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Using iPads to Improve Mathematics Skills for Students with Emotional and Behavioral Disorders and Autism

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ABSTRACT

Teaching and learning in the classroom is improved by incorporating technology into instruction, especially when working with students with special needs. New technologies like iPad, have the potential to help meet students' individual needs, encourage their learning, and help them to prepare for a digital society. The goal of this literature review is to determine the effectiveness of using the iPad as a tool to improve the mathematics skills of students with Emotional and/or Behavioral Disorders and Autism Spectral Disorder. Given the importance of effective technology such as iPad among special education teachers of students with disabilities, will help the students both academically and behaviorally.

Keywords: iPads, mathematics Skills, Emotional and Behavioral Disorders, Autism.

Introduction

Almost 30% of mathematics class time is devoted to traditional instruction methods (Haydon et al.2012). In the activities associated with these methods, students with Emotional and Behavioral Disorders (EBD) and Autism Spectral Disorder (ASD) are less engaged and have lower performance in mathematics when compared with their peers (Haydon et al., 2012; King, Thomeczek, Voreis, & Scott, 2014). Most of these students get discouraged with math, especially when they do not get good grades or are unable to improve their performance (Calhoon, Emerson, Flores, & Houchins, 2007).

With the integration of computers in education, students had access to new ways of learning academic skills. iPads are rapidly replacing mouse and keyboard interaction methods. Anthony, Brown, Nias, Tate, and Mohan, (2012) stated that this shift in technology moves students from a more indirect interface method (mouse and keyboard) to a more direct interface method (touch screen). It has become increasingly important for students with EBD and ASD to gain technological skills to be successful in both their educational and career lives. Presenting technological devices as learning tools can increase their success in school and in life (Dove, 2012).

Integrating technology in mathematics classes may help students with EBD and ASD to improve their academic performance (Dove, 2012). New technologies can help teachers to meet student's individual needs, encourage their learning, and prepare students to live in today's digital world (Wright & Wilson, 2011). Applying new technologies in the classroom, including iPads, can be exciting for both teachers and students when they know how to properly integrate them into their teaching methods (Draper, Strnadová, & Cumming, 2014). By integrating technological tools in math instruction, such as iPads, these students may improve their skills in math (Calhoon et al., 2007).

Purpose

The purpose of this review of literature is to determine the effectiveness of using iPad as a tool to improve the mathematics skills of students with Emotional and/or Behavioral Disorders (EBDs) and Autism Spectral Disorder (ASD). The guiding question for this review is whether iPad, as a teaching device, can effectively improve mathematics skills for students with EBD and ASD. It will interpret the findings of others who have examined their effectiveness of iPad. Students with disabilities in schools often get discouraged with math, especially when they do not get good grades or are unable to improve their performance (Calhoon et al., 2007). The majority of students with these disabilities have lower performance in mathematics when compared with their peers (Calhoon et al., 2007). Often, their behaviors significantly affect or interfere with the learning process. For these reasons, many students may even withdraw from school. By using promising technological tools in math instruction, such as iPads, these students may be more likely to successfully improve their skills in math (Calhoon et al., 2007).

Review of literature

Research on iPad usage in instructional settings has tended to fall into two broad categories. In the first, the effectiveness of iPads is compared to more traditional pencil and paper methods. The following section contains a review of three articles in regard to examine different populations (students with EBD and students with ASD) and different aspects of student behavior and academic performance in math. In the second, iPad effectiveness is compared to other computer-based instructional methods. iPads are rapidly replacing both the traditional methods; they are also replacing earlier computer-based applications for math instruction.

Studies Comparing Traditional Methods and iPads

Haydon et al. (2012) compared the effects of using iPads to traditional paper/pencil worksheets on student outcomes in math. In this study, iPads were integrated into a high school special education mathematics classroom. This study was conducted with three students with EBD. One group completed problems using worksheets and pencils, while the second completed problems with the incorporation of iPads. The specific math concepts being taught during this study included money management skills. During timed work sessions, an alternating schedule of iPads and worksheets were used to document the numbers of problems students solved correctly. During the iPad sessions, all three students got the greatest number of correct answers. The mean numbers of problems solved correctly were 3.23, 3.93 and 3.23 per minute using the iPad, while the means using worksheets were 1.23, 0.75, and 0.65 respectively. The study also examined changes in levels of on-task and disruptive behaviors. Teachers reported that the iPads seemed to increase time on-task and decrease disruptive behaviors (Haydon et al., 2012).

In 2013, a study was conducted to examine the differences in students' academic engagement between iPad and traditional methods (pencil/paper, flash cards), but this time with two students with ASD (Neely, Rispoli, Camargo, Davis, & Boles, 2013). During the iPad sessions, both student's academic engagement showed great improvement over sessions using traditional methods (from M=8.6% to 89.3% for student 1, from M= 29.2% to M=70.3% for student 2). The authors conclude that the use of an iPad, when integrated into classroom instructional methods, may increase the engagement of students with autism.

O'Malley, Lewis, Donehower, and Stone (2014) found that iPads are an effective tool to increase the level of independent task completion among students with ASD and to improve their math skills performance. The study was conducted in special education with seven participants with ASD ages 10 to 13. During the baseline phase, traditional math instructions methods were used; during the intervention phase, an iPad was used with an application of basic math skills.

The iPad intervention was then withdrawn in the second A phase, and then reinstated in the final B phase. The researchers found that during the first intervention phase,

students were able to improve their performance and achieve academic goals they were unable to achieve during phases using the traditional instruction. The students also showed more interests in the content. The authors concluded that iPads positively impacted academic performance and engagement. When compared to the worksheet sessions, the students showed higher levels of engagement, and they answered more math problems correctly in less time.

Studies Comparing Computers and iPads

Another set of research studies has focused more generally on examining students' classroom interactions with computer software and how it affects student outcomes on a variety of measures. While less research was found related directly to students' use of iPads in educational settings, as the technology is newer, some recent studies have begun to emerge in the literature. In recent years, use of iPads have been growing and spreading rapidly, in society generally and in both regular and special education settings. This trend has led to growing interest to how iPads compare to earlier forms of classroom technology.

iPads are beginning to replace earlier technology platforms in the classrooms of many schools. Arthanat, Curtin, and Knotak (2013) examined the use of iPads and computers with students with Developmental Disabilities (DD), including students with Autism Spectrum Disabilities (ASD). These students were selected based on their learning needs in math. The students were observed using computers to form a base line for the study. The iPad was introduced as an intervention. During both the baseline and the intervention phases, video was taken to compare and control for differences in instruction and teacher engagement. Neil, who had been selected for deficiency in math and money recognition, did not correctly answer a single question on the baseline academic test, responded correctly 30% of the time in the intervention phase. Jake's participation using iPad was better than with computer while counting. As reported by his teachers, Jake showed an active interest in the iPad, and his academic performance increased from 40% at baseline to 60 % at the intervention.

iPads and Math Skills

It is important to teach the students the functional math skills to increase their independence after they leave school, especially for students with ASD (Weng & Bouck, 2014). The skills included in the definition of a student's functional ability include price comparison, purchasing, calculation and numeracy skills. One study examined teaching a functional mathematical skill critical to increasing independence, price comparison, to secondary school students with autism and intellectual disabilities in a high school setting. Price comparison is a combination of many tasks, including knowledge and understanding of numbers and other mathematical concepts (Weng & Bouck, 2014). Research regarding the teaching of students with ASD the

skills of numeracy and calculation was conducted to evaluate the effectiveness of using an iPad.

Weng and Bouck (2014) examined the effectiveness of video prompting to teach price comparison skills using an iPad. With video prompting, step-by-step visual prompts were shown to the students before they were asked to do each step. Students received verbal directions from teachers, with the goal of having them choose the lowest price for an item within 20 seconds. Responses were counted as correct if the student chose the lowest-priced item and put it in the basket within 20 seconds. The responses were counted as incorrect if the student did not choose the lowest-priced and put it in the basket, or did not respond to the task within 20 seconds. The research results indicated that two out of the three students benefited from video prompting from an iPad when comparing prices, both during class and in the grocery store setting. One student, however, showed a decline in performance. During baseline, the first student's average for selecting the lowest-priced item was 25%. During intervention, his performance increased to a mean of 77.5%. During baseline, the second student's average for selecting the lowest price was 20% and it increase to 40% during the intervention. During baseline, the third student's mean for choosing the lowest-priced item was 40%. During the intervention, this student selected the lowest-priced item independently only an average of 16.7% of the time.

The results of this study had positive effects on the performance of the students in math when an iPad was used. This study by Burton, Anderson, Prater, and Dyches (2013) examined the effects of video self-modeling (VSM) via iPad on mathematics skills achievement for four male adolescents with autism and intellectual disabilities. The goal of the research was to better understand the math skills students' need in making purchases. In a series of five videos, students watch themselves on an iPad solving five story problems. Students had to estimate the amount of money needed to buy an item and the change they would receive back.

The authors found that video modeling using the iPad was an effective and successful tool for increasing the functional math skills of students with autism in secondary schools. Based on the results, there was a functional relationship between video self-monitoring and math skill achievement and accuracy of math calculations for all four students. The authors conclude that VSM via an iPad was an effective method of providing adolescent students with autism and intellectual disabilities academic content in math.

Children at a young age have incomplete ability to use technology due to developing cognitive and motor skills. Research found that children in the age range of 5 to 7 have difficulties in understanding complicated instructions (Revelle & Reardon, 2009). Instruction should be simple, direct, and the child's age should be considered (McKnight & Cassidy, 2010). Another study evaluated the effectiveness of an iPad-based video modeling package to teach Jack, a 5-year-old with autism basic numeracy skills (Jowett, Moore, & Anderson, 2012). Jack's IQ was 72. The video modeling package materials were used to teach Jack the numbers from 1-7. The package included an iPad to show videos teaching numeracy, trial sheets with three attempt boxes used to write the numbers, and quantity cards which showed

pictures of his favorite cartoon “angry birds” to identify and count the number of birds.

Jack showed irregular improvements in his ability to accurately draw numerals, eventually stabilizing at 100% accuracy. The study found that iPad-based video modeling was an effective and successful technique for teaching numeracy skills to children with an ASD when used in a package (Jowett et al., 2012).

iPads can be used effectively with a variety of students, but it should be adapted to the age level and the needs of the students. Teachers should always consider a student’s individual needs when they use iPad technology in classrooms. All students are different and need interactions that acknowledge these differences with teaching and learning, therefore, teachers should provide them with suitable technology (Wright & Wilson, 2011). It is important that the teachers accommodate the special needs of students with disabilities.

The perception exists among some educators that iPads and other touch screen devices are not serious educational tools. Some resistance seems to relate to a feeling that students will just use these devices to play games, and not for more educational purposes (Crichton et al., 2012). To address this, researchers have begun to study how students use touchscreen devices naturally; these researchers wanted to find out how students with ASD might choose to use iPads at school when given no instructions (King et al., 2014).

In a study by King et al. (2014), students did not receive instruction before they were videotaped using iPads. The apps were installed to help students improve their performance in math. During observations, the participants spent an average of 51% of their time on academic apps. The researchers found that students with ASD, when presented with iPads, spent the most time using academic apps, and conclude that the device was a useful tool to enhance the learning of children and adolescents with ASD.

Beyond direct instructional time, Flower (2014) wanted to examine the effectiveness of iPad use while students were completing tasks during independent practice. In the study, the teachers gave students instruction on how to use the application. Students were provided with applications, such as Math Bingo, to practice math skills. The students and teachers involved in this study responded to a survey to examine whether the students liked the use of iPad, and to find out what they liked the most about it. The teachers reported that iPad was an effective tool to use with students during math independent work and that they could be used with different classes too. All three students reported that they learned new skills and that their performance on math improved. It was fun and they never got bored when they solved problems using iPads.

Results suggested that iPad implementation increased time on-task for all three students. Teachers and students both reported that the iPad was a positive, helpful, effective and acceptable tool for independent study (Flower, 2014).

Barriers and Challenges

When teachers know how to appropriately integrate them into the classroom, iPads can be exciting and useful tools for both teachers and students. While there are benefits to using this technology in classrooms, especially for students with EBD and ASD, there are also many challenges and barriers to implementation. Incorporating iPads into classrooms involves more than just purchasing the devices and giving them to students.

Studies cite two major barriers and challenges to integrating iPad technology in classrooms. First, teachers need to have a full understanding of how to use the device effectively as an instructional tool (Peluso, 2012). In order to fully integrate a technology, Cumming et al. (2014) suggested that teachers should plan and train on a device before bringing it to class. They also suggested the use of rubrics to assess whether the application is effective or not. A second challenge involves cost (Carr, 2012). Limited funding faced by most schools can make it difficult to provide iPads in the classroom (Peluso, 2012). Other barriers to incorporating technology in classrooms include: the policies of educational institutions, the attitudes and beliefs among educators about integrating technology, the teachers' and students' existing base of technological knowledge and skills, and lack of guidance on how to assess a device's effectiveness (Crichton, Pegler, & White, 2012).

Discussion and Conclusion

Summary

Research on the effectiveness of using iPads as a teaching tool in mathematics for students with EBD and ASD is very limited. However, in this review, research was uncovered which provides important evidence that iPads are an effective tool to use with students with these disabilities. While implementing iPads in classrooms comes at a high cost for schools, these devices do seem to be useful tools for improving engagement and learning outcomes for students. This review of research has revealed some limitations with the studies of these concepts. However, the studies that have been conducted hold some important implications for teachers working with students with EBD and ASD, and for schools. This review has also identified gaps in the research which point to the need for future studies.

Limitations

This review also identified some limitations in the research regarding this topic. The samples sizes used in the studies were uniformly small, the number of participants in all studies was less than 10, and in one study only a single student participated. These small sample sizes prevent broad generalization of the findings of

these studies. In addition, the existing studies only demonstrate the effect of using iPads over relatively short periods of time. It remains unclear if the positive effects observed will be lasting. Finally, not all these studies were examining identical concepts, some of them mixed measures engagement with those of academic improvements, while others further combined measures of on-task or disruptive behaviors.

Implications for Students, Educators, and Schools

Students appeared to be more engaged when using iPads and were disappointed when iPads were taken from them (Haydon et al, 2012). Senior high students are less engaged in traditional activities in mathematics class. Students showed higher engagement levels when they used iPads, and the devices seem to improve their ability to solve more complex problems in math (Haydon et al, 2012). The students found the devices easy to use; it took students less than an hour to become familiar with the devices Teachers and observers confirmed that students were more actively engaged during math class compared to traditional methods (Haydon et al., 2012; Neely et al., 2013; O'Malley et al., 2014).

Research findings suggested that iPads can be used successfully in instruction for students from the preschool level to the university level and helped to prepare students in high schools for transition from secondary education to employment and university life (Haydon et al., 2012; Jowett et al., 2012; Neely et al., 2013; O'Malley et al., 2014; Weng & Bouck, 2014; Wright & Wilson, 2011). Using iPads increased student involvement, engagement, participation, and levels of motivation during the whole class (Haydon et al., 2012; Neely et al., 2013; O'Malley et al., 2014).

iPads have been used successfully in teaching students with disabilities (Douglas, Wojcik, & Thompson, 2012). Kagohara et al. (2013) stated that other research found that when using iPads with students with development disabilities, math skills improved, and students generally developed their academic skills. iPad instruction also has particularly positive effects on academic performance among students with EBD and ASD in learning basic math skills.

Many researchers conclude that the use of technology in the classroom helps improve teaching

(Haydon et al., 2012; Jowett et al., 2012; Neely et al., 2013; O'Malley et al., 2014; Weng & Bouck, 2014; Wright & Wilson, 2011).

Additionally, methods incorporating iPads appear to be superior to those using only traditional materials. However, when iPads were compared with other computer-based platforms, there were less noticeable engagement differences among students using the different technologies. Overall, however, iPad as a technological teaching

device, helped students with developmental disabilities to increase their own knowledge and improve their learning (Cumming, Strnadová, & Singh, 2014).

The studies highlighted some of the ways schools can overcome challenges involved with implementing iPad technology in the classroom. To effectively integrate this new technology in the classroom, schools have to have a vision, a plan, money to purchase the devices, and assessments tools that can measure the effectiveness of using a particular device with students (Hew & Brush, 2007). Schools have to offer courses and training to teachers in order to change their attitudes and beliefs about integrating these new devices in their teaching.

Future research

Future studies should be conducted using larger sample sizes in order to facilitate their findings to be generalized to the broader population. Research should also be designed to examine the more long-term effects of using iPads in classrooms. There is also a need for similar longitudinal designs to examine these effects in educational settings serving students with EBD and ASD. Future research should also be structured to define and narrow the concepts being measured more clearly. Too many existing studies mix measures of concepts in ways that limit their ability to make causal connections.

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