The Impact of Increased Technology Integration on the Achievement of Students

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Abstract

The purpose of this quasi-experimental study was to examine the impact of increased technology integration on the math achievement of students in a general education second-grade class. The study compared the spring MAP math scores of 19 second-graders that received traditional math instruction and 23 second-graders that received traditional math instruction supplemented with increased technology integration. For a period of 44 sessions over four months, students in the experimental group used the DreamBox math application in addition to traditional instruction from Pearson's **enVision**math**2.0** curriculum. After taking the spring MAP math test, the mean score of the control group (mean = 191.53, SD = 11.81) did not differ significantly from the mean score of the experimental group (mean = 187.26, SD = 14.89) [$t(40) = 1.01$, $p = 0.32$]. The results of the study failed to reject the null hypothesis, but suggested other possible benefits and dependent variables such as increased student motivation, engagement, and excitement. It is essential to continue exploring connections between the use of classroom technology and achievement.

CHAPTER I

INTRODUCTION

Overview

"Technology is rapidly changing the nature of adults' day-to-day and even minute-to-minute experiences" (Hirsh-Pasek, Zosh, Golinkoff, Gray, Robb, & Kaufman, 2015, p.3). It infiltrates our personal and professional lives. Tools, like FaceTime, provide opportunities to connect with loved ones and foreign contacts. Offices communicate via texts and emails. People of all ages stream entertainment from tablets and phones. So, it is no surprise that technology permeates the world of education. The initiation of 21st century classrooms, ones that implement technology tools to build skilled thinkers and collaborators, changes the landscape of teaching and learning.

Integrating technology to boost learning in an inner-city, kindergarten through eighth, public-charter school in the mid-Atlantic region was one of the job responsibilities of the researcher of this study. In this researcher's school, each grade-level had access to one class-set of iPads. Access to tools, such as iPads, leads to an opportunity to use applications (apps), to teach and practice skills. Teachers have many apps from which to choose, and it is important that they select the ones that are most effective. This researcher was particularly interested in finding an effective application for the second graders in her school that were not making typical gains in math. Zhang, Trussell, Gallegos and Asam (2015) note that students in elementary grades struggle to attain basic math skills and they list three benefits of using math apps: High-quality math apps are self-paced, provide immediate feedback, and break down complex processes into small steps.

One application that meets those criteria is DreamBox Math (DreamBox Learning, Inc., 2017), a math application that allows students to work at their own pace through levels of game-based math lessons, while providing step-by-step videos and hints to students when goals are unmet. The application links its activities to the Common Core State Standards (CCSS) and provides real-time data, giving teachers the opportunity to maximize the app's impact on instruction.

Hirsh-Pasek et al., (2015) state that "we have not begun to understand the impact of the app explosion" (p.3). This study focused on the impact of DreamBox Math in a second-grade math classroom and contributed research-based evidence toward examining the role of educational applications in the classroom.

Statement of Problem

The purpose of this study was to examine the impact of increased technology integration on the math achievement of students in a general education second grade class, as shown by Northwest Evaluation Association's (NWEA) Measures of Academic Progress (MAP) test data.

Hypothesis

The null hypothesis was that there would be no significant difference in the spring MAP Math scores between second-grade students that received traditional math instruction and second-grade students that received traditional math instruction supplemented with increased technology integration.

Operational Definitions

Math Achievement is operationally defined as students' final MAP score, called a Rausch Unit (RIT). At the end of each test session, students received a RIT score. It can be used to measure growth, when compared to previous RIT scores, and mastery, when compared to the nationally normed RIT scale. This study focused on mastery and compared students' RIT scores to the national norm.

Traditional math instruction, in this study, is defined as the implementation of Pearson's **enVision**math**2.0** (Pearson Education Inc., 2017a) curriculum. Using this program, teachers spent 70 minutes daily teaching skills from the Common Core State Standards (CCSS) such as adding and subtracting within 20, gaining conceptual understanding of multiplication, working with time and money, understanding place value, and interpreting data. The typical lesson included a warm-up, guided practice, independent practice and differentiated tasks. The differentiated tasks may have included worksheets or games from Pearson's online portal, Pearson Realize, but in this study, the worksheets were printed from the teacher's dashboard for students to complete in the traditional paper-and-pencil way. Access to iPads was limited and inconsistent.

Increased technology integration is defined as the frequent and consistent use of technology tools – such as different hardware, apps, or programs – during instruction to elevate the students' understanding or representation of the content. In this study, it was operationally defined as the use of the DreamBox Math application.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this literature review is to examine models and types of technology integration, discuss the changes to teaching and learning because of technology, and describe the possible impacts of technology integration on student achievement. The first section defines "technology integration", describes established frameworks to use when implementing this style of teaching, lists different types of technology that could be used in the classroom, and introduces recommended strategies to use in the 21st century classroom. The second section explores potential effects of technology integration on teaching and learning, focusing on the changes it places on planning, instruction, and assessment. The third and final section shows ties between studies linking technology integration with student achievement.

Models of Technology Integration

In traditional classrooms, students learn from a teacher and text books, and represent knowledge through paper-and-pencil tasks and assessments (Lim, Zhao, Tondeur, Chai, & Tsai, 2013). In the ideal 21st Century classroom, teachers discern whether to use technology or more traditional methods to enhance learning, and act as facilitators, helping students navigate the options technology brings. In this idyllic setting, students choose from a multitude of technological tools to advance learning goals and deeply understand the content and concepts (Keengwe, Schnellert, & Mills, 2011). Tools could include stationary desktops used for researching or word processing, or more integrative tools like personal laptops, eReaders, or iPads (Union, Union, & Green, 2015).

Teachers can choose from a variety of models and frameworks to guide their path toward creating a 21st century classroom. Two frameworks gaining more popularity are the Substitution, Augmentation, Modification, and Redefinition (SAMR) Model and the Technological Pedagogical Content Knowledge (TPACK) construct (Hamilton, Rosenberg, & Akcaoglu, 2016). Both frameworks lead teachers to leverage technology in a way that promotes student learning.

Puentedura's SAMR Model is a reflection tool (see Figure 1), visually represented by a ladder, meant to help educators gauge the selection, use, and evaluation of classroom technology (Hamilton et al., 2016). Hudson (2013), from DreamBox, provides examples to distinguish the differences between each category. The first two levels, substitution and augmentation, enhance traditional teaching and learning. In the bottom level, substitution, technology acts as an alternative way to complete a paper-and-pencil task. For instance, instead of using a handheld Judy clock to help answer a test question about elapsed time, students could use a digital substitute for the clock manipulative. In the next level, augmentation, technology acts as a substitute, plus added features. So, instead of simply using the virtual clock to answer a paper-and-pencil test question, students could answer questions from a digitized worksheet with a digital clock, leading to higher accuracy in depicting hand placement on a clock face. The latter two levels, modification and redefinition, transform the learning experience. In the third level, modification, technology reshapes the assignment. For example, students could open an app, like DreamBox Math, that uses a digitized clock with multiple scaffolds and representations that adapt and differentiate the activity based on the students' needs. In the highest level, redefinition, the use of technology permits the representation of knowledge through a new, and collaborative task. So, after receiving data about their level of mastery in relation to telling time, students could choose to represent their learning through screencast technology, with voiceovers, then share the video with an online community for discussion and feedback.

The ladder-like representation of the SAMR Model leads its users to believe that the substitution or augmentation rungs are less desirable than modification or redefinition, leading Hamilton et al., (2016) to caution educators about its lack of contextual considerations in teaching and learning. They posit that when integrating technology, educators should focus on meeting student needs instead of altering all activities to meet the criteria of the redefinition level.

TPACK is another model leading to technology integration in the classroom. In its visual representation (see Figure 2), TPACK shows three circles of knowledge: technological, pedagogical, and content (Baran, Chuang, & Thompson, 2011). Educators with an understanding of different hardware and software possess technological knowledge, or TK. Teachers with a strong background in the methods and processes of the classroom possess pedagogical knowledge, or PK. Experts with a deep understanding of a subject possess content knowledge, or CK. Educators strong in all three areas fall into the middle intersection. In this space, technology integration is paramount and fluent. All three areas, and their overlaps, sit within the context of the lesson, which is the missing piece of the SAMR Model.

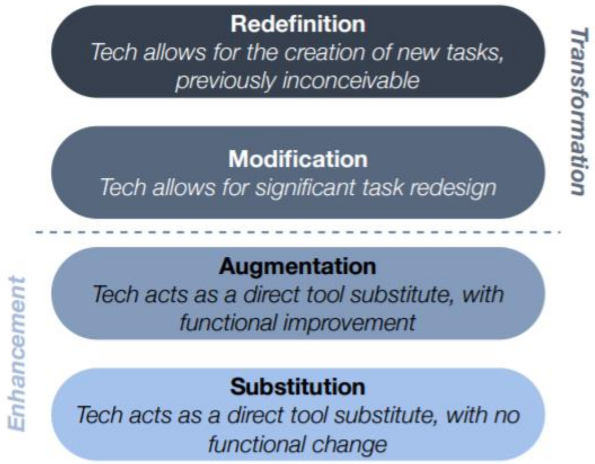

Figure 1. This image is a visual representation of Puentedura's SAMR Model. Reprinted from *As We May Teach: Educational Technology, From Theory Into Practice,* by R. R. Puentedura. Copyright 2009. Reprinted with permission.

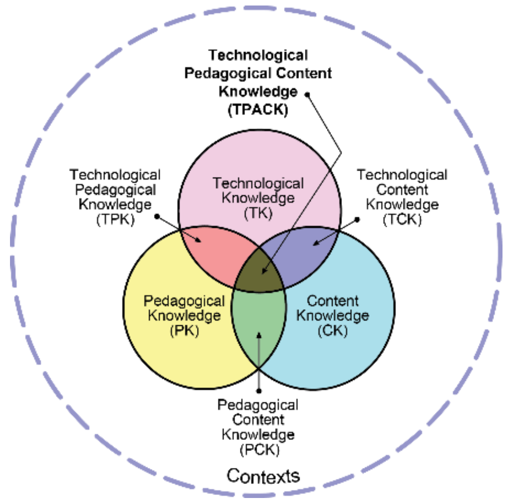

Figure 2. This image is a visual representation of the TPACK framework. Reproduced from *TPACK.ORG.* Copyright 2012. Reprinted by permission of the publisher.

Laptops, eReaders, iPads and apps are technology tools that, if used alongside frameworks such as the SAMR Model and TPACK, could help teachers reach successful levels of technology integration. Several studies discussed the benefits of implementing technology tools in classrooms.

Keengwe et al., (2011) surveyed students and faculty to determine the possible effects of a 1:1 laptop initiative on the academic performance of high school students, and found that both students and teachers perceived an improvement in learning because of the laptops. Union et al., (2015) explored the effects of eReaders on the English/Language Arts performance of third graders, and discovered an increase in student responsibility and improved achievement. Ward, Finley, Keil, and Clay (2013) created and implemented an ecology lesson, utilizing iPads, in three sophomore Science, Technology, Engineering, and Mathematics (STEM) classrooms to study the successes and challenges of the iPad as a tool for learning. They noticed increased student motivation and engagement. Beach and Castek (2016) reviewed research about the use of educational apps with mobile devices by students at the secondary and college levels. They noted that mobile devices foster constructivist and connectivist learning, help teachers differentiate instruction, promote collaboration, improve student perceptions of learning, and produce civic engagement because of the ability to share presentations.

The cited benefits of incorporating technology in these studies, especially in the form of an app, outnumber the challenges shared, but it is important to heed the suggestions and recommendations when discerning technology implementation. Attard (2013) cautions those using iPads to push beyond substituting a task with playing a game on an app, and to be more creative with how students interact with the apps. Lim et al., (2013) warn that the technology tools are only as effective as the teachers using them. Keengwe et al., (2011) cite perceived barriers from teachers that include negative attitudes, a lack of knowledge about technology, a lack of technical support, and issues of time and access.

Changes to Teaching and Learning

The implementation of technology transforms the way teachers and students think about learning. Students can use devices to collect information, connect with peers, and connect with the world (Keengwe et al., 2011). This change affects how teachers plan, instruct, and assess.

Planning periods and professional development sessions might now focus on eliminating barriers (Keengwe et al., 2011). By removing these barriers to planning, teachers can begin brainstorming about how to take advantage of the benefits technology can afford. The ideas developed from that brainstorming session, balanced with meeting student needs and content standards, merge to shape meaningful and engaging lessons. In her article, Attard (2013) lists questions to remember when planning for use of instructional technology, such as "What function of the iPad could you utilize to *enhance* teaching and learning?" and "Will all students be engaged in exactly the same task using the iPads, or will there be a range of tasks that address the same mathematical content?" (p.39).

Plans developed to meet student needs with thoughtful implementation of technology changes how teachers instruct. Teachers can more easily vary tasks for students utilizing tools such as iPads, which were not intended for classroom use, but are now coveted by many schools for their propensity to permit differentiation (Attard, 2013). Ok and Bryant (2016) investigated the effects of purposeful mathematics intervention with iPads which ended with the improvement of all participants. Attard (2013) doted on the positive effects of intentional and creative additions to application usage.

This change in education also alters how students learn and express information. Keengwe et al., (2011) explained that because laptops allow some anonymity, students felt more comfortable asking questions they would not typically ask. They also cited significant gains in motivation, writing competency, and critical thinking with laptop use.

The Impact of Technology Integration on Achievement

With high-quality implementation and participation from teachers and students, technology integration has the potential to affect student achievement. Kiger, Herro, and Prunty (2012) examined the influence of a Mobile Learning Intervention on third grade math achievement where one group learned math facts with the Everyday Mathematics program, while the other coupled the program with iPod touch devices, loaded with math apps. Students in the latter group achieved higher on the post-assessment. Ok and Bryant (2016) noticed significant improvement in the math scores of students with learning disabilities after intensive intervention with iPads. Union et al., (2015) equipped third-grade students with e-Readers to use in school and at home, to supplement normal literacy instruction. They reported that the use of e-Readers had a positive impact on the scores of students. Serin (2011) revealed significant growth in the problem-solving skills of students using a computer-based instruction (CBI) technique, in which students interacted with an "Earth, Sun, and Moon" unit on the computer.

Most studies shared improved achievement, indicating the power of purposeful technology integration. Lim et al., (2013) caution that these individual success stories do not prove, on a wide scale, that technology integration consistently leads to academic accomplishment.

CHAPTER III

METHODS

Design

This study was designed as a quasi-experimental study using a pre-test to determine if the groups differed significantly prior to the intervention and a post-test to determine if the groups differed after the intervention. The independent variable was whether students used increased technology integration in the form of an application called DreamBox Math (DreamBox Learning, Inc., 2017) or not. The dependent variable was MAP math scores. The study used a convenience sample of intact classes and a nonequivalent control group design. Second grade was chosen to participate in this study because the teachers were willing to participate, students had access to and experience with iPads, and state testing did not interfere with the timeline of the study's intervention.

Participants

The participants in this study were second-grade students of a kindergarten through eighth grade, public-charter school in the inner-city of a mid-Atlantic state. It was a Title 1 school with mostly low-income families. Forty-two total second graders, with an average age of seven years old, participated. The forty-two students were broken into two heterogenous classes at the beginning of the year. Overall, about half of the students in each class tested below grade-level on their beginning-of-year assessments. The control group class consisted of seven boys and twelve girls. Three of those students received special accommodations during classroom instruction due to an Individualized Education Plan. Seventeen students in this group identified as African-American and two identified as Caucasian. The intervention class consisted of five boys and eighteen girls. Five of those students received special accommodations during classroom instruction due to an Individualized Education Plan. Nineteen students in this group identified as African-American, two identified as Caucasian, and two identified as Filipino.

Instrument

Data were collected from Northwest Evaluation Assessment's (NWEA) Measures of Academic Progress (MAP) math assessments. The MAP test is an adaptive assessment, which means that as students answer questions correctly, the questions get harder, or are pulled from higher grade-level standards. As students answer questions incorrectly, the questions get easier, or are pulled from lower grade-level standards. It aligns with the Common Core State Standards in Reading, Language Usage, and Mathematics and can be taken on a computer or device, like an iPad. The typical test has approximately 40-60 multiple-choice and selected-response questions and is taken three times per year. The assessments in kindergarten, first and second grades are accompanied by audio. The audio reads the directions, questions, and answer choices to the students. In Math, the audio limits the possibility of a student answering incorrectly due to an inability to read. At the end of each test session, students receive a Rausch Unit (RIT) score. There is a separate RIT score for each test the students take. The score can be used to measure growth, when compared to previous RIT scores, and mastery, when compared to the nationally normed RIT. The RIT provides an estimation of content achievement on a scale ranging from 140 to 300 (NWEA, 2016). This study focused on mastery, and scores were based off of NWEA's 2015 national norms. The national mean math score for second graders in the winter was 186.4 and the national mean math score for second graders in the spring was 192.1 (NWEA, 2015).

Northwest Evaluation Association (2016), reported three types of reliability evidence: Marginal reliability bore estimates for scores from .92 to .96 across grades 2-10. Test-retest reliabilities yielded stability estimates no lower than .77 and no greater than .94. The third type of evidence, conditional standard errors of measurement, was "small across most of the effective range of the RIT scale" (p.4). Overall, MAP scores were determined to be reliable.

NWEA (2016) also reported two sources of validity: The content of users' input probably reflected curricular goals and standards. Also, the scores of other tests are "fairly strongly related" to the scores of the MAP test (p.4). This test was found to be valid, meaning "MAP scores do not have different interpretations over time" (p.5).

Procedure

Students' classroom groups had been formed prior to the onset of this study and remained intact throughout the experiment. A veteran teacher of nine years taught one class, the control group. A novice teacher of two years taught the other class, the intervention group. The teachers were randomly assigned as "control" and "intervention" groups.

In the first week of January, all second-grade students participated in a round of math MAP testing. Each class went to the computer lab to complete the assessment on desktop computers. On the first day of testing, students worked for 45 minutes, then the test was paused. Students returned on the second day to resume and finish the 56-question assessment. Since MAP was used as a benchmark, no accommodations were given. At the end of the test, the computer program generated a RIT score. The Math MAP scores were then compared using an independent samples t-test. The mean Winter MAP score of the control group (Mean = 186.53, SD = 14.45) did not differ significantly from the mean Winter MAP score of the experimental group (Mean = 178.52, SD = 13.22) [t(40) = 1.87, p = 0.07].

After testing, the control group continued following the Pearson **envision**Math**2.0** curriculum in the 70-minute daily lessons. The teacher modeled a skill, went through guided practice, and assigned independent practice. After informally assessing the independent work, the teacher assigned differentiated work to each student by printing worksheets from the Pearson Realize portal, an online learning management system used to ascribe content videos, worksheets and assessments (Pearson Education, Inc., 2017b). The experimental group continued following the **envision**Math**2.0** curriculum for the whole group lesson, guided practice, and independent work, but instead of assigning work through the Pearson Realize portal, the teacher began implementing the DreamBox Math application on iPads.

DreamBox Math is an adaptive math application that adjusts to the student's level of understanding. If a student makes an error, a hint or video explaining the correct process appears, then the student tries the task again. If a student understands the material, the levels are condensed and the student can move onto learning skills within their realm of understanding. This adaptive quality allows students to work on math skills at their own pace and interact with immediate feedback. The activities in the application were designed around the CCSS. The Curriculum Guide on the app's website lists the specific CCSS taught and assessed through the app. For example, the activity shown in Figure 3 helps students make groups of equivalent expressions DreamBox Learning, Inc., 2016).

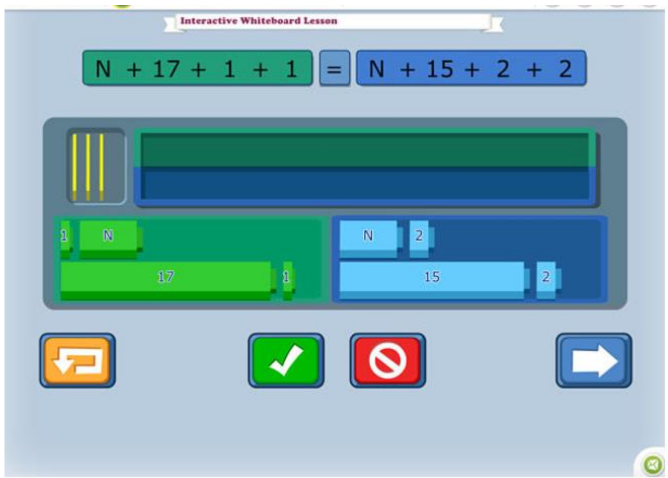

Figure 3. This image is a screenshot of one activity from the DreamBox Math app.

Overall, the experimental group implemented the DreamBox Math application through forty-four 10-15 minute sessions. In May, all second-grade students participated in math MAP testing again to obtain a RIT score. The RIT scores of the two groups were compared by an independent samples t-test.

CHAPTER IV

RESULTS

The purpose of this study was to examine the impact of increased technology integration on the math achievement of students in a general education second-grade class. Achievement was assessed using NWEA's MAP test. After taking the spring math MAP test, the mean score of the control group (mean = 191.53, SD = 11.81) did not differ significantly from the mean score of the experimental group (mean = 187.26, SD = 14.89) [$t(40) = 1.01$, $p = 0.32$]. Consequently, the null hypothesis that there would be no significant difference in the spring MAP math scores between second-grade students that received traditional math instruction and second-grade students that received traditional math instruction supplemented with increased technology integration failed to be rejected. Please see Table 1.

Table 1. Means, Standard Deviations and *t*-Statistics for Spring MAP Scores

Group	N	Mean	Standard Deviation	*t*-Statistic
Traditional Math Instruction (control)	19	191.53	11.81	1.01 (NS)
Increased Technology Integration (experimental)	23	187.26	14.89	

NS = non-significant at $p < .05$

Degrees of Freedom = 40

CHAPTER V

DISCUSSION

The purpose of this study was to examine whether the math achievement of a group of second-grade students differed significantly between those who participated in traditional math instruction and math instruction enhanced by increased technology integration. The null hypothesis that there would be no significant difference in the spring math MAP RIT scores of the students receiving traditional math instruction and the students receiving increased technology integration failed to be rejected.

Implications of Your Results

After analyzing the results of this study, there was no statistically significant evidence to support that either traditional math instruction or math instruction enhanced by increased technology integration produced stronger MAP data. Although the groups did not differ on the MAP testing, the researcher believed that the level of motivation, engagement, and excitement around math time was higher among students in the intervention group due to use of the app. This was based on observations during student work time: more students were on task, students muttered disgruntlements at the teacher's request to return the iPads, and most lessons started with several students asking if they could use the app.

The level of engagement around math time was also very high with the teacher of the experimental group. Due to the DreamBox Math app's adaptability and capability to intervene as well as challenge students without any direct attention from a teacher, the teacher was available to differentiate lessons and had time to pull small groups and support students in ways specific to the **enVision**math**2.0** curriculum. Ward et al., (2013) stated that "a big benefit to integrating technology into the classroom was the ability to "provide a seemingly personalized educational experience" (p.378). Whether through an adaptive app, like DreamBox Math, or instructor-created opportunities, differentiation allows for instrumental and integral changes to the teaching and learning landscape of the 21st Century. If this study persisted more than the four months, this level of student engagement plus the subsequent one-on-one teaching situations may have translated into a statistically significant difference in the data.

Theoretical Consequences

The TPACK framework and SAMR Model support teachers in learning how to integrate and evaluate technology in classroom teachings and learning. Benefits of technology integration might include heightened student achievement, motivation, and engagement along with more opportunities for teachers to differentiate the work to meet students' individual needs.

The TPACK framework outlines the need for teachers to blend their pedagogical, technological, and content knowledge to meet the needs of each individual student (Baran et al., 2011). This study enacted pieces of the TPACK framework: The technological content knowledge (TCK), or "knowledge of how technology can create new representations for specific content," was applied in using understandings of the second-grade math standards to choose a high-quality application for participants. The pedagogical knowledge, or "knowledge about the methods and processes of teaching such as classroom management, assessment, lesson plan development, and student learning" was applied in developing lesson plans that blended the demands of the **enVision**math**2.0** curriculum alongside the use of the DreamBox Math app, while including ways to differentiate. Although this study provided no evidence to support a strong statistical difference between the achievement of a class with traditional math instruction and a class with increased technology integration, the use of the TPACK framework did encourage anecdotal occurrences of heightened engagement, motivation, and excitement around learning math.

The SAMR Model, represented as a ladder with four categories, is “an approach to selecting, using, and evaluating technology in K-12 education” (Hamilton et al., 2016, p.434). The four categories are Substitution, Augmentation, Modification, and Redefinition. These researchers paraphrased Puentedura’s theory to mean that reaching the latter two categories through a blended environment leads to deeper levels of teaching and learning. The control group’s teacher used technology to assign students differentiated tasks. Once assigned, she printed them out as worksheets and students completed them in the traditional paper-and-pencil fashion. Because it acted as another way to complete a paper-and-pencil task, the traditional math instruction met the criteria for the Substitution category. The DreamBox Math application used in this study was considered a high-quality choice because the activities, of the Modification category, were scaffolded and skills were represented in a variety of ways. Although this study provided no evidence to support a strong statistical difference between the achievement of a class with traditional math instruction and a class with increased technology integration, the use of the SAMR Model did lead to choosing a high-quality application that engaged learners and supported the teacher.

Threats to The Validity

There were some threats to the internal and external validity of this study. One threat to internal validity was attrition. When the study began, the control group had twenty-one students, and when it ended, the class had lost two students. When the study began, the experimental group had twenty-four students and when the study ended, the class had lost one student.

Another threat to internal validity is selection maturation. By the two groups being in two different classrooms with two different teachers, there could have been factors besides technology integration impacting the development of math skills in the classroom. For example, the teacher of the control group was a veteran of nine years while the teacher of the intervention group was a novice in her second year of teaching.

A threat to external validity included selection-treatment interaction. The groups chosen for this study were not randomly selected. The class populations remained intact with beginning-of-year groupings created by the administration and staff. In studying the effectiveness of increased technology integration on math achievement, the classes chosen to participate in this study may not have been indicative of the broader range of second-grade students.

The brief duration of the experiment was also a validity concern. The experiment occurred from January through May, a little over four months. If the study had persisted longer, it is possible that the differences between the groups may have been larger. These findings cannot be generalized as being a measure of the effectiveness of a year-long intervention.

A final validity concern was that the results of this study could only be generalized to performance on MAP testing. The DreamBox Math application is not specifically designed to prepare students for MAP testing. Different methods of assessment may have led to other results.

Connections to Previous Studies/Existing Literature

Adding elements of increased technology integration to teaching and learning, such as the implementation of the DreamBox Math app, is steadily infiltrating educational practices. The results of this study indicated no significant difference between the control and intervention groups, but other researchers of similar studies reported statistically significant increases in achievement, engagement and student learning, and interest and motivation due to technology integration.

An increase in student achievement was seen in Serin's (2011) study in which participants in the experimental group learned about the world, sun, and moon using a computer-based program and students in the control group learned in a more traditional, teacher-led, environment using white boards. The results showed a positive effect of technology during instruction on student achievement. In Union et al., (2015) study, participants in the experimental group completed English/Language Arts assignments on Nook eReaders in the classroom and at home. The researchers concluded that this intervention contributed to improved student performance. According to Zhang et al., (2015) research, the use of math apps "improved student learning in mathematics and reduced the achievement gap between struggling students and typical students" (p.32).

Keengwe et al., (2011) conducted a study in which high school students were surveyed using the question "What effects does a 1:1 laptop initiative have on student academic performance?" (p.141). From the responses, the researchers concluded "the integration of 1:1 laptop computing increased student engagement and learning, motivation, and ability to work individually" (p.144). Becker and Park (2011) discovered similar results in their study where participants partook of classes blending technology and one or more subject areas. In the end, researchers reported that this melded style of teaching boosted student interest and motivation across the STEM subjects in future lessons.

The aforementioned studies saw increases in achievement, engagement and student learning, and interest and motivation due to various forms of technology integration. This study focused on the implementation of a single application on an iPad. In Serin's (2011) study, students in the experimental group used a computer-based program to learn about the world, sun and moon. Students in Union et al., (2015) experimental group used the Nook Simple Touch eReader as the intervention tool, and Zhang et al., (2015) study looked at three separate apps on iPads to conclude improved student learning. The differences in technology tools used during intervention may have contributed to the difference in outcomes between this study and their studies.

The varying sample sizes and study designs may also have contributed to the conflicting results between this and other research. Forty-two participants form two classrooms partook in this study using a quasi-experimental design, whereas 5 third-grade classes took part in the Union et al., (2015) mixed methods case study, 18 students participated in Zhang et al., (2015) exploratory study, 105 students contributed to the Keengwe et al., (2011) survey, and 28 students were selected for the Becker et al., (2011) preliminary meta-analysis. The differences in the amount of participants and the type of study may have contributed to the difference in outcomes between this study and their studies, as well.

Implications for Future Research

Researchers should continue to explore the impact of increased technology integration on student achievement. In future iterations of this experiment, researchers should attempt altering at least three integral pieces to improve the validity and clarity of this study.

First, a veteran educator taught the control group and a novice educator taught the experimental group. Using teachers of similar tenure and experience would strengthen the validity of this experiment. Second, the intervention in this study was applied from January through May. Extending the length of time between the pretest and posttest may produce more statistically significant change in one group over the other. Third, the groups in this study were selected out of convenience. They had different numbers of students enrolled on their rosters, different numbers of students receiving special education accommodations in each class, and an unbalanced representation of gender (more girls than boys).

In the future, researchers will ideally be able to randomly assign students to groups. However, if necessary to use pre-existing groups, the groups should be more similar in characteristics. Using a larger sample size would increase the statistical power of the study. If a study used subjects from more grade-levels, the results could be generalized to a larger population.

In addition to studying the impact of technology integration on achievement, future studies may also focus on other effects of the blended learning environment. For instance, researchers may address potential benefits such as student motivation and engagement, on-task behaviors, or teacher satisfaction. Keengwe et al., (2011) touched on this branch of the classroom technology research when they surveyed a group of faculty members about the effects of a 1:1 laptop initiative. Participating faculty (76.9%) reported an improvement in engagement, interest, motivation, and ability to work independently among students. More studies of this nature may ground future generations of teaching pedagogies.

Conclusions/Summary

This study raised a question that confronts teachers of the 21st Century classroom: What is the impact of increased technology integration on student achievement? According to this study, there was no statistically significant difference when comparing the two groups. However, both groups made appropriate math achievement gains. Observational data suggests other benefits of the increased technology integration including increased student motivation, engagement, and excitement. It is essential to continue exploring the connections between classroom technology use and student achievement. As Hamilton et al., (2016) concluded, "when educators understand the relationships between teaching, technology, and learning, they will be more prepared to use technology to enhance student growth and achievement, thus equipping students to meet the demands of today's world" (p.439).

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