MIDDLE AND HIGH SCHOOL TEACHER PERCEPTIONS OF IPHONE AND IPAD USAGE IN MATHEMATICS EDUCATION

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ABSTRACT

The symbolic, abstract, and visual nature of mathematics makes the subject one of the most challenging to teach. However, with the introduction of technological interventions, it is possible to expedite the learning process by making the learning experience more appealing to the student. This paper sought to explore the perceptions of teachers on the efficacy of iPad and use in advancing learning of mathematics. The quantitative study surveyed a sample of approximately 100 teachers teaching mathematics at middle and high school levels in Coosa County, Alabama. Semi-structured questioners were used in collecting data from the respondents and entered in SPSS for analysis.

The findings indicate that majority of the respondents found the frequent use of iPads in the classroom to be important in improving student understanding (74.55%), enhancing communication (89.2%), and improving performance (91%). While there might be certain barriers such as lack of support from administration or insufficient access that could limit the adoption of the iPads in certain circumstances, teachers perceive their usage is associated with improved learning outcomes. The results concur with existing literature, especially Dewey's theory that shows that learning can be influenced positively by presenting students with opportunities to experience the iPad.

Technological interventions in the form of iPads seem to benefit both teachers and students in the mathematics classroom, however their usage should be the sole method of instruction.

DEDICATION

This thesis is dedicated to everyone who helped me and guided me through the trials and tribulations of creating this manuscript. In particular, Dr. Philo Hutcheson, my dissertation chair, who never quit believing I could complete my EdD. I also want my two children, Derreck and Savannah, to always know that they are the reason I set and completed this manuscript.

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CHAPTER I

INTRODUCTION

Background of the Study

As the world becomes engrossed in technology, it appears unavoidable that the mathematics classroom will, as well. Using technology in enhancing student learning is not a new approach. Students have gained from the benefits of software use, for instance, Tinker plots and Geometer‘s Sketchpad, for many years. Content management systems such as Blackboard and Desire2Learn (D2L) help students access and hand in videos and assignments, as well as other learning materials electronically. Interactive whiteboards such as SMART Boards enable instructors to save classroom notes as well as manipulate and display websites and software for the class (Henderson & Yeow, 2012). Student polling sites and response systems, which make it possible for students to text feedback with their mobile phones, can provide information from the students for immediate response on what they know and are able to do, are also another important component of technological devices. Computer algebra and graphing system calculators are changing how students obtain solutions to problems with functions.

Statement of the Problem

Without a doubt, technology is changing the way mathematics is taught and the way students’ access pieces of information. While these tools enhance learning and benefit students, they come with various challenges. Activities which use Geometer‘s Sketchpad are only beneficial

in schools that have acquired this software and can access computers during lessons. Furthermore, students who miss class because of illness or school activities are not able to make up this type of learning if they cannot access the software at home. If the students provide their own calculators, they may purchase those that the teachers cannot use, thus making these tools much less beneficial. The SMART Board is very useful if students are able to interact with them, but again, it is only beneficial if the students can access the Internet at home. With such differences in the ease of access of technical resources, it can be hard to find a way to integrate these materials into the classroom frequently. While the benefits of technological resources probably overshadow the challenges, integrating these tools in the classroom requires the teacher to learn how to use them efficiently, teach the students how to use them, address access issues, and find funds to buy and maintain the software or equipment. While students carry cell phones and portable gaming systems everywhere they go, they seldom have a laptop or a graphing calculator that has dynamic geometry software (Kaleta & Joosten, 2012).

Christensen (2002) reveals that teachers have an extraordinary opportunity to reach students with mathematics just as Facebook, online gaming, and texting have captured the students' attention. If teachers can acquire a user-friendly, unobtrusive, and affordable learning device, which can do some of the above tasks, it could be very easy to make these practices part of the classroom often. According to Johnston and Stoll (2011), the use of iPads should be focused on aiding high-impact educational practices, not on the device itself. More and more people use these devices, with about 397 million people actively using their iOS devices (Meurant, 2010).

In today's world, the education community is excited about the tablet computer of Apple, the iPad (Melhuish & Falloon, 2010). Various classroom technologies took a long time to enter classrooms; however, since the iPad was introduced in 2010, it has become a trending classroom

device (Melhuish & Falloon, 2010). The iPad refers to a handheld tablet computer, which can connect to the internet through 3G or Wi-Fi. Moreover, its size is the same as that of a notebook. Instead of a touch pad or a mouse, it has a touch screen that enables users to move or scroll objects through sliding a finger across the screen. The touch screen also allows users to click through tapping on the screen. The iPad is a portable and compact computing device that students with special needs, young children, and non-tech-savvy senior citizens can operate without a lot of instruction (Melhuish & Falloon, 2010). This tool has a great potential in making a positive influence on students learning in a mathematics classroom (National Council of Teachers of Mathematics (NCTM), 2010).

If technological devices are available, teachers and students should determine how they can make use of them to advance students' learning (Christensen, 2002). Without a doubt, the benefits of using technology in learning makes it necessary to move from the traditional lecturing formats to concept-building, student-centered and collaborative learning. Both the iPad and iPhone can allow students to collaborate and use internet resources in the classroom and at home to communicate with the teachers and among themselves (Christensen, 2002). According to Purcell, Heaps, Buchanan and Friedrich (2013) students and teachers can use the internet to access content, share ideas, interact through the use of emails, study platforms, and social platforms. These resources enable quick access to information, creation of learning content for students, and submission and retrieval of tests and assignments (Murray & Olcese, 2011). As a result, the use of technology leads to saving time in the learning process. In addition, the use of technology has been cited as a means for increasing student participation in learning (Kearney & Maher, 2013). These resources enable the teachers and students to enter mathematical notations on computers without the need of typing out equations in bulky programs (Kearney & Maher, 2013). The potential of the

iPad and iPhone in using discovery applications (Apps) and explorations, allowing for direct formative assessment and facilitating communication about mathematics, is intriguing. Neither the iPad and iPhone may be the answer to the mathematics classroom problems; however, they may be the solution to some of them. This dissertation seeks to determine if teachers think that the iPad and iPhone are advancing learning.

Research Questions

The use of technology in learning has been argued to be effective in increasing learning in students and motivating participation (Kearney & Maher, 2013). This study seeks to investigate the perceptions of teachers and students on the efficacy of iPad and iPhone use in advancing learning of mathematics. This aim will be assessed through an examination of the following research questions:

1. Do teachers think that iPads and iPhones can improve the achievements of students in the mathematics classroom, by facilitating or supporting the following practices in mathematics high school education?
    - Can iPads and iPhones facilitate communication within the mathematics classroom (including communicating between the instructor and the students, collaboration and writing about mathematics)?
    - How effective are iPads and iPhones in supporting the use of student exploration materials (for instance spreadsheets and Geometer‘s Sketchpad) for discovering and experiencing mathematical concepts and relationships?
2. How do the teachers use the iPads and iPhones in mathematics classes to improve instruction?

3. Have there been increases or decreases in student scores since use of the iPads and the iPhones in mathematics classes began?

Justification of the Study

Using technology to promote learning in mathematics classrooms is not a new idea. According to the NCTM (2010), technology is one of six major principles for efficient mathematics instruction. NCTM's publication, "Principles and Standards for School Mathematics" (2010), states that technology is significant in learning as well as teaching mathematics. It enhances students' learning and influences the level of mathematics, which is taught. Furthermore, computers and calculators can assist students in exploring relationships so that they can focus on reflection, decision making, problem solving and reasoning (NCTM, 2010). As the news of iPads and iPhones in the mathematics classroom spreads, excitement has been mounting. Without a doubt, there are hundreds of articles about adoption of iPads and iPhones in schools at varying extent of implementation across the nation (Barseghian, 2011). Some schools have made iPads and iPhones available to sign out from the library or media center. Other schools have created iPad labs and provided classroom sets on carts for mathematics classroom use only. One of the most ambitious programs include 1:1 initiative, whereby one iPad or iPhone is given to each faculty member and student for use at home and school. Jim Siegl, a technical architect in the field of education, and Eric Lai, ZDNet Sybase and Ubermobile blogger, have maintained an online spreadsheet titled: iPad and iPad 2 Deployments, which summarizes the companies, agencies and schools that have implemented various iPad initiatives (Kaleta & Joosten, 2012). They also maintain links to the websites of these companies, schools, agencies, and programs, which describe each initiative. In 2011, their site listed more than forty schools worldwide that

piloted one-to-one iPad programs (Barseghian, 2011). Furthermore, the site listed a number of schools that had incorporated iPads in the classrooms. These schools used iPads as textbooks. However, it is improbable that the above list is exhaustive since other surveys revealed that many more schools were implementing iPad initiatives in 2011 (Kaleta & Joosten, 2012). Several schools were also planning to implement iPad initiatives (Bonnstetter & VanOverbeke, 2012).

According to critics, the iPad has a number of limitations. They assert that iPads and iPhones lack Flash (Church, 2001), therefore, they are unable to run Java applets, which power a number of learning websites. This means that some well-known learning tools, for instance the National Council of Teachers of Mathematics or the National Library of Virtual Manipulative Illuminations websites, are inaccessible on the iPad and iPhone. Moreover, iPad and iPhone programs can also be expensive. Since the devices are still new in the field of education, schools have not fully studied their educational benefits. According to previous research there is very little confirmation that students learn better, faster, or more by using the iPads and iPhone. Educators in some areas argue that the amount of money spent on iPads and iPhones by schools could be better spent on recruiting and training high-quality teachers. In spite of these challenges, some educators have observed positive changes in their mathematics classrooms. Indeed, it is imperative to determine if the benefits of both the iPads and iPhones outweigh the limitations.

Research Assumptions

Although practices involving the continuous use of iPads and iPhones have not been comprehensively implemented in mathematics high school education, researchers have extensively studied them and shown that they increase the achievement and performance of students in mathematics (Henderson & Yeow, 2012). This research will include the assumption

that a small number of sources on the above practice topics represent a larger body of proof that supports these practices in mathematics high school education. It will also include the assumption that information regarding improvement of student learning using iPads and iPhones in classrooms for subjects apart from mathematics will be appropriate for the high school education in some way. Since iPads and iPhones are still new in the field of education, some of the practices that will be investigated in this research have not yet been studied with iPad and iPhones. This research will include the assumption that if a practice or function has been confirmed to be successful in improving student learning, and if it is practically achievable on iPad or iPhone then these technological devices can be used in this way to improve student learning in mathematics high school education. Finally, this research will include the assumption that if a function is considered to be operative on another tool for instance iPod, the same function can be effective in a similar way on iPad or iPhone as well.

Limitation of the Study

When studying the use of iPads and iPhones in mathematics high school education, this research will be limited to one-to-one iPad and iPhone initiatives in which each student has an iPad or iPhone that they can take home. This research will involve studying iPads and iPhones since these are the tools that many institutions worldwide are currently considering implementing. This research will not include study of primary grades; instead, it will concentrate on seventh grade through high school. Of all the well-known practices in mathematics pedagogy, this research will be limited to student exploration tools, for instance spreadsheets and Geometer‘s Sketchpad. The research will be limited to communication, for instance collaboration, communicating between students and the teacher, and writing about mathematics. Finally, this research will be limited to,

the general functions of iPads and iPhones that can be effective in the enhancement of instruction in mathematics high school education. While this dissertation may highlight some apps of iPads and iPhones, specifically if they have been considered to improve learning, it will not be an all-encompassing review of all available apps.

Definition of Terms

App

This refers to the application created for a mobile device, for instance a tablet computer or a Smartphone.

Flash

This refers to a media platform, which enable websites to contain interactive elements, videos, or animations.

Java Applet

This refers to a computer program, which can run through a browser by using a Flash.

Smartphone

This refers to a cellular phone that can run applications and connect to the internet.

Student response system

This refers to a device that allows students to submit instant feedback electronically to a software program.

Conclusion

The introduction of technology in the classroom has changed the learning process significantly. The learning process has become more efficient as new devices such as the portable computers are introduced in the classroom. Software such as the Tinker Plots and the Geometer's

Sketchpads has been very beneficial to the learners especially in the mathematics classes. The content management systems are also very beneficial to the learners because they allow them to access and to hand in videos and assignments electronically. The success of technology in the classroom creates the foundation of the current study whereby the efficacy of IPAD usage in mathematics is assessed. The following section outlines the literature review.

CHAPTER II

LITERATURE REVIEW

Introduction

The main goal of education, as depicted by Perry (2010), is to prepare students to lead lives which are independent and productive in society. Mathematical skills which are taught at the elementary grade are of great importance because they help to provide the basic knowledge, skills, and the necessary solid foundation which is fundamental for students to advance their education. Making achievements in mathematics at an early age is thus critical for the educational success of learners in the future (Ağır, 2015). It is, thus, important to nurture and establish a positive disposition towards mathematics very early in the education of a child. Students who lack mathematical skills or possess a negative attitude towards the study of mathematics are at risk of failure in their education (Carr, 2012). In order to ensure achievement and satisfactory performance by students in mathematics there have been major efforts in the reform of mathematics instruction in order to incorporate technology in the teaching and learning of mathematics. In the reforms, various curriculums that would aid in the teaching of mathematics were formed, and an infrastructure was also laid to form the groundwork and devise ways in which children would be taught mathematics (Li & Leung, 2014). The study conducted by Li and Leung (2014) was aimed at having an understanding of whether teachers and students believe that the introduction of iPads in learning mathematics is advancing learning. While it is believed that there is substantial research

on the integration of technology in different classrooms, Zhao & Frank (2003) argue that there is a need for additional research to postulate how iPad devices for mathematics encourages students in changing their attitudes and achievements towards learning mathematics.

Theoretical Review

The theoretical basis for the current research is the Experimental Theory that was developed by John Dewey (Dewey, 1938). According to Carr (2012) Dewey developed this theory in an endeavor to gain increased comprehension of the reasons and the manner in which students learn. Form his investigative studies Dewey concluded that one of the most significant ways in which learners gain knowledge is by the individual experiences and life occurrences that they go through. Carr (2012) asserts that in a manner dissimilar to most other theorists in his era, Dewey placed preeminence on the adoption of a progressive approach towards responding to the needs of students. This was due to Dewey's belief that the formulation and application of student-centered experiences of learning is both valuable and flexible to the educational needs of learners (Dewey, 1938). In the midst of transformations and innovation which typify contemporary educational practices, the student-focused theory proposed by Dewey remains both relevant and evident in modern schools (Carr, 2012). According to an experiential and student-centered theoretical point of view, the scholarly performance of students, particularly in mathematics, can be influenced positively by presenting students with opportunities to experience the iPad. The application of Dewey's theory in the current research implies that the experimental theory is the foundation for the hypothesis that classroom experiences with the iPad influence the performance of students in mathematics positively (Carr, 2012).

The Spread of IPad Technology in the Classroom

Technology may be described as any tool that can be of great importance and that can be used to promote human learning (Palmer, 2014; Nguyen, Barton, & Nguyen, 2014). Christensen (2002) asserts that educators, particularly special education teachers, have been under increased pressure to improve the performance of students in order to attain state and federal standards. Earle (2002) posits that education in the contemporary day is characterized by the integration of innovations and technology in education. There are many kinds of technological advancements that have been incorporated into the classrooms over the past few decades. In some instances, it has been shown that technology increases and improves attitudes and achievements of different subjects in the education curriculum (Nguyen & Chaparro, 2012). The use of the conventional computers, including notebooks and laptops, is fairly well established in different schools around the world. There are several authors, for example Pilli & Aksu (2013), who affirm the value and impact of such technology and innovations in education.

Over the past few years, there have been efforts by curriculum development teams in different parts of the world to integrate tablet devices such as iPads at the innovation stage of learning and development (Earle, 2002). Interestingly, due to the limited number of published papers on the impacts of technological devices in learning, the educational benefits of tablets and other personal devices that are used in learning and teaching are not comprehensively documented. (Palmer, 2014). There are several investigative studies carried out by researchers which examine the implementation and outcomes of technology use in learning, particularly in Mathematics classes. As indicated by Carr (2012) such studies involve trials whereby students in classes such as Mathematics are presented with technological devices to use in their learning activities in order to determine whether the devices are beneficial. While such trials clearly demonstrate that

technology has its benefits, the fact that most of the technological devices were shared among two or more students makes it problematic to conclude with certainty the benefits of such devices to students (Traxler, 2010).

The recent introduction of iPads in many schools across the world thus provides an excellent opportunity for a study on the impacts of iPads on teaching and learning processes (Nguyen & Chaparro, 2014). Moreover, such introduction has created the necessary scope for more longitudinal studies regarding the significance of technology in education. The world is at a point where technological evolution occurs at a very rapid pace (Li & Leung, 2014). However, it is not understood how the access and the use of such technological devices will transform the manner in which learning and teaching are carried out and the impacts that it will have on the people in the educational arena (Ertmer, 2005). Without an understanding of such impacts, coupled with the inadequacy of empirical research in this field, conditions result that reduce the effectiveness of policy decisions and creates a cycle of misunderstanding and doubt that is self-sustaining at both national and school level.

Since its inception in the technological world, there have been several studies that have been carried out regarding technological devices being effective educational tools (Donovan, Green, & Hartley, 2010; Li & Leung, 2014; Nguyen, Barton, & Nguyen, 2014). Despite this, most preeminence has been placed on the iPad for several reasons. The most important include how the iPad functions compared to other computer tablets, the range of applications that are on the iPad, and the attractiveness and street credibility of the iPad among young people (Del Campo, Negro, & Naaez, 2012). Various researchers have explored the impacts of iPads in several situations. However, their trials have been on a small scale (Nguyen et al., 2014). Moreover, in these trials, the ownership and management of the devices was by the schools thus making the collected results

inconclusive; it is of great importance to note that iPads and similar tablet devices are designed so that they can be used for personal activities rather than communal ones (Carr, 2012). This causes a significant shift in the idea that they should be personally owned, that is, the ownership of knowledge and technology (Traxler, 2010).

The introduction of personal computers that were developed in the 1980s was the beginning of technological advancements in the field of education. Trazler (2010) asserts that during this time, the benefits that come with the use of computers to support the classrooms were recognized by various educators all over the world. To help bridge the gap that existed between the individual needs of students and different environments of the classrooms, there was a need to integrate computers into the classrooms (Donovan et al., 2010). As technology developed at a rapid pace, educators began to recognize that there were indeed benefits of using computers in the educational field. As time passed by and technological advancements progressed, there occurred a rapid increase in the presence and use of computers in classrooms. Today, there are more computers in classrooms all over the world than there were in the past (Pilli & Aksu, 2013).

In many cases, students are always enthusiastic and eager to utilize every bit of technology while they are in the classroom (Carr, 2012). In the past years, for example, in order to engage students more in the learning process, desktops were used in classrooms (Nguyen et al., 2014). Recent research conducted on the effects of instructions that are assisted by the computer on the achievements, attitudes, and retention in Mathematics classes and attitude towards instructions that are not assisted by the computer of fourth grade students shows that there is a lot to learn about the technology in classrooms (Pilli & Aksu, 2013). In the study, a sample of students were involved in the experiment and they were taught how to operate the computer while a group of students that were used as a control group received traditional instructions were based solely on

lectures. The study revealed that the students who were exposed to instructions assisted by computers outperformed the students who were exposed to the traditional instructions in the achievement post-test significantly (Earle, 2002). Moreover, findings from the results of an attitude scale test on mathematics showed that students that participated in the experimental group gained a more positive attitude towards the learning of mathematics that is assisted by computers than those in the control group (Pilli & Aksu, 2013).

The methods of pedagogy used in learning institutions have transformed significantly over the past few decades, which makes necessary the consideration of new models of teaching as well as the way the translation of information to students is done (Del Campo et al., 2012). Currently, in different educational systems across the world, students are provided with new opportunities for becoming more independent in their education. This is commonly done by providing them with tablet devices such as the iPad which is becoming more prevalent in contemporary classrooms. Devices with tablet-like technology are unique in that they are highly portable, have a touch screen interface that is flat, and offer programs and applications that can easily be downloaded directly to the device (An, Alon, & Fuentes, 2015). Based on its technological features, the iPad can be used to revolutionize learning in educational institutions (Kats, 2013). It is notable that the iPad has features such as the dual bank Wi-Fi that enables users to browse at high speed so as to download information quickly and easily and also use the device as a source of entertainment.

Technological Features and Applications of the iPad

The iPad provides inspiration for creativity and learning that is hands-on with features that cannot be found on any other tool that is used for educational purposes. It is also a device that

students enjoy using for various purposes (Reys, Lindquist, Lambdini, & Smith, 2015). There are powerful applications from the app store such as iTunes and iBooks that students find fun. Using them lets the students engage with content in interactive ways, find information anytime they want and access the entire library in all locations where they may be (Polly, 2013). The iPad is very useful in that it has a processor that is a dual-core, front and rear camera that supports software for video chat that was developed by Apple and also offers more than enough applications that are available for Apple devices. Moreover, an iPad has a display that is excellent due to higher pixel resolution (Takahashi, 2011). The iPad can accommodate a 30-pin VGA adapter, which is very useful especially during class time. It is possible to connect it to the projector and also use quick graphs, graphs that are developed quickly using graph applications, as part of the teaching aid. It also contains a TI-89 graph calculator for faster results (Lofte, 2013); the use of quick graph in class becomes very essential. The graphing calculator is a tool that is used for college entrance exams, such as the ACT, to solve higher level mathematics problems. The students also can use this particular application as they practice the various skills instilled during class (Henderson & Yeow, 2012).

There are various applications on the iPad comprised of lessons via video which act as online learning platforms, through which student assignments and activities can be personalized to each student depending on their level of learning (Shuler, 2012). Using these applications, students are able to work on skills that they feel that they do not have sufficient know-how through constantly referring to the resources that are available in the applications. Furthermore, IPads have a text to speech feature which has many features that are suited for the students with various needs, for example, slowed speech. The feature helps students with reading and hearing problems (An et al., 2015). The teacher can also use WordPress on the iPad or iPhone to upload the files instead of

using Mac to do the same job. Doodlecast Pro is another app on the iPad which helps in recording of videos, and together with Pogo Sketch Pro where particular illustrations are made (Lofte, 2013), the teacher is able to make instructional videos which they can send to their students via the email or post them on their YouTube channel (Lofte, 2013). There is also the Numbers app, which can be found on both iPad and iPhone, which help to keep track of the student's grades. This is useful as it makes it possible to make corrections and update the grades student get in a class (Nooriafshar, 2011).

There are multiple applications for use in a mathematics class. The Apple store contains over five thousand applications for use with the Apple devices; about a thousand of these applications available are free to the users. Mathematics applications are among the huge number of Apple embedded applications. It does not require much effort to be able to manipulate these applications from the iPad or the iPhone. In a class situation where the teacher makes demonstrations on the projector using their tablet, it becomes easier for the students to follow the examples and the format of designing their own charts and graphs on their devices (Meurant, 2010).

Applications in place enable the creation of graphs and other drawings, for example the use of the Quick graph (Meurant, 2010). This application enables students to make graphs and statistical comparison systems. This includes statistical graphs such as the pie chart, the line graph, and the bar graph. It also used in comparing statistics in higher levels of study, which makes it an application to be incorporated in mathematics curriculum (Shuler, 2012). The ability of these devices to multitask in another interesting characteristic about them that has made them popular among the students and the teachers. An example in a mathematics class is that a teacher can use the iPad to go through their prepared notes while at the same time using the same device to make

and demonstrate examples to their students. The device has multitasking capabilities which make navigation through the different application easy and fast enough for the teachers and the students (Shuler, 2012). The fact that a teacher is able to directly go to individuals, and their work without having to worry about the geographical distance is another very important fact to note.

The iPad can accommodate video conferencing with other devices, and as long as there is network connectivity, then this becomes very easy for the teacher and the students alike. The teacher is able to teach their intended topic and also provide examples which they can explain through a pre-recorded video or even a live portal to the students. The students can also ask questions where they do not fully understand and can even ask for more examples from the teacher via the email. In the case of illness, the teacher can easily keep the student updated on the topics taught in class and guidelines on how to go about the class (Henderson & Yeow, 2012).

The Application of iPad in the Learning Process and in Mathematics

Why is the idea of using iPad or the iPhone in class very intriguing to the students? The simple ability for students to manipulate the applications is one thing that makes them excited. It is human nature to be excited in knowing how to manipulate particular concepts in nature; hence this is one factor that excites the students (Henderson & Yeow, 2012). The features that the iPad and the iPhone contain helps keep the mind of the students engaged which can help explain why the use of these devices as part of study is a great addition to the learning system as a whole. This helps to diminish the monotony in class and ensure that that the students' minds are engaged in constructive learning through their devices. This is a revolution which exemplifies the impact of technology in education (Meurant, 2010).

Note taking with the iPad has particularly been easy and fast for students. This is similar to the laptops. However, the difference between the two is the file structure of the two. The iPads lack a file structure, therefore, files and documents remain inside apps. On a laptop, it is easy to make new files and store them in various formats, while the iPad contains web based file structures which makes it more like cloud computing (Mott, 2013). In this sense, when someone creates files using the iPad the same files have to be stored on the internet, such as cloud computing. It is a particularly interesting feature which ensures that there is safety to the documents stored while at the same time enabling them to access these files at any time. The iPad contains the iAnnotate which is a note taking application that enables to take notes during class (Mott, 2013). This application enables the students to take notes on a PDF platform by use of a stylus pen or even by the use of a finger. This application can also work efficiently with the class organizer app which organizes the notes taken by the students. The simplicity and expansive nature of the applications in the iPad make it the ideal device for use by the students (Ertmer, 2005).

According to the NCTM Principles of Assessment (2010) the test is important to show the students what is really essential in their study. It helps the student adjust the instructions to provide the appropriate results. The ability to correct the mistakes made by the students, and offer appropriate guidelines on how to correct that particular mistake is an essential and invaluable quality of the devices. The iPad has the ability to assess students as programmed by the teacher on the questions. The teacher is also able to use the same platform to provide the correct answers and ways to solve the particular problem in question. A teacher is also able to provide additional information on the steps to follow to be able to solve the problem which is accommodated by various applications in the iPad and the iPhone. After a test, the use of notability is a common aspect of the student and the teachers, as the students tend to seek solutions to the test they did.

The notability can support PDF format of files which makes it easy for the teacher to write solutions to the particular test (Mott, 2013). Here it is possible to show the various ways of solving a particular problem and also provide extra examples to which the student can relate. This is particularly very essential to the students as they are able to revise for the exams to come and are well equipped with the necessary skills. The notability app also provides the option of importing the PDF files to the Drop box (Lofte, 2013). Lofte (2013) also claims that there is a great advantage in the use of notability as the teacher is able to easily correct any kind of error that students may make while providing appropriate solutions to their students. They can then upload these files on their website which can be downloaded in the PDF format. It makes it easy for the students to learn from the mistakes that they make in the subsequent assessments. The simplicity of this system simply makes the work of the teachers easy and they can also attend to individual students (Lofte, 2013).

Shy students can easily express themselves through iPad platform. They do not have to worry about their colleagues in the class who might demean them if they dared ask questions where they did not understand. This makes it easy for the teacher to understand the problems and the weaknesses of that a student and help that student accordingly. The iPad and the iPhone certainly have the potential to have a great impact to the study of mathematics (Lofte, 2013).

The Benefits and Impacts of iPads in Learning and Mathematics

Computers have enhanced the learning of students in a myriad of ways. The integration of computers into the curriculum helps in the generation of an atmosphere that both interests and motivates to the learners (Keengwe, 2013). Using computers in classrooms helps to create a classroom environment that is student centered and effective in furthering the thinking skills of

students. Various studies have shown that classrooms in which teaching methodologies that incorporate computers are used allows students to take a more participative role in their education (Purcell et al., 2013). Such an approach makes it possible for students to learn on their own, thus producing learning outcomes that are positive in regards to achievement in mathematics (Lewis, 2010).

The iPad which uses current technology can be of great importance in that it can transform traditional classrooms so that students utilize current and efficient technological resources (Valstad, 2010). Such a step will enable students to gain constant access to resources that are important in education and the transformation of the experiences in learning to the students. Moreover, since the iPad is a versatile device, it provides many ways for the enhancement of education. It is thus of great importance to determine if devices such as the iPad have an effect that is similar in an elementary Mathematics classroom as in a high school one (Unrein, 2011).

Students can refer to the iPad more easily more than they do digital textbooks. In addition, the iPads serves as a device which can be used for increased interaction in the classroom in order to enhance the learning experiences of learners (NCTM, 2010). Students can receive instructions that are personalized based on their educational needs which are detected by educators through various readily available applications and on e-Books on the iPad. If a student misses a lesson and needs that he/she be taught, then they can just use the iPad to access the learning materials at any time and from any place (Carr, 2012). There are currently many schools that use technologies and learning tools such as laptops, planners, paper worksheets, textbooks, and student response systems with iPads. The usage of the iPhone and the iPad has been adopted extensively by instructors as well as the students (Purcell et al., 2013). This adoption has been very instrumental in expanding the learning experience of the students. For educators, in particular, the use of such

devices has been practically essential in the preparation of educational content from home. The use of various teaching apps is also important to the academic life of students since it has simply made the work of both the students and teachers easier (Ireland & Woollerton, 2010).

The use of email has been very important, especially with most of the mathematics teachers. Most of these instructors do not have a specific office where they can have office hours. They, however, have set up an email from where they are able to communicate with their students effectively (Herbert, 2010). Here, the students can send their questions and receive responses using the email as a platform. The teacher is able to respond to their questions by providing an adequate and comprehensive explanation to particular problems. The use of the email service also enables the students to send many questions to the instructor at the same time and at any time. The instructor can view the emails in their own time. The students are also able to communicate some personal issues to their instructors through the use of the email services (Polly, 2013). The instructor may not be able to handle all the problems of the students at once in the classroom because some students prefer personal attention in order to perform better. Communication using email services enables the instructor to classify queries that students have, and the process enables the instructor to establish the most common problems that students are faced with (Polly, 2013). The instructor can then find time to address the most challenging topics in the class. The process enables the instructor to assess the abilities of the students as they submit assignments. In addition, e-mails act as a good record of the progress of the learning activity because the instructor can assess the activity of the learners by looking at the e-mails sent to her or him by the learners.

The fact that both the iPad and the iPhone have enabled e-mail platforms where there is a direct notification regarding incoming emails makes it even easier for the teacher because they can know when the students send urgent messages that need quick responses (Lofte, 2013). The iPad,

in particular, has a note shelf where it is possible to hand-write answers and thus eliminate any kind of confusion through instant reply to a specific student at a time. An example is the use of mathematical symbols and formulas which makes it easy for the students to understand Mathematical issues. Once a teacher has constructed answers to questions, they can compile them and convert them to PDF files which they can then send to their students. This shows the simplicity and the huge benefits of the use of iPad and the iPhone (Lofte, 2013).

In mathematics quizzes and examinations where there are some problems which require students to use calculators, the use of iPhone and iPad is instrumental since the devices have calculators which are accessible to all the students. The use of these calculators makes it easy for the student as they do not need to buy a calculator. At the commencement of the examination, the instructor can lock the students into a calculator app that is approved (Lewis, 2010). When the students finish the examination, the instructor can give them the full access to their device by giving them the password to enter and access all other applications. The guided access feature allows the teacher to restrict the student to a particular page on the iPad. To activate the feature, the teacher goes to the settings section, and then he or she chooses the general option and accessibility (Lewis, 2010). After choosing accessibility, the teacher selects the guided access option and then chooses a simple passcode to use in the guided access. The teacher then goes to the page that he or she wants the student to use and presses the home button three times. The teacher also has an option to deactivate the feature by pressing the home button three times and entering the passcode followed by the cancellation of the guided access. The guided access feature helps the teacher to keep the students focused on a specific task. It is extremely important because it helps the teacher to monitor the progress of the learners and to identify the students who need special attention in the classroom (Lewis, 2010).

The use of notability is also essential to the students as they are able to revise their work for their exams. This particular app supports PDF annotations, for which the teacher is able to write the solutions to a particular quiz and then import files to the Drop box (Lofte, 2013). This makes the work of the teacher easy as they do not have to physically print the files and later scan and convert them to PDF files (Shuler, 2012). Once the teacher compiles their work, they are able to post them into their websites as downloadable files which the students can access (Lofte, 2013). The notability allows the instructor to use pen strokes which make rich colors, allowing instructors to fix the errors that are made during a process. These are just but a few ways in which the teachers in mathematics classrooms are able to use their iPads and iPhones to teach their students, and students are able to access all of their teacher's resources and interact with them through this particular platform.

IPads offer learners an opportunity to highlight a section or a word of print in the pages or notes or the online text. The students can then pop-up the speaker prompt that enables them to listen as they read along (An et al., 2015). There are students who can see, but they cannot hear well. Such students struggle to understand what the instructor is telling them. The use of the iPad allows the teacher to explain instructions accurately and easily instead of writing instructions on the board. The teacher dictates the instructions to students using the speech to text feature (Kats, 2013). The speech to text feature allows the teacher or students to convert their spoken words to written text using the special feature in the iPads. The feature also allows the learners to compose emails and then send them to the teachers quickly (Kats, 2013). Many high school teachers have found these organizational tools very helpful in keeping track of school work. Students are delighted in using calendar options, which can be synced to calendars that are web-based (Eichenlaub, Gabel, Jakubek, McCarthy, & Wang, 2011).

According to a study about the use of clickers at one high school, student response systems are an efficient tool for improving engagement in the mathematics classroom and giving feedback to teachers and students (Kaleta & Joosten, 2012). Similar studies conducted in other high schools in the United States revealed that participation and, engagement, as well as classroom interactions increased significantly after the schools started using iPads in mathematics classrooms (Bonnstetter & VanOverbeke, 2012). Students were found to be more comfortable responding to questions anonymously rather than responding out loud in the presence of classmates. Moreover, students prefer receiving immediate feedback in order to ascertain if they are on track (Kaleta & Joosten, 2012). They pay more attention to class activities since they know they have to respond to questions throughout the mathematics lesson.

Studies have also revealed that there is a positive correlation between the performance of a student and the amount of instructional time that educators spent on mathematics (Church, 2001). Johnston and Stall (2011) discuss how supporting learning outside school and giving access to more instructional opportunities at home can result in enhanced student achievement. Conversely, a flipped classroom includes instructional videos (assigned from places like iTunes, YouTube or created by the teacher) that students watch as their homework in order for them to spend class time on group work, homework problems, and class activities.

The textbook app incorporates step-by-step examples, interactive links to the glossary, homework assignments, explorations, and tests, providing instant response. In a case study of a high school teacher Jeanette Mitchell, in San Francisco, found that students use the videos to complement instruction, not as the instruction itself (Quillen, 2011). The teacher asserts that the feedback she gets from students using instant response system is more genuine as compared to the response she would get from asking students to raise their hands. During the pilot study, teachers

contacted the developer regularly to provide feedback about the app in order for adjustments to be made (Quillen, 2011).

The developer, HMH, reports improved student engagement in a mathematics classroom and more reading and completion of homework outside class (Herbert, 2010). High school students who have iPads or iPhones and the HMH Fuse app regularly report watching videos several times until they clearly understand educational content. In contrast, students using textbooks probably never say that they read the book several times to understand the content (Barseghian, 2011). Parents have considered the app very favorable since its features allow them to assist the students with their homework at home. In Riverside, CA, a number of teachers claim that the mean score on the district's algebra test was about 10% higher, in 2011, for students who used the iPad and HMH Fuse than students who did not use the app. Various researchers such as Barseghian (2011) have studied the impact of using GraphingCalc HD, a graphing calculator app, and Numbers, a spreadsheet application, on iPads in a mathematics high school class and have found that students stay on task more than students using laptops with a Java graphing applet and Excel. These researchers postulated that the physical barriers created by the laptops' upright screens make students feel disconnected from the classroom, thus more likely to stray to social networking sites while in class (Rogers, 2000). Conversely, the flat design of the iPad that enables it to lay flat on the table makes students remain focused on a particular classroom activity.

There are several reasons why many schools are currently using iPads and iPhones in Mathematics classes (Christensen, 2002). While there are many personal computing devices which may be used, several schools are choosing iPads as their tablet of choice since it is smaller and weighs much less. The iPad is thus convenient since it is uniquely portable. Furthermore, it has a remarkable ability for manipulation and an intuitive touch screen. Mobile devices such as laptops,

tablets, Smartphones, and netbooks are ideal for education since students are able to access them with ease and stay connected to others through 3G networks or Wi-Fi (Melhuish & Falloon, 2010). The iPad has a short startup time and eight- to ten-hour battery life (Quillen, 2011). It has a touch screen and most of the functions of a laptop are available in it (Melhuish & Falloon, 2010).

The iPad has high quality graphics since it has LED backlit display, lighting that makes adjustments depending on the environment, and a screen resolution of 1024 x 768 (Johnston & Stroll, 2011; Valstad, 2010). The iPad has a secure circuit that minimizes technology glitches and provides a virus-free environment. Students are able to use the iPad with ease in classrooms because of its single home button and touch screen: The user simply taps an app to open it. IPad users can manipulate images, scroll, zoom in and out, and flip through pages by sliding, tapping, or using various fingers on the touch screen (Valstad, 2010).

According to Ertmer (2005) iPads are an attractive choice for the classrooms because of their costs. In Roslyn, New York, a school purchased many tablets at a cost of $750 per tablet to substitute for consumable materials and costly textbooks. Apple offers a 10% discount to schools that purchase iPads or iPhones. In the past, students had a tendency of showing up for lessons without writing materials, textbooks, or notebooks; however, with these devices that problem could be reduced or completely become a thing of the past (Hu, 2011). According to Valstad (2010), Apple gives schools up to 50% off of apps if they purchase in bulk. When schools decide to use iPads in classrooms, they can save money by using fewer copied materials and paper, thus offsetting some of the costs of the devices (Hu, 2011).

According to Ireland and Woollerton (2010) whether people like Apple's products or not, they are considered exciting and user friendly. Mobile computing devices are part of the daily life of students (Melhuish & Falloon, 2010). Schools are making attempts to take advantage of the

engaging features of the iPads and iPhones to improve student learning. According to Ireland and Woollerton (2010), schools that fail to join the mobile education revolution are likely to be left behind. The use of the iPad and iPhone enables the teacher to instruct and monitor a large number of students simultaneously, a task that would be impossible in the past when the technology was not available.

The spreadsheets and geometer's sketchpads are very useful exploration materials for discovering and experiencing mathematical relationships and concepts (Kearney & Maher, 2013). The iPads and iPhones enable teachers to connect with their students in their own technological language. Since students are excited by the iPads and the iPhones and they develop interest in their learning activities. IPhones and the iPads are used to give the students access to communication, assessment, and exploration. The 4G iPad options are very useful for the students who cannot access the internet or the Wi-Fi in their homes. Teachers find iPads and iPhones useful because they can post PowerPoint presentations and blank SMART Board to the D2L or Google Docs for the students to take notes on the templates. E-learning is also possible with the use of iPhones and iPads (Szczecinski, 2014). The applications in these devices are user friendly and successfully meet the needs of the students. The teaching load for teachers has been simplified by the use of the iPad because teachers can connect a projector to their iPad using the VGA cable and communicate to an entire class (Morishita, Fujii, Yatsuka, & Higashibara, 2016).

Challenges in iPad Use in Mathematics

It is noteworthy that data collected on the usability of the iPad is collected quantitatively with a statistical analysis of the frequency of activities which the students and the teachers use their devices for. This then projects how the students use their iPads and their iPhones. The data

collected here projects a worrying trend in that most of the students used their devices for music and video. Education is commonly the last item that the students use their devices on. This in mind, the most frequently used devices have been the iPad which most of the students preferred for their study. In this light, then we can apply this knowledge into the number of students that used some of these devices in their mathematics class. It is likely that most of the students do not use their iPhone and their iPad to carry out their studies; however, there are significant percentages that have been using them for learning activity (Quillen, 2011).

It is, however, notable that there are a number of challenges that have been observed based in regard to the use of iPads and iPhones in Mathematics classes. Firstly, not a very large number of students have these particular devices with them (Rogers, 2000). Hence, even if a teacher opts to use this particular platform to teach their students, it will be hard to coordinate with each and every student in their class. It is thus important to be able to provide these devices to all students (Bonnstetter & VanOverbeke, 2012). If teaching of Mathematics can be done effective using iPad or iPhone, then each and every student should be required to have either of the devices (Nooriafshar, 2011). In addition, some students do not have an internet access in their homes. The lack of internet access makes it difficult for the students to study at home and this reduces their competitive capacity because other students who have access to the internet have more time to learn. Some students cannot access the technological resources due to financial constraints in their homes (McNaughton & Light, 2013).

The teachers also need to be trained on how to use the iPad and the iPhone. This is also necessary for the students who also need to understand how to use these devices (Meurant, 2010). This shall require concerted efforts of all the stakeholders to help in this training. However, another question arises on the right thing to do, should the amount of money spent in buying the iPad and

the iPhone be used in training more teachers and recruiting them? It is a very critical dilemma, which also begs the question of how the devices shall be instrumental in the development of the students into holistic individuals who are able to make an impact in the society. Herbert (2010) says that the answer can be viewed in two ways. First, what a holistic individual entails and, secondly, the needs of the current and future world (Herbert, 2010).

It is notable that the use of iPads or iPhones in Mathematics classes is characterized by particular weaknesses. First the devices are expensive to acquire hence becoming a limitation to students who cannot afford them individually. This means that considerable monetary resources are required to afford these devices for every student in a school; this raises more questions regarding moral obligations in the educational sector. Such questions include should these devices be bought while there aren't enough teachers in place to teach the student? The maintenance of these devices is another issue that should not be ignored, especially due to the fact that there is no guarantee regarding the ability for individual students to maintain their devices. The availability of WIFI connectivity is also another challenge since it is important for the devices to be connected to the internet in order to access useful information (Bonnstetter & VanOverbeke, 2012).

The use of iPads and iPhones in Mathematics classes in high school education has various challenges too. Critics of the use of these computing devices in a mathematics classroom cite their inability to run Java applets, cost, and lack of file structure as their main drawbacks. Various researchers assert that Apple iPad, for example, does not allow Flash on its iPad, iPhone, and iPod (Unrein, 2011). The free Illuminations activities of NCTM are perceived as valuable resources for learning and exploring mathematics through the interaction with virtual discovery and manipulative activities (NCTM, 2010). However, these Illuminations cannot be run on iPads and iPhones because they contain Java applets and iPads lack Flash to run Java applets. Furthermore,

other valuable sites, for instance the National Library of Virtual Manipulatives, are not accessible on iPads and iPhones.

All apps are downloaded through Apple's iTunes software or through the app store on the iPad and iPhone. Therefore, the students lack choices of where to purchase their apps. Gaps exist in the needs of educators and the availability of quality educational apps (Christensen, 2002). Additionally, a great number of the students prefer the iPad and the iPhone due to a number of factors; first, the design of the devises is an attractive feature for students (Rogers, 2000). Both the iPad and the iPhone have a slim design, which makes it look sleek while at the same time it is lightweight making it easy to carry. The screen resolution also plays a key factor in attracting students since most them like the hyper sensitive screen and the applications contained therein (Quillen, 2011).

Impact of iPad Use on the Attitude of Students towards Mathematics

Mathematics plays a key role in ensuring that the way in which individuals deal with the various spheres of social, private, and civil life is good (Nooriafshar, 2011). Skills gained during learning of mathematics help to provide the basic knowledge and skills, which are essential advancing education and making decisions (Ağır, 2015). For this reason, it is justified that all students that go through the basic secondary and primary education all over the world take mathematics as a compulsory subject. It is the reason mathematics is viewed and taken to be a core subject at such levels of education in every part of the world (Perry, 2010). Therefore, it is regrettable that in the contemporary times there are many students that struggle in understanding mathematics and therefore performing low in their mathematics examinations. In many parts of the world, the performance of students in both primary and secondary education is not encouraging

as many students are reported to have a poor understanding of the concepts in mathematics and are therefore not able to form any mathematics model which require the basic skill to solve. One also realizes that the attitude of students in the mathematics subject is negative and more students are also developing the negative attitude, and as a result there is a significant number of students who fail in the subject (Mott, 2013). Learning the subject is useful and is contingent on a myriad of factors.

Polls that are carried out in different parts of the world indicate that adults recall that they hated mathematics as a subject when they were still in school (Kaleta & Joosten, 2012). These people who hated mathematics in school and are now adults cannot even do a simple calculation just because they perceive mathematics to be a difficult subject (Zhao & Frank, 2003). The big question that rings in some minds is why people would hate mathematics to such an extent. Some of the reasons that are due to this are the low-self expectations as a result of the experiences that one had with mathematics in the past, the bias of the parent on mathematics, inadequate skills for the learning of mathematical concepts and the fear of having to make mistakes (Bonnstetter & VanOverbeke, 2012). The teacher always knows that the negative attitude towards mathematics has various consequences for the learning of mathematics by the students. The consequences that come with the negative attitude towards mathematics include low motivation, stress, levels of participation in class decrease, and avoiding the mathematics classes that are advanced for subsequent success professionally.

Researchers in the education field have spent their time and energy trying to make sure that they unravel the possible causes of poor attitudes of students and their performance in mathematics (Donovan et al., 2010). There is an area that has not been explored extensively and this is the influence of the teachers on the attitudes of the students towards studying this subject.

The findings, based on the various research that have been carried, indicate that teachers that are effective facilitate learning by caring truly about the engagement of their students and creating an atmosphere that is appropriate and that which enhances the learning of students (Li & Lueng, 2014). The researchers have high expectations that are realistic about enhancing the capacity of the students to reason, think, communicate, critique, and reflect upon their own practice and they also provide an opportunity to the students to ask why the class is doing different things with what effect. The relationship between the students and teachers that are developed in the classroom becomes a useful resource for developing the attitudes of the students and the competencies and identities in mathematics (Berseghian, 2011). These resources are very essential and useful in the learning of mathematics.

According to Bell (2005), the concept of attitude is always concerned with the way an individual think, behaves, and acts. Attitude has serious implications to the learner in that it determines one's performance in the subject, and it also has implications for the teacher and the immediate social circles with which the learner always relates and the entire system of the school (Bell, 2005). Attitudes always come due to some learning experiences that learners go through during the time that they have been in school and this is viewed as a mimicry which is believed to be having a part to play in the learning and teaching situation. In this respect disposition by the learner to form an attitude is drawn from the teachers, which likely affect the learning outcomes of the students (Church, 2001). It is believed that teachers who teach their students with a positive attitude towards mathematics are always inclined to stimulate attitudes that are favorable to their pupils. It immediately puts the teacher in the spotlight as being people whose attitude are expressed in their behavior while they are teaching and which has a telling effect on the students that are

taught by that particular teacher (Bonnstetter & VanOverbeke, 2012). The beliefs and attitudes of a teacher play a very vital role in shaping the practices in a classroom.

There is positive anticipation that the introduction and use of iPad in the Mathematics classroom will help increase the engagement of students and also their attitudes towards the learning of mathematics as a subject (Melhuish & Falloon, 2010). Indeed, there are already signs that show that this will lead to a change. According to Carr (2012), for instance, there is an iPad application that is known as Math Motion that was initially intended to teach the preliminary concepts in the study of fractions. However, it was found that the applications helped to solidify the understanding of students, which also helped improve the attitudes of students towards the concept of fractions (Ireland & Woollerton, 2010). It is true that the attitude of students towards technology and mathematics will have a large effect on the success of the devices such as iPad in the mathematics classroom. Research has shown that the attitude of students has great effect on the acceptance of new instructional technology that is also followed by the conditions for facilitating, the expected performance and the social norms (Koppel & Berenson, 2009).

In many parts of the world, despites the efforts that have been made by science and technology in advocating for increased student interest in Mathematics, students still have a negative attitude towards the subject (Greene, DeStefano, Burgon & Hall, 2006). The history behind the negative attitude towards mathematics by students is founded upon factors such as math anxiety which can have a negative impact on the performance of students in mathematics and is very high and correlated negatively with the perceptions of mathematics ability (Quillen, 2011). It is also believed that the differences in gender in the mathematical achievements and attitudes can perhaps be attributed to math anxiety due to gender differences. The anxiety that is brought about by mathematics should be distinguished conceptually from mathematics ability. The components

of the anxiety that are brought about by mathematics are similar in all gender and age groups and the main components are the negative affective reactions and the worry about having to perform well in mathematics (Shah, 2011).

Supporters of digital technology hope that these devices such as the iPad will have a positive effect on the attitudes of students and also alleviate some of the anxiety that is brought about by Mathematics subject (Carr, 2012). However, it is unfortunate that the negative attitudes towards mathematics by students are often already well formed when they start schooling during their early years. There are some studies that have proved that technology can be used as a motivator, resource, and facilitator of efficient communication. Such qualities can be of great help to the students that have the anxiety brought about by mathematics as well as other disturbances that are emotional. Emotions often have a strong negative effect on the performance of students not only in mathematics but also in all subjects (Shuler, 2012). Even if there are insights provided to teachers by technology so that the perception and feelings of students about the subject are improved by the means of providing a more private and intimate means of gathering journals by students, the benefit of the understanding of the teacher of the attitudes of the students could help in the improvement of the experience in the classrooms.

Another concern with regard to the attitudes of students towards technology in the learning of mathematics is that such attitudes can be established at a tender age, although this may not be necessarily always the case (Fisher, 2011). For example, recent studies on the attitudes of university students towards the digital textbooks that are found on e-reader devices found that after a couple of years, majority of students were getting used to the textbooks that are digital (Kaleta & Joosten, 2011). Students are nowadays used to reading books online than in the past when they

thought that reading online world have an impact on their sight and questioned whether such information was indeed credible to help them pass their examinations.

The benefits of using iPads and iPhones in mathematics classes may outweigh the weaknesses of the devices. The use of the devices, for example, improves efficiency and accuracy in the task being carried out. This is due to automation and multitasking aspect of the devices in which both the students and the teachers use (Mott, 2013). The concept of interest is another benefit which is brought about by using these devices. The students, as discovered in the study by Mott (2013), became more interested in the study of mathematics, mainly due to the introduction of the devices. IPads and iPhones also improve the relationship between the teachers and the students, as the teacher is able to understand the weaknesses of individual students while the students are able to freely express themselves and also be able to ask questions where they do not understand (Bonnstetter & VanOverbeke, 2012). The use of such devices is important in the process of teaching mathematics because it gives mathematics students the ability to interact constructively with the technology. The interaction with technology enables the students to be innovative in the process of using the established products to aid in the computing processes (Dickens, Churches & 21st Century Fluency Project, 2013). Mathematics students who wish to become accountants or engineers in future find the iPad technology to be very effective in the process of aiding computation and organizing files in the required format. Such students will not require an extensive training on how to handle office computer systems and analyze data because they have the basics. Students who take courses that require mathematics, for example engineering, find it easy to use the computer systems for research purposes because of the familiarity they get from the use of iPads (Reys et al., 2015). Another advantage of using the gadgets in the classroom setting is that

the teacher can handle a large group of students with the use of the products than the group he/she would handle without the products.

The efficiency of the iPad and iPhone devices is undisputable especially when considering the fact that most of the publishers are now converting most of their textbooks to digital form. This ultimately makes the iPad and the iPhone part of the e-reader systems that are useful in class. Digital books have been created in such a way they are very interactive with the students as they also have active links which students can easily follow to get more information regarding a topic. Although the features contained in the iPad, particularly its good visual screen systems, attract students, Quillen (2011) asserts that the use of iPads brings about several questions such as: What do students use their devices for- is it for education or music and video navigation? Which of the devices is mainly used to carry out some of the activities that they engage in-is it the iPad or the iPhone?

Conclusion

It is incontrovertible from this literature review that in educational research, the subject of mathematics has been a never-ending struggle for a majority of students regardless of whether they have disabilities or not. As a consequence, educators, have been expected to significantly improve the performance of students in order to attain state and federal standards. It is this need to improve the learning prospects and results of students with intellectual and developmental incapacitations as well as those without such challenges in mathematics that has caused increased usage of technology in the teaching of mathematics. The use of technology, specifically the iPad in the teaching and learning of mathematics, enhances the ability by students to acquire mathematical knowledge in a manner that is not only more meaningful but also increasingly receptive. In the contemporary day an increased number of educational institutes and educators perceive technology

as one of the viable solutions to the challenge of student achievement in mathematics. This part of the current research has described the iPad as a popular mainstream technological device that has been adopted extensively by schools in order to supporting the learning experiences of students with and without intellectual and development disabilities in mathematics.

The iPad is characterized by several characteristics which mathematics students may access and use in a variety of settings. The importance of the iPad in Mathematics classrooms is that it not only enables students to be more creative in the learning process but also ensures that the students remain active and engaged in carrying out learning activities which they would have required the help of another person to carry out if they were not using iPads. The introduction of iPad in mathematics classrooms has a direct dynamic impact on individual students on how they view their studies. Moreover, it has enhanced interactive learning and communication between the teachers and the students. The use of the iPad also helps the individual students to mature into self-reliant individuals who are able to implement their knowledge to practical and workable ways for self-sustenance. In the teaching of mathematics, the iPad has been useful in reducing the energy required by educators to teach since teachers can communicate more speedily with their students and subsequently offer the necessary assistance. This is useful in improving the relationship between the teacher and student.

It is, however, notable that the use of the iPad by educators in mathematics classes should not substitute actual pedagogical instruction but rather act as a complement or support the process of actual teaching. In their use of iPads in mathematics instruction it is fundamental for educators to ensure that they adhere to the strategies, regulations, and guidelines which are offered by research and theory regarding the use of technology in education, particularly in the learning and teaching of mathematics. Moreover, educators must be careful to ensure that in the implementation

of the iPad in learning and teaching mathematics, they select Apps which are not only aligned to the curriculum and standards of education but also successful in enhancing the levels of engagement, motivation and participation of students in the mathematic classroom. Moreover, such applications must be differentiated and flexible enough to ensure that the learning needs of all students in the classroom are met. It is however notable that the use of technology such as the iPad in a mathematics class could be typified by several challenges. Despite this, such challenges are easily resolved through engaging in proper implementation and use of the technology to support the process of teaching and learning.

CHAPTER III

METHODOLOGY AND METHOD

Introduction

This chapter deals with the procedures that were involved to conduct the study. It involves the area of study, the population, the techniques used for sampling and the methods used by the researcher to collect data. This quantitative research aimed to investigate if the use of iPhone and iPads in mathematics classrooms were enhancing learning. In addition, the researcher also wished to investigate how the usage of iPad and iPhones were making it easier for the student to develop a more thorough understanding of the material presented in all levels of mathematics. Due to the nature of this study, it involved a survey that took about ten minutes to complete. A survey was preferred because it provided an opportunity for the researcher to collect specific information that can help in answering a given research question.

Research Design

In this study, the researcher collected data using surveys. According to Allan (2010), surveys are data collection instruments that are used to collect large volumes of data. Bryman (2014) adds that through surveys, it is possible to collect data from a large sample, summarize it and present it for analysis. Unlike other data collection instruments, surveys are easier to administer and analyze. Surveys were administered directly to the respondents and thus its very simple to collect data using them. Another reason why surveys were preferred to other data

collection techniques are their confidentiality. Since surveys were administered individually to respondents, it is possible to maintain a high level of confidentiality.

There are still other benefits that can be associated with surveys. These include the ease of interpretation and analysis of data. As Bryman (2014) argues, when designing a survey, questions are arranged in a manner that it will be easy to interpret the data to obtain final results. Surveys can also be arranged on a definite scale like the Rickert scale to enhance coding which in turn eases the process of interpretation. Data analysis using computer software is done when the data is arranged in a manner that it can be coded into the software. This is achieved through appropriate survey design.

The framework was used to seek answers to the research questions and consisted of a survey that was conducted in both high school and middle school academic institutions with a target population of 100 teachers. The survey will be described in details later in this section. The survey consisted of ten multiple questions (Appendix 1). The research involved the use of descriptive statistics. SPSS software was used in the research to carry out a comprehensive statistical analysis. The software was useful in conducting the cross tabulation and calculating various frequencies, for example the frequency of a certain type of answer.

The main tool that was used in this research was the survey. The survey was composed of multiple-choice questions. The questions that were asked in this survey were short and direct, and the answers that are needed will also be short and precise in nature. The structuring of the questions was done in a way that eliminated ambiguity in the answers given. The survey was divided into two sections, A and B. Section A was made up of general questions on demographic and social characteristics of the respondents while the second section of the survey was composed of questions that require the teachers to think critically before giving their response or their opinion.

The last question of the survey asked the teachers to identify their gender. The first question asked the teacher to identify all the mathematics classes he or she taught. The second question in part A required the teachers to answer the question of whether they use the iPad in class. The teachers were required to answer the question with a yes or no answer. The question was important because it helped the researcher to determine the extent of use of these technological devices in class. The third question asked the teachers if they felt that the applications on these devices were user friendly.

The next question asks about the purpose that the teacher uses the devices for and the frequency in which they use them. The answer to the question will help to determine the rate of use of the devices, the amount of time used for educational purposes compared with other reasons such as music and videos. The survey question answered the third research question. The question helped the researcher to determine the degree of distraction that the devices can bring in the learning process. Distractions were assessed based on the time and frequency of deviations to irrelevant activities from the main learning process. In addition, the answer to this question helped to determine the various problems that are solved by the devices. The teachers also were asked whether the devices they use are user friendly. The question is important to determine the effectiveness of the devices in delivering the required services to the teachers, seeking to answer the second research question that focuses on the limitations of the devices. The response to the question helped the researcher to determine the ease of use of the devices. The other question focused on the use of the devices by the teachers in the mathematics class. The teachers were asked a question about whether they use the devices for mathematics in class. The response to this survey question answers the third research question that focuses on how the teachers use the iPhones and

the iPads in the classroom. The response helped to determine the usefulness of the device in the mathematics lessons (Reys et al., 2015).

The teachers were also asked whether they think that the regular use of the devices will help to improve the performance in the class. The answer to this survey question answered the first research question that focused on the opinion of the teachers on the usefulness of the iPads and the iPhones in improving the achievements of the students. The response to this survey question also answered the fifth research question. The response of the teachers helped to determine the impact that the devices have at facilitating the learning process in mathematics. The instructors were required to indicate their level of agreement on three issues that included the capacity of iPhones and iPads to improve the performance of the students in mathematics, the ability of the iPhones and iPads to provide a personalized platform for the teachers to interact with their students and to understand them and the capacity of the devices to enhance communication between the teacher and the students. The answer to the three survey questions answered the first research question that is described above.

Population and Locale

The target population of this research is composed of 100 middle and high school teachers. The schools are located in Coosa County in Alabama. In line with the 2010 census, the county had a population of approximately 11,539 people with 3293 families. The same census also estimated that 23 percent of the population were children below the age of 18 years. The target population was selected because the schools have implemented the use of iPads in learning and are using this technology on a regular basis. Some teachers also use them to download music and videos. Due to the research limitations highlighted in the introduction section of this study,

the inclusion of a very high number of respondents might lead to challenges in the research process. Similarly, a very small number would not provide a proper representation of the study population. Therefore, the population is in the best position to help the researcher to determine the capacity of the devices to cause distraction in the learning process and their usefulness in solving various mathematical problems. The target population has enough knowledge to answer the questions effectively.

The schools in Coosa County receive Title I funding. Title I funding along with other sources of federal money has been used to purchase iPads so that enough issued for each student to have one. The purchase of iPads provided students and teachers a resource that submitted for textbooks, calculators, and other needed materials. For examples, the iPad replaced textbooks that were in cases 20 years old. This type of device was placed in all mathematic classrooms, and training for the students has been provided so that they can effectively use the iPad.

Sampling Technique

The survey sampling was very important in this research. The survey sampling technique included the purposeful selection of a sample of elements from the target population. The technique involved administering the survey mentioned above to evaluate the usefulness of the iPhone and iPad devices (Reys et al., 2015).

Data Analysis

The methods that were used to analyze the data included the use of frequency tables, pie charts, SPSS software to carry out statistical analysis of the data and graphs. The use of pie charts and graphs are very important in enabling the comparison of the data obtained.

For the analysis and presentation of data, based on the research questions of the current study, it was hypothesized that the use of these devices were instrumental in the achievement of better grades in mathematics and earn more interest from the students to learn and understand mathematics. With little proven information that directly relates the performance of individuals to the use of iPad or iPhone, it is a credible assumption that the use of these devices shall be important and instrumental in bettering the performances of the students.

The data was differentiated based on the type of respondent, which was determined by the classes the respondents indicated that they taught. The last section of the survey contained agreement statements which are self-answering questions that the respondent agreed with the statement provided. The level of agreement or disagreement to the statement was determined by a scale of 1-7 where one is for completely disagree while the seven is for completely agree with the given statement. This part was analyzed based on the type of respondents and also a compilation of the general responses with regard to the total number of the respondents. The classification was categorized in their respective levels to help understand who among the middle and high school teachers have the greatest optimism in the use of the iPad or the iPhone in mathematics class.

The data and analysis was presented using percentage and frequency tables, graphs, pie charts, and figures. The data collected were from approximately 67 teachers who taught at the middle or high school level. From the participants, information regarding the iPads and the iPhone usage, the most common device in use and the percentages shall be collected to give a projection to other similar schools.

Ethical Considerations

According to Lynn (2009), the researcher needs to be sensitive to ethical issues when conducting a survey study. Usually, the conventional guidelines for ethical research touch on issues anonymity, voluntary participation of the respondents, and proper illustration of the purpose of the study. Bryman (2008) argues that the ethical observations by the researcher promote the values that are critical to successful engagement and collaboration needed during research process. In this study, the permission to conduct this study was sought from the Institutional Review Board before collection of data was conducted. During data collection, the respondents had the freedom to skip the questions that made them feel uncomfortable. This study protected the confidentiality of the respondent by not asking them to provide personal details. Only the investigator and no one else has access to the data needed for this study. To enhance the security, the data was password protected through the survey site and during statistical calculation. Later, only the summarized data will be presented at meetings and publications.

Conclusion

This quantitative research aims at investigating if the use of iPhone and iPads in mathematics classrooms is enhancing learning. In addition, the researcher also wished to investigate how the usage of iPad and iPhones is making it easier for the student to develop a more thorough understanding of the material presented in all levels of mathematics learning. The framework that used to seek answers to the research questions consisted of a survey conducted in both high school and middle school academic institutions with a target population of 100 teachers in schools located in Coosa County in Alabama. The survey technique involved administering the survey mentioned to evaluate the usefulness of the iPhone and iPad devices.

Data was analyzed using frequency tables, pie charts, and SPSS software to carry out statistical analysis of the data and graphs. The researcher was sensitive to ethical issues when conducting the survey study. In addition, the conventional guidelines for ethical research that touch on issues anonymity, voluntary participation of the respondents, and proper illustration were taken into consideration.

CHAPTER IV

RESULTS

Introduction

The purpose of this data analysis was to determine the role played by iPads during the academic procedure. This chapter analyzes various aspects of academic performance and also looks at major indicators of the learning environment. By focusing on teachers' perceptions of the role played by the two electronic devices in ensuring the understanding of concepts by students, the chapter thus answers the research questions. Some of the factors that are to be determined include the frequency of use by teachers in making various academic instructions. Also, the survey aimed to determine a number of classes making use of iPhones and iPads to facilitate academic excellence. On the role played by iPhones in student participation, the chapter addresses some of the opinions from teachers regarding an application in their lectures.

The research was carried out based on responses from 67 teachers. The types of questions asked were relative to the research design so as to get information on teachers' perceptions of the role played by iPhones and iPads in enhancing student mastering of concepts. The main group on which research was carried was a sample of all fulltime teachers of mathematics in middle and high school in Coosa County, and Alabama. Frequency tables were obtained together with graphs and pie charts using the data that was collected.

Reliability Analysis

A reliability analysis is done for the like-art scaled questions so that the consistency of the measurements is determined. Cronbach's alpha is used to measure reliability. The alpha coefficient should fall between 0 and 1 in which case a scaled coefficient is said to be reliable if it is close to 1. The table below shows the reliability analysis.

Table 1

Overall Reliability

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.807	.806	4

As can be seen from the table above, Cronbach's Alpha is 0.807 which implies that the measure is strongly reliable.

Table 2

Overall Subscale Reliability

	Cronbach's Alpha if Item Deleted
Regular use of iPads improves performance	.823
Use of iPads provides personalized platforms	.699
Use of iPads enhances communication	.767
Use of iPads has shown to improve the student understanding	.727

As can be seen from the table above, the Cronbach's alpha range from 0.669 to 0.823 signifying that there is a good to strong reliability within the Likert scaled questions.

Frequency Distribution

From the survey that was conducted, the number of male respondents was 20 while the number of female respondents was 40. There were 7 respondents who did not reveal their gender.

Table 3

Frequency Distribution of the Classes Taught by Respondents

	Frequency	Percent	Cumulative Percent
Algebra	25	37.3	37.3
Advanced Mathematics	8	11.9	49.3
Geometry	8	11.9	61.2
8th grade Mathematics	14	20.9	82.1
7th grade Mathematics	12	17.9	100.0
Total	67	100.0	

From the table above, it can be seen that the number of respondents who teach algebra are 25 while those who teach Advanced Mathematics are eight. Moreover, the respondents who teach geometry are eight, those who teach 8^{th} grade Mathematics are 14 and those who teach 7^{th} grade Mathematics are 12. Most of the respondents were teaching algebra, indicating that the study will show the perceived impact of using iPads and iPhones in studying algebra.

One aspect of using iPads and iPhones that is very important in classroom instruction is the opportunities for professional development for teachers. Various methods of professional development are offered to the teachers on a regular basis.

Table 4

Methods of Professional Development Used

	Frequency	Percent	Cumulative Percent
Online discussion	20	29.9	29.9
Face to face workshops	15	22.4	52.2
Other teachers within	18	26.9	79.1
Video tutorials	5	7.5	86.6
Social networks	4	6.0	92.5
Not received	4	6.0	98.5
Prefer not to answer	1	1.5	100.0
Total	67	100.0	

From the above table it is seen that the number of respondents who received professional development regarding iPad through online discussion are 20. Those who received professional development regarding iPad through face to face work shops were 15. Moreover, those who received their professional development through other teachers within were 18. It is also seen that some respondents received their professional training for iPad through video tutorials were five. Another group of respondents received their professional development through social networks and they were 4. Some respondents did not receive professional development regarding iPad and they were four. There was only one respondent who preferred not to answer.

Table 5

Teachers' Responses Regarding Frequency

	Frequency	Percent	Cumulative Percent
Daily	25	37.3	37.9
2-3 times a week	16	23.9	62.1
Weekly	11	16.4	78.8
Monthly	7	10.4	89.4
1-3 times an academic year	4	6.0	95.5
Never	2	3.0	98.5
Prefer not to answer	1	1.5	100.0
Total	66	98.5	
System	1	1.5	
Total	67	100.0	

The above table shows that the number of respondents who used iPad daily were 25. The number of respondents who use iPad 2-3 times a week are 16. It is also seen that the frequency of respondents of who use the iPad weekly was 11. Another group of respondents only uses the iPad monthly and had a frequency of seven. The respondents who use the iPad 1-3 times an academic year have a frequency of four. The respondents who never use iPad had a frequency of two. One respondent preferred not to answer as it was shown in the table above.

Table 6

iPads Providing Personal Platform

	Frequency	Percent	Cumulative Percent
Strongly disagree	1	1.5	1.6
Disagree	6	9.0	10.9
Agree	28	41.8	54.7
Strongly agree	28	41.8	98.4
Prefer not to answer	1	1.5	100.0
Total	64	95.5	

The above table shows respondents who strongly disagree that iPad usage provided personalized platforms with a frequency of one. Another group of respondents that disagreed with this have a frequency of six. Moreover, respondents who agree that iPad usage provides personalized platforms have a frequency of 28. There are also those who strongly agree and they have a frequency of 28 also. One respondent chose not to give an answer.

Table 7

Frequency Table for the Different uses of Inbuilt Systems that Come with iPad

Role	Count	Total	Percentage
Make instruction decisions	35	67	52%
Understand student mastery of concept at end of unit	25	67	37%
Understand student mastery of concept in beginning of unit	17	67	25%
Document student overall performance	16	67	23%
Gauge student engagement with material	10	67	15%
Prepare students for state tests	29	67	43%

Data in the above table shows that on the one hand 52% of the total respondents use inbuilt systems in iPads to make instruction decisions. On the other hand, 37% of the total respondents use inbuilt systems in understanding the students' mastery of concepts at the end of the unit while 25% of the total respondents use inbuilt systems in iPads to understand mastery of concepts by students during the beginning of the unit. Twenty-three percent of the respondents use the inbuilt system in iPads in the documentation of the overall performance of students while 15% of the respondents use inbuilt systems in gauging student engagement with materials. The

last section shows that 43% of the respondents use inbuilt systems in preparing students for compulsory state tests.

Another important issue is how teachers decide to choose different pedagogical approaches and tools. Table 8 provides data in regard to these teachers and their decisions.

Table 8

Influence on Respondents

	Frequency	Percent	Cumulative Percent
Views of other teachers	31	46.3	46.3
The included assessment program	20	29.9	76.1
Research evidence	11	16.4	92.5
Student opinion	4	6.0	98.5
Prefer not to answer	1	1.5	100.0
Total	67	100.0	

The table above shows the frequency of respondents whose decisions are influenced by the views of other teachers to be 31. It is also seen that those whose decision is influenced by the included assessment program to have a frequency of 20. Another group of respondents have their decisions influenced by research evidence and have a frequency of 11. From the table it is also seen that respondents whose decision is influenced by student opinion have a frequency of four.

Table 9

Possibility of Barriers

	Frequency	Percent	Cumulative Percent
Insufficient time	26	38.8	38.8
Not sure	11	16.4	55.2
Unfamiliar with technology	3	4.5	59.7
Lack of support from admin	1	1.5	61.2
Lack of support from parents	12	17.9	79.1
Emphasis on standardized test scores	12	17.9	97.0
Other	1	1.5	98.5
Prefer not to respond	1	1.5	100.0
Total	67	100.0	

In addition to the possible positive contributions to student learning that an iPad might support, there is the possibility of barriers, as shown in Table 9. From the above table it is seen that the number of respondents who had insufficient time to use the iPad is 26. The table also shows that the number of respondents who were not sure of the barriers, causing them to not use the iPad is 11. The number of respondents who are unfamiliar with iPad technology is three. It is also seen that the frequency of respondents of who lack support from the administration on iPad usage is 1. Another group of respondents identified the lack of parental support on the use of iPad, a total of 12 of the teachers. Time was found to be the greatest barrier of using iPads in class.

Research Question 1

The first research question asked whether teachers think that iPads can improve student achievements in the mathematics classroom by facilitating various practices such as communication, and use of student exploration materials. Questions regarding these practices were asked and the frequency of the respondents are presented below.

Table 10

Teachers' Responses on iPad Effect on Student Achievement

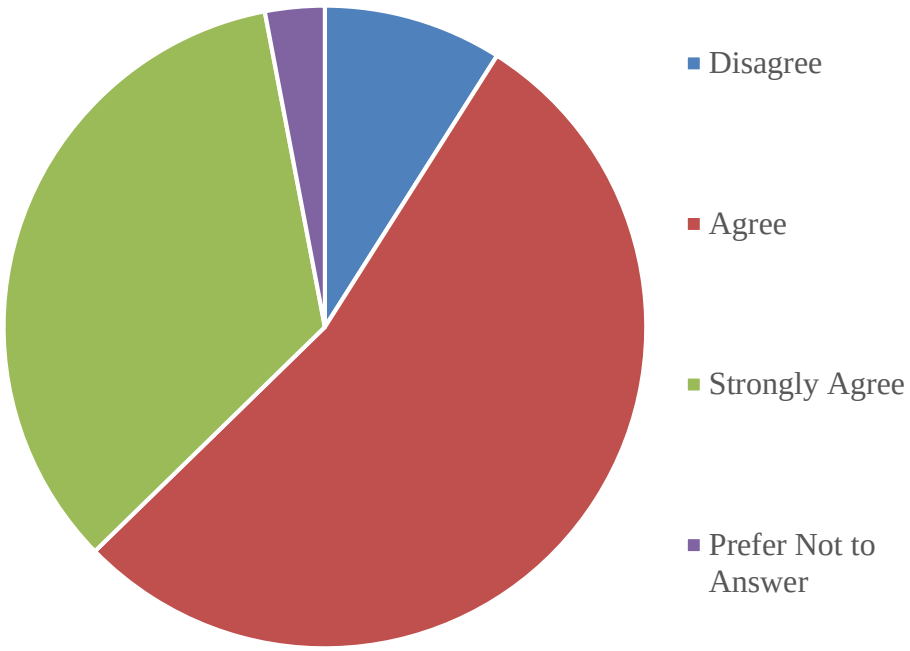
	Frequency	Percent	Cumulative Percent
Disagree	6	9.0	9.0
Agree	36	53.7	62.7
Strongly agree	23	34.3	97.0
Prefer not to answer	2	3.0	100.0
Total	67	100.0	

From the above table the number of respondents who disagreed that iPad usage improves performance was six. Another group agrees that iPad usage improves performance and the frequency is 36. From the table the respondents that strongly disagree with this have a frequency of 23. There are respondents who chose not to answer and they had a frequency of two. Clearly, iPads enhances learning of mathematics since most of the teachers agreed to this

statement. More resources should be put in place to make sure that there are improvements in the use of iPads in the classrooms.

Figure 1

Distribution for the Level of Agreement on Whether Regular use of iPad Improves Performance



Another question in the survey, addressed communication with iPads.

Table 11

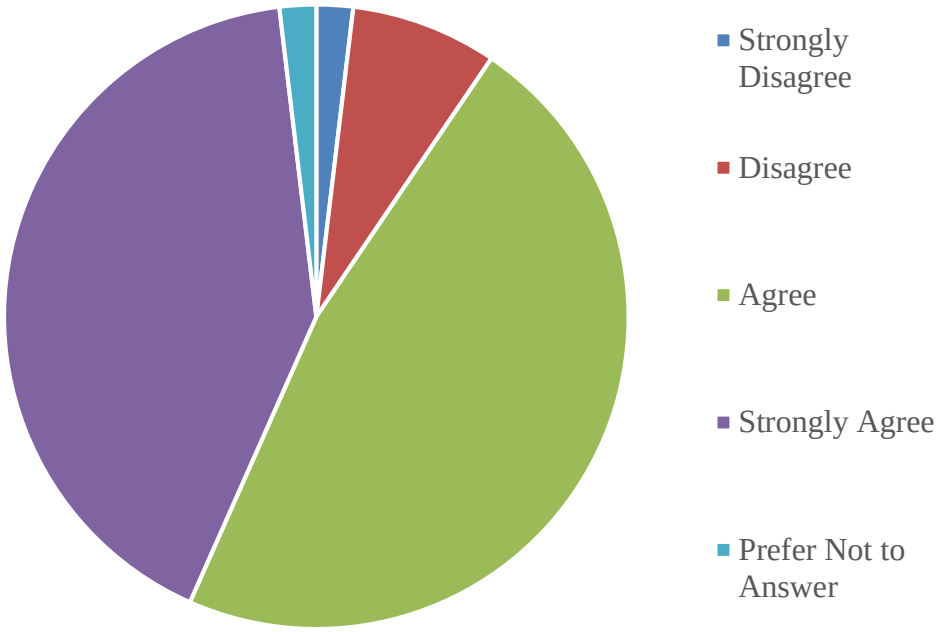
Communication with iPads

	Frequency	Percent	Cumulative Percent
Strongly disagree	1	1.5	1.9
Disagree	4	6.0	9.4
Agree	25	37.3	56.6
Strongly agree	22	32.8	98.1
Prefer not to answer	1	1.5	100.0
Total	53	79.1	

From the above table the number of respondents who strongly disagreed that iPad usage improves communication had a frequency of one. Another group disagreed that iPad usage enhances communication, and the frequency is four. From the table the respondents that agree with this have a frequency of 25, whereas those who strongly agree that iPad usage enhances communication have a frequency of 22. There is 1 respondent who chose not to answer. Communication between the student and the teacher is key in the performance of the students. Since the use of iPads enhances communication, then teachers perceive that the learning of mathematics is enhanced.

Figure 2

Distribution for the Level of Agreement on Whether use of iPad Enhances Communication



Research Question 2

The second research question asked how teacher use iPads and iPhones in mathematics classes to improve instruction. The table below show the descriptive statistics on the frequency of using iPads for various functions to improve instruction.

Table 12

Descriptive Statistics on Frequency of Using iPads for Various Functions

Role	Mean	Standard error	Standard deviation	Variance	Minimum	Maximum	Count
Teach new Material	3	0.26	2.16	4.67	1	7	67
Perform Assessment	3	0.19	1.31	1.71	1	7	50
Formative Assessment	3	0.21	1.48	2.20	1	7	49
Summative Assessment	4	0.17	1.16	1.36	1	6	49
Motivate & Reward	4	0.27	1.88	3.54	1	7	48
Manage Classroom	3	0.29	2.02	4.07	1	7	48
Communication With Students	3	0.26	1.78	3.18	1	7	48

Data presented in the table above shows that the mean use of iPads for teaching new materials was three with a standard error of 0.26. Statistical analysis taken on the variable

showed that values given had a smaller deviation from the mean of 2.16 with maximum and minimum use of iPads for teaching new materials being seven and one respectively.

Data analysis on the variable showed that responses had a standard deviation of 1.31 from the original mean of 3. The second row presents data analysis on the use of iPads in the performance of assessment by teachers and it also recorded a mean frequency of 3 with a standard error of 0.19. The variable had a minimum record of 1 while the highest record was 7 of a total of 50 observations. The next level analyzes the use of iPads for conducting formative assessment, and the frequency presented a mean of 3 with a standard error of 0.21. The sample statistics had a standard deviation relative to the variance of 1.48 with minimum and maximum frequencies being 1 and 7 respectively. The other section analyzed the use of iPads for conducting summative assessment, and here it recorded a mean frequency of 4 with the standard error of 0.17. The frequency had a standard deviation of 1.16 with minimum and maximum observations being one and six respectively.

Research Question 3

The third research question asked whether there has been an increase or decrease in student scores since the use of iPads and iPhones in mathematics classes began. Below is a frequency table that shows the teachers' perceptions for the students who have benefitted the most since the introduction of iPads and iPhones in mathematics classrooms.

Table 13

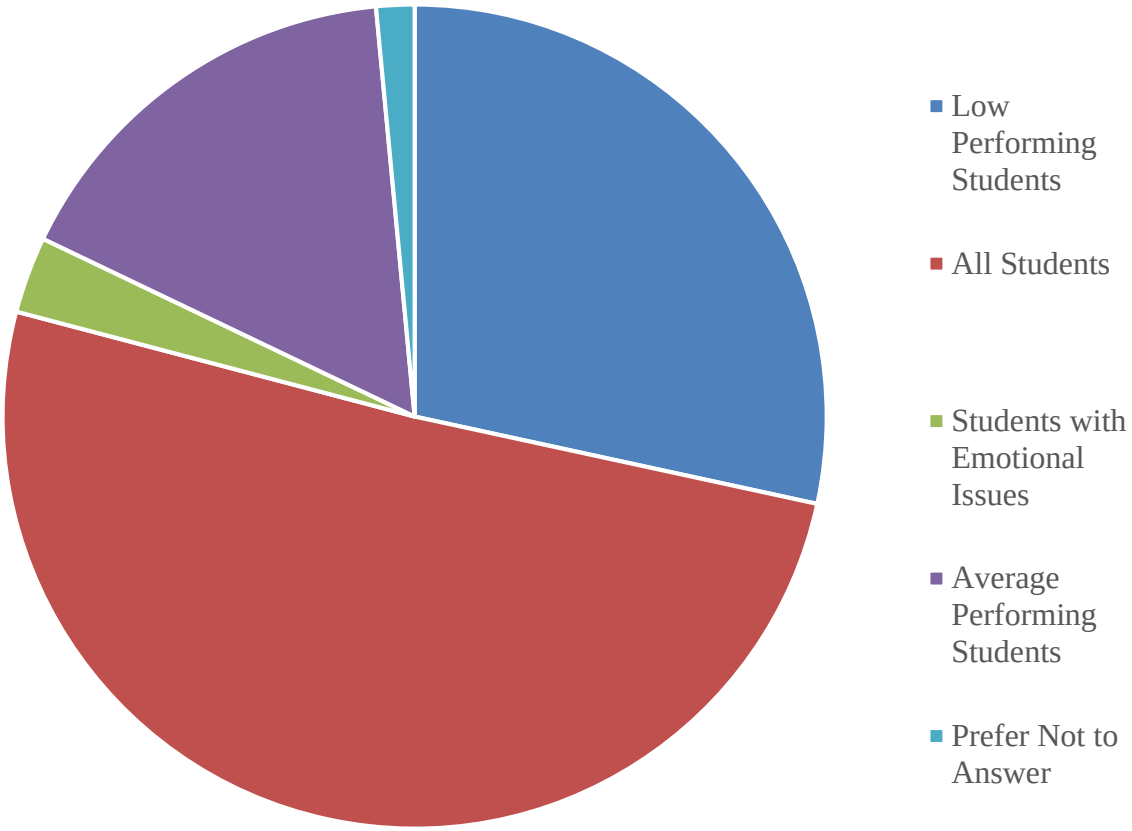
Frequency of Teachers' Perceptions of Students that Benefited from iPad Usage

	Frequency	Percent	Cumulative Percent
Low performing students	19	28.4	28.4
All students	34	50.7	79.1
Students with emotional issues	2	3.0	82.1
Average performing students	11	16.4	98.5
Prefer not to answer	1	1.5	100.0
Total	67	100.0	

The above table shows that the frequency of low performing students who benefited from iPad usage daily is 19. From the table it is clear that all students benefited most from iPad usage, with a frequency of 34. It is also seen that the frequency of students with emotional issues who benefit are two. Another group of average performing students who benefit have a frequency of 11.

Figure 3

Frequency of Teachers Perceptions' for Students that Have Benefited from the Use of iPads



The results showed that according to teachers' perceptions there is a relationship between iPads for teaching and student benefits.

Table 14

Professional Development and Years of Experience

Type of professional development	% score for professional development	Average years of experience
Online Discussion with Other Educators	28.36	6
Face to Face Workshops for Educators	61.19	14
Other Teachers Within my School or District	61.19	12
Video Tutorials	26.87	7
Social Networks	20.90	5
No Professional Development	2.99	1
Prefer Not to Answer	1.49	4

It is clear from the above table that less experienced staff are using technology oriented techniques like social networks, video tutorials and online discussions more that experienced staff. It can thus be concluded that there is a relationship between experience and type of professional development.

Conclusion

The results have shown that teachers perceive there is a relationship between the use of iPads in mathematics and student performance. The use of iPads in teaching mathematics is seen to be improving the scores of the students. Moreover, the teachers use the iPads in different ways while teaching mathematics. They use it for various functions so as to improve the performance of the students. The research also found that most of the teachers think that the use of iPads in teaching mathematics is import important in improving the performance of the students.

CHAPTER V

DISCUSSION

Introduction

The study aims to determine how various technologies, such as the applications in the iPad may be used appropriately to advance learning for the students. Therefore, the results illustrate some of the importance of the application of iPad in teaching mathematics. As evident in the literature, achievement in mathematics at an early age of the children is critical for their education and career development, something that has been clearly affirmed by the results in this study indicate that teachers perceive that iPad usage improves achievement for older students. In this chapter, various findings are evaluated to determine how variables are used to answer the research questions. The discussion also determines whether there is any improvement that these results have made in regard to previous research on the same topic with specific recommendations made for the future research and policy making within the education sector.

Discussion of the Results

Previous studies have been conducted to determine how technology is applied in classrooms to facilitate student learning, especially mathematics. From the literature review, it has been noted that application in some of the technologies in education helps in motivating students at early age to carry on with their education with a positive attitude and perception. This then helps in improving their quality of lives in the future. Bearing this in mind, the results in this research illustrate how teachers perceive the application of iPads can help in improving the

manner in which students perceive mathematics, how some teachers think iPads may be used to improve students' performance in mathematics classes, whether the actual applications in iPads can facilitate effective communication within the mathematics classes between the teachers and their students, and how such technologies ensure explorations of different learning materials. Attard (2013) showed similar results. The results also show how various mathematics instructors use iPads to improve the way they provide instruction to their students.

The results in this research shed light on the role played by iPad technologies in ensuring the improvement in teaching mathematics. The results confirm some of the previous studies, which illustrated how the use of technologies improves learning outcome within the education sector, especially in mathematics lessons. In line with Ağır's (2015) arguments, the findings in this study show the relationship between the application of technologies and teachers' perceptions of the improvement of the learning outcomes among middle school and high school young students. By analyzing various mathematical applications in iPads and the experiences they create for the students and teachers, the findings suggest that teachers perceive that there is performance improvement among the students. Such analysis is very crucial because it identifies the only important applications within iPad technologies that should be applied in teaching.

The professional development of the teachers on the use of the iPads in teaching has been indicated as very high with most of the teachers choosing to develop their skills through a variety of platforms like online discussions, video tutorials, social networks, etc. For instance, such high level of experience through platforms seems to help the respondents provide reliable responses on the research questions regarding the application of both technologies in mathematics class. Their interest and ability to use technology in solving various mathematical problems provides information regarding the applicability of technologies in mathematics teaching (Fischer, 2011).

This finding is helpful in determining how the application of both Apple technologies could be adopted and utilized within the education sector to improve the education outcomes of the students. According to the literature, the experiences of both the teachers and students in using various technologies in education are an important determinant in how they perceive them and how such technologies motivate them. This includes the use of informal professional development on the use of such devices like through the social networks. Similarly, the findings from this study illustrate how such experiences for teachers play a crucial role to determine how the technologies are adopted within the sector.

The range of years of experience indicates a substantial difference with the calculated range in the result section being 20. This is a relatively large value. There are those who had many hours of classroom experience within the mathematics field while others had much less experience. The difference shows that the participants had different teaching experience, especially with iPads. Such findings play a crucial role in creating a clearer understanding on the perceptions of the teachers within the mathematics sector regarding the adoption and utilization of various technologies, including iPads. A future research question exists to determine more clearly if teachers who had a longer experience in the field appeared to react in a certain manner towards the introduction of the technologies in the field.

Another future research question exists to determine if the participants majored in mathematics, or had a minor in mathematics, appeared to react in a certain manner towards the introduction of the technologies in the field. It may be that their interest and ability to use technology in solving various mathematical problems provides information regarding the applicability of technologies in mathematics teaching (Fischer, 2011). This finding is important in the application of both Apple technologies could be adopted and utilized within the education

sector to improve the education outcomes of the students. According to the literature, the experience of both the teachers and students in using various technologies in education determines a lot in how they perceive them and how such technologies motivate them. Similarly, the findings from this study illustrate how such experiences for teachers play a role to determine how the technologies are well adopted within the sector.

In the second part of the survey, which evaluates the responses on advanced mathematics teaching, the total count indicates that among the participants, eight teachers responded positively reacted on the application of iPhones and iPads in mathematics classes. It shows that among the mathematics teachers, some of them believe that the application of iPhones and iPads helps in teaching advanced mathematics. Such reaction shows how these teachers perceive how these technologies have improved the advanced mathematics learning at school. Past literature has also affirmed to this finding (Keengwe, 2013). For instance, Earle (2002) found out that over the past few years, there have been efforts by curriculum development teams in different parts of the world to integrate tablet devices such as iPads at the innovation stage of learning and development, which has seen some improvements in the education sector. Such past positive outcomes are the ones that have made students and teachers believe in the effectiveness of the application of iPads and iPhones in teaching mathematics

The study's results as report that even though the application of iPhones and iPads has been adopted in education, especially in teaching mathematics, the implementation has been unequally adopted in different sectors. This finding is also illustrated in the literature review, for example the study by Carr (2012) indicates that not all students have had a chance to utilize or apply such technologies at school thus creating the inequality in their perception of implementation.

The inequalities in technologies' implementation are affected by various factors, such as the nature of every mathematics topics, and the applicability of the technologies in solving specific problems. For instance, as shown in the results, advanced mathematics seems to be difficult due to various complex applications, thus making it hard to use mobile technologies in solving such problems (Christensen, 2002). Complexity seems to be different when it comes to geometric applications or essential math where a total of 15 participants responded on the application; teacher perception indicates that students in lower level mathematics are more likely to improve their learning outcomes by the use of iPads than those in high level classes, such as calculus. Such difference might be due to the fact that in essential mathematics, most of the mathematical formulae and applications are supported by iPhone features, thus making it easy for the teachers and students to use the technologies in such lessons (Carr, 2012). The study's findings therefore indicate that the type of mathematics determines the applicability of the technologies in teaching, thus influencing the teachers' perceptions towards the introduction of the technologies.

The other set of results shows how different respondents had access to various teaching and learning techniques using the applications in iPads. The participants responded positively towards the questions regarding application of iPads in mathematics classes, as argued in the literature, which indicates that the teachers who have applied iPads and iPhones in mathematics have developed positive perception towards their usage; the results in this study indicate that even if there have been slightly challenges in the application of Apple technologies in teaching mathematics; there are those who perceive it as the most effective to ensure proper performance in mathematics applications, as Fischer (2011) also concluded. The findings also indicate that in the contemporary world, Apple, one of the largest technological companies in the world, has

managed to reach out to a large customer base, which ensures that its technologies are been adopted in different levels and sectors of developments, like in education (Herbert, 2010). This therefore means that the accessibility of the technologies is a major determinant of how they are adopted and applied in the concept of education.

As reported on Table 4 for received professional development regarding the iPad, the total number of 41 respondents acquired knowledge through face-to-face interaction. The figure showed the number of the participants who applied both technologies in teaching and learning mathematics. A figure of 41 is nearly two-thirds of the total respondents, which also illustrates how the applications have been largely adopted by these mathematics teachers. This finding answers the main research question, whether these technologies are applied in mathematics classes in this school district. Most of these respondents indicated that they acquired such knowledge through online discussions with friends and tutors and by following the tutorial instructions provided in Apple. Social media networks provided in these Apple devices helped the students acquire up-to-date mathematics applications and learning techniques, which help in improving the overall performance (Herbert, 2010). The count for those respondents who never received any teaching or experience through the application of iPads was only two. Such findings illustrate how the technologies have been adopted in teaching mathematics in schools and how some teachers see them as the better options and the best alternative to solving some of the challenges in education sector because teachers engage in a variety of professional opportunities. Ensuring easier interactions between the teachers and their students through the technologies has enhanced distance learning programs, thus making it easier for more students to access a quality education. As indicated in the literature, the features in the Apple products motivate students to freely participate in various learning programs with their teachers, thus

improving their outcomes. The positive responses clearly illustrate the positive implications the use of iPhones and iPads has in teaching mathematics.

Based on the findings on the frequency usage of iPads a maximum frequency was seven and a minimum of one was recorded, which shows a large gap indicating that there were people who never used the technologies at all while others fully adopted it in their teaching practices. In that case, there is a great need of applying more Apple technologies in teaching to determine the benefits and implication of these technologies in teaching mathematics (Fischer, 2011). This result clearly shows the need for the application of the technologies on a regular basis in order to enhance their benefits in the education sector. As the literature indicates, regular application of such technologies inspires students to be more creative and innovative, which are major aspects that improve the education outcomes (Fischer, 2011).

Table 5 shows the results on how the application of iPads plays a role in improving mathematics teaching. From the literature review, application of advanced technologies in the education sector have been a major challenge to teachers and students as well. However, proper incorporation of these technologies plays a major role in ensuring better performance among the students by facilitating positive relationships with their instructors (Herbert, 2010). From the results, it is also clear that teachers think that various applications in iPads and iPhones improve the manner at which various mathematics lessons are taught to the students.

The results in table 5 further shows how Apple devices are used in teaching new materials in classes. The results therefore illustrate that these technologies in teaching new materials are more effective in enabling performance according to the teachers who responded to the questions. Such results mean that the use of the technologies in iPads has the ability to ensure various new and advanced mathematical applications are well taught and incorporated in the

current syllabus (Christensen, 2002). The results also show how well the technologies facilitate performance in assessments. The interactive features in these technologies help both the teachers and students participate well in mathematics tests (Carr, 2012). Furthermore, such positive responses from the participants are clear indications that the application has positive results in teaching new concepts and taking the assessments (Nooriafshar, 2012). Additionally, Table 5 shows that teachers think that the overall application of iPhones in teaching practices promote its overall performance by motivating both the teachers and the students to participate more effectively in the process. This is similar to the findings by Henderson (2012), which indicate that various features that the iPad and the iPhone contain helps to keep the students engaged which can help explain why the use of these devices as part of study is a positive addition to the learning system as a whole.

As the initial aim of the study was to determine whether teachers perceive that the use of iPhones and iPads have improved the manner at which mathematics is been taught in schools, the results further illustrate the role played by both technologies in ensuring effective decisions and policy making processes within the education system. Almost half of the participants agreed that the use of Apple technologies has been enabling teachers and other tutors to make the right decisions regarding the teaching approaches in mathematics classes, confirming the work of Keengwe (2013). This is also affirmed by various studies, which indicate that some of the applications in Apple technologies create better teaching and learning features that promotes the outcomes of the students. Most of such studies indicated that the use of the technologies has helped both the teachers and students make the right and the most appropriate programs, which ensures an effective learning process by motivating the players to fully participate in the process (Quillen, 2011).

Table 6 results also show a count of 25 for the participants who have recognized the role played by the technologies in helping teachers use inbuilt systems to understand how students get the concept within mathematics units. Understanding the learning progress of students is vital for every teaching practice. As indicated in the literature review, Apple technologies allow the teachers to plan the best teaching approaches which help their students meet their overall goals (Christensen, 2002). The study's results also show how teachers using iPads understand how their students master mathematics concepts at the beginning and end of the units. Understanding students at the beginning of the unit or lesson and at the end is vital for the teaching practices (Murray & Olcese, 2011). It allows teachers plan and come up with the most appropriate approaches that ensures every students digest and benefits from what is been taught in the class (Nooriafshar, 2012).

From these results, it is clear that most teachers have realized the benefits associated with iPads in teaching mathematics. According to the literature, teachers have noted that the incorporation of these technologies has enabled them understand the strengths and weaknesses of every student at the beginning of the unit thus coming up with the most appropriate teaching approaches that ensure better performance (Falloon & Melhuish, 2010). According to the study's results, teachers have admitted that using iPads in teaching mathematics is easier than using the traditional techniques as (Li & Leung, (2014) argued. Most of the respondents agreed with the fact that the use of the technologies helps students understand the concepts well perhaps quickly. With some of the most advanced features in contemporary mathematics, the applications in iPhones and iPads help students understand and participate well in class work (Falloon & Melhuish, 2010). With features and social media platforms in iPads, students and teachers enhance their communications thus facilitating the learning process (Barseghian, 2011).

Mathematics is an interactive subject that requires both the instructors and students to directly and freely share their ideas, skills and knowledge thus ensuring better final performance (Murray & Olcese, 2011). Teachers use the technologies to pass instruction to their students. Teachers perceive that such benefits of the application have made the use of iPhones and iPads more effective in teaching mathematics.

Barriers

One of the major challenges illustrated in the literature is usage of the Apple technologies by student beside the educational applications. According to Quillen (2011) it is likely that most of the students use their iPhone and their iPad to carry out their studies; however, there are significant percentages that have been using them for other activities. The findings in this study also illustrate that teachers perceive that some students use the device in their personalized platforms for consultations on tasks that seem difficult, including preparations for tests, gauging engagement with learning materials, documenting performance, etc. Additionally, similar to the findings by Rogers (2000), most students do not have these devices due to lack of accessibility and cost of acquiring. Based on these findings, for these technologies to be well and effectively applied in teaching mathematics, various adjustments must be made to ensure that they meet the personalized platforms of the students. For instance, strict rules on usage must be put in place; in addition students need to be financed so that they can afford the devices (Murray & Olcese, 2011).

How the Results Inform Practice Inside and Outside of the District

The use of various advanced technologies has changed the manner at which things are done in many sectors of education. In the education sector, the applications in Smartphone and other modern technologies have facilitated the interactions between the teachers and students thus facilitating effective ways of teaching the concepts (Falloon & Melhuish, 2010). Based on the results in this dissertation, teachers perceive that the use of iPads in teaching mathematics has helped in improving the overall performance among the students. The results have indicated how teachers perceive different levels in the manner at which the applications in both technologies improve practices inside and outside the mathematics classes or the district.

The use of iPads has facilitated better communication and interactions between the teachers and their students in mathematics classes (Fischer, 2011). As shown in the results analysis, some of the applications in iPads have more advanced and effective communication channels, which teachers think help both teachers and the students exchange ideas, and information regarding various mathematics techniques. In geometrics and essential mathematics, the technologies help by providing programs and features that make it easy to solve various problems thus facilitating easy learning (Murray & Olcese, 2011). Communication is vital to any class work because it ensures more effective interactions through which information and skills are passed from instructors to students or from students to other students (Barseghian, 2011). With such applications as social media networks in iPhones and iPads, such communication can be easily achieved, which is a major objective in learning processes.

The other way that the mathematics teaching benefits from the applications is by allowing teachers to pass instructions to their students without too many challenges (Fischer, 2011). Passing instruction is one way that ensures the overall learning performance. Therefore,

by allowing such a development, the introduction of iPads in teaching mathematics has made class work much easier and effective (Reys, Lindquist, Lambdin & Smith, 2015). Teachers can instruct their students at any time and place. Applications such as social media networks in the device help instructors reach out to their students whether in classes or even when they are at home thus facilitating proper learning process (Attard, 2013).

The results in Table 10 have also indicated that teachers perceive that the regular use of and iPads has increased the performance of students learning mathematics with 53.7% of the respondents strongly agreeing. These teachers think that the use of these technologies enhances proper communication as indicated with 47.2% of the respondents agreeing as shown in Table 11, thus allowing proper sharing of ideas and information, which are essential in decision making process (Fischer, 2011). In every sector of development, decisions and policy making is a key aspect of any success. In that case, by facilitating proper communication, the application in these Apple technologies helps various stakeholders make effective and reliable decisions, which ensure proper problem solving (Christensen, 2002). In management (Attard, 2013), for instance, this concept can be applied to ensure problem solving and strategic planning. Also, in teaching other subjects in schools, the application in iPads facilitate proper sharing of instructions and ideas thus promoting better performance (Carr, 2012). The results have indicated that most of the teachers agreed that the use of these technologies makes their work easier and comfortable. Christensen (2002) asserts that educators, particularly special education teachers, have been under increased pressure to improve the performance of students in order to attain state and federal standards. Similarly, such application might enable teachers in other subjects' teachers have the same experience.

What the Research Adds to Current Studies

According to the literature review, a number of scholars have conducted research with an aim of investigating the application of various technologies in teaching mathematics and other subjects within the learning system. Most of the studies have noted that proper education is essential in the lives of the students (Quillen, 2011). They have agreed that with high achievement in their education, students attain their goals in lives, thus managing to raise their living standards. Mathematics has been identified as one of the most important subjects within the education system that changes the lives of the students (Attard, 2013). In that case, it is clear that the previous studies agreed that there is a great need to introduce the best learning practices in mathematics lesson as an effort of raising performance, which ensure improvements in the students' lives. Reys et al. (2015) noted that proper teaching of mathematics in early age is very crucial because it helps the students attain their goals in life. Additionally, Carr (2012) indicated that due to lack of proper skills in mathematics, most children develop negative attitudes towards the entire education system, thus probably increasing the likelihood of their failure in life. It is clear that the current studies have noted the need for proper teaching approaches for mathematics units as part of facilitating better performances among the students in schooling and in their future (Falloon & Melhuish, 2010).

The results in this research emphasized on the need for proper teaching of mathematics basics. From the results analysis, a number of participants agreed with the fact that to help young students develop positive attitudes towards learning, there has to be effective teaching mechanisms, which help them understand the basic concepts of mathematics. The research has indicated that teachers think that introducing proper mathematics teaching techniques in grade 7 and grade 8 is very essential in facilitating proper learning practices. In that case, similar to the

previous studies, the findings in this research indicate that teaching mathematics plays a crucial role in the overall education performance of the students (Keengwe, 2013). Additionally, this research has emphasized that teachers perceive improvement among grade 7 and 8 students in high school who use such advanced technologies thus affirming the benefits associated with such developments.

Current studies on the use of iPad applications in classrooms have noted that the use of advanced technologies, such as iPads have played a great role in promoting the overall learning process among the students (Attard, 2013). Most of the scholars have agreed with the fact that teachers, especially mathematics teachers, are under pressure to ensure their students perform better in classes (Barseghian, 2011). They are therefore, forced to apply new approaches, such as the use of technologies, to change the learning process thus improving the performances. The studies have also noted that the use of iPads at schools has helped different teachers understand well the special needs of the students thus enabling them come up with proper teaching approaches that ensure high performance (Christensen, 2002). Such findings have been reflected in this study. In that case, this study has provided more light on what the previous studies found out thus providing clear suggestions on how the process may be improved to enhance better performances.

Recommendations for Future Research

The previous studies have concentrated on evaluating the application of advanced technologies in enhancing teaching and learning process in mathematics classes. From a number of results in these studies, it has been noted that the use of such technologies in learning is effective in increasing students' motivation and participation thus improving their performances

at school. In this study, the perceptions of teachers on the efficacy of iPhones and iPads in teaching mathematics were evaluated with an aim of determining how the devices improve the performance in mathematics classes. Having evaluated a number of literature studies, the study has concluded that most of the participants have positive perception towards the application and have benefited from it. However, there are gaps the study has left that require investigation in the studies. One, the study has not illustrated how the issues regarding the drastic change of learning techniques following the adoption of iPhones and iPads can be solved. In that case, in the future studies, the researchers should investigate the effects of such changes in the normal learning systems and how the whole situation may be improved. Second, future study should focus on investigating whether people can afford such Apple devices when introduced in the education system. These are very crucial points that require thorough investigations in the future.

Future Policy

From the research findings, it is clear that the use of iPhones and iPads ensure effective learning of advanced mathematics. However, despite the benefits of this application, the technologies have not been fully adopted within the education system (Nooriafshar, 2012). Given those circumstances, the government and other stakeholders involved should come up with a policy that involve purchasing equipment such as iPhones and iPads, and introduce them to schools as part of regular teaching equipment. The policy should also involve changing the current syllabus to fully incorporate the application of the technologies in mathematics learning units. The results have indicated that most of the teachers agreed that the use of these technologies makes their work easier and more effective. Similarly, such application of

technology might enable teachers in other subjects' to teachers have the same experience as long as they receive both formal and informal professional development on the use of the devices.

Outside teaching mathematics, the use of iPhones and iPads enhances socialization among the students thus making it appropriate for teaching other social subjects (Earle, 2002). As a matter of fact, there are those subjects, such as philosophy, sociology, business, and leadership that require both the students and teachers to socialize more. Social media platforms in these devices help the students and teachers to interact with the social world thus getting firsthand experience with the concepts they learn in school (Earle, 2002). Thus, understanding the gap of those who understand well the need for the application of technologies and those who have little knowledge and experience will eventually help the stakeholders within the education sector come up with the best strategies to incorporate iPads and iPhones in mathematics classes.

Conclusion

From the discussion, it is clear that the results from the research have illustrated the positive perception of the surveyed teachers towards the application of iPads and iPhones in teaching mathematics. From a number of analyses, it has been noted that most participants identified the effectiveness of applying these technologies in improving the students' performances in mathematics subjects. Most participants indicated that the applications in these technologies facilitate proper communication, offer effective ways of passing instruction from teachers to students, and provide advanced methods of solving mathematical problems. Nevertheless, the use of the iPad by educators in mathematics classes should not substitute for actual pedagogical instruction but rather act as a complement or support the process of actual teaching. Teachers also think that helps the individual students to mature into self-reliant

individuals who are able to implement their knowledge to practical and workable ways for self-sustenance, although future research is necessary to determine what teachers think is the nature of self-reliance. In the teaching of mathematics, teachers think that the iPad has been useful in reducing the energy required by educators to teach since teachers can communicate more speedily with their students and subsequently offer the necessary assistance. Educators must be careful to ensure that in the implementation of the iPad in learning and teaching mathematics, they select Apps which are not only aligned to the curriculum and standards of education but also successful in enhancing the levels of engagement, motivation, and participation of students in the mathematic classroom. The discussion has also indicated that this research has given more light to the findings from the previous studies, on the future study approaches. For instance, future researchers should focus on how various challenges associated with the use of iPads and iPhones in teaching mathematics might be solved.

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APPENDICES

APPENDIX 1: Survey

Q1 THE UNIVERSITY OF ALABAMAHUMAN RESEARCH PROTECTIONS PROGRAM

Nicole Ivey, Principal Investigator from the University of Alabama, is conducting a study called IPad and IPhone Usage In Mathematics Education. She wishes to find out if the use of iPhones

and iPads in mathematics classrooms is enhancing learning. The investigator wants to determine if the usage of these devices is making it easier for students to develop a more thorough understanding of the material presented in all levels of mathematics. Taking part in this study involves completing a web survey that will take about 10 minutes. We will protect your confidentiality by not asking you to provide any personal identifying information. Only the investigator, Nicole Ivey, will have access to the data. The data will be password protected through the survey site and during statistical calculating. Only summarized data will be presented at meetings or in publications. The results of this study will be used to help and improve practices in the district. There will be no direct benefits to you. The findings will be useful to teachers, administrators, and system personnel within the school system. The chief risk is that some of the questions may make you uncomfortable. You may skip any questions you do not want to answer. If you have questions about this study, please contact Nicole Ivey at 205-479-9001 or by email, cnivey2519@gmail.com. If you have questions about your rights as a research participant contact Ms. Tanta Myles (the University Compliance Officer) at (205) 348-8461 or toll-free at 1-877-820-3066. If you have complaints or concerns about this study, file them through the UA IRB outreach website at http://osp.ua.edu/site/PRCO_Welcome.html. Also, if you participate, you are encouraged to complete the short Survey for Research Participants online at this website. This helps UA improve its protection of human research participants. YOUR PARTICIPATION IS COMPLETELY VOLUNTARY. You are free not to participate or stop participating any time before you submit your answers. If you understand the statements

above, are at least 19 years old, and freely consent to be in this study, click the YES button above.

- ❍ YES (1)
- ❍ NO (2)

If NO Is Selected, Then Skip To End of Survey

Q10 What is your sex?

- ❍ Male (1)
- ❍ Female (2)

Q11 How many years have you been teaching mathematics?

Q2 Mark all classes that you teach

- ❑ Algebra I, Algebraic Connections, and/or Algebra II (1)
- ❑ Advanced Mathematics and/or Calculus (2)
- ❑ Geometry and/or Essential Mathematics (3)
- ❑ 8th Grade Mathematics (4)
- ❑ 7th grade Mathematics (5)

Q4 Where have you received professional development on the use and integration of iPads in math classrooms? (Mark All That Apply)

- ❑ Online Discussion with Other Educators (1)
- ❑ Face to Face Workshops for Educators (2)
- ❑ Other Teachers Within my School or District (3)
- ❑ Video Tutorials (4)
- ❑ Social Networks (5)
- ❑ I Have Not Received Any Professional Development (6)
- ❑ Prefer Not to Answer (7)

Q5 How often do you use the iPad in your mathematics class?

- ❍ Daily (1)
- ❍ 2-3 Times a Week (2)
- ❍ Weekly (3)
- ❍ Monthly (4)
- ❍ 1-3 Times a Semester (5)
- ❍ 1-3 Times an Academic Year (6)
- ❍ Never (7)
- ❍ Prefer Not to Answer (8)

Q15 How often do you use the devices for the following activities in your class?

	Daily (1)	2-3 Times a Week (2)	Weekly (3)	Monthly (4)	1-3 Times A Semester (5)	1-3 Times An Academic Year (6)	Never (7)	Prefer Not to Answer (8)
Teach New Material (1)	❍	❍	❍	❍	❍	❍	❍	❍
Perform Assessments (2)	❍	❍	❍	❍	❍	❍	❍	❍
Conduct Formative Assessments (3)	❍	❍	❍	❍	❍	❍	❍	❍
Conduct Summative Assessments (4)	❍	❍	❍	❍	❍	❍	❍	❍
Motivate/Reward Students (5)	❍	❍	❍	❍	❍	❍	❍	❍
To Manage My Classroom (6)	❍	❍	❍	❍	❍	❍	❍	❍
To Communicate with Students (7)	❍	❍	❍	❍	❍	❍	❍	❍

Q16 I use the built in assessment systems that come with applications on the iPad to (mark all that apply):

- ❑ Make Instructional Decisions (1)
- ❑ Understand Student Mastery of Concepts ar the End of a Unit (2)
- ❑ Understand Student Mastery of Concepts at the Start of A Unit (3)
- ❑ Document Student's Overall Performanace and/or part of my Grading System (4)
- ❑ Gauge Student Engagement with Material (5)
- ❑ Prepare Students for Mandatory District/State Tests (6)
- ❑ Other (7) _____

Q17 When you select applications on the iPad to use with your students whick of the following influences your decision the most?

- ❍ What Other Teachers Say About the Application (1)
- ❍ The Included Assessment/Tracking Program that Comes with an Application (2)
- ❍ Research Evidence (3)
- ❍ Student Opinion (4)
- ❍ Other (5) _____

Q18 Which of the following types of students, if any, have you seen benefit the most from instruction involving the iPad?

- ❍ Low Performing Students (1)
- ❍ All Students Seem to Equally Benefit (2)
- ❍ Students with Emotional/Behavioral Issues (3)
- ❍ Students with Cognitive or Developmental Issues (4)
- ❍ Average Performing Students (5)
- ❍ Students wth Physical Impairments (6)
- ❍ Other (7) _____

Q22 What is the greatest barrier you face when using iPads in the classroom?

- ❍ Insufficient Time (1)
- ❍ Not Sure Which Application to Use (2)
- ❍ Unfamiliar with Technology (3)
- ❍ Lack of Support from School Administration (4)
- ❍ Lack of Support from Parents (5)
- ❍ Emphasis on Standardized Test Scores (6)
- ❍ Other (7)
- ❍ Prefer Not to Answer (8)

Q9 When considering your students and the experiences you have had with using the iPad and iPhone in mathematics, please indicate your level of agreement with the following statements.

	Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)	Prefer Not to Answer (5)
Regular use of IPads and/or IPhones help improve the performance of students in mathematics. (1)	❍	❍	❍	❍	❍
Use of the iPad and/or the iPhone in class provides a personalized platform for teachers to interact with their students and understand them. (2)	❍	❍	❍	❍	❍
The use of the IPad and/or IPhone in class enhances communication between teachers and students. (3)	❍	❍	❍	❍	❍
The use of the IPad and/or IPhone during instruction has shown to improve students' understanding of math topics in class. (4)	❍	❍	❍	❍	❍

Q23 Please share your thoughts about iPad usage in math classes. Please include what you consider to be the positives and negatives of using iPads in math classes for instruction. In your response please share your experiences (both good and bad) with students using iPads.

APPENDIX 2: Consent Form

THE UNIVERSITY OF ALABAMA

HUMAN RESEARCH PROTECTIONS PROGRAM

Nicole Ivey, Principal Investigator from the University of Alabama, is conducting a study called IPad and IPhone Usage In Mathematics Education. She wishes to find out if the use of IPhones and IPads in mathematics classrooms is enhancing learning. The investigator wants to determine if the usage of these devices is making it easier for students to develop a more thorough understanding of the material presented in all levels of mathematics. Taking part in this study involves completing a web survey that will take about 10 minutes.

We will protect your confidentiality by not asking you to provide any personal identifying information. Only the investigator, Nicole Ivey, will have access to the data. The data will be password protected through the survey site and during statistical calculating. Only summarized data will be presented at meetings or in publications. The results of this study will be used to help and improve practices in the district.

There will be no direct benefits to you. The findings will be useful to teachers, administrators, and system personnel within the school system. The chief risk is that some of the questions may make you uncomfortable. You may skip any questions you do not want to answer.
If you have questions about this study, please contact Nicole Ivey at (205) 479-9001 or by email, cnivey2519@gmail.com. You may also contact my UA faculty advisor, Dr. Philo Hutcheson at (205) 348-5641 if you have any questions.
If you have questions about your rights as a research participant contact Ms. Tanta Myles (the University Compliance Officer) at (205) 3488461 or toll free at 1-877-820-3066. If you have complaints or concerns about this study, file them through the UA IRB outreach website at http://osp.ua.edu/site/PRCO_Welcome.html. Also, if you participate, you are encouraged to complete the short Survey for Research Participants online at this website. This helps UA improve its protection of human research participants.
YOUR PARTICIPATION IS COMPLETELY VOLUNTARY. You are free not to participate or stop participating any time before you submit your answers. If you understand the statements above, are at least 19 years old, and freely consent to be in this study, click the YES button above.

APPENDIX 3: IRB Approval Letter

University of Alabama
Research & Economic Development
Office of the Vice President for Office for Research Compliance

August 30, 2016

Christian N. Ivey

Department of ELPTS
College of Education
The University of Alabama
Box 870302

Re: IRB # EX-16-CM-088 "IPhone and IPad Usage in Mathematics Education"

Dear Ms. Ivey:

The University of Alabama Institutional Review Board has granted approval for your proposed research.

Your protocol has been given exempt approval according to 45 CFR part 46.101 (b)(2) as outlined below:

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects 'financial standing, employability, or reputation.

Your application will expire on August 29, 2017. If your research will continue beyond this date, complete the relevant portions of Continuing Review and Closure Form. If you wish to modify the application, complete the Modification of an Approved Protocol Form. When the study closes, complete the appropriate portions of FORM: Continuing Review and Closure.

Should you need to submit any further correspondence regarding this proposal, please include the assigned IRB application number.

Good luck with your research.

Sincerely,