The Effects of iPad Use on Student Engagement Versus Paper and Pencil

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Approved by: Betsy Klinger

Betsy Klinger	3·20·2018
Signature of Advisor	Date Approved

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University of Wisconsin-Platteville

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by

Brent Niemeier

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Abstract

Technology is a growing part of classroom instruction. One of areas where we have seen an increase in technology is mathematics, especially at the elementary level. Game-based learning applications create exciting interactive learning opportunities for students that may lead to higher academic achievement. The purpose of this experimental study was to explore the effect using a math fact fluency iPad app (Reflex) would have on student engagement versus a paper and pencil fact book. The participants included five fifth grade students with an Individualized Education Plan (IEP). I used a structured observation form to collect data on the level of student engagement. During weeks one and three students completed the traditional factbook with paper and pencil. On weeks two and four, the students played the Reflex math fact fluency app on the iPad. I observed the group for 15 minutes in 30 seconds intervals. The finding showed that students were more engaged in the iPad app. However, the students showed a preference for the traditional fact book.

Keywords:

student engagement

iPad

math fact fluency

CHAPTER 1: INTRODUCTION

Background

My project was guided by the question, does using a math fact fluency application on the iPad engage elementary students with disabilities more than a traditional paper and pencil fact book?

Flower (2014) explored the effects of using an iPad during independent work time versus the traditional paper and pencil independent work time. Flower (2014) compared the scores from three boys (second, third, and fourth grade) who had Individualized Education Programs (IEPs). These students' IEPs suggested that they struggled with on-task behavior. Flower (2014) identified two conditions, the typical practice condition and the iPad condition. The typical practice condition consisted of the students completing worksheets independently at a table with pencils and crayons. The iPad condition consisted of the students completing their independent practice using an iPad. Results indicated that the on-task behavior of the students was higher during the iPad condition and lower during the typical practice condition. This raises the question: Can the finding that iPads help students with disabilities work independently be replicated? Flower (2014) used a variety of apps focusing on different areas of mathematics (shapes, counting, etc.), but I would like to only use one, the Reflex math facts fluency app.

O' Malley, Lewis, and Donehower (2013) wanted to understand whether an iPad is an effective instructional tool for students with disabilities. They examined seven students (two girls and five boys) who had a primary diagnosis of attention deficit hyperactivity disorder (ADHD) and were between the ages of 10-12. The first and third weeks they completed traditional math activities without using an iPad. The second and fourth weeks, the students completed their intervention using an iPad app. O'Malley et al. (2013) explained that class-wide data revealed a

positive effect on independent task completion when using the iPad. I would like to replicate parts of this study in my classroom. For example, I like the equivalent time samples design. I will be implementing the Reflex math fact fluency app (iPad) and comparing the students' engagement to the level of engagement with the district's traditional math fact book.

Statement of the Problem

The problem addressed was student engagement. I wanted to find the most effective teaching tools to keep students engaged during academic activities. Based on the above research, I hypothesized that my elementary students with disabilities would be more engaged using the Reflex math fact fluency app versus the traditional fact book. I also hypothesized that the students would enjoy using Reflex more than the fact book.

Definition of Terms

Student Engagement

Student engagement is "the quality of effort students themselves devote to educationally purposeful activities that contribute directly to desired outcomes" (Hu & Kuh, 2002, p. 555).

Math Facts

Math facts refer to "one digit by one digit addition, subtraction, multiplication and division problems" (McCallum & Schmitt, 2011, p. 227).

Math Fact Fluency

Math fact fluency refers to reciting math facts with ease.

Delimitations and Limitations of the Research

There are several delimitations involved with this study. The participants are all students with disabilities. I chose this because I am an elementary special education teacher and I was interested in the most effective instructional tools for students with disabilities. This is also

the reason I chose elementary students for participants. Finally, all the participants are from Abraham Lincoln Elementary in Monroe because it is convenient for me to conduct my research in the same building I teach in.

There are also several limitations involved with this study. I was only able to choose participants from fourth and fifth grade because those are the grade levels I worked with this year. Another limitation is that I was only able to have five to ten participants in this study because of my caseload of students this year.

Method of Approach

I used a structured observation form (see Appendix B) to collect data on the level of student engagement. During weeks one and three students completed the traditional math fact fluency book with paper and pencil. On weeks two and four, the students played the Reflex math fact fluency app on the iPad. I observed the group for 15 minutes in 30 seconds intervals. For each 30 seconds, I recorded whether each student was engaged or not engaged in the activity using a number corresponding to each student. Engagement in the activity includes working on the activity without prompting or distraction. Non-engagement behaviors included being out of their seat, talking to another student, looking away from the activity, fidgeting in their seat, etc.

After the observation, I calculated the percentage of time each student was engaged in the activity. Then I found the average percentage of time each student was engaged while doing the fact book and iPad. Also, the students filled out a survey asking them how much they enjoyed each activity and which one they enjoyed more (see Appendix B).

CHAPTER II: REVIEW OF THE LITERATURE

Research Question

There have been many studies involving the use of technology in education. I examined whether providing technology-based interventions would increase student engagement. I implemented the Reflex math fact fluency application (an Ipad app) and compared the students' engagement with Reflex to the level of engagement with the district's traditional math fact book.

Discussion of Prior Research

Flower (2014) explored the effects of using an iPad during independent work time versus the traditional paper and pencil independent work time. Flower (2014) compared the scores from three boys (second, third, and fourth) who had Individualized Education Programs (IEPs). These students' IEPs suggested that they struggled with on-task behavior. Flower (2014) identified two conditions, the typical practice condition and the iPad condition. The typical practice condition consisted of the students completing worksheets independently at a table with pencils and crayons. The iPad condition consisted of the students completing their independent practice using an iPad. Results indicated that the on-task behavior of the students was high during the iPad condition; however, the on-task behavior during the typical practice condition was low. This raises the question: Can the finding that iPads help students with disabilities work independently be replicated?

Sessions, Kang, and Sue (2016) investigated the effects of integrating iPad applications into writing instruction for fifth grade students. Using random assignment, they separated a group of 30 students (13 girls and 17 boys) into Track A and Track B. Track A received teacher instruction and used paper and pencil methods in their writing and Track B received the same instruction but used iPads and writing applications. The students completed three writing units

in their tracks. Sessions et al. (2016) found that students on Track B had increased motivation for writing compared to the students on Track A. The students described it as a fun way to get their ideas out. Even though Sessions et al. (2016) based their study on writing instruction, they still provide evidence supporting the idea that the use of iPads can increase student engagement.

Musti-Rao and Plati (2015) compared two interventions using iPad instruction versus detect-practice-repair (DPR) in a third grade classroom. Both interventions were meant to increase the students multiplication fact fluency. The participants were twelve third-grade students (five male and seven female) who did not receive special education support in math. The DPR condition involved several versions of a 20 slide PowerPoint presentation. The first 15 slides included the student learning new multiplication facts. The last five had the students practice on worksheets and correct the ones they got wrong. The iPad condition involved students playing the Math Drills app on their own iPads. Over the three-week period, the students in the iPad condition showed greater gains in multiplication fact fluency than the students in the DPR condition. The response rate of the students also increased at a higher rate under the iPad condition versus the DPR condition. While this study examined third grade students, I believe it is still provides strong evidence that these results can be replicated throughout elementary-aged students.

Shanley, Cary, Clarke, and JungJohann (2013) investigated how successful the classroom implementation of KinderTEK math apps was for kindergarteners. There were fifty (24 female and 26 male) kindergarten students that participated in the study. KinderTEK is actually comprised of two apps. One app provides explicit instruction for each student at their individual level and the other app lets their teacher monitor their progress. The students received this intervention for three days a week for fifteen minutes. Their findings provided evidence of a

significant association between KinderTEK use and changes in mathematical performance. It also showed that students' oral counting was positively related to the amount of time spent and the number of activities completed on the KinderTEK app. This is yet another study that shows iPad app inclusion in math intervention can have a positive outcome on mathematical success.

Attard and Curry (2012) explored how the incorporation of iPads in a Year Three (4th grade) classroom related to the students' engagement with mathematics. The teacher was given 30 iPads for six months. The teacher met with a focus group at the beginning and end of the trial to discuss their engagement with mathematics. The teacher believed that the students were more engaged with the math lessons than they had been previously. He also noted an increase in enthusiasm and participation. While Attard and Curry (2012) conducted a case study, they still support the argument that iPads can increase student engagement.

Haydon, Hawkins, Denune, Kimener, and McCoy (2012) compared the effect of worksheets versus iPads on math fluency and student engagement in a high school math class. The study included three high school students who demonstrated math skill deficits. Haydon et al. (2012) identified two conditions: the worksheet condition and the iPad condition. The worksheet condition consisted of the students completing worksheets. The iPad condition consisted of the students completing work on an iPad app. The teacher would announce that it was either a "worksheet day" or an "iPad day." According to Haydon et al. (2012), all three of the students demonstrated lower percentages of engagement during the worksheet condition compared to the iPad condition. Haydon et al. (2012) examined high school students and not elementary students, but still provides evidence supporting the previous studies.

O' Malley, Lewis, and Donehower (2013) wanted to understand whether an iPad is an effective instructional tool for students with disabilities. They examined seven students (two

girls and five boys) who had a primary diagnosis of attention deficit hyperactivity disorder (ADHD) and were between the ages of ten and twelve. The first and third week they completed traditional math activities without using an iPad. The second and fourth week, the students completed their intervention using an iPad app. O'Malley et al. (2013) explained that class-wide data revealed a positive effect on independent task completion when using the iPad. I replicated parts of this study in my classroom. For example, I used the equivalent time samples design.

Summary Statement

Overall, the research indicates that the use of iPads increases student engagement. Several of the studies examined math fact fluency apps (Flower, 2012; Haydon et al. 2012) and I proposed to examine if the Reflex fact fluency app would increase student engagement. I made the mode of the delivery (iPad versus paper and pencil) my independent variable and student engagement the dependent variable.

Hypotheses

Based on the above research, I hypothesized that my elementary students with disabilities would be more engaged using the Reflex math fact fluency app versus the traditional fact book. I also hypothesized that the students would enjoy using the Reflex app more than the fact book.

CHAPTER III: METHOD

Participants

My participants were chosen from the investigator's current caseload of five fourth grade students and five fifth grade students. All the participating students attended Abraham Lincoln Elementary (K-5) in Monroe, Wisconsin. These students all had an individual education program (IEP). These students have either been labeled with a speech and language impairment or a specific learning disability (SLD). Five fifth graders (four boys and one girl) participated in the study. Their ages ranged from nine to twelve years old with a mean age of 10.6 years old. In this district 87.1% of the students were Caucasian. Also, 50% of the students at Abraham Lincoln Elementary receive free and reduced lunch.

Materials

Reflex math fluency application. The Reflex math fluency app is an iPad app that uses repetition through puzzles and games to help student become more fluent with their basic math facts.

District fact book. The district fact book is a paper bound book that teaches the students facts using memorization tricks and repetition to become more fluent with their basic math facts.

Procedure

This was a four-week study conducted during the students' math intervention time. During weeks one and three students completed the traditional math fact fluency book. On weeks two and four, the students played the Reflex math fact fluency app on the iPad. I used a structured observation form (see Appendix B) to collect data on the level of student engagement. I observed the group for 15 minutes in 30 seconds intervals. For each 30 second period, I recorded whether each student was engaged or not engaged in the activity using a number code

corresponding to each student. Engagement in the activity included working on the activity without prompting or distraction. Non-engagement behaviors would include being out of their seat, talking to another student, looking away from the activity, fidgeting in their seat, etc.

After the observation, I calculated the percentage of time each student was engaged in the activity. Then I found the average percentage of time each student was engaged while completing the fact book and iPad. Also, the students filled out a survey asking them how much they enjoyed each activity and which one they enjoyed more (see Appendix B). Answers to question 1 were assigned negative values. On question three, -1 points were assigned for "fact book" and +1 point for "reflex." Once the three answers were summed up, a positive value indicated preference for the Reflex app and a negative value preference for the fact book.

CHAPTER IV: RESULTS

Table 1 – percentage of engagement during week 1 using the factbook

WEEK 1 Factbook	Monday	Tuesday	Wed	Thurs	Friday	Avg Week
Student 1	60%	76.67%	76.67%	80%	86.67%	76.00%
Student 2	80%	80%	63.33%	93.33%	76.67%	78.67%
Student 3	76.67%	76.67%	76.67%	73.33%	ABS	75.84%
Student 4	ABS	73.33%	80%	86.67%	76.67%	79.17%
Student 5	86.67%	80%	86.67%	90%	86.67%	86.00%

Table 2- percentage of engagement during week 2 using the Reflex app

WEEK 2 Reflex	Monday	Tuesday	Wed	Thurs	Friday	Avg Week
Student 1	96.67%	100%	96.67%	96.67%	ASSEMBLY	97.50%
Student 2	90%	93.33%	93.33%	93.33%	ASSEMBLY	92.50%
Student 3	93.33%	86.67%	86.67%	90%	ASSEMBLY	89.17%
Student 4	83.33%	86.67%	90%	86.67%	ASSEMBLY	86.67%
Student 5	93.33%	96.67%	ABS	96.67%	ASSEMBLY	95.56%

Table 3– percentage of engagement during week 3 using the factbook

WEEK 3 Factbook	Monday	Tuesday	Wed	Thurs	Friday	Avg Week
Student 1	83.33%	73.33%	70%	80%	73.33%	76.00%
Student 2	73.33%	76.67%	80%	73.33%	83.33%	77.33%
Student 3	76.67%	73.33%	76.67%	80%	80%	77.33%
Student 4	80%	70%	73.33%	80%	73.33%	75.33%
Student 5	86.67%	83.33%	96.67%	96.67%	86.67%	90.00%

Table 4- percentage of engagement during week 4 using the Reflex app

WEEK 4 Reflex	Monday	Tuesday	Wed	Thurs	Friday	Avg Week
Student 1	90%	93.33%	86.67%	90%	73.33%	86.67%
Student 2	86.67%	93.33%	86.67%	83.33%	80%	86.00%
Student 3	83.33%	93.33%	90%	90%	76.67%	86.67%
Student 4	83.33%	86.67%	93.33%	80%	67%	82.07%
Student 5	ABS	93.33%	96.67%	96.67%	86.67%	93.34%

Table 5- Average percentage of time engaged in each activity

Student	Factbook	Reflex app	Difference in percentages
Student 1	76.00%	92.08%	16.08%
Student 2	78.00%	89.25%	11.25%
Student 3	76.58%	87.92%	11.34%
Student 4	77.25%	84.37%	7.12%
Student 5	88.00%	94.45%	6.42%

Table 6 – Results of Engagement Survey

Student	Preference Score
Student 1	-3
Student 2	-1
Student 3	+3
Student 4	-3
Student 5	-2

positive scores indicate preference for Reflex and negative scores indicate preference for the factbook

CHAPTER V: DISCUSSION

In the studies I mentioned previously in the literature review section, there were multiple studies that suggested using technology can increase student engagement and academic achievement. Some of the studies showed more significant improvements than others. In my study, there are clear increases in student engagement. Student 1 showed the highest increase in engagement with 16.08%. On average, each student's engagement increased 10.42%. I believe this study shows that teachers can increase student engagement by using an iPad versus paper and pencil learning tasks.

Surprisingly, the student surveys showed a preference for using the paper and pencil factbook versus the iPads. Answers to question 1 were assigned negative values. Answers to question 1 were given positive values. On question three, -1 points were assigned for "fact book" and +1 point for "reflex." Once the three answers were summed, a positive value indicated preference for the Reflex app and a negative value preference for the fact book. I found it interesting that four out of the five students showed a preference for an activity that did not engage them more. Also, the highest score (either positively or negatively) was a three. This shows that students did not strongly like or dislike either activity. One explanation for the majority of the student preferences is that the students have used Reflex in the past, and the factbook was something new that they do not get to do very often.

CHAPTER VI: REFERENCES

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APPENDIX A: IRB APPROVAL LETTER

APPENDIX B: PROJECT MATERIALS

STUDENT CODE NUMBERS

Student Number	Student Name
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Principal Consent

To: Sara Latimer, Principal
From: Brent Niemeier
Re: Request for Permission to Conduct Research in Abraham Lincoln Elementary
Date: August 1, 2017

In the completion of my master's degree at the University of Wisconsin-Platteville, I am required to conduct an action/applied research project. I am asking permission to collect data at our school. The IRB proposal describes my study and identifies who I would like to participate. I am requesting your approval to carry out the study. I believe the results from this study will benefit our district by finding the most effective way to provide instruction to our students. Once the study is completed, I will share a summary of results with you.

Attached is a copy of my research protocol. If you have any questions, please feel free to contact me or my faculty sponsor.

Thank you,

Brent Niemeier, Researcher

Betsy Klinger, faculty sponsor
School of Education
University of Wisconsin - Platteville
klingerb@uwplatt.edu

I give consent for Brent Niemeier to conduct his research on student engagement, using iPads, at Abraham Lincoln Elementary.

_____ Yes. I give consent.
_____ No, I do not give consent.

_____ _____ _____
(printed name) (signature) (date)

PARENT CONSENT FORM FOR PARTICIPATION OF HUMAN PARTICIPANTS IN RESEARCH
UNIVERSITY OF WISCONSIN-PLATTEVILLE & ABRAHAM LINCOLN ELEMENTARY

1. **Purpose:** The purpose of this research is to determine student engagement and enjoyment at Abraham Lincoln Elementary during math activities.

2. **Procedure:** Your child will be asked to complete math fact work using an iPad and a paper and pencil fact book. During weeks 1 and 3 students will complete the traditional math fact fluency book with paper and pencil. On weeks 2 and 4, the students will play the Reflex math fact fluency app on the iPad. They will also be asked to complete a survey asking them about how much they enjoyed participating in each activity and which they enjoyed more. PARTICIPATION IS VOLUNTARY AND HE/SHE WILL BE ASKED TO GIVE HIS/HER ASSENT. YOUR CHILD'S NAME WILL NOT BE RECORDED ON THE RESEARCH MATERIALS AND WILL NOT BE INCLUDED IN OUR DATA SET OR IN ANY REPORTS ABOUT THE PROJECT.

3. **Time required:** Participation is expected to involve 4 hours (15 minutes per day for 4 weeks). However, that time will be part of the math curriculum so there is no additional class time for the students.

4. **Risks:** No short-term risks are foreseen. The only "cost" to the participants will be the time and effort required to participate in the study.

5. **Benefits:** Understanding which instructional tools are best for our students can benefit our school district. It can inform the teachers and administrators how our students learn and can be engaged in academic activities.

6. **Your Rights as the Parent of a Student Participant:** The information gathered in this study will be confidential. Data or summarized results will not be released in any way that could identify you or your child. If your child would like to withdraw from the study at any time, he/she may do so without penalty or repercussions. The information collected from your child up to that point would be destroyed if you or he/she so desire. At the end of the study participants will be given a debriefing detailing the exact purpose of the research. If you have any questions afterward, please ask:

Brent Niemeier, Graduate Student in Education and Special Education Teacher
University of Wisconsin-Platteville
608-328-7845
brentniemeier@monroe.k12.wi.us
Faculty Sponsor: Betsy Klinger (klingerb@uwplatt.edu)

Once the study is completed, you may request a summary of the results by contacting me (Brent Niemeier) or Sara Latimer.

7. If you have any questions about your child's treatment as a participant in this study, please call or write:

Barb Barnet
Chair of the UW-Platteville IRB
608 342-1942
barnetb@uwplatt.edu

or

Sara Latimer
Principal
608-328-7552
saralatimer@monroe.k12.wi.us

I have read the about information and (check one):

___ I DO give consent ___ I DO NOT give consent

Please print your child's name (First, Middle, Last): _____

Please print your full name (First, Middle, Last): _____

Please Sign: _____ Date: _____

STUDENT ASSENT FORM FOR PARTICIPATION IN RESEARCH
UNIVERSITY OF WISCONSIN-PLATTEVILLE & ABRAHAM LINCOLN ELEMENTARY

Dear student,

We want to provide the best education possible to you and to future students. Therefore, we are conducting this research project. You are invited to participate in our study on student engagement and enjoyment. The purpose of this study is explore what type of instruction is most effective and enjoyable for students at Abraham Lincoln Elementary.

Participation in this study will have absolutely no impact on your grades. Sometimes you will be completing math fact work using an iPad, and other times you will use the paper and pencil fact book. The information gathered in this study will be used to help make Abraham Lincoln a better, more helpful place for you and your classmates.

Your parents have already given permission for you to participate in our research project and we are hoping that you will agree to participate. Your voluntary completion of this task constitutes your agreement (assent) to participate. Thank you for helping us to better help you.

If you do not agree to participate, tell me or Mrs. Latimer as soon as possible

Sincerely,
Brent Niemeier, Graduate Student in Education
University of Wisconsin-Platteville
608-328-7845
brentniemeier@uwplatt.edu

Faculty Sponsor: Betsy Klinger (klingerb@uwplatt.edu)
Sara Latimer
Principal
608-328-7552
saralatimer@monroe.k12.wi.us

If you have questions about your treatment as a participant in this study, please call or write either of us or contact:
Barb Barnet
Chair or the UW-Platteville IRB
608-342-1942
barnetb@uwplatt.

OBSERVATION FORM

Date: _____ **Type of activity :** Reflex fact book

Time:	Engaged in activity	Not engaged in activity
0:00-0:30		
0:30-1:00		
1:00-1:30		
1:30-2:00		
2:00-2:30		
2:30-3:00		
3:00-3:30		
3:30-4:00		
4:00-4:30		
4:30-5:00		
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12:30-13:00		
13:00-13:30		
13:30-14:00		
14:00-14:30		
14:30-15:00		

Date: _____ **Type of activity :** Reflex fact book

Time:	Engaged in activity	Not engaged in activity
0:00-0:30		
0:30-1:00		
1:00-1:30		
1:30-2:00		
2:00-2:30		
2:30-3:00		
3:00-3:30		
3:30-4:00		
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13:00-13:30		
13:30-14:00		
14:00-14:30		
14:30-15:00		

Key: Student 1 = 1, Student 2 = 2, Student 3 = 3, etc.

Student Enjoyment Survey

Please read and answer each of the following questions carefully.

1 = did not enjoy 2= did not enjoy it very much 3=neutral 4= a little enjoyable 5 = very enjoyable

1. How much did you enjoy using the fact book? (Circle one) 1 2 3 4 5

   Why? _____

   _____

2. How much did you enjoy using the Reflex app? (Circle one) 1 2 3 4 5

   Why? _____

   _____

3. Which would you prefer to use in the future? (Circle one) Reflex fact book

   Why? _____

   _____