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Potential of using iPad as a Supplement to Teach Math to Students with Learning Disabilities

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Abstract

This qualitative study was conducted to identify the potential of using iPad as a supplement to teach math to students with learning disabilities. Ten teacher candidates from a university in the south provided one-on-one math tutoring services to ten students in a self-contained classroom at a local high poverty elementary school. The students were tutored math for five weeks using ten free math apps in addition to the traditional teaching methods. The apps were selected as they deemed fit with the math content standards, and abilities of the students. Each week, teacher candidates reflected on their tutoring experiences and at the end of five weeks, they completed an open-ended survey regarding their use of iPads as a supplement to teach math to the students. Findings confirmed the use of iPad as a supplement to help students' conceptual understanding of numbers, order of operations, expressions, and multiplication and division skills.

Introduction

Mobile devices like iPads have revolutionized the ways in which education is delivered and received in the 21st century. Since their introduction in 2010, schools across the United States have been investing in this device to promote teaching and learning across curriculum. They are suitable to meet the learning preferences of the students and the curriculum needs (Hahn & Bussell, 2012). Different educational apps allow opportunities for creativity, collaboration, engagement, motivation, achievement, and communication. Portability, versatility, ease of access to information and manipulation of this device has attracted people in education (Koszalka & Ntloedibe-Kuswani, 2010) and other users regardless of their age and technological skills. The touch-screen and other built in features such as sounds, images, animations, text enlargement, highlighting etc. allow users to manipulate content and experience things in ways that they never have before. There are several studies conducted to identify the benefits of using iPads with students in several subject areas. The purpose of this study was to identify the potential of using iPad as a supplement to promote conceptual understanding of numbers, order of operations, expressions, multiplication and division of students with learning disabilities.

Background

Research related to technology in education is immense. With the increasing advancements in technology the need for research to identify the associated implications keeps increasing. Ipad is a new and intriguing form of technology that has variety of functions and potential to enhance teaching and learning. Ipad offers opportunities for extra practice by allowing students to work with interactive educational apps (Ensor, 2012). With the increasing use of iPads in education since their introduction in 2010, it is necessary to examine the pedagogical effectiveness of this device (Milman, Carlson-Bancroft & Boogart, 2014). Since the use of iPads in K-12 classrooms, several studies have been conducted with teachers and students across different subjects to identify how iPads promote teaching and learning. However, there is paucity of research related to iPads and special needs students in high poverty schools. It is important to note that most students in high poverty schools might not have access to this technology outside of the classroom. These students must have additional assistance through small group instruction and opportunities to explore learning (Ensor, 2012) within the school settings. This study was conducted to examine the potential of using iPads as a supplement to support math learning of students with special needs at a high poverty school.

Literature Review

IPads and Literacy

iPads are found to be very effective in developing literacy skills (Beschoner & Hutchison, 2013), enhancing student motivation, promoting independence, providing opportunities for self-expression (Flewitt, Kucirkova, & Messer, 2014) and improving engagement (Hutchison, Beschoner, & Schmidt-Crawford, 2012). Beschoner and Hutchison (2013) conducted a study to determine how well iPads facilitate emergent literacy in an early childhood classroom. They found that the young children were able to use iPads without assistance, and they were able to develop emerging knowledge about print in digital context. Flewitt et al. (2014) conducted a case study research with a diverse group of students aged 3 to 19 years in a special school in the English Midlands to identify the potential of iPads for supporting literacy learning in special education. The researchers focused on the literacy learning opportunities offered by the touch screen interface of the iPads and found that the sensory and kinesthetic experience with iPads enhanced students' motivation, control and independence, increased their achievement and provided opportunities for self-expression. Hutchison, et al. (2012) found that iPads used for literacy instruction supported student learning and improved engagement.

Ipad and Differentiation

iPads have also been used to differentiate instruction to meet the varied learning needs of the students. Milman et al. (2014) conducted a mixed methods study at an elementary school in the United States, to determine how teachers used iPads to differentiate instruction and how the iPads were used in multiple content areas. It was found that teachers used iPads to enhance their lessons and used them in combination of at least two different content areas during a particular lesson. With the iPads they were also able to personalize the activities to match the learning style of the students. For instance, visual learners could take a picture of something and then write about it and auditory learners could record something and turn it into a movie. To enrich instruction using iPads, Powell (2014) emphasizes the importance of aligning apps with the learning goals, standards and abilities of the students. When iPads are aligned with the learning styles and standard related apps it helps to meet individual learning needs and enhances instruction.

IPads and Students with Special Needs

McClanahan, Williams, Kennedy, and Tate (2012) reported the results of a six-week tutoring program using an iPad with a student with Attention Deficit Hyperactivity Disorders (ADHD) in an elementary education reading course. The iPad not only helped the student with his attention focus but also made him more metacognitive in his reading. The authors found that iPad instruction can significantly improve the reading abilities of students with reading disabilities. Vogelgesang, Bruhn, Coghill-Behrends, Kern, Troughton (2016) examined the effects of an iPad application called SCORE IT to monitor the behavior of three fifth-grade students at risk for ADHD who exhibited low rates of academic engagement. They found that the use of the SCORE IT app had led to substantial improvements in academic engagement. Flower (2014) investigated the effect of iPads on time on-task during independent practice for three students with emotional/behavioral disorders compared to their time on-task during a typical independent practice condition. It was found that the use of iPads produced increased time-on-task compared to the typical independent practice conditions for all three students. Flores et al. (2014) found that the use of iPads as an assistive technology device to deliver literacy-based behavioral interventions and social stories to students with autism spectrum disorder (ASD) improved their social skills and poor behavior.

IPads, Mathematics and Students with Special Needs

Zhang, Trussell, Gallegos, Asam (2015) conducted an exploratory study in an inclusive fourth grade classroom to see the effects of apps on math skills of students and found that the use of math apps improved student learning and reduced achievement gap between struggling and regular students. On the other hand, Carr (2012) investigated the impact of iPad use on fifth-grade students' mathematics achievement over the course of one academic quarter and found that the change from pretest to posttest was not significantly different between the experimental and control groups, however, both groups did improve their math performance scores. Haydon et al. (2012) compared the effects of using worksheets versus iPads on math fluency and academic engagement of high school students with emotional disturbance and found that the iPads proved superior to the worksheet in

both math fluency and academic engagement. O'Malley et al. (2013) researched the effect of using a basic math skill application to increase basic math fluency of students with moderate to severe cognitive disabilities. The math app was found to be an effective tool and it allowed students to make progress toward learning goals and improved their interest. A study from Aronin and Floyd (2013) involved using iPads with preschoolers to introduce science, technology, engineering, and mathematics (STEM). Their purpose was to introduce the STEM curriculum to the youngest learners to hopefully see, overtime, an increase in collaboration skills, vocabulary, and the ability to create and discuss scientific relationships. They used small, teacher-led groups, when introducing iPads and the related apps. With regard to students with disabilities they state that "the motivation of playing with the iPad has been shown to increase student's determination and resolve" (p.39).

Ipads, Motivation and Behavior

Research indicates that the use of iPads also helps to improve student motivation. Ciampa (2014) reported the perceptions of sixth graders and their teacher regarding the relationship between mobile learning devices and motivation. The findings were consistent with Malone and Lepper's intrinsic motivation theory and proved that motivation can be enhanced through challenge, curiosity, control, recognition, competition and cooperation. Neely, Rispoli, Camargo, Davis and Boles (2013) suggest that using iPads as an instructional tool instead of traditional teaching methods helps to reduce behavior problems and increases academic engagement. Delacruz (2014) conducted research to see how using the iPad app "Nearpod", influenced student motivation and engagement of nine 4th graders involved in the study. It was found that the students were more engaged using the app because they were able to remember their vocabulary words and were able to explain them.

Since the introduction of iPads in 2010 and their use in K-12 classrooms thereafter, researchers have conducted several studies both with regular students and students with special needs. They have researched several aspects of education such as academic engagement, motivation, behavior, differentiation, learning styles to name a few and have focused on several content areas such as literacy and mathematics. However, there is scarcity of research related to the use of iPads with special needs students in high poverty schools. As mentioned earlier, most students in high poverty schools might not have access to technology outside of the school. Keeping that in mind, this study was conducted to explore the potential of using iPads to teach math to students with learning disabilities at a high poverty school in the south.

Method

Description and Setting

This research was a part of a five-week service learning project during which ten teacher candidates enrolled in undergraduate education programs at a southern university provided one-on-one math tutoring services, using iPads, to promote math skills of ten students enrolled in a self-contained fourth grade classroom at a local high poverty elementary school in the south. The students tutored had specific learning disabilities; they were below grade levels in math and had below average scores on Measures of Academic Progress (MAP) testing in mathematics. They were tutored at the local school, for two hours each week using ten free math apps that aligned with the math content standards and the abilities of the students. Teacher candidates designed weekly math lesson plans related to the topics provided by the classroom teacher. They first taught the math lessons using the traditional teaching methods and then used apps as a supplement at the end to reinforce learning. At the time of the study, 89% of the students were on free and reduced lunch which qualified this school as a high-poverty school.

Participants

The students tutored in this study included three African American females, four African American males, and three Caucasian males. The teacher candidates who tutored the students included two Caucasian males, three African-American females and five Caucasian females. Two teacher candidates were from early childhood, six from elementary, and two from middle level program. The classroom teacher was a Caucasian female.

The teacher candidates selected for this study had successfully completed a technology course in which they were trained on how to use different types of technology in K-12 classrooms. They had been introduced to various educational apps and how to use those apps to enhance student learning. This study provided an

opportunity for teacher candidates to work with special needs students during their clinical experience for a three hour math content course and prepared them for future jobs in high poverty schools. On the other hand students tutored received supplemental help to enhance their math learning by using different educational apps under the guidance of the teacher candidates with curriculum support from the classroom teacher.

Ethics and Consent

The project was approved by the university Institutional Review Board. Informed consents were explained and signed by the teacher candidates and the parents of the students tutored, prior to the beginning of the project. To protect the privacy, confidentiality and anonymity of the participants, no names were required during the online survey. The weekly reflections were assigned numbers instead of names and the teacher candidates used pseudonyms when referring their students in the weekly reflections.

Data Collection

Each week, the teacher candidates had to create a lesson plan including the math topic to be addressed for the week, the standard that it aligned with, the app that was to be used and the reason for choosing the particular app. They also had to reflect on their tutoring experience each week focusing on whether or not the app was effective, and any changes that they had to make for the following week. During the tutoring sessions, the teacher candidates used free apps such as Chalkboard, Division for Kids, Division Wiz, Grade 4 Math, iTooch, Math Animations, Number Frames, OoO Calc, Splash Math, and Y Homework to address the math standards and topics provided by the classroom teacher. Table 1 shows the alignment of these apps with the math topics addressed during the tutoring sessions. At the end of the project, the teacher candidates were required to fill out an online open-ended survey regarding their experience of using math apps with the students

Table 1. Alignment of the math topics addressed and the apps used

Math topics addressed	Free math apps used
Dividing Whole Numbers Review	Division for Kids, Division Wiz, iTooch, Number Frames
Using Variables to write expressions	Grade 4 Math, Splash Math, Chalkboard, Y Homework
Order of Operations	Y Homework, iTooch, OoO Calc, Chalkboard
Evaluate Expressions	Y Homework, Splash Math, Grade 4 Math, iTooch
Input/ Output Tables	Number Frames, Chalkboard
Multiply decimals by 10, 100, and 1,000	Grade 4 Math, Splash Math, Y Homework, Chalkboard
Multiply a decimal by a whole number	Splash Math, Grade 4 Math, Y Homework, Chalkboard
Dividing decimals by 10, 100, or 1,000	Y Homework, Chalkboard
Divide whole number by decimal	Y Homework, Math Animations, Grade 4 Math

Data Analysis

The survey responses and weekly reflections for this study were analyzed by examining the common words and phrases that had similar underlying meaning. To establish credibility, all three researchers looked at the data individually and came up with the commonalities. All commonalities were grouped together to form themes by putting together the common responses under the relevant themes. They were then refined by comparing and clarifying until agreement was reached on the meaning. This process was continued until all the commonalities were grouped and agreement was reached regarding the formation of the themes. To ensure validity, the findings were supported with direct quotes from the participants. Altogether the following six themes emerged: using iPads as a guide; using iPads as an informal assessment tool, using iPads for different learning styles; using iPads to develop mathematical understanding; using iPads to improve engagement, independence and participation; and using iPads to individualize instruction.

Results and Discussion

The findings from the data support the use of iPads as a supplement to the traditional teaching methods with the students involved in the study. The following six themes emerged from the data:

Using iPads as a Guide

Apps used on the iPads acted as a guide for teacher candidates as well as the students. Teacher candidates had access to readily available math problems related to the math topics that the students were required to learn. Problems were also accompanied with step-by-step instructions with explanations and answers including different methods to solve them. When students had trouble with any of the problems, the teacher candidates were able to go through the step-by-step instructions already available in the apps. This helped the students pinpoint the exact step they were missing or were confused about and helped them to understand the problem better. For example, the “Division for Kids” app showed the student step by step how to divide 2-digit and 3-digit numbers, and it also showed the solution at the end of the problem, while identifying the divisor, dividend, and the quotient. One of the teacher candidates quoted:

Not only was it [iPad] helpful with activities that the students could do, but it also showed step by step procedures on many of the apps I used.

Using iPads as an Informal Assessment Tool

Apps served as a great tool for informal assessment to check for understanding of the math concepts. Apps such as “Grade 4 Math” had sample problems and practice exercises and provided points for correct answers. Students wanted to get as many points as they could and without even knowing it, they were improving their math skills while solving the practice problems and earning points. The apps also challenged the students to think critically about the problems. The problems were presented in a game form which interested and motivated them to think, in order to solve the problems correctly to earn the points. The practice problems directly tested the students’ understanding of the material. Before working with the iPads, the students were unclear about how to solve certain math problems but once they started working with the iPads their ability to solve the problems increased exponentially. One of the teacher candidates commented:

One of the benefits of using the iPad was that the student got direct feedback on whether the problem they completed was correct or incorrect which in turn would allow me to help the student see their mistake in order to correct it.

Using iPads for Different Learning Styles

The iPads engaged all types of learners. It was a great tool for visual learners because certain apps demonstrated the steps involved in solving the problems. The iPads have headphone jacks built into them, which was great for students who were easily distracted or were auditory learners. The touch screen features helped kinesthetic learners to move things around when solving problems and playing math games. One of the teacher candidates commented:

I cannot just expect the student to get it, but have to really take into consideration the students’ learning style.

Another teacher candidate commented:

The iPad helped the students who learn better with a visual cue such as seeing the bubbles in Number Frames [app] so they didn't have to waste their time drawing circles with dots in them.

Another teacher candidate commented:

I have found that teaching in ways that are hands on and use kinesthetic and visual methods have been the most successful.

Using iPads to Develop Mathematical Understanding

Using apps along with the traditional teaching methods helped students to understand order of operations, expressions, multiplication and division better. Visual demonstration of the steps involved in solving the math problems really helped students to understand how to solve the problems which they were not able to do before. Apps such as “Division Wiz” and “Math Animations” broke down the steps of a problem which helped the

students to visually see what they needed to do. Students were also more engaged with the content because the apps were interactive and provided instant feedback which helped them to figure out mathematical equations that they were not used to doing before the use of iPads. They were able to understand the math concepts more clearly than ever before. Apps allowed them to see math topics presented in many different ways and appealed to their learning styles. The apps allowed them to work independently, as well as together with the tutor. As one of the teacher candidate commented:

I learned that being able to allow the students to explore math while using the iPad allowed them to take knowledge to a whole other level.

Another teacher candidate commented:

I learned that being able to present more visual aid to students and allowing them to see the work can really benefit their learning.

Using iPads to Improve Engagement, Independence and Participation

To begin with, the students were very reluctant to learn math but by the end of study, they became very comfortable and were eager to solve math problems. They wanted to spend more time with the apps to practice math and wanted to participate more than ever. Using interactive math apps along with the traditional teaching methods allowed students to practice math in a fun way and improved their willingness to solve math problems. Once they were instructed on how to use the apps they were able to work with the apps on their own, which gave them a sense of independence. Some apps included problems in a step-by-step manner, some were set up more like a game, and others provided in game manipulative. Instant feedback along with virtual rewards from apps such “Splash Math” increased their willingness to work on more math problems and helped them to stay focused and engaged in the learning process. Teacher candidates noticed that as time went on, motivation became a major factor while using the iPads. The students couldn't wait to get on the iPad to complete different tasks that were asked of them. They looked forward to using different types of apps to practice math. They were more willing to learn with the use of iPads and were more engaged in their learning. As one of the teacher candidates stated:

The iPads, in my opinion, was a great success because it did what any teacher wants to do, motivate their students to learn.

Another teacher candidate commented:

They [iPads] engaged the students, motivated them to complete the problems.

Another teacher candidate commented:

Students love working with the iPad's and the apps, and I believe it helps them become more motivated to learn.

Using iPads to Individualize Instruction

Ipads helped teacher candidates to individualize instruction for the students. They were able to decide which apps to use with the students based on their individual abilities, so that the students could comprehend the concepts better. It was noticed that with the implementation of the right apps based on the learning abilities of the students, the understanding of the math concepts had improved. For examples, students who understood the math concepts better by using the paper and pencil approach really benefitted from the Chalkboard app. The chalkboard app was more like a virtual whiteboard where students could pick a color and start writing the problem like they would on a whiteboard or a paper. One of the teacher candidates commented:

I believe the iPad use and the more individualized instruction is helping them tremendously.

Some mathematical concepts can be difficult for students to grasp. Also, some students grasp them quicker than others. The students, both advanced and slower-working, enjoyed using the iPads as a supplement to their math lessons. The apps used with the students were on a level they understood, and they were able to work as slowly, or as quickly as they liked. Advanced students could work quicker through the iPad app, which provided them a challenge. While the slower working students could move at a pace that allowed them to fully grasp the lesson.

In this way, using the iPad helped with mathematical understanding. The apps in the form of math games acted as an incentive for students to learn math concepts.

Another teacher candidate commented:

This experience has shown me the many different free apps you can acquire for supplements to your lesson.

Conclusion

In an increasingly technology-dependent world, the use of iPads opens up an entirely new approach to teaching and learning. Educational applications of iPads are endless and they can be a great asset to any classroom. Use of iPads in addition to the traditional teaching methods improved conceptual understanding of numbers, order of operations, expressions, and multiplication and division skills of students with learning disabilities involved in the study. Content specific apps when used in alignment with the learning abilities of the students kept them engaged, focused, and motivated. Interactive educational apps with instant self-correcting feedback helped them to understand and retain the content better. Readily available practice exercises within the apps served as informal assessments. Apps acted as a guide for students to help them with the understanding of the content in ways that they were not exposed to before this study. Teacher candidates were able to use iPads to individualize instruction based on the abilities and learning styles of the students. Having the iPads in their hands allowed students to take charge of learning and was an incentive for students to complete tasks. Use of iPads with students reduced distractions, eliminated behavior problems, and increased their willingness to learn math. With the use of iPads, students were more involved with the content, had more opportunities for repetition and practice, and were more focused.

Overall, it can be concluded that iPads have the potential to help students with learning disabilities to understand the math content better when used in addition to the traditional teaching methods. Appropriate math apps when used as a supplement based on the particular learning needs of the students can help teachers with the traditional teaching styles to meet 21st century learning preferences. They can serve as a helpful aspect of an ever changing classroom.

Recommendations

The short duration and small sample size of this study warns against the generalization of the results to a larger population. Similar studies with larger sample sizes are recommended to fully determine the effectiveness of using iPads as a supplement to promote math skills of students with learning disabilities. Also, this study was from the perspectives of pre-service teachers only and perhaps other studies involving in-service teachers can help better identify the benefits of using iPads with special needs students.

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