, as well as student participation and peer collaboration. However, interviews with parents and data from teacher surveys indicates that iPads can easily turn out to be a great distraction for students, if it does not happen along with instructional coherence and comprehensive changes in class. By highlighting a number of caveats with the effective implementation of iPads, and exploring the appropriate use of iPads in schools, the findings of this research shed light on avenues where educational leaders and policy-makers are charged with making the decision of whether to use iPads in classrooms in their districts as a valid educational tool of choice.

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Chapter 1

Introduction

The ultimate goal of education is to prepare students for leading productive and independent lives to the maximum extent possible. Aligned with this mission, the U.S. Department of Education encourages schools to design instruction using the most recent technological tools, whereby students become more productive members of society. In its new study regarding technology implementation in schools (2010), the U.S. Department of Education suggests that schools should "support the development and use of open educational resources to promote innovative and creative opportunities for all learners and accelerate the development and adoption of new open technology-based learning tools and courses" (p.19).

However, based on previous research studies, there seems a lack of standards and clear definitions about technology integration in schools (Bebell, Russell, & O'Dwyer, 2004). This lack of standards and definitions has led to some arguments with respect to technology integration in K-12 schools. Cuban et al. (2001) claim that technology integration is characterized by the extent to which teachers bring computers into classrooms to give students an opportunity to conduct online research, or to prepare PowerPoint presentations. From this perspective, it appears easy to accomplish the goal of technology integration as long as schools have computer laboratories or laptops available for students. Other scholars indicate that technology integration should open doors for students to develop higher-thinking skills through discussions, projects, and

research (Barak, Lipson, & Lerman, 2006). This idea appears more promising, since learning outcomes aligned with this approach lead to enhanced learning experiences.

After Steve Jobs, the CEO of Apple, introduced the iPad tablet in 2009, more than three million tablets were sold within a two-week time frame. Experts in the industry attribute this success to the iPad's unique and small design, as well as its nearly 100,000 applications in a variety of areas. Following this trend, the iPad tablet began to gain popularity in the education world. Even though the "One Laptop Per Child" promise has not yet been fulfilled in this country, many school districts across the nation have began to provide an iPad tablet to their students over the past several years.

The iPad is a small, flat, touch-screen tablet that is capable of completing many tasks that are expected from a personal computer through specific applications. There are thousands of applications on the market that are available for Apple users; many of them are related to education. With the advent of the iPad, tablet technology found a greater chance to enter classrooms. For several years, laptops were traveling between classrooms to give students access to the internet during instructions. However, this practice did not prove to be convenient for teachers or students. For example, teachers had to spend a considerable amount of instructional time on the logistical issues of laptop use. Additionally, students did not have enough space on their desks to use their laptops along with their textbook. Tablet technologies such as the iPad, however, are user friendly and appears more convenient. Conversely, it takes only a second or two to turn the iPad on. Moreover, most publishers already make textbooks available in the iPad format. As students swapped their textbook's printed for the new digital format, they no longer have to carry cumbersome textbooks between classrooms, nor do they need to go to their

lockers every other period to retrieve texts appropriate for a specific class. Even though the content of a textbook in both digital and traditional versions is close to identical, the digital version appears more appealing to students due to interactive colorful diagrams, videos, and pictures that accompany the text. For instance, in Social Studies class, students can explore a geographic region from different points of view, and magnify images by merely touching its screen. The iPad also enables students to highlight a part of a text or take notes in between the lines.

The idea that the integration of new technologies could increase student achievement led school districts to invest millions of dollars into the technology marketplace. Whenever new technology is marketed to schools, there have been always advocates for the benefits to students, as well as opponents for the negative effect on students. Advocates of the iPad tablet in education often times viewed it as penicillin that will improve both student learning and student achievement on district-wide exams, since tablet computers increase student motivation and leads to active leaning and collaboration (Barak, Lipson, & Lerman, 2006; Johnson, 2011; Pearce, 2011). Even parents of students with special needs sometimes request the iPad tablet to be included in their child's individualized education plan as an assistive technology, without really looking beyond the popular "Apple" symbol on the iPad's surface to see if the tablet has anything to offer in an effort to overcome their child's academic difficulties. On the other hand, opponents argue that many alleged new learning methods that an iPad tablet produces could be achieved with a few alterations in classroom environment, and students would be lured by its possible negative effects. Ironically, most of the "new" technologies are actually not new to students, since most are already inundated with similar technologies products

at home as well as in school. However, digital technology seems to affect many aspects of students' lives. Digital technology has changed the way students play in school, learn in the classroom, and communicate and socialize with each other. Today, students are spending numerous hours in front of a laptop or tablet screen to fulfill needs that allegedly would remain unfulfilled.

One of the challenges that teachers face every day in the classroom is to differentiate instruction based upon different types of learners. Incorporating technology-based tools such as Smart Boards, overhead projectors, and interactive multi-media tools into classrooms have been proven to increase students achievement (Wang & Reevess, 2007), since traditional lecture-based instruction is supported by non-verbal and visual stimuli. These new classroom technologies help students comprehend confusing content more easily by outlining the connections between the subtopics in a more meaningful way. As a result of technology integration, students not only avoid frustration in class, but also have more time to interact with the instructor as well as their peers. Learning is the product of a lengthy process, yet occurs in a holistic manner, beginning with student motivation. Motivation brings about interest in learning, and it keeps the learner on task, even at times when the learning material becomes very challenging. Research has found that students' motivation to learn increases when instruction is designed with educational technology (McClanahan, 2008). Often times, the technology behind the learning material makes students more interested in the content being taught, as they are tired of traditional teaching methods. The high level of interest and student engagement seems to lead to possible student achievement in the end. However, only elaboration, discussion,

and practice of the new knowledge can bridge the gap between student motivation and achievement.

The Individuals with Disabilities Education Act (IDEA, 2004) describes assistive technology as, "any item, piece of equipment, or product system that is used to increase, maintain, and improve the functional capabilities of children with disabilities." The definition is so broad that it may include a pair of glasses as well as a brand new iPad if it helps students to complete a task within an area that is negatively affected by the disability. Historically, assistive technology could not be implemented successfully in schools for several reasons, such as lack of teacher training, clear goals and expectations (Edyburn, 2004). Teachers hosted technological devices in their classroom for many years, without exactly knowing why they were utilizing the resources. Students with special needs also tend to stay away from assistive technology because they did not want their peers to see them "different" because of "special" technology accommodations they were using. Today, the iPad tablet is as commonly used as a cell phone; it does not make anyone look "different". The idea of using the iPad tablet in special education settings, as well as general education classrooms, seems promising to increase student achievement, yet there are a number of concerns from parents, as well as teachers, regarding iPad practice of students. Parents are reporting that their children are spending countless hours on the iPad to do their homework, whereas teachers are not observing that much difference in students' achievement level. Cuban et al. (2001) found that the quality of learning outcomes is not correlated with the amount of time pupils spend on using educational software applications. In addition, a recent study proved that reading devices such as the iPad tablet is not superior to traditional textbooks in helping students prepare

for exams (Weisberg, 2011). Even though there has been a growing interest in iPad practice in the schools, the disadvantages as well as the advantages of the iPad have yet to be fully examined before leaving the student to work independently with the iPad and its numerous applications. Social acceptance and widespread popularity in the media does not guarantee student achievement, while a number of barriers such as a lack of student and teacher training, digital distractions caused by irrelevant applications, and a lack of curriculum planning for iPad integration still exist. Therefore, educational leaders and policy-makers should carefully consider whether using one-to-one tablet computers in classrooms, as well as at home, would enhance or hinder student achievement. If this shift to digital teaching and learning in schools fails, there are two serious consequences awaiting educational leaders. First, a considerable amount of tax payers' money given to school districts to promote student learning would be wasted. Secondly, and more importantly, the education of thousands of students would be negatively impacted by this-trial-and error experience.

A charter school in North Jersey provided each of its students with an iPad tablet, so that students would have the ability to use it in school instead of printed materials, as well as at home to complete homework. Little research has been conducted on comparing actual and perceived characteristics of the iPad in practice for students with learning disabilities in a high school. The purpose of this study is to examine the potential pitfalls of iPad use both in a general education setting as well as in a resource room setting. The study will also seek answers to the following questions:

RQ1: To what extent does an iPad help students with learning disabilities grasp tenth-grade math subjects in a more efficient manner? For the purpose of this study,

'more efficient' refers to how quickly students learn and complete their assignments with less teacher support under digital and traditional textbook condition.

RQ2: When the iPad is utilized in the classroom, how classroom climate in an Algebra-2 class changes and what classroom practices are more likely to yield higher math achievement for high school students with learning disabilities?

RQ3: How does iPad integration affect the learning and teaching dynamics in a high school math classroom? To answer this question, this research examined the learning behaviors in classroom such as student participation, rehearsal and elaboration of new knowledge, logical thinking and problem solving skills, and peer collaboration.

This research employed a "Mixed Research" method to develop an in-depth understanding of students' behaviors and the factors which control such behaviors. To gather data, the research will be garnered from interviews, observations, surveys, and classroom assessments on a focus group of six students with specific learning disabilities in a high school. My hypothesis was that the iPad tablet is not superior to printed classroom materials or traditional learning methods in increasing student achievement in high school.

Key Terms

iPad Tablet- a 9.7 inch touch screen computer made by the Apple Corporation.

Smart Board- an interactive projection screen that enables the user to manipulate its surface with an electronic pencil and eraser

Wireless Device- an electronic device that communicates through radio waves.

Digital Textbook- a textbook that is published to be used on a handheld device

iPad Applications- a software program designed to perform a specific task on the iPad

Educational Technology- technological resources that help facilitate student learning. This technology includes, but is not limited to, software programs, internet applications, video slides, etc.

One-to-One Computing- giving every teacher and student a computer with internet access available all times in all locations.

Summary

The idea of using iPads in schools as an instructional tool is quite new. It is still too early to fully support or reject this idea. Given that students spend multiple hours on the iPad tablet, and teachers and parents are unable to note a significant increase in students' achievement, the potential barriers that the iPad tablet brings to classrooms appear to be much more serious than when barriers stem from other disruptive factors, such as chatting, napping, or teasing peers in class. My hypothesis was that the iPad tablet is not superior to printed classroom materials or traditional learning methods in increasing student achievement in high school. The findings of this research will shed light on avenues where educational leaders and policy-makers are charged with making the decision of whether to allow iPads to enter classrooms in their districts as a valid educational tool of choice.

Chapter 2

Literature Review

Horizon Report (2012), a widely-accepted educational technology report, states that tablet computer practice in classrooms is one of the most significant trends in educational technology in recent years. Tablet computers, including the iPad may be useful classroom tools. On the other hand, they may become inadequate replacements for teachers who can better support student learning.

A study of the use of tablet computers in the classroom by Manuguerra (2011) yielded positive results regarding student engagement, homework completion, and decreasing classroom distractions. Similarly, Franklin and Peng, (2008) investigated the role of interactive tablet computers on eighth grade students' engagement, and found similar results. Since studies about iPad use in the classroom are in their infancy, there is little reliable information about the possible pedagogical advantages for the classroom environment.

This literature review examines learning behaviors that are most likely to be influenced by the iPad practice in classrooms. Key words for this literature search will be; Student Participation, Active Learning, Rehearsal and Elaboration, Collaboration and Critical Thinking, and Students' Computer Use at Home.

Active Learning

Early in the 20th Century, John Dewey, in addition to other educational philosophers, initially used the term "active learning", believing that student involvement in the learning process is definitely necessary in order for the new information to be used

in various settings. This term was based on the idea that when new information only traveled from the ears to the writing hand, it did not appear to be grasped well by students (Keyser, 2000). Barak et al. (2006) coined the term "active learning" and defined it as a process that requires students' active participation to build up the new knowledge. Adams (2006) expended on Barak et al.'s definition by indicating that "active learners prefer hands-on, and sometimes team-oriented activities, while reflective learners want to deeply think about the problem before solving it" (p.26).

Active learning, as its names suggests, recognizes learning as an ongoing process in which the student actively carries out his/her own learning, rather than something that is fulfilled by a teacher on behalf of the student (Johnson, Johnson, & Smith, 1998). It promotes higher order thinking skills while holding students' attention alive in the course of learning. Furthermore, active learning lays the responsibility of learning in the hands of the students by allowing them to create their own cognitive framework and organize their own conceptual understanding, whereas in the traditional learning methods students were expected to absorb whatever is being put in front of them. In the past, students were often times expected to listen to the lecture, copy from the chalkboard, and repeat the new knowledge after some time had passed. However, studies have shown that passive learning, in which the students only listened to verbally-delivered instructions, only leads to the ability to answer knowledge-based questions (Johnson, Johnson, & Smith, 1998). Thus, under the passive learning conditions students' attention levels gradually decreases over time because of the way the instruction is delivered.

New classroom technologies changed many longstanding traditional teaching and learning methods away by favoring collaborative and constructive learning approaches

with a greater flexibility. The transition from chalkboards to projectors and Smart Boards altered the way that instruction is delivered as well as student and teacher expectations. For example, in response to a high dropout rate among its graduate students, the Statistics Department at Macquarie University in Australia thought that teaching staff should offer students more opportunities than a study guide before major exams. As a result, they began to significantly consider the integration of the iPad in classrooms. Each student and faculty member was given an iPad tablet to be used in a range of teaching and learning activities. In this department, video-recorded lectures were created and posted online so that on campus students and distance learners would be able to watch the lecture repeatedly to study for major exams. As students reviewed the course content in a video lecture with the iPad tablet, they indicated that they were able to catch more "ah ha" moments while watching, since the iPad allowed them to go back and forth on the video to watch complex points again. Thus, because of the touch screen feature of the iPad, the students were able to take notes on the iPad screen while working on dynamic graphs or formulas.

Manuguerra, a faculty member in that department, (2011) compared the dropout rates for certain online and on campus courses for fifteen months. Formal evaluations of teacher comments as well as informal discussions with students were used to understand students' and teachers' feelings about the iPad practice. Manuguerra (2011) indicated that the new way of delivering instructions with iPad integration seemed to motive students for learning, because the student dropout rate significantly declined from 50 % to 10 % in one semester.

Over the past years, the integration of tablet devices in classrooms has helped teachers switch their roles from lecturers of information to facilitators for active learning. As teachers have hosted these new technologies in their classrooms, they gradually become more constructivist-minded with respect to their philosophy of learning. A number of studies revealed various means of active learning opportunities in classrooms that come along with the handheld devices such as the iPad tablets. For instance, Manuguerra (2011) pointed out that tablet devices enable students to seek for information online, while promoting critical thinking skills in and out of the school, due to portability of these devices. A short discussion about a topic, once initiated in classroom, is no longer limited within the classroom walls in order to be further investigated, because students are able to carry their iPads to different places to continue searching. Also, tablet devices can be given teachers, in the role of facilitator, and this provides an opportunity to deliver online coursework and administer a test simultaneously for an open-book exam. While dealing with the test questions, students can go back and forth on the digital version of the course material through the tablet device, and retrieve the needed information.

Since mobile handheld devices such as the iPads, provide users with an opportunity to stay connected to the digital world at all times, many students in higher education no longer want to sit in classroom when they could have the professor's lecture by podcast or as an online streaming video. With this in mind, Franlink and Peng (2008) believed that "mobile technologies provide a key to engaging students through the use of video and audio that goes beyond reading a textbook" (p.3). This curiosity led the researchers to conduct a case study in which they employed the iPod Touch Technology

in two eighth grade math classrooms to determine whether mobile devices can be used to support the understanding of the content by presenting it in terms of math videos. This case study focused specifically on the concept of slope, absolute value, and elimination in eight grade math curriculum while including a total of 39 eighth graders in two math classrooms at a middle school. The ability level of students in the first classroom ranged from gifted to low achievers, while the second classroom included students with special needs and low achievers. Math teachers working with those students were given twelve hours of training on how to download and upload videos with the iPod Touch Technology. Next, the teachers collaborated to figure out the eighth grade math topics that could be easily presented by videos.

Data collection, that occurred three days per week in math class and six hours per week in study hall, continued for four weeks in this study. Qualitative data came from comprehensive surveys, classroom observations, and student and teacher interviews. The results suggested that the practice of using the iPod Touch for creating math videos could increase the students' understanding of difficult math concepts, and it gives students opportunities to elaborate their understanding through small group discussion. Even though, this study did not utilize a pre- and post-test to measure the students' learning outcome while the iPod Touch was in place, the participation level of the students in both classrooms significantly increased as it is reflected on the formal and informal observations. Moreover, faculty members were impressed by the cooperation of the students inside and outside of the classroom for creating an advanced math video, yet the iPod Touch integration appeared to be interesting for the students and helped them develop a sense of ownership regarding the math concepts that they convert into movies.

ERICSON's technology report (2012) suggests that more than 80% of people will have access to the Internet through tablet computers by 2015. This tendency towards tablet computer use indicates that the iPad will eventually pervade every aspect of education in the near future. Unfortunately current pedagogy seems to be following the footsteps of new technologies, whereas it is supposed to be quite the opposite. Teachers tend to design instruction based on what the new technologies can offer in a class, instead of what widely-excepted learning theories indicate about classroom culture. Even though tablet device practice in classrooms leads to various active learning opportunities, a number of potential drawbacks have yet to be considered. Mishra and Koehler (2006) suggested the acronym "TPCK" to describe the relationship between pedagogy, technology, and content knowledge indicating that these terms are at the heart of effective learning with technology, and have a lot to offer to the discussion of technology integration at different grade levels. Neither having mastered in theories of pedagogy nor having known perfectly how to teach a specific topic is enough for facilitating an effective active learning, unless the technology integration is well-designed and carefully implemented in a classroom. Effective active learning requires the consideration of the relationship between all of these components.

A body of literature suggests that learning materials should be designed based on student's cognitive abilities in order to foster active learning which ,otherwise, can cause students to "turn off" academically due to the high volume of the cognitive load. For example, Franklin and Peng (2008) recommended that teachers keep the variety of instruction in a period at a reasonable level, so that tablet computer practice helps increase student engagement. Students, when presented more information than they can

handle, are most likely to be overwhelmed, and eventually tend to lose focus on learning (Johnson, Johnson, & Smith, 1998). Just because the learning material is presented in multiple ways with tablet devices and students appear to be interested in looking up something online, may not always guarantee an increased level of learning. According to some researchers, multiple presentations of instruction may even decrease the level of learning depending on the learning environment and the type of the learner (Kerawalla, 2007). This assumption may be partially true, because students may tend to determine the value of instruction based on the effort they spend on gaining it. The less effort they spend on obtaining the new information, the more likely they will consider it worthless. Easy access and different means of presentation may mislead students about the significance of the learning material.

Even though learning environments enriched with technology help facilitate social-constructivist learning models and close the achievement gap between high and low achievers (Manuguerra, 2011), Schmid (2008) alerted teachers regarding technology practice in classroom, "a drawback of having easy access to resources is that it may encourage laziness towards the students, if the teacher 'spoon-feeds' them" (p.12).

Student Participation

Student participation is one of the most essential elements regarding the active learning process. It is an important work habit that often times leads students to a learning product. Even if the teacher and student characteristics have been long considered to be the most important factors in determining the level of student participation, research has shown that the way that the learning material is presented, along with environmental

factors, contribute most to students' willingness to engage in learning activities (McClanahan et al., 2008).

Once teachers noticed students who were initially unwilling to learn became motivated and engaged in the learning process with the arrival of iPad's in the classroom, they began to significantly consider incorporating tablet devices into their classrooms. Many teachers were further impressed by the power of the iPad devices on students' common work habits, when they witnessed students sacrificing their recess or lunch time to finish a task that they started earlier in class. This tendency of teachers towards the new tablet technologies was fairly acceptable, because several studies highlighted that student participation in learning process results in higher learning outcomes for low functioning students (Barak et al. 2006).

The iPad is capable of performing many things that an e-Reader device, such as Kindle, can do. McClanahan et al. (2008) conducted a study in a rural K-8 school setting including a pre-service teacher and a fourth grade student with ADHD who was reading at least two years below grade level based on the results of an informal reading inventory. Results from an Individualized Reading Inventory showed that the student was making many miscues during oral reading, and not utilizing context clues to figure out the sequence of the story. Twice a week one-on-one tutoring sessions were held consistently for six weeks. While the iPad was used in the first tutoring session for reading instruction, traditional methods were followed in the other session to present the reading material and comprehension questions. Results of pre- and post- assignments indicated that the iPad practice helped the student to gain a year's growth in reading within a six

weeks time period. Thus, the student became more confident in reading and learned how to control his impulsive behaviors with the iPad implementation.

The authors indicate that this study included only a struggling reader who had ADHD and a pre-service teacher. Therefore, the results may not be generalized to the other students. While the iPad practice did not help the student to fully eliminate his attention problems, it allowed the student to stay on task for a longer time period and close the achievement gap that existed for a few years. McClanahan and colleagues (2008) further investigated the results of this study to figure out what features of the iPad tablet may have played a major role on the student's motivation. They argued that the manipulative touch screen feature of the iPad addressed his visual/tactile needs, while the voice recording feature promoted his auditory learning skills.

Student participation during the learning process is crucial when it comes to active learning for a number of reasons. First of all, it allows students to master the new knowledge. Second, students get an opportunity to share their thoughts about the new concept while having misunderstandings corrected on the way with teacher's or peers' comments. Additionally, it is important for teachers to gain more insight into students' cognitive framework and conceptual understanding for the subject matter. When student participation in the active learning process becomes a solid work habit, many learning obstacles, which may emerge on the way subsequently, do not appear due the teacher guidance and correction (McClanahan et al., 2008). While a number of researchers cited several other benefits of student participation in the active learning process besides those mentioned above, the level of student participation differs from individual to individual

as well as from classroom to classroom. This study focused on the physical manifestations of student participation, since they are more observable and measureable.

Until 1997, students at a Western Pennsylvania college had only the opportunity to use either their own laptops or the laptops in the computer rooms to complete homework and projects. Starting from 1998, the university began to provide all full-time freshmen students with a laptop as they were enrolled to a program. The goals of this information technology initiative were (a) to provide students more convenience in using computer technology, (b) to employ computer technology practices into classrooms, and (c) to give students opportunities to improve themselves towards their career goals. Finn and Inman (2004) designed research on a random sample of alumni from the classes of 1997, 1998 and 2000. The purpose of this research was to determine whether the laptop technology initiative achieved its goals over the respective years. The results indicated that laptop integration did not cause to a dramatic change on the modes of teaching and learning in most college courses. However, the majority of alumni from the classes of 1998 and 2000 expressed positive feelings and attitudes about the course they took, since they considered the laptop integration helpful in completing homework and assignments as well as improving themselves in their majors. In addition, the alumni from the class of 1997 indicated that using their own laptops while doing a project or assignment helped them to stay on task more easily than when they used the laptops in the computer rooms. The new educational program seemed to make more sense to those who used a laptop given by the university, because their acceptance of laptops in this study was driven by their perceived impact of laptops on their learning.

Using a wireless laptop may bring about three advantages for students (Barack et al, 2006). First, wireless laptops allow the procedural understanding of a concept to turn into a conceptual understanding because of the hands-on problem solving and active learning activities that found in the websites. Second, wireless laptops, when installed with an applicable software, would have the ability to give instant feedback and support to the user in regard to the concept being studied. Finally, students can share their coursework with the instructor and their classmates without having to deal with time and location constraints. Barak and colleagues (2006) conducted a study in Massachusetts Institute of Technology in Boston to examine whether wireless laptops promote or hinder active learning in lecture halls. This study, which continued for three semesters, included 318 students from various academic majors that enrolled into the "Introduction to Computers and Engineering Problem Solving" course. Students were provided with a laptop to be used in lecture halls if they did not have their own by the time they enrolled to the course. Qualitative and quantitative methods were employed for data collection. More specifically, an online survey was administered to examine non-observable domains such as the affective and perceptional changes, while in-class observations were conducted to measure observable domains such as operative and behavioral changes.

The online survey that consisted of 35 open-ended questions revealed that students found laptop practice very helpful for preparing their projects, searching something online, and sharing their thoughts and ideas with multiple individuals at a time. In addition, at the end of the study, students exhibited less interest in turning back to the traditional teaching method in lecture halls. Each classroom observation was recorded with a video camera as a "second pair of eyes" so that the researchers would

always go back and revise the data when there seemed to be disagreement in analyzing the students' behaviors. Classroom observations indicated that wireless laptop practice facilitated more student-centered active learning opportunities and allowed students to interact with each other as well as the instructor more frequently.

Researchers warn teachers to be careful with laptop practice, because a wireless laptop may potentially become a "source of distraction" as well when it is used for non-educational purposes by students (Barack et al., 2006). During the lecture, students may pretend to listen to teacher behind their laptops while surfing on the web or sending messages on social networks such as Facebook or Twitter. This concern led many school districts to limit students' access to certain websites. However, many of these attempts are not successful, since there are many non-educational iPad applications that can work without an Internet connection.

Rehearsal and Elaboration of Knowledge

The U.S National Council for Teachers of Mathematics (NCTM) (1989) suggested that teachers help students to "reflect upon and clarify their thinking about mathematical ideas and relationships, express mathematical ideas orally and in writing, and ask clarifying and extending questions related to mathematics they have read or heard about" (p.140). This recommendation highlights the importance of active student involvement, while research shows that it is important for problem solving in math (Franklin & Peng, 2008). Weinstein and Mayer (1986) used two lenses to describe learning activities from a cognitive perspective: rehearsal and elaboration. Rehearsal is in this framework refers to repeating the learning material so that it is not forgotten. This may be accomplished by a number of ways, such as reading the material again by

highlighting important points, repeating it verbally, or writing the needed part verbatim over and over until it becomes rote knowledge for the learner. Several researches have worked on the effectiveness of computers as a tool of rehearsal, and found positive results (Franklin and Peng, 2008; Manuguerra, 2009).

Mobile devices such as the iPad make it possible to record a video or a voice in an environment. However, several ethical issues may occur through mobile device integration in schools. Aubusson and colleagues (2009) formed a small study group which included education stakeholders in Australia and United Kingdom, and they tried to examine ethical issues that may emerge as mobile technologies are used in schools. In each country, eight stakeholders were selected from school districts where mobile devices were used. The small groups consisted of different professionals ranging from principal to instructional-aid so that the results would reflect a more comprehensive and reliable picture of research questions. Pseudonyms were used in this study for the names of participants. Semi-structured interviews have been conducted in an informal manner for 40-90 minutes each week to seek answers to the questions such as, "what would help create opportunities for mobile teacher professional learning, or what ethical issues may arise in mobile learning environments?" (p.5). The research team utilized the "constant comparative method" to analyze, organize, and interpret the data that came from semi-interviews.

After three months of data collection, the results indicated that some ethical issues regarding the mobile devices could not be seamlessly eliminated, even though mobile devices appeared to have a great potential to add new qualities to traditional classroom culture. Moreover, participants pointed out that obtaining parental consent or having rigid

rules may not be enough to prevent some students from uploading classroom videos to the internet or YouTube. One participant argued that allowing mobile devices in schools would not always lead to advanced student learning, yet some students may attempt to embarrass their teachers by recording the lesson with handheld mobile devices and sharing it on the web.

In recent years, as classrooms have evolved around the student-centered learning methods rather than traditional teacher-centered learning methods, the concept of elaboration in the learning process began to gain more importance. Elaboration refers to the amount of details used to extend a response, and it indicates one's ability to develop, discuss, and embellish his/her ideas on a topic. According to Franklin and Peng (2008), elaboration helps students understand and internalize a new concept with a greater extent. Elaboration may manifest itself in a classroom setting through a variety of forms such as, taking notes to develop questions on a topic, making inferences between prior and new knowledge, demonstrating the relationships among various concepts in an expended manner, or creating mental analogies to describe an issue, yet it differs from rehearsal or the solid memorization of a new knowledge. In elaboration, the student is fully involved in the processing of information by building the new knowledge on his/her prior knowledge and creating new cognitive frames, whereas in rehearsal the student is only occupied with keeping the information on a solid base.

In the past, computers in classrooms offered students many meaningful activities that promoted elaboration in the active learning process. Students used computers to prepare media presentations, which help to facilitate elaboration more in-depth than just showing and telling information in front of the class, or students used computers to draw

dynamic graphs for an equation easily without having to use colorful markers. The iPad is actually capable of offering these and many other important elaboration opportunities for students, as it is portable and smaller than a computer. For example, once students set up an application such as "Notability" on their iPads, they can elaborate what they have learned about a new topic by taking notes on the iPad screen with a special magnetic pencil, or annotating on their digital textbook while simultaneously recording the lesson. Likewise, if the teacher opens up a discussion where students need to determine the best geometric term to describe a sea creature, they can easily search this on the web and figure out the best term in a geometry class. For students, asking a question is as important as being able to answer a question, because, as students ask a question, they will be provided an opportunity to clarify and monitor their understanding based on the feedback of others. Moreover, the iPad makes it possible for students to generate questions that they can upload on a Smart Board screen as long as a wireless network is set up in the classroom.

Nowadays, iPad tablets are as commonly used as smart phones in our society. Since many tablet devices use an operating system that is similar or the same to that of a smart phone's, school districts do not see an urgent need to train teachers on how to use the iPads in classrooms. Crichton et al. (2012) conducted a study in a large, urban school district in Canada to determine the infrastructure which is necessary for the implementation of tablet devices in classrooms. This study also shed light on the opportunities and challenges that teachers and students in K-12 settings faced with their iPod practice in and out of the classroom. The study employed a mixed approach conducted in two phases. With respect to data collection, the researchers looked at the

school database, weekly lesson plans, regular classroom activities, student work samples, and monthly staff-in-service programs. Five schools were randomly chosen from the district to participate in both Phase 1 and Phase 2, and three additional schools involved in the study during Phase 2. The whole project took approximately one and a half years.

Students and teachers in Phase 1 were provided with an iPod Touch and a laptop dedicated for educational purposes. However, the laptops were taken away so that the iPod Touch could only be used during Phase 2. Since all the devices were using the same network to connect internet, the researchers were able to identify the websites that students and teachers visited by monitoring the school database. Data indicated that 63% of participants in Phase 1 used their iPod Touch for playing games, while 62% of participants used their laptops for checking emails and searching the internet. Even though the laptops were taken during Phase 2, the majority of participants continued to use their tablet devices for non-instructional purposes.

During classroom observations, the researchers also noticed a significant change in the way that teachers and students interacted with each other and several distractions emerged with the iPod practice. A decrease in student participation was noted, since the students preferred to search their questions on Google instead of asking the teacher. Managing multiple applications, while trying to focus on classroom discussions, appeared as an obstacle blocking the students' full involvement in classroom activities. Finally, the researchers cautioned school leaders to take a holistic approach including long term goals in deciding whether or not to implement a school-wide tablet project.

Collaboration and Critical Thinking

Collaboration has long been used as a term by educators while employing active learning methods in classrooms. Lately it has become more popular once it was identified by the Partnership for 21st Century Skills as one of the most important skill that students will need in the workplace after graduation. Also, the new Common Core State Standards mention collaboration as a valuable communication tool pertinent for college success. Some researchers (Roschelle & Teasley, 1995) defined collaboration as "the mutual engagement of participants in a coordinated effort to solve a problem together" (p. 9), while the others consider it as "a situation in which two or more people attempt to learn something together." (Dillenbourg, 1999, p.1)

Collaboration is, in fact, a form of active learning. Aubusson et al. (2009) claimed that collaboration among students, as well as teacher involvement in this process, has a significant impact on student learning, because both student-to-student exchanges and student-to-teacher exchanges occur during the learning process. Dillenbourg (1999) indicated that collaboration gives students opportunities to discuss their ideas in groups, while allowing them to improve their critical thinking skills.

Fall et al. (1997) administered a multi-step assessment on 500 tenth graders to determine the impact of collaboration on student learning. In the first step, all students were assigned to read a story and answer a number of comprehension questions individually by using the themes mentioned in the story. In the next step, the students were randomly divided in two groups where the first group discussed the story in small groups of three, and the other group proceeded to work on the story individually. In the final step, all students were asked to continue working on the story individually as it was

in the first step. Results indicated that students who worked in collaborative small groups in the second stage were more accurate in remembering the story facts and components than their individually-working counter parts, due to the active learning opportunity that came along with collaboration.

In addition to active learning, collaboration opens up doors for a number of advanced learning skills such as critical thinking, problem solving, and metacognition. Several studies found links between collaboration and critical thinking. Aubusson et al. (2009) claims that critical thinking helps increase the ability to make important decisions for problem solving. Even though it is a mental process, which may not be easily observed, critical thinking in a student's behavior may manifest itself as seeking a discussion on diverse viewpoints, an interest for being well-informed, or figuring out different ways to accomplish a task.

Arnone et al. (2011) contended that computer-based communication tools such as "group gaming, chat rooms, instant messaging, social networks, virtual worlds and the like…" (p. 184) evoke collaborative curiosity. The iPad tablet can help educators to pair the benefits of technology with the value of collaboration and critical thinking in order for students to have various opportunities of active learning, since students can connect to each other using their iPads through Wi-Fi or Bluetooth systems. For example, if students want to share their ideas with their peers, all they need to do is to have an application installed on their iPads whereby everyone can come together online to collaborate on a task. Unlike the traditional methods of collaboration, this method does not require students to physically come together as long as they are connected to the internet. Participants in a collaborative setting may need to talk with each other while working on

a task. When students work in online collaborative groups with their iPads, they are able to see each others' work on the iPad screens, which allows misunderstandings to come to the surface for immediate correction.

Murray and Olcese (2011) conducted a study to examine the potential of the iPad and its applications in K-12 settings, and they tried to determine "whether these technologies allow educators and students to accomplish what they otherwise could not, from a teaching and learning perspective" (Murray & Olcese, 2011, p.1). One of the main goals of this study was to examine different ways of integrating the iPads into the current classroom settings, and to find out whether the iPad and its so many applications would have an advantage over the traditional teaching tools used in schools for years. The study had many steps to test various iPad applications that are found in the Apple Store under the "Education" section. Of the 317 applications examined, only 56 were deemed suitable for a classroom setting.

The authors discussed the importance of choosing the appropriate applications, as the iPad application only determines the purpose for which the tablet would be used. Many of iPad applications seemed to provide only skill and drill learning opportunities, while they were intended to promote creativity and student interaction (Murray & Olcese, 2011, p. 45). The main reason for this conclusion is the lack of educational applications that are designed to promote the 21st Century skills, such as collaboration and metacognition. The learning experiences and resources that are offered by Apple's educational applications do not appear any different than those that have already been used in classrooms.

The idea behind bringing portable computers and Wi-Fi internet into classrooms was to help advance classroom discussions by giving students an opportunity to share what they found important about a topic with others in class. Nworie and Haughton (2008) proved that computer-mediated activities may hinder student learning instead of enhancing it, when they are used for different purposes. For instance, students may go to the internet for "playing video games, checking the weather, cheating with each other, or even worse hacking into the database systems to change their grades" (p. 57). There seems to be a backlash from teachers, as well as parents, in allowing students to permanently use tablet devices with an internet connection.

Students' Computer Use at Home

One of the features of tablet devices that capture many people's attention is that they are portable and easily used in various places. For example, once an idea or knowledge is captured on the Internet, further development is no longer limited within the classroom walls, because tablet devices allow users to continue working on their tasks over a different time period and setting. Portability and the sense of ownership triggered the extensive use of the iPad tablet among students. When this tendency is combined with the fact that teachers and students spend more of their time with computers outside of the school than they do inside of school, another important concern began to rise among educators and parents: Are students using iPads at home for educational purposes?

Kerawalla et al. (2002) conducted a quantitative research to gain more insight into students' computer use outside of school and identified two obstacles preventing effective computer practice at home. The first is that computers are being used for playing games, and the second is that parents do not really have the knowledge base to

guide their children at home to use computers effectively for educational purposes. Livingston and Bovill (1999) argued that students spend most of their time on computer games leaving many school assignments uncompleted. Furthermore, some parents who participated in Kerawalla's et al. (2002) study complained that they rarely see their kids in the living room, because they are in the bedroom engaged with computers. Parents seemed to be accurate in their complaints about computer practice at home, because educational software and applications have yet to beat myriad popular computer games to gain students' attention.

In addition, the extent to which students' use a computer at home for educational purposes greatly depends on the way that parents handle their children's computer use. Kerawalla's et al. (2002) research revealed that parents determine the location of computers at home based primarily on the computer's safety, the room's aesthetic appearance, and whether the computer placement would be fair for siblings rather than for educational purposes. This data makes it clear that parents have been mismanaging their children's computer practice at home.

Summary

As the letter "i" before each Apple Company's product indicates, many portable products originally came out for individual usage. Most of the research regarding the iPad integration in education has been done with college-age students. Because there is a lack of research in the K-12 classrooms, Barak et al. (2006) indicated that it is too early to determine whether tablet computer practice in classrooms enhances or hinders students learning. However, Nworie and Hauhton (2008) strongly recommended that educational leaders and policy makers should make needs assessment in school and

determine current teaching and learning dynamics in classrooms before excessively spending public funds to employ one-to-one tablet computer-mediated programs in schools. Furthermore, Barack et al. (2006) alerted educators, "…wireless laptops can become a source of distraction, if used for non-learning purposes" (p. 245). It appears that it is necessary to look at a number of variables which has an impact on a classroom climate such as student participation, peer collaboration, logical thinking and problem solving, and rehearsal and elaboration of new knowledge while determining the iPad's value in education. This research will strive to determine whether the iPad tablets have been used for educational purposes by high school students in a Charter School in North Jersey, and how the iPad implementation may change a number of specific teaching and learning dynamics in classrooms.

Chapter 3

Methodology

Participants and Setting

This study strove to determine whether or not the iPad is superior to printed materials in increasing student achievement, and how iPad integration may affect the culture of a high school math classroom in a Charter School located in North Jersey.

The school where the study was conducted serves approximately 660 students in grades Kindergarten through tenth. It is one of the most successful Charter Schools in northern New Jersey because of its students' high achievement on State-wide exams. Twenty students (8boys and 12 girls) in a tenth-grade Algebra-2 class participated in this study. The majority of the students come from families in which English is the primary language. The average classroom size is twenty students, and the instructional time is 42 minutes per period. Each classroom has a Smart Board, which is connected to the school's Wi-Fi network. The Algebra-2 course is taught by a Caucasian male who holds a master's degree in mathematics education and had eight years of prior teaching experience.

In 2011, the school board decided to initiate a "One iPad for Each High School Student and Teacher" program on their campus. The plan was to pilot the initiative only with high school students, and expand it to the middle school grades over four years. The purpose of this initiative was to enhance the students' ability to complete academic tasks, and give them opportunities to excel in 21st century skills such as creativity, problem solving, decision making, and learning. Teachers and students are required to use their

individual iPads in the school, as well as at home. Each iPad is loaded with educational applications as well as digital versions of the textbooks for all tenth-grade subjects. Moreover, teachers and students are allowed to personalize their iPads with personal photographs, files, applications, and various other items.

Twenty tenth-grade students who are currently taking this Algebra-2 course were involved in this study through a web-based survey to determine their perceptions about the iPad integration. However, this study specifically focused on six special education students and strived to determine under which condition, iPad or textbook, they learned and completed Algebra-2 topics better and with less teacher support. Due to a lack of parental consent only five of those students were involved in this study. In terms of service delivery options, the school has only inclusion and resource room support for special education students. The focus group received resource room support in mathematics from a special education teacher, since they all demonstrate math skill deficits according to their Individualized Education Programs. The special education teacher has held that position for two years, and had a master's degree in learning disabilities.

According to their Individualized Education Plans, all five students were classified under the Specific Learning Disability category and none of them had a history of retention. Pseudonyms were used to secure the confidentiality of the students' records. Brad is a 15 years and 4 months of age Hispanic male who enrolled in the school in September 2012. A psychological evaluation completed in 2010 revealed that Brad's intellectual functioning falls within the Below Average to Low Average range (WISC-III Full Scale I.Q: 74; Verbal I.Q: 78; Performance IQ: 82). It was noted that Brad has

strengths in sight vocabulary and social judgment. However, he demonstrates weaknesses in recalling information, as well as abstract and arithmetic reasoning. On a formal achievement test, Brad's performance fell within the Low Average range on the calculation subtest, and he performed within the Low range on a subtest that assessed his ability to apply math concepts. Even though there is not a significant discrepancy between his level of cognition and achievement scores, his math performance is below the expectation of a student his age.

Mary is a 15 years 3 months of age White female who has attended the school since 6th grade. Her performance on the most current Woodcock-Johnson III Test of Cognitive Abilities revealed a full I.Q score of 80, with scores of 86, 75, and 82 for Working Memory, Short Term Memory, and Processing Speed, respectively. Mary was also administered a curriculum-based measure on math fluency and calculation skills. The results of this measure indicated that her math skills are two years below her grade level.

Daniel is a 15 years and 5 months of age Black male, who enrolled in the school in February 2011. A review of his Individualized Education Program points out that he was classified in fifth grade due to difficulties in reading and math. According to the results of his Woodcock-Johnson III Test of Cognitive Abilities in 2011, Daniel demonstrates weaknesses in working memory and retrieval fluency, specifically for abstract and complex pieces of information. In addition, Daniel's low attention span appears to substantially influence his ability to solve multi-step math problems. Daniel's performance on this standardized measure resulted in a Total Achievement score of 81,

with scores of 73, 84, and 80 for Math Fluency, Applied Problems, and Calculation Subtests, respectively.

Zeynep is a 15 years and 6 months of age White female. She was provided with after-school remedial math support twice a week for six months at her previous school. After she transferred to the charter school during fifth grade, Zeynep's parents referred her for a full evaluation, because she was still experiencing difficulty with simple math calculations, as well as reading fluency. Last year, Zeynep was administered the Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV) and attained a Full Scale I.Q of 92 (52^{nd} percentile) with scores of 92, 71, 84, and 80 for Verbal Comprehension Index, Perceptual Reasoning Index, Processing Speed Index, and Working Memory Index, respectively. Her math knowledge and skills, as indicated by her teachers and parents, are below the mathematic standards and expectations of the school. Noted weaknesses include her lack of attention to operational signs, her inability to visualize numerical relationships, and retrieval of math facts.

Dana is a 15 years and 4 months of age White female. She received speech-language services for two years, beginning in fourth grade. During sixth grade, Dana was referred by her teacher for a full evaluation due to academic difficulties in math calculations and she was administered the Woodcock-Johnson III Test of Cognitive Test in 2011. Weaknesses in simple math calculation and visual processing skills appeared to affect her ability to solve algebra problems with more than one variable. As a result of this evaluation, Dana began to receive Resource Room math and language arts support.

A closer look at those students' Individualized Education Programs (IEP) revealed that only Dana and Zeynep requires specific testing accommodations; in the

form of using an examiner who is familiar with the student and taking tests in the resource room. These testing accommodations do not interfere with the purpose of this study.

Materials and Procedures

Teacher and student surveys. In January, permissions were obtained from the School Director and the parents to conduct the survey. Since all participants had been using the iPad tablet in school and at home, first of all surveys were administered in the data collection process to gauge the attitudes of students and teachers to the new iPad practice, as well as to gather information regarding current classroom climate. In the second week of January, the researcher went into the Algebra-2 Class and informed students about the purpose of the current study and the date in which the student survey would be administered the following week. It was considered that since current study was related to the iPad practice in education, it should measure participants' perceptions through a web-based survey instead of a typical paper and pencil survey whereby participants could use their iPads to answer survey items. For this purpose, both student and teacher surveys were uploaded to a web database (Surveymonkey.com). This survey database was provided with a web link that gave access to survey questions. During the following week, the researcher went into the Algebra-2 classroom again during the second half a classroom period while special education teacher was also present. The teacher and student survey links were written on the board and all twenty students in the Algebra-2 class along with the general education and special education teacher serving that classroom were asked to go to the website links with their iPads to answer the web-based survey. Participants spent about 15-20 minutes completing the survey. In addition,

participants were reminded during the session that there was no "Right" or "Wrong" answer so that they would be more honest in their responses. Participants were encouraged to answer all the items and be honest in their responses. The teacher survey included items that examine how the iPad integration changed classroom climate from teachers' perspective as well as factors that may hinder or enhance successful implementation of iPads in the school. Moreover, several items in the teacher survey aimed to measure teachers' pedagogical beliefs, perceived role and impact of iPads on classroom climate, the need for professional development, and the experience teachers had since the beginning of iPad initiation in the school.

To make sure that the results would be both reliable and valid, the items in both surveys were primarily chosen and adapted from a technology survey created by Kirshstein, Lovitts, Lundmark, and Weidler (1999). Items in the survey measured the students' and teachers' perceptions of the iPad integration with a five point Likert response format, a copy of which can be found in Appendix A. Participants were asked to answer a number of questions on a five-point scale ranging from "Strongly Disagree" to "Strongly Agree". Examples of student survey items include, "With the implementation of the iPads, I record the lesson and listen it at a later time, I solve online practice questions, I work on online group projects etc." A total of 30 questions on a Likert-scale, along with two open-ended questions, were used for both the teacher and student surveys. To help analyze the data and determine how the iPad integration changed the classroom culture, as well as teaching and learning dynamics, survey items over the web database were sorted into one of the following themes: student participation, rehearsal and

elaboration of new knowledge, logical thinking and problem solving skills, and peer collaboration.

Parent interview. In the school district where the study took place, home-visits are not something new to parents. As the school had a good rapport with the parents through parent-teacher organization activities, teachers are encouraged by the school administration to make home visits so they can get to know students, as well as their parents, better. The researcher took this opportunity to interview the parents of five special education students during the home visits he did along with a teacher over five weeks. During the home visits, parents were reminded that their responses would not be shared with teachers or administrators. Each home visit took about a half an hour, and included a semi-structured interview that allowed parents to give flexible responses during the conversation. Parents were asked a set of five open-ended questions, a copy of which can be found in Appendix B, as to what they thought about the iPad initiative. The majority of the interview questions were chosen based on the concerns that teachers voiced during the grade level and general staff meetings. Since the students spent most of their time with the iPad out of school, it was believed that the current study would be of little value without parental input. The interview questions mainly focused on what parents think about the new iPad initiative and whether the new iPad practice caused to any changes in the way that their children study for school assignments at home. By getting verbal permission during the home visits, all interviews were recorded with a digital device and then typed in Word to identify emergent themes. Parents' responses were extracted later on to determine main concerns, and a number of comments have also been included in this study to illustrate particular concerns.

Classroom observations. In this school district, there was no specific policy that prohibits classroom observations done by the staff, as long as the data is used only for educational purposes while being kept confidential, and the observer does not interfere with the instructions. However, consent forms were obtained from the parents of the students in the focus group. Classroom observations were conducted in the Resource Room, when the special education teacher was working with five students with Specific Learning Disabilities on Thursdays and Fridays. The overt non-participant observation method was used. The students were informed that they were being observed as a part of current research. However, the observer sat in the back of the classroom so that he could take notes without interfering with any classroom activity.

Observation data was gathered through two visits each week to the Resource Room for a total of ten sessions. Each observation took the entire duration of the math instruction time, which was about 25 minutes. Students used iPads to take notes and follow the topic on the digital textbook. Observations were recorded with the Momentary Time Sampling Form, a copy of which can be found in Appendix C. This method enabled the researcher to record the number and frequency of the target behaviors immediately following certain time intervals. A Momentary Time Sampling sheet was prepared for each individual student and two students were observed with one minute intervals for a total of twelve minutes during each visit. The definition of each target behavior was written above the interval box in which the frequency of the target behavior was recorded. Student Participation was defined as "the capability of the iPad to support students to be actively involved in their learning" (Catholic Education Press, 2011, p.145). Rehearsal and elaboration was defined as "repeating words and concepts,

paraphrasing and summarizing with the iPad". Logical thinking and problem solving was defined as "application of new knowledge to situations using the iPad" (Amelink et al., 2012, p.4). Peer Collaboration was defined as "a situation in which two or more people attempt to learn something together" (Dillenbourg, 1999, p.1). The number of teacher assistance was defined as "physical or verbal means of teacher interacting with a student to explain a question". Finally, a record sheet on the side bar was used so any engagement issues other than those identified on the observation sheet could be recorded during the observations.

Classroom assessment and social validity survey. The classroom assessment took place during the last 15 minutes of resource room support on Thursdays and Fridays. The purpose of this assessment was to determine under which condition, iPad or textbook, students could finish classroom assignments more accurately and with less teacher support. Prior to the sessions in the Resource Room, the researcher met with the special education teacher several times to discuss the purpose of the current study and to determine the procedures that should be followed to increase the reliability of the results. In addition to these regular meetings, the special education teacher was provided with ongoing support after each session.

First, the school curriculum for Algebra-2 course was reviewed in order to determine the math topics and skills that would be covered during the duration of the sessions held in the Resource Room. Next, two separate worksheets, each of which contained 5 multiple-choice questions, were developed for each week to measure students' knowledge on that weekly topic. The questions in worksheet were aligned with the school curriculum for each week. To make sure that each item in each worksheet had

the same difficulty and measured the same math skill, parallel questions were developed by only manipulating the numerical expressions on questions, so that the effect of each condition, iPad or textbook, could easily be measured.

Targeted math topics for each week included: (a) quadratic functions, (b) solving quadratic equations by factoring, (c) and linear functions. While the observations took place in the Resource Room during first 20-25 minutes, weekly classroom assessments under the iPad or textbook condition were conducted during the last 10 -15 minutes of the period. In all assessment sessions, students were allowed to utilize from their iPads or their textbooks depending on the condition of the day. Finally, it was considered that a procedural adherence was required to minimize the classroom distractions that would otherwise affect the learning outcomes. Baseline data was equalized with the following procedural adherence in both conditions. Each day, the special education teacher got started by informing students of the lesson's objective. Next, the teacher asked the students to work on the "Do Now" question posted on the Smart Board to activate students' prior knowledge. Once students were done with it, the teacher employed a short classroom discussion to help students understand the point of the lesson. The students then solved sample questions on the Smart Board. After each question, the teacher checked the students' understanding with a verbal question. This process took about 25 minutes in each session. The teacher did not change her expectations or the way that the instruction was delivered for both conditions. Procedural adherence was recorded as 100 % for both conditions.

During the last 15 minutes, the worksheet ,which was collaboratively developed by both teachers, was distributed to students and they were informed of whether it was an

iPad day or a textbook day. Students were allowed to use a regular calculator or the calculator software of iPad in both conditions. In order to maximize the fidelity of the assessment, students were reminded of the following rules for each session, (a) work individually, (b) raise your hand if you need assistance, (c) do your best without skipping any questions, (d) double-check your answers in case you finish early. It was noted that students who finished early in the textbook condition used their extra time to double check their answers, whereas that extra time was used by the same students to wander between applications during the iPad session. After the teacher distributed the worksheet and she asked the students to solve the questions with the help of the iPad or textbook, depending on the condition of the day. In addition, the teacher informed the students of the page number to help them find the topic related to the questions in worksheet. Start and End time for each student was recorded on the side of his/her worksheet. As students were working on the worksheet, the teacher walked around them to make sure that they were working on the appropriate application. The number of teacher supports was recorded by the researcher for both conditions.

As described in the section below, the present study employed an "Alternating Treatment Design" (Cooper, Heron, & Heward, 2007) to collect quantitative data. Alternating treatment design has many advantages when the purpose of the study is to compare the effectiveness of two different conditions on one behavior, yet it includes a "Social Validity" survey to gauge the attitudes of students and teachers about the treatment. One benefit of this method is that it is not necessary to withdraw a treatment to determine the effectiveness of either of the treatment conditions. In addition, it takes less time to produce results compared to other research designs. When the assessments under

iPad and textbook condition were completed over the five weeks, the social validity survey was administered to the students in the focus group and their teacher. The survey included a 4-point Likert-type scale in which (3) indicated *Very Agreed* and (0) indicated *Disagreed* (See Appendix D). The results of this survey were analyzed to figure out the treatment acceptability and how satisfied the students were with the overall intervention.

Research Design and Data Analysis

Data collection for the current study required the measurement of several variables considered to have an impact on student achievement and classroom climate. Therefore, a mixed-method approach was used, combining both qualitative and quantitative data to answer the research questions. Quantitative data was collected from surveys and classroom achievement tests while the qualitative data was collected from parent interviews and classroom observations.

Two different surveys were used, one for the students in Algebra-2 classroom and one for their teachers. Both surveys included items in a five-point Likert format as well as open-ended questions. Items in a five-point Likert format provided with quantitative data while open-ended questions helped gain more in depth into perceived advantages and disadvantages of iPads for classroom climate**.** The analysis of the survey data was made possible with frequency distributions with simple percentages. The percentage of each survey item was automatically calculated by the 'Surveymonkey.com" website which was used to administer the survey. To answer the research questions of the current study in a more visually meaning way, each item in student survey was sorted into one of the following subgroups; (1) Student Participation, (2) Rehearsal and Elaboration of New Knowledge, (3) Logical Thinking and Problem Solving Skills, (4) Peer Collaboration.

The percentage of each survey item is shown in the following section. Participants' responses to open-ended questions were compared and analyzed to determine the ideas and concerns that illustrate the majority of responses.

O'Neill, McDonnell, Billingsley, and Jenson (2011) suggest six steps to obtain the best results with alternating treatment designs: (a) identify the dependent variables; (b) identify each intervention; (c) align the introduction of the interventions for both conditions; (d) equalize start points before implementing interventions; (e) gather data until a difference on the target behavior is emerged; (f) stabilize the reliability of the data during all sessions of the treatment. Data on student achievement in a number of Algebra-2 course topics are gathered from objective, teacher-made classroom tests. Dependent variables were defined as the number of correct responses per session for each student for each assessment day and number of teacher supports during each session. Independent variables were defined as iPad and textbook conditions. This method was chosen to allow the effects of the two conditions, iPads and textbook, on the focus group's academic performance and learning behaviors to be compared. Visual methods such horizontal and vertical bar graphs were considered to be the best to present each student's performance under two different conditions. The next chapter will illustrate the performance of each student under iPad and textbook condition.

Parent interviews were conducted to understand what parents think about the iPad initiative. An inductive method was employed to determine the main themes in the parent interviews. Common themes that emerged from the parent interviews were color-coded according to their specific educational impact, such as "doing homework style", "student engagement", "parental support," or "non-educational purposes." After the color coding

was done, the researcher identified the quotations that best exemplified the common concerns which are explained in the next chapter.

Chapter 4

Results

A mixed-method approach was used to answer the following research questions:

1. To what extent do iPads help students with learning disabilities grasp tenth-grade math subjects in a more efficient manner? For the purpose of this study, 'more efficient' refers to how quickly students learn and complete their assignments with less teacher support under digital and traditional textbook condition.

2. When the iPad is utilized in the classroom, how classroom climate in an Algebra-2 class changes and what classroom practices are more likely to yield higher math achievement for high school students with learning disabilities?

3. How does iPad integration affect the learning and teaching dynamics in a high school math classroom? To answer this question, the learning behaviors in a classroom, such as student participation, rehearsal and elaboration of new knowledge, logical thinking and problem solving skills, and peer collaboration were examined.

Data analysis consisted of calculating the percentage of each survey item, determining the emerging themes in parent interviews, analyzing the observation data, and comparing each individual student's performance under iPad and textbook conditions.

The teacher and student surveys contained both quantitative and qualitative portions to gather comprehensive information on participants' perceptions regarding the iPad initiative. Survey items were sorted into several categories to aid in answering the research questions. Frequencies for each item were automatically calculated by the online

survey database. The qualitative portion of the survey, along with the mean and number of participants for each item, were reported with descriptive statistics as shown in Table 1.

Table 1. Response Counts and Means of Close-Ended Questions on the Online Survey

Topics	Questions With the implementation of iPads in Algebra 2, I	Mean Response (1-5)	Count
Logical Thinking and Problem Solving	Created presentations by using technology and the internet.	4.40	20
	Created notes, drafts, and mind maps to complete assignments.	4.55	20
	Began to use applications that helped me practice a skill that I learned in class (i.e., math drills, typing apps, spelling games, etc.).	4.45	20
	Could identify and present relevant information regarding a problem.	2.20	20
	Allocated resources for math problems.	1.95	20
	Became a self-directed learner.	2.20	20
Rehearsal and Elaboration of New Information	Recorded lessons and listened to them at a later time.	2.05	20
	Typed assignments and submitted them online.	4.30	20
	Figured out the similarities of the current situation and familiar ones ot elaborate details of a problem	4.15	20

(Table 1 Continues)

(Table 1 Continued)

Topics	Questions With the implementation of iPads in Algebra 2, I	Mean Response (1-5)	Count
	Began to use the touch-screen technology of the devise to analyze and interpret data, graphs, and tables.	4.75	20
	Recognized and defined variables of a given math problem.	2.25	20
	Visualized what I read and heard by drawing a diagram.	2.15	20
Peer Collaboration	Conducted research online and collaborated with my peers in the class.	4.25	20
	Worked on online group projects/assignments.	4.45	20
	Felt more comfortable interacting with my classmates.	4.20	20
	Began to write, send, and receive emails form classmates more easily.	4.10	20
	Figured out strategies to solve a math problem in a group.	4.05	20
	Saved time collaborating with my friends on an assignment.	3.80	20
Non-Educational Purposes	Began to play digital games more often.	4.05	20
	Enjoyed using the iPad for applications unrelated to school.	3.80	20
	Got in trouble or disciplined more often.	2.95	20

(Table 1 Continues)

(Table 1 Continued)

Topics	Questions With the implementation of iPads in Algebra 2, I	Mean Response (1-5)	Count
	Got a greater chance to follow up my profile on social networks (Facebook, Twitter, etc.).	3.95	20
	Started to make online purchases more often.	4.05	20
	Listened to my favorite songs comfortably.	3.85	20
Student Participation	Began to read Digital/eBooks in school/at home.	2.40	20
	Solved online practice questions and benchmark tests.	4.15	20
	Engaged more in class work.	4.10	20
	Showed more interest in school and learning.	4.35	20
	Participated more in lessons and classroom discussion.	3.00	20
	Wanted to participate more in iPad technology integrated class than in a regular class (e.g., gym, music).	4.25	20

At the beginning of the surveys, students and teachers were asked to rate their prior knowledge and experience of using an iPad. Students rated their knowledge and experience with iPads as 3.8 on a 5-point scale. This was greatly higher than their teachers, who rate 2.8 on a 5-point scale. Following this item, students were asked whether they want to have all of their textbooks on iPads or not. The majority of the

students, 90%, would prefer to have all of their textbooks on iPads. This indicated a high level of comfort that the students felt with digital content and electronic textbooks.

In relation to the focus area of *student participation* in an Algebra-2 class, various results were recorded from the student survey. The majority of students agreed or strongly agreed that they felt more interested in the Algebra-2 course and school in general after the iPad integration began (rating average 4.35). Of the twenty students in the Algebra-2 class, 90 % indicated that they used their iPads to take online tests and benchmarks, while 95% indicated that their engagement in classroom activities and discussions were increased due to the iPad implementation. However, students exhibited less interest in reading digital or eBooks with iPad in school or at home (Rating Average 2.40).

In relation to the focus area of *rehearsal and elaboration of new information* in an Algebra-2 class, when students were asked if they use their iPads to record the lesson and listened to it later on, 20% reported that they did so and 80% did not. Several students indicated that they used their iPad's camera to capture the board when there was a lot of information to copy down. When asked if they utilized their iPad to compare two different math problems to elaborate more details, 90% of the students said they did. Students considered the iPads to be the most helpful for analyzing visual data using its touch screen feature (rating average 4.75). When solving a math problem, more than two-thirds of the students reported that they did not use their iPads to define variables of an algebra problem.

A substantial portion of the work in math classes involves the use and marking up of documents. Teachers easily distributed the documents to students, who had been using

"Notes Plus" app for highlighting and annotating the documents. In the category of *logical thinking and problem solving skills* in an Algebra-2 class, the majority of students utilized their iPads to take notes during instructions and to create mind maps for solving math problems (rating average 4.55). Thus, students used various iPad applications to practice knowledge or a skill that they learned in class (rating average 4.45). However, students "somewhat disagreed" or "disagreed" that they allocated resources to solve math problems and became a self-directed learner (rating average 1.95 and 2.20 respectively).

Student survey results showed that students in the Algebra-2 class found iPad integration to be a positive initiative that helped them increase their collaboration with the others in class. In relation to the focus area of *peer collaboration*, students were asked to judge whether the iPad initiative increased their collaboration with other students in class. They responded uniformly that their collaboration was increased through online group projects (rating average 4.25) and e-mails that they easily sent to each other due to the iPad's portability (rating average 4.45). Students also indicated that the easy communication and collaboration that the iPads brought about helped them save more time that would otherwise be wasted due to physical constraints (rating average 4.10). One student commented that, "I do not have to wait until the next day to discuss a question with my friends, since I can get my point across though text messages or e-mail." In addition, students felt more comfortable in collaborating on an assignment through iPads than when they came together in small groups. The overall response average to this category appeared to be very high.

One section of the student survey included items related to non-educational activities that iPads are generally used for by students. The most commonly reported

activities were “playing games” (rating average 4.05), “listening to music” (rating average 4.25), and “going onto social media websites, such as facebook or twitter” (rating average 3.95). Although the majority of students honestly stated that they used iPads for a variety of purposes other than educational, when asked if this caused them to be involved in discipline issues in school, almost half of the students said “no” (rating average 2.95). Another survey item asked students for which activities and purposes they used iPads outside of school. Similarly to previous results, “social media” and “chatting” received the highest vote (80 %), while “games and entertainment” was chosen as the second highest along with “homework (65 %). “Reading” and “research” had the fewest votes from the students (40 % and 25 % respectively).

The qualitative portion of the student survey included two open-ended questions. Students’ responses to these questions were analyzed; similar responses were combined and sorted into two categories based on whether they were positive or negative. Students’ responses to the first open-ended question, “What are some issues/concerns (if any) that you have had with the iPad initiative thus far?” consisted of 10 positive and 6 negative statements. Examples of students’ positive responses to learning and studying with iPads included:

- It is easier to access the textbook and you do not have to carry them all over the places.
- I like the iPad’s multi-tasking ability, because now I am able to take notes while reading the digital textbook.
- Since iPad applications and textbooks are dynamic, it is easier for me to figure out where I went wrong on a problem.

- With the iPads we have more resources to look into. Now I do not have to go to the library to research something, since I have a portable library next to me.

Aside from a number of technical issues related to iPads and the Wi-Fi system in the school, which blocks specific websites and applications, students mentioned several concerns in learning and studying with iPads. For example, students stated;

- Sometimes the iPad is a distraction because it is very tempting to go on the internet during class for off topic reasons.
- Many students still unlock their iPads to download games when they aren't supposed to. And when the school disciplines them, the whole student body suffers from this instead of the individual.
- Even though it is a lot better than a paper and pencil, I cannot concentrate on lessons because of the messages that come though social network applications.
- I am really distracted when the student next to me is using his iPad to explore areas of personal interest.
- I really want to use iPad at home differently, because I am tired of being block for most websites and apps throughout the day in school.

Before starting the observations and classroom assessments, a general education and a special education teacher completed a teacher survey, with the objective of gaining more insight into their opinions about iPad initiative and the key elements responsible for the best iPad integration and student success in class. The teachers reported that the iPad initiative has increased student participation and collaboration in Algebra-2 class. However, the teachers expressed their belief that incorporating iPads into their lessons

did not significantly enhance their capability as teachers or allow them to design better lessons that focused on each student's individual needs. The most important consideration was that the iPads should be truly integrated to school curriculum when they are given to teachers and students. According to teachers, this was largely because the school district did not provide applicable and technology-enhanced instruction training with teachers. The general education teacher commented,

> "iPads should not be assumed as just an electronic device, but the quality of our teaching is still on spot during our formal observations. I mean, iPad does not substitute with good teaching in class. We are still required to design better lessons and figure out ways that students complete their assignments through the iPad."

The special education teacher felt that she was somewhat illiterate in terms of how to use applications for the special education classroom to design better lesson plans. In addition, when describing the barriers in front of the successful implementation of iPad technology, teachers mentioned a lack of time for planning, lack of salary incentives for those who use iPads effectively in class, lack of administrative support for integrating iPads into the curriculum, and frequent schedule changes for teachers, which limits collaborative planning time.

Since students spent the majority of their time with iPads at home, interviewing parents to gain insight into students' iPad experiences with iPad at home were considered to be necessary to best answer the research questions of the this study. The interview data was collected through home visits done over three weeks in February. Home visits made it possible to gain further insight into the iPad initiative from the parents' perspective. Each home visit took about half an hour, and the parents of students with specials needs were asked to respond a total of 5 questions in a semi-structured interview format. Their

responses were digitally audio-recorded and typed in Microsoft Word later on. Distinct themes and categories were determined, and several responses were combined with the others that included similar concerns (See Table 2).

Table 2. Parent Interview Questions

Questions	Responses
Have you noticed any changes in your child's working habits at home with the iPad integration? If so, please describe some of them.	"I used to check his school work in his binder, but now I cannot log into his iPad since I do not know his password." "He is rushing to complete his homework so he can do something else with the iPad." "The number of hours on homework is dramatically increased, 4-5 hours each day, but we do not see that much increase in his homework grades." "My son used to work on his desk in his room, but now he is working everywhere with the iPad in hand. iPad goes everywhere along with on the diiner table, around on the bed." "My daughter used to forget to submit her homework. After the iPad initiative, she forgets to do homework, not to hand it in.
Describe the feedback you have heard from your child about the iPad integration, if any?	"Overall I hear good feedback. The iPad helped my daughter enhance her learning and communication with her classmates, both in and out of the school." "The iPad is his best friend, of course I always hear good news about it." "My son is absolutely in love with his iPad. He did not tell me anything negative happened in the school so far."

(Table 2 Continued)

Questions	Responses
Do you have a preference for the iPad or a traditional textbook for your child to use at home for completing school assignments?	"Textbook, because the frequent use of the iPad and easy access to web was not good for his concentration." "Textbook. I think the iPad does not provide a better instruction for students." "Digital textbooks are best since figures and graphs are more dynamic and interactive."
What are the challenges and opportunities that you observe at home in your child's usage with the iPad?	"The greatest challenge that came out with iPad is that it really blurred the clear and distinct boundaries between work and play." "My son has been in touch with his friends through messaging applications which I cannot even imagine would have been possible otherwise." "She spent a considerable amount of time, 2-3 hours per day, on social networks like Facebook and Twitter."
One of the major goals of the iPad initiative is to extend the learning day through a home-school connection. To what extent do you think this goal has been met at home?	"Not fully, because we need to know more about the purpose of the project as well as our responsibilities at home with the iPads." "No. The iPad is being used for entertainment at home since kids are already bored in school." "Not really. Students are to turn their iPad back in to school before the summer break, and I do not know how my son will survive without his iPad."

The parent interviews also revealed several important facts. Three out of five parents stated that they did not have an iPad at home before it was given by the school, while four out of five parents preferred their children to have a traditional textbook at home rather than a digital version on an iPad. Parents came up with more than one reason why they preferred traditional textbooks. First, parents never estimated that iPad would have possibly turned out to be a source of distraction instead of a source of learning for their children**.** This was largely due to the high trust they have towards the school district. It was also noted by parents that the desire to use iPads for non-educational purposes led their children to complete homework in a quick manner and with less care. Several parents said they were unable to check how well their child had completed their school work since the iPad was locked with a password by the child. The parents also noted that the frequent use of the iPads, in addition to their easy access to web, was not beneficial for their child's concentration while working, since many applications send instant notifications and distracting messages periodically to the iPad screen. The majority of parents believed that the goal of the iPad initiative had not yet been met, and their concerns and complaints were centered on the lack of awareness among parents regarding the purpose of the iPad initiative, which, according to them, resulted in the lack of management of their children's iPad use at home. For example, one parent commented that, "the greatest challenge that came out with the iPad is that it really blurred the clear and distinct boundaries between school work and play." Another parent said that, "students were given a crash course on how to use their iPad in class, but we do not know how to host this new guest at our home in the best interest of our child."

Another question examined in this study was whether there was difference in achievement for students with learning disabilities when they used traditional textbooks and digital textbooks on an iPad in an Algebra-2 class. The data for this part of the study was collected from short weekly quizzes that were given to five students with learning disabilities after learning a new topic in the Resource Room. The data of this assessment for each of the five students in this study is shown in Figures 1-5.

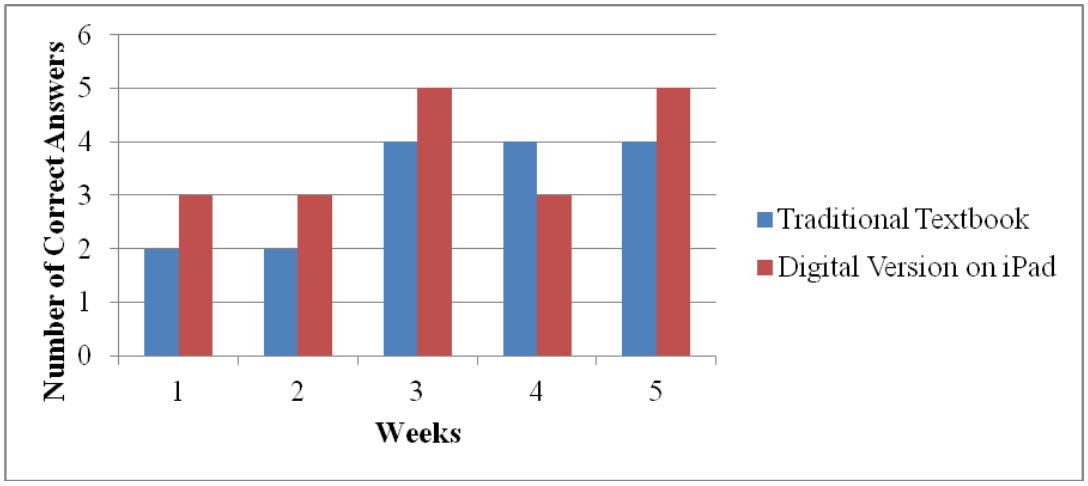

Figure 1. Comparison of Dana's performance on Algebra-2 quizzes.

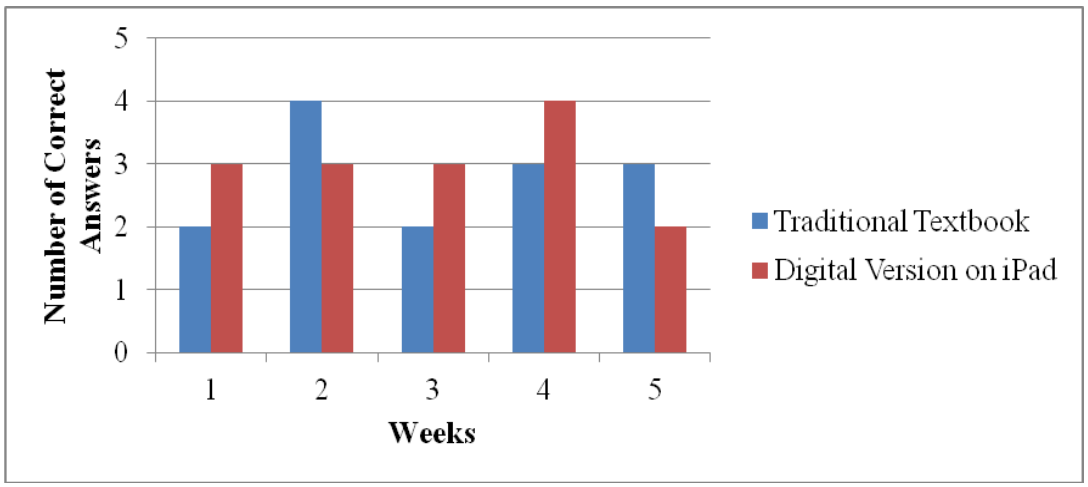

Figure 2. Comparison of Daniel's performance on Algebra-2 quizzes.

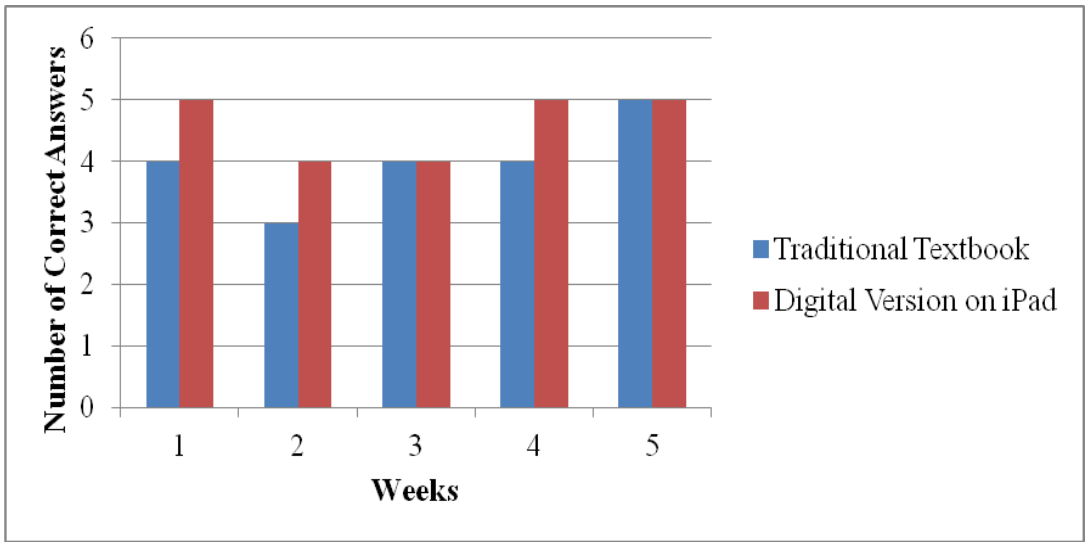

Figure 3. Comparison of Zeynep's performance on Algebra-2 quizzes.

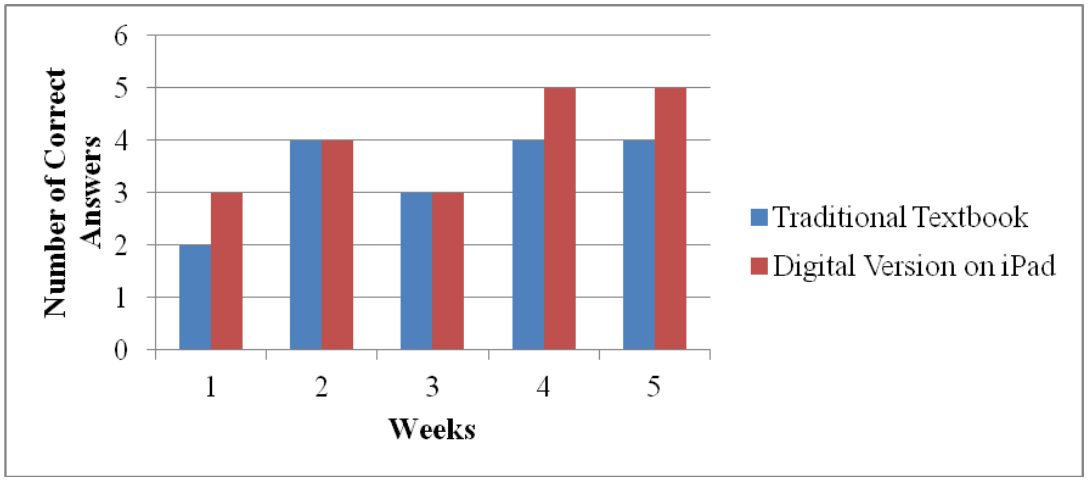

Figure 4. Comparison of Mary's performance on Algebra-2 quizzes.

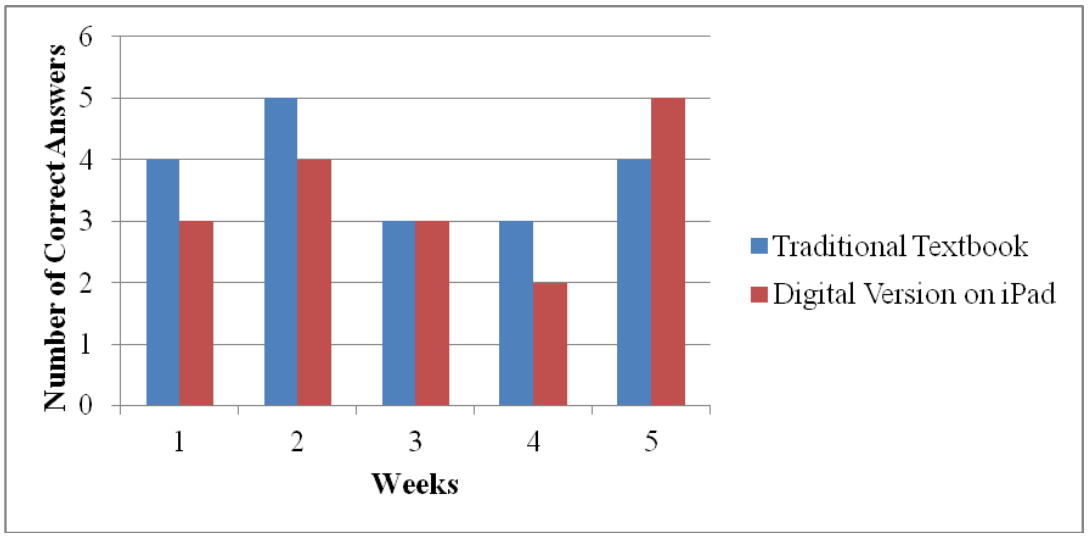

Figure 5. Comparison of Daniel's performance on Algebra-2 quizzes.

Figures 1-5 show the number of correct answers per session for each student across the two different conditions**.** The number of correct answers was generally higher under the digital textbook on iPad condition than it was under the traditional textbook condition for all five students. A slight increase in the mean number of correct answers was observed with the digital textbook for the majority of students. Under the traditional

textbook condition, the mean number of correct answers per session was 4, 3.8, and 3.4 out of 5 for Zeynep, Brad, and Mary, respectively. However, these numbers were slightly lower for Dana and Daniel, 3.2 and 2.8 out of 5, respectively. Under the digital textbook condition, the mean number of correct answers per session was 4.6, 4, and 3.8 out of 5 for Zeynep, Mary, and Dana, respectively, while it was 3.4 and 3 out of 5 for Brad and Daniel. Further data analysis revealed that all of the students except Daniel responded to all of the questions correctly at least once under the digital textbook condition throughout the treatment, and they all received the lowest score under the traditional textbook condition. Students' tendency to skip questions without even trying or writing "I do not know" was noted during the digital textbook condition. The students who skipped questions in this way appeared to finish the test in a rushed manner under the digital textbook condition, and they did not use their extra time to retry the questions they skipped or double check their responses. While solving the questions it was also noted that the students needed more teacher assistance during the digital textbook condition than they needed it during the traditional textbook condition across all the sessions.

At the end of the five-weeks treatment period, all five students and their teacher were administered a short social validity survey (See Appendix D) to determine their thoughts and feelings regarding each intervention condition and its effectiveness, as well as acceptability. The high results of this survey indicated that the interventions under both conditions seemed overall beneficial, fair, and applicable to both the students and the teacher.

This study also aimed to observe the students in the Resource Room to better understand the classroom climate with the iPad initiative. Each specific student behavior

was sorted into one of the following categories: (a) student participation, (b) rehearsal and elaboration of new knowledge, (c) logical thinking and problem solving, and (d) peer collaboration. The observation data, which was recorded on the Momentary Time Sampling Form, was examined to determine the frequency as well as characteristics of each student's specific behaviors during the instruction with the iPads. Figure 6 shows the average frequency of observed behaviors in one period for all five students.

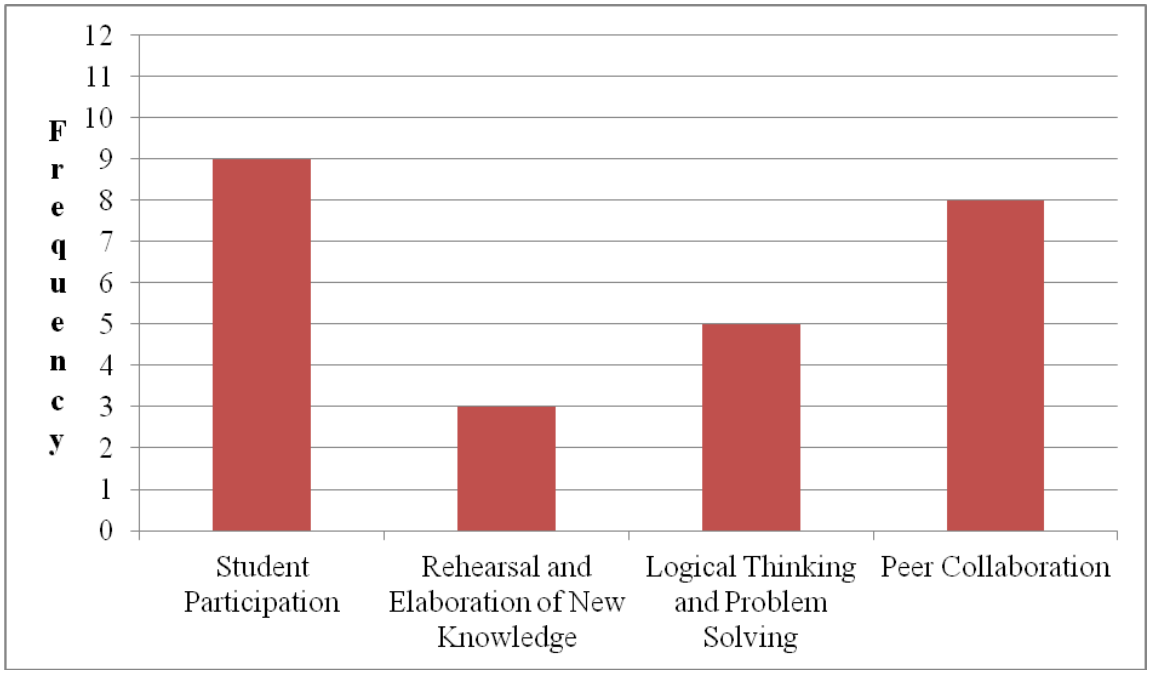

Figure 6. Student behaviors in Algebra-2 class with iPads

The iPads appeared to be mostly used for various activities related to classroom participation and peer collaboration. Some activities in which the iPads were utilized allowed for an easy flow of information, while the other activities led to a better display of the content being learned. For example, in order to solve the "Do Now" question during the initial minutes of the class, students did not have to spend time copying it. As

they entered the Resource Room, the "Do Now" question that was posted on the Smart Board automatically appeared on the students' iPad screens as an instant message through the Wi-Fi system. This easy access to the question did not only allow students to save time, but also allowed the teacher to walk around and provide assistance to the students as needed. When the teacher asked for the best definition of an Algebraic term, students came up with several meaningful definitions, since they had used their iPads to search the web to find various definitions. In addition, the teacher used an application called "Dropbox" to import the class notes and worksheets that were covered during the period for those who had been absent on that day. As a result of this, the students who had been absent did not have to wait until the next day to be aware of what was taught in the class.

In addition, creating and managing short polls to determine which areas students struggle with could be done easily by using iPads. The teacher used the eClicker app to poll her students on what they knew and didn't know. It was helpful because it allowed for real-time responses. Teachers allowed students to answer a question that was on the Smart Board and received instant feedback from iPads. Once the teacher determined that the majority of the students did not answer the question correctly, the teacher had an opportunity to review the topic again and clarify misunderstandings, rather than waiting until the next day to see if the topic is understood based on students' performance on homework.

Chapter 5

Discussion

This study investigated opportunities and challenges presented by iPad integration in an Algebra-2 class, and also aimed to evaluate whether or not iPads are superior to printed materials. The data gathered in this study showed that iPad integration caused an increase in student participation and collaboration. However, it did not show any significant increase in student achievement compared to traditional textbooks and printed materials.

The opportunities that portable devices, such as iPads, provide for students are many. Students no longer have to carry their cumbersome textbooks between classrooms, nor do they need to worry about forgetting their materials at home. In addition, iPads provide students with immediate access to various educational applications as well as the internet, so if a topic needs to be investigated further, it can be easily done without physically being in class or asking the teacher. As indicated in the survey results, student motivation and engagement in the classroom were increased with iPad integration, and there was also a significant increase in student collaboration since the iPad allowed students to form online study groups and collaboration teams with its Wi-Fi technology. For instance, by using the Wi-Fi technology and applications such as "Keynote", the teacher was able to design partially completed slides about algebraic expressions and send it to the students' iPads, so that they could solve them online in small groups. The students could easily fill in the blanks on the slide, put labels on the diagrams, and answer questions with the Keynote application. As the students finished, they sent their

completed slides back to the teacher. In addition to helping reduce the amount of paper consumed for classroom worksheet activities, this practice also kept the students engaged in small online groups in a way that would have been impossible with traditional worksheets and textbooks. Overall, these findings are consistent with those of McClanahan (2008) and colleges who found that the way the learning material is presented contributes most to students' level of participation in the learning process.

While these advantages are largely accepted by the majority of iPad users, relying excessively upon an iPad for solving math problems may impair students' writing skills over time. The smooth information flow that the iPad presents did not appear convenient for a number of students in this study. In response to an open-ended question, several students mentioned that they could write better on a notebook rather than typing on an iPad screen. They expressed feeling more comfortable solving math problems with paper and pencil, and that they could write faster on paper than an iPad screen. Students specifically pointed out difficulties that they experienced with typing Algebraic symbols with iPad's touch screen keyboard and drawing mathematical figures on the iPad screen. While students stayed away from iPads for note taking and problem solving, they came up with alternative ways. Survey results revealed that about one third of the students used their iPads to capture teacher notes written on the board instead of typing them on the iPad screen. In addition, several other students preferred to use their iPads to record their teacher's voice when an important point was stressed in class. Even though voice-recording of an important point discussed in class may not pose a problem for student learning, taking a picture of teacher notes on the board, while there is also an opportunity to write it in a notebook, may not be beneficial for students. Teachers looked at the issue

from a different perspective and pointed out that as students get used to taking the picture of a problem that was solved on the board, they tended to not pay close attention to every step in the problem solving process. As a result of this, students' iPads were inundated with too many pictures to be reviewed and they had difficulty understanding the steps in the problem solving process when they arrived at home. Moreover, taking a picture of the classroom does not have a lot to do with promoting higher order thinking skills, since the learner is not very involved in the learning process. According to teachers, note taking as opposed taking pictures gives students an opportunity to write explanations in their own words next to each step in the problem solving process, which helps students develop a conceptual understanding of math concepts in the long run.

The iPad allows its users to watch online videos as long as the device is connected to internet. A number of websites, such as "www.khanacademy.org", offer students free tutorial videos in many subject areas. Despite the positive feedback from several parents and students in regards to watching teacher videos that were recorded in class, or mainstreamed tutorials from these websites, teachers approached this idea with caution. Teachers indicated that this new way of learning brought on by portable devices may seem like a great opportunity for students to study a topic at their own pace at a later time, however this may cause a decrease in students' classroom participation. As students rely too much on math tutorial videos, rather than actual classroom learning, they would eventually shut down in class in terms of participation and collaboration. It should be noted that students not only learn from the teacher, but also from each other through classroom activities and discussions. Thus, learning from peers could make more sense to students. The language that teachers speak in a problem solving process may sound

somewhat formal and difficult compared to the language that students use with each other in collaborative groups. This informal, but effective, way of peer learning may eventually get lost if students excessively rely upon watching videos on iPads.

As Barak et al. (2006) indicated, portable wireless devices may turn out to be a distraction rather than a source of learning for students, depending on how they are used. In practice, facilitating a new way of learning would not mean too much for academic success unless students are committed to use it for learning purposes. Although student participation and collaboration appeared to increase with iPad integration, parent and teacher feedback raised a red flag in regards to iPads being used for various other purposes besides the educational ones. Teachers reported that it was difficult to make sure that all of the students were on task with their iPads, because students could easily pull up a non-educational application and then close it as teachers walked by them during class. This finding collaborates with Murray and Olcase's findings (2011) that indicated it is extremely important to choose appropriate applications since the applications determine the purpose for which the device will be used. Teachers' concerns seemed to be confirmed by the students, since more than half of them said in the survey that they did not get involved in discipline issues for using their iPads for non-educational purposes. There are several possible explanations for this. One might be that there is a lack of supervision for iPad usage in school, and a lack of procedure in school prohibiting specific applications and websites. In addition, due to the fact that students have all of their textbooks and materials in their iPads, taking away a student's iPad seems to be impossible as it would be depriving a child of a "Free and Public Education." As a result, students' misuse of iPads would have to fall between the cracks without getting

recognized. Furthermore, there is always a potential risk of losing everything stored in the iPad in case of software failure or hardware damage. Another possible explanation for this might be that since students have more skill and knowledge of using iPads than their teachers, as indicated in the survey results, students take advantage of this to avoid getting in trouble by tricking teachers when they use iPads for non-educational purposes. Even though students have expertise using iPads, they are obviously not using this advantage to increase their achievement with iPads.

As mentioned earlier, iPads provide students with an opportunity to collaborate with each other while they are out of school, as well as in school, thorough internet and Wi-Fi technology. This required the researcher of this study to conduct parent interviews to capture students' iPad usage at home. Parents reported that there had been an increase in the number of hours students spent on homework and, contrary to the expectations, a decrease in their homework grades. Furthermore, one parent commented that, "the iPad initiative really blurred the clear boundaries between school work and computer games. Now we are unable to determine whether or not our child is working on schoolwork, because educational and non-educational applications are all mixed in a box." Similar to this issue, several students voiced their concerns about getting distracted too easily while doing homework on the iPads by receiving instant messages from social network websites and applications. Another parent pointed out that the reason why students tend to use their iPads for non-educational purposes at home was because students were already bored of using it for school work; when they come home, where there are no network restrictions for certain websites, they are more likely to use their iPad for non-educational purposes. These findings are in agreement with Kerawalla's (2002) finding

that computers at home are used for playing games, and parents do not know how to guide their children to use computers for doing schoolwork at home.

A number of recent studies have looked at iPads from only a behavioral perspective aimed at determining whether iPads increase or decrease student motivation and engagement (Manuguerra, 2011, Franglin & Peng, 2008). The current study also strived to determine whether iPads are superior to textbooks in increasing the achievement of five special education students. The findings showed that all five students answered the same or a slightly higher number of questions correctly under the iPad condition as opposed to the textbook condition, and they needed less teacher assistance under the iPad condition. In addition to this, it was observed that students finished the test earlier during the iPad condition compared to textbook condition. These findings are not consistent with the hypothesis of the current study, since student achievement was slightly higher under the iPad condition than the textbook condition. Several possible factors may have played a role in students' slightly higher achievement under the iPad condition. First, during the iPad session, students may have used the internet on their iPad to look a term or a formula needed to solve a problem, since they were allowed to use the Wi-Fi system in the school. Second, they might have collaborated with each other on the same problem by sending instant messages and e-mails. Finally, it might be easier for students to search through the digital textbook than the traditional textbook for an Algebra fact they needed to know while solving a problem.

The findings of this study are subject to at least three limitations. First, these results cannot be generalized across the entire student body in the school, since the current study was limited by only fifteen regular education and five special education

students who took an Algebra-2 course. It is not known how well the students in other grades would respond to such an iPad integration. Therefore, future studies should focus on the investigation of iPad integration including more grade levels and more students. Second, each week, the classroom assessment under the iPad condition was conducted before the assessment under the textbook condition. Even though the teachers tried their best to prepare similar questions in terms of difficulty for each day, students started the iPad day with more knowledge and experience. Last but not least, data for the classroom assessments was collected over five weeks. Considerable more work over a longer period of time needs to be done to determine whether the difference in student achievement with iPad integration is significant in the long term.

Conclusion and Moving Forward with iPads

Many portable products were originally designed for individual usage, as the letter "i" in "iPad" brings to mind. However, this study showed that iPad integration in an Algebra-2 class resulted in an increase in student participation and peer collaboration. It also compared the effects of digital and traditional textbooks on student achievement, and found a slight increase in student achievement when iPads were used. In addition to these findings, this study taught valuable lessons as to what needs to happen on a school level to enhance student learning. There are number of courses of action for the best implementation of iPads in high schools. One of the biggest obstacles to the best implementation of new educational technologies in schools is the lack of a needs assessment prior to implementation. Due to the widespread use of new technologies on the market, school leaders and decision-makers tend to jump the gun and replace old devices with new ones without making a comprehensive needs assessment including

teachers, students, and parents. When iPads are employed in schools without a comprehensive needs assessment, a possible source of instruction will turn into a source of distraction for students, and teachers will suffer from the lack of knowledge on how to best use the device in class. In addition, teachers who consider utilizing the iPad, or similar new educational devices, should first start, as Mishra and Koehler (2006) suggest, with the acronym “TPCK” to describe the relationship between pedagogy, technology, and content knowledge, by defining the goals of the lesson and specific characteristics of the learners. Following this, they should determine the type of activity that will carry students to these defined goals, and the type of assessment that will be used to measure student learning prior to selecting the technology tool to be used in class. For that purpose, iPads should be deemed as one educational resource among many others that have been used in class, rather than a panacea that will meet all needs of all students. New educational tools could work best to enhance classroom instruction and student learning only when their employment is carefully planned and they are used specifically as needed. Moreover, a well-known saying among hardware experts, "garbage in, garbage out," is still rulling. Student success will be left to change unless the iPad is carefully integrated into the school's curriculum, and specific classroom activities are developed with the iPad in mind. It is almost impossible to back up a poorly-designed lesson with a fancy and popular portable device. Such comprehensive projects also require providing teachers with ongoing training and support as they have difficulties with the device along the way. In conclusion, as Crichton et al. (2012) suggest, school leaders and policy makers should take a holistic approach in determining which new

deceives to allow in their schools, and this should happen along with a comprehensive and systematic change in school programs.

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Appendix A

1. Would you prefer your textbooks to be in iPad or in the print?

◯ A) Print version ◯ B) Digital version

***2. Rate your knowledge about using iPad in general**

Very Low	Low	Average	High	Very High
◯	◯	◯	◯	◯

***3. With the implementation of I pads in Algebra-2 Class, I**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Created presentation by using technology or computer	◯	◯	◯	◯	◯

***4. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Created notes, drafts, and mind maps to complete assignments.	◯	◯	◯	◯	◯

***5. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Used apps that helped me practice a skills I learned (e.g., math drills, typing apps, spelling etc.)	◯	◯	◯	◯	◯

***6. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Identified and presented relevant information regarding a problem	◯	◯	◯	◯	◯

***7. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Allocated resources for math problems	◯	◯	◯	◯	◯

***8. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Become a self-directed learner	◯	◯	◯	◯	◯

***9. With the implementation of I pads in Algebra-2 Class, I**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Recorded the lesson and listen it at a later time	◯	◯	◯	◯	◯

***10. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Typed assignments and submitted them online	◯	◯	◯	◯	◯

***11. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
figured out similarities of the current situation with familiar ones to elaborate details of a problem	◯	◯	◯	◯	◯

***12. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Began to use touch-screen technology of the device to analyze and interpret data, graphs and tables	◯	◯	◯	◯	◯

***13. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Recognized and defined variables of given math problem	◯	◯	◯	◯	◯

***14. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Visualized what I read and hear by drawing a diagram	◯	◯	◯	◯	◯

***15. With the implementation of I pads in Algebra-2 Class, I**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
made online researches and collaborated with my peers in the class	◯	◯	◯	◯	◯

***16. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Worked on online group projects/assignments	◯	◯	◯	◯	◯

***17. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Felt more comfortable in interacting with my classmates	◯	◯	◯	◯	◯

***18. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Began to write, send, and receive E-mails to my classmates more easily	◯	◯	◯	◯	◯

***19. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Figured out strategies to solve a math problem in a group	◯	◯	◯	◯	◯

***20. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Saved more time to collaborate with my friends on an assignment.	◯	◯	◯	◯	◯

***21. With the implementation of I pads in Algebra-2 Class, I**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Began to play games more often	◯	◯	◯	◯	◯

***22. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Enjoyed to use the iPad for applications unrelated to school.	◯	◯	◯	◯	◯

***23. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Got in trouble with discipline rules more often.	◯	◯	◯	◯	◯

***24. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Got a greater chance to follow up my profile in social networks (Facebook, Twitter, etc.)	◯	◯	◯	◯	◯

***25. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Started to make online purchases more often	◯	◯	◯	◯	◯

***26. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Listened my favorite songs comfortably.	◯	◯	◯	◯	◯

***27. With the implementation of I pads in Algebra-2 Class, I**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Began to read Digital/eBooks in school/at home.	◯	◯	◯	◯	◯

***28. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Solved online practice questions and benchmarks tests.	◯	◯	◯	◯	◯

***29. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Engaged more in class work.	◯	◯	◯	◯	◯

***30. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Showed more interest in school and learning	◯	◯	◯	◯	◯

***31. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Participated more in lessons and classroom discussions.	◯	◯	◯	◯	◯

***32. .**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Wanted to participate more in iPad technology-integrated class than in a regular class (E.g., Gym, Music...)	◯	◯	◯	◯	◯

***33. Outside of the school day, what activities are you doing on the iPad? Click all that apply.**

- [ ] Learning New Materials
- [ ] Reading
- [ ] Homework
- [ ] Games/Entertainment
- [ ] Research
- [ ] Creating (Movies, Drawings, Music, etc.)
- [ ] Communicating and Collaborating
- [ ] Social Media/Chat

Other (please specify)

***34. What are some issues/concerns (if any) that you have had with the iPad project thus far? Please explain.**

***35. Please describe the changes in your learning and work habits that the iPad integration brought about?**

Appendix B

PARENT INTEVIEW

Child's Name: _____ Age: ____ Grade: ____

Language Spoken at Home: _____ Date of the Visit: _____

Home Address:

_____

QUESTIONS

1) **Have you noticed any changes in your child's working habits at home with the iPad Integration? If so, please describe some of them.**

Probe: Did you have an iPad at home before the school gave one to your child? Does your child use the iPad by himself/herself? With a sibling? With a fiend?

Probe: Does your child sit quietly when he/she use or interact with the iPad?

2) **Describe, if any, the feedback you heard from your child about the iPad integration?**

Probe: How often do you get that feedback?

3) **Do you have a preference for the iPad or a traditional textbook for your child to use at home for completing school assignments?**

Probe: Do you think your child learns more from the iPad than from doing traditional textbook? Why do you think so?

4) **What are the challenges and opportunities that you observe at home in your child's usage with the iPad?**

Probe: Were you provided with training about the iPad initiative?

5) **One of the major goals of the iPad initiative is to extend the learning day through a home-school connection. To what extend do you think this goal has been met at home?**

Appendix C

Momentary Time Sampling Form

Student's Name: _____ Teacher: _____

Subject/Period: _____ Date(s): _____

Behavior Definition (in specific, observable, measurable terms):	
Student Participation: The capability of the iPad to support students to be actively involved in their learning	
Examples: With iPad, student is always prepared for the class with classroom materials, solves "Do Now" question, proactively contributes to class by offering ideas and asking questions, comes to board to solve a question etc.	
Total Observation Time: 12 minutes	Length of each interval: 1 minute

Date	Interval #													Total times behavior occurred (X)
	1	2	3	4	5	6	7	8	9	10	11	12		
O or X														

Need assistance from teacher

.....

Behavior Definition (in specific, observable, measurable terms):	
Rehearsal and elaboration: is "repeating words and concepts, paraphrasing and summarizing with the iPad".	
Examples: With iPad, student pays close attention and record the important points of the class with iPad voice/video recorder, records others' important responses, looks up something into websites, asks questions to learn more, and paraphrases or summarizes with the iPad etc.	
Total Observation Time: 12 minutes	Length of each interval: 1 minute

Date	Interval #													Total times behavior occurred (X)
	1	2	3	4	5	6	7	8	9	10	11	12		
O or X														

Disturbing the class or making fun of something

.....

Other noteworthy behaviours

....

.....

Behavior Definition (in specific, observable, measurable terms):	
Logical thinking and problem solving: is defined as "application of new knowledge to situations using the iPad"	
Examples: With iPad, student applies information and formulates solutions to a new situation, shows creativity and problem solving skills, responses logically to others' views/ideas, substantiates his/her own point with clear evidance etc.	
Total Observation Time: 12 minutes	Length of each interval: 1 minute

Date	Interval #													Total times behavior occurred (X)
	1	2	3	4	5	6	7	8	9	10	11	12		
O or X														

Behavior Definition (in specific, observable, measurable terms):	
Peer Collaboration: is defined as "a situation in which two or more people attempt to learn something together"	
Examples: With iPad, student teaches another to do a math calculation, works collaboratively to solve a problem, discusses questions within small groups, sends/shares online data/info to group mates etc.	
Total Observation Time: 12 minutes	Length of each interval: 1 minute

Date	Interval #													Total times behavior occurred (X)
	1	2	3	4	5	6	7	8	9	10	11	12		
O or X														

Appendix D

Answer by circling one number from the following rating scale

1: Strongly Agree, 2: Agree, 3: Neutral (Neither Agree nor Disagree) 4: Disagree 5: Strongly Disagree

Digital Textbook on iPad	1: Strongly Agree	2: Agree	3: Neutral	4: Disagree	5: Strongly Disagree
1) This intervention to improve my Algebra skills was fair.	1	2	3	4	5
2) This intervention gave me enough time to practice Algebra-2 skills.	1	2	3	4	5
3) This intervention is good one to use with my peers.	1	2	3	4	5
4) I like this intervention for my Algebra skills.	1	2	3	4	5
5) I think this intervention helps me to achieve more in school.	1	2	3	4	5
6) With this intervention I feel I am good at Algebra-2.	1	2	3	4	5
7) With this intervention I feel I can achieve in Algebra-2 as much as my classmates.	1	2	3	4	5
8) With this intervention I feel I can do Algebra-2 problems quickly.	1	2	3	4	5
9) With this intervention I feel I can memorize Algebra-2 facts easily.	1	2	3	4	5
10) With this intervention I feel I can figure out the answer of a problem more easily	1	2	3	4	5