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Cover Page Footnote

Thank you to The Teacher Fellows Program at Texas State University for supporting and assisting me through this processes. Thank you Courtney Talley for supporting me in my classroom and in my research.

Implementing Personal Devices in Math

Jamie W. McDaniel ~ *Texas State University*

Abstract

This study examined the effect of implementing personal devices into a fifth-grade mathematics classroom. Thirty-eight fifth graders participated in this eight-week project with a focus on six students to track their growth. During this study, students engaged in technology-based stations that pertained to our geometry unit and coordinate unit. Students took pre and post tests on paper to track progress. In addition, students completed online assessments within their practice websites to track comprehension and growth of the content. Furthermore, students were observed to ensure they were staying engaged in the online activities and to track student engagement about using personal devices within math.

Keywords: personal devices, math, technology

Introduction

During my first year of teaching, I taught on a departmentalized team where each teacher in the team taught a different academic subject. My assignment was to teach math to two classes of Fifth-Grade students. Across the first few weeks I noticed my second class would come in daily, distraught claiming the skills were “too hard” or that the math concept “didn’t make any sense.” I noted that the second class groaned and shut down when it was time for individual practice. They requested help constantly without trying the problems on their own first. Unsurprisingly, when I checked their work at the end of the lesson, most of the students got the problems incorrect.

I began to wonder what caused the negative attitudes in my second math class. As the weeks passed, I noticed that the attitudes continued to be bored and unenthusiastic which resulted in the student’s comprehension of the skills decreasing. I knew I needed to do something to help the students in my second class become excited about the content and fast. I decided that

I wanted to try to incorporate more of my students' interest into my teaching to possibly encourage excitement over what was being covered. As I listened in on student conversations for the next few days, I found a common thread: technology. They all played video games and begged to pull out their phones any chance they were given. I realized that no matter what we discussed, if it involved technology my students were interested.

I wondered what would happen if I used technology in my math instruction. I decided to conduct an action research project that would investigate what happens when a fifth grade, departmentalized teacher implements technology into math instruction. I specifically asked the following research questions.

Research Questions

1) What happens when personal devices are used to supplement Fifth Grade math instruction?
    a) How does technology impact students' math competency?
    b) In what ways does the implementation of technology impact students' ability to perform on math assessments?

Literature Review

Theoretical Framework and Terms

This research is based off of the conceptual work of John Dewey who was an American Philosopher during the early 1900s. He observed that students learn through hands-on experiences that allow them to connect to the content they are learning (Dewey,1922). For modern day students a hands-on experience means using something they can manipulate and connect to things they use in their daily lives. Technology allows a student to manipulate and

interact with things on the screen that correlate back to what is being studied. Students are able to use personal computers and iPads to play games, solve real world problems, and review content with hands on devices that are so prevalent in their everyday lives already.

As technology has advanced over the last few generations educators have found that the use of wireless, mobile technology, portable and hand-held devices, has increased in classrooms (Traxler, 2007). In response to this increase, researchers and educators have been prompted to investigate how this technology affects students in all academic areas; however, it is important when researching to focus in on one content area to allow for a more focused look at how the technology is truly working in the classroom (Polly, 2014). Additional research on the ways technology use impacts education will help teachers become more effective in making choices about which technologies are most appropriate for their students (Polly, 2014).

Technological Effects on Student's Mathematical Performance

In classrooms today, technology is used for enrichment, extension, and extra practice of the content after teaching it directly to the students. Researchers have looked at how this technological extension enhances learning beyond direct teaching. For example, when iPads were added as an intervention piece to math instruction in one classroom, they demonstrated an improvement in test scores by 0.07% compared to a classroom that did not use iPads (Carr, 2012). Other research has found that when technology is implemented into daily mathematical practice, such as using online math programs, results in students answering more items correctly on a post technological intervention test versus those who did not receive the daily technological practice (Kiger, Herro & Runty, 2012). Furthermore, weekly technology mathematical use has been shown to result in an increase in accuracy in scores on both paper and computer-based tests when compared to those who did not receive the technology practice (Rich, Duhon & Reynolds,

2017). This is important for educators because the research is revealing that technology has the potential to increase student comprehension and understanding of concepts through the analysis of post-tests. Educators are finding that the use of hands-on activities through technology allows their students to have a firmer foundation of the material which in turn better prepares the students to be able to repeat the skill and show what they know on tests and assessments.

Teacher's Feelings About Technology in the Classroom

Other studies have investigated the way that teachers feel about using technology in classrooms. The way a teacher approaches using technology within their classroom can have an impact on student engagement and use the technology. Some studies have found that educators find that as they utilize technology within their teaching as a resource for enrichment or intervention, they perceive that teaching itself becomes easier (Polly, 2014). Specifically, teachers indicate that when students are able to review the content and use technology, it helps to close learning gaps and work on correcting misconceptions (Polly, 2014). This allows students to be able to focus on the concept itself and work at their own pace on their level. The teacher in turn can assist with correcting misconceptions and assisting those that are struggling or needing an enrichment activity. In addition, educators also find themselves thinking that technology will help make learning more concrete for students since they will be applying the concepts to actual situations (Kul, 2018). Technology is created on a mathematical basis. Most jobs dealing with technology use math, and the online math programs that are available today provide activities and games that assist in educating students in math. Thus, if educators find that using technology yields positive outcomes within their teaching, then they may be more likely to include technology into their classroom which plays into student's interest. This may allow students to

have a better chance at working with and comprehending the content in a new way that they are actually excited about.

Ways Technology is Being Used in the Classroom

Although the research indicates that technology has the potential to increase student academic growth, most teachers only use technology in the form of PowerPoints, videos, or image projections (Polly, 2014). Yet, there is research that indicates that these approaches do facilitate wider access to content, the most effective use of technology in classrooms occurs when students personally use technology to construct their own understanding such as through apps or games on iPads or personal computers (Polly, 2014). One researcher found students working on content through technology, such as apps on iPads, enhanced their mathematical performance in the classroom (Khoo, 2016). Students in this study talked to other students about educational apps they were using. The use of apps resulted in the development of further understanding of the content through the app's games and exploration activities (Khoo, 2016). In addition, some educators are working with online programs that allow immediate feedback for teachers and students through interactive class activities and online based tests (Enriquez, 2010). This immediate feedback for students particularly is extremely important. Students in today's society are eager to know how they did immediately so they can learn from their mistakes. Using these online programs allows students to learn what they missed and how to fix it immediately so they can continue the practice correctly instead of doing the wrong steps to solve over and over. These studies show that technology can be used to enhance the learning of students within the classroom.

Conclusion

In summary, technology has the potential to have a positive impact on student learning and the teacher's attitudes. This can lead to students having a better understanding and grasp on the content as they work with the content in new interactive ways. In addition, the type of technology used in the classroom seems to be constantly changing and advancing with the times. The research on technology's use in math instruction so far is positive and continuously expanding.

Methods and Procedures

Classroom Demographics

This research took place at Math Hall Elementary School in Mathtech ISD. This is one of two Dual-Language campuses within the school district. The campus population consists of 84.6% Hispanic students, 11.1% White students, 2.4% African American students, 0.9% Asian students, and 0.1% Pacific Islander students. The following pie chart shows the school's ethnicity percentages.

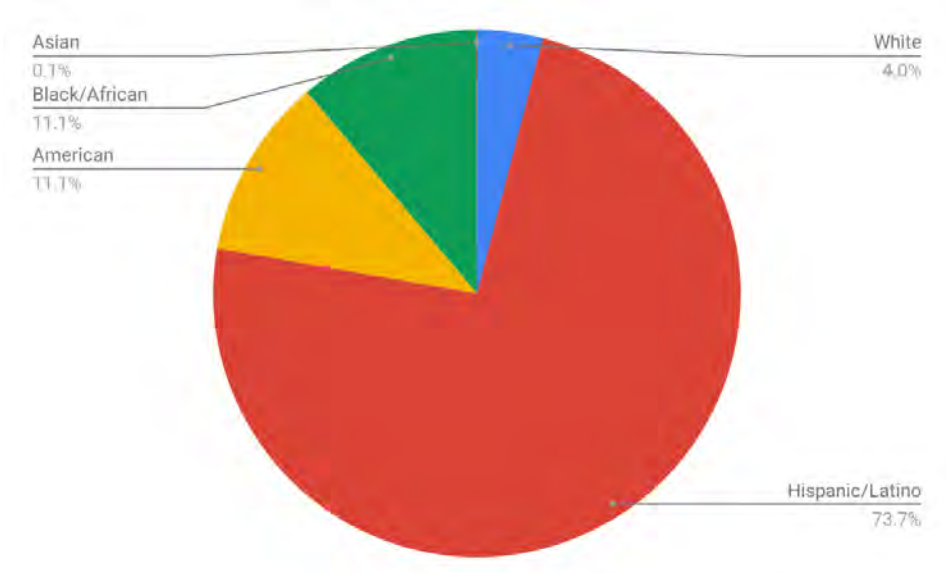

Figure 1 Race/Ethnicity Demographics

During the year of the study, my classroom consisted of 73% White students with 94% of those having a Hispanic/Latino ethnicity, 11% American Indian or Alaska Native, 11% Black or African American, and 0.05% Asian. In addition, the 10% of the students participating in the study received free and reduced lunch, 72% were labeled "at risk" for failure due to difficulties within the home such as incarcerated parents, 10% were labeled as gifted and talented, 6% were identified as needing Special Education (SPED) services including 15% of students receiving dyslexia services and 24% receiving English language intervention services such as including more pictures and labels on different images and utilizing the Gomez to Gomez approach for labelling with English in blue and Spanish in red ("Why Choose the Gomez and Gomez Model? Gomez and Gomez Dual Language Consultants.").

Implementation Procedures

For the purpose of this study students used online math programs (Education Galaxy and Dreambox) on IPADs and Chromebooks to enhance what they were learning in class. Education Galaxy is an online math assessment and intervention program that allows the teacher to add assignments and tests for students to interact with. The more questions students answer correctly, the more points they earn and games they can play. As students answer questions, they can get points for correct answers or immediately receive video intervention that walks them through how to correctly solve a similar problem before trying the problem again. There are also math fact review games where students can race other students for the most correct answers in the shortest time. I also utilized Dreambox which is an online assessment program that allows teachers to assign students concepts they need more work on. Dreambox will gauge a student's understanding of the concept and adjust the lessons based on how they are doing with the material. Teachers can pick practices for the students, but the program will adjust the difficulty

of the lesson and types of problems based on the student's correct answers through the practice. Teachers have less control of the types of problems students see and interact with on Dreambox verses Education Galaxy. I utilized these two online programs for my research due to the fact that my school was paying for them and they are state standard aligned. Students had their own logins that allow them to access assigned content from the teacher. These programs had students interact with word problems that aligned with state standards to practice the content and prepare for curriculum assessments and the state end of the year exam. Both programs had a great range of questions from simple to more complex to help students push their thinking and understanding of a concept. Students were on the programs a minimum of twice a week during an hour long math block. Students would usually be logged on for 10 to 15 minutes at a time. Students were evaluated on their mathematical performance on class assignments, and their performance on math paper assessments.

Data was taken from all students, but six targeted students were picked for closer inspection. These six students were chosen due to their performance ability in math and their lack of interest. These six students put in the least amount of effort and complained about the work the most before the study began. This resulted in lower grades on assignments even though they had on level math conversations in small groups. The six targeted students each showed limited interest in math class before technology was introduced.

Data Collection/Analysis

Data was collected and analyzed in the following ways for the purpose of this research. First, teacher created paper pre and post-test were given to students to track math ability and understanding before and after technology was used. The teacher was able to compare the number of questions answered correctly before and after using the technology within the class. In

addition, teacher created quizzes were given throughout the unit over concepts covered in the personal device websites to track how students progressed with the content. These quizzes could both be given online or on paper depending on the time in the unit. For example, in the beginning and close to the end of the unit paper quizzes were given whereas in the middle of the unit online quizzes were given through Education Galaxy. Furthermore, student data was pulled from the online math programs to see how students were doing with the content being covered online and in class. Students would work on assignments over the curriculum through interactive questions and games. The programs would then organize the student's responses into charts and graphs based off of class or individual responses for the teacher to view and use for further instruction. . Finally, student test scores were tracked and analyzed. In this district, tests are called unit assessments (questions over content from the current unit) and curriculum-based assessments (questions over content from all units covered so far). The following table breaks down each type of data collected and why it was needed.

Table 1 Rationale for Data Collection

Data Collected	**Why It Was Needed**
Unit Pre and Post Test	To track student progress through the units.
Online Assignments	To check on student understanding of material covered through the online activities.
Paper and Online Quizzes/Test	To ensure students could show comprehension of material covered online on paper since that is how they are tested by the district and state.
Anecdotal Notes	To keep track of students' work and student conversations about personal devices with the content.

Findings

Through this study I found three major findings. First, students showed growth within their math competency; however, this growth cannot be solely contributed to personal device intervention and activities used in class. Second, students need to be taught how to use the devices and the online programs correctly first for efficient use of the online programs and devices. Third, students will switch apps and tabs to go to other online games to avoid the work if not properly monitored by the teacher.

Math Competency

During the study the six targeted students were able to answer 3.6% more questions correctly on the post assessments than the pre-assessment. This was calculated by taking the number of questions answered correctly within the pre versus post test. The following graphs show the number of questions correctly answered on the pre versus post test of the two units covered during this study. The comparisons between pre and post teacher made test questions were looked at by state standards within the unit versus the unit as a whole.

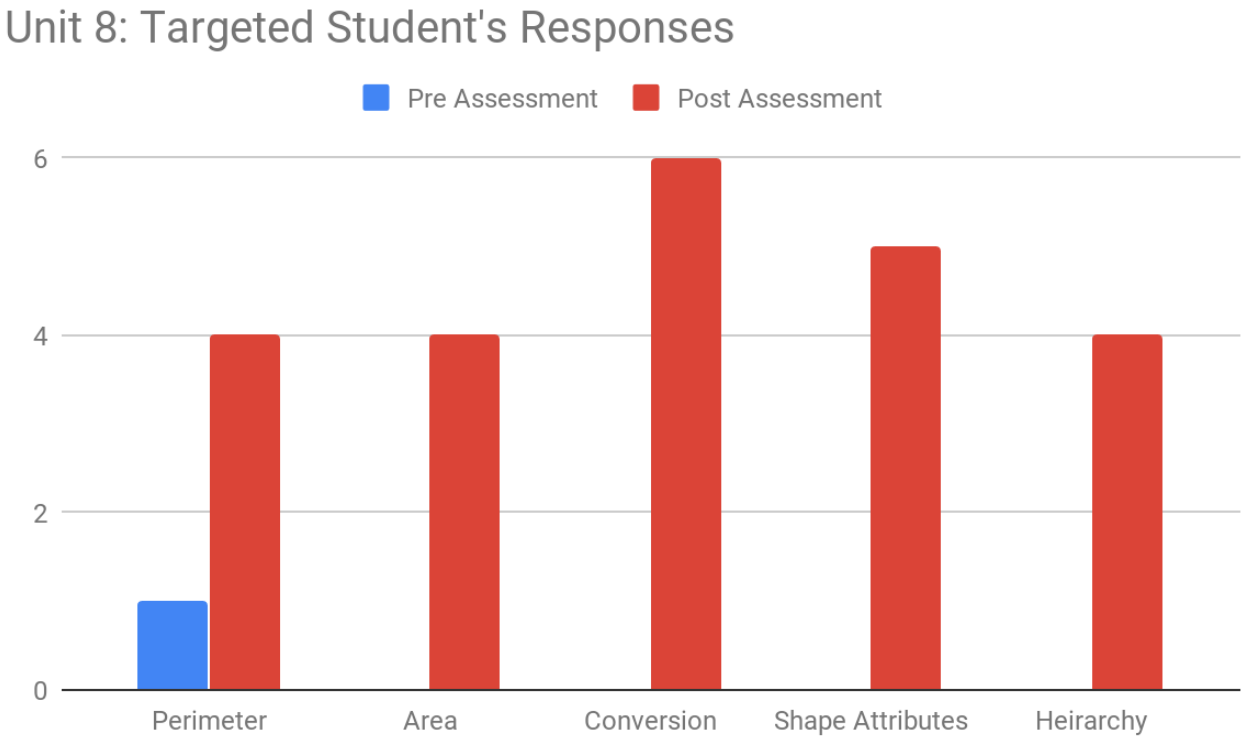

Figure 2 Unit 8: Targeted Student's Responses

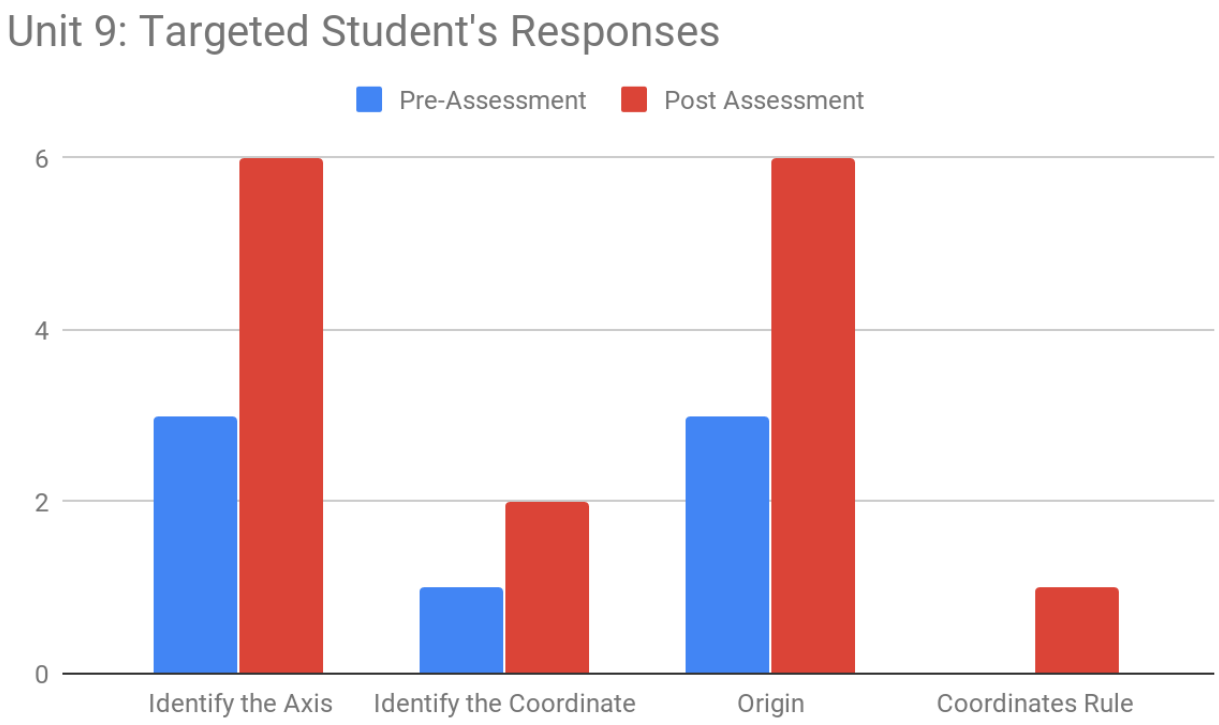

Figure 3 Unit 9: Targeted Student's Response

The in class personal device practice exposed students to different types of test-like questions throughout the eight-week study. This was important because students were continuously asked to analyze and answer state level questions within class to help prepare students for their state and district assessments. Even though this growth is major it cannot be solely attributed to the technology intervention strategies. I had continued to pull small groups, incorporate cooperative learning strategies, and continued to directly teach the students many whole group lessons. The technology was a supplemental aid in the students' growth, but there is not enough evidence to prove that the increase in the students' math ability was solely based on the use of technology due to other intervention strategies being utilized.

Logistics of Personal Devices

At the beginning of the study I had repeatedly written in my notes about how students did not know how to use, let alone logon, the programs to truly reap the benefits. Students were constantly interrupting my small group time with other students to ask me logistical questions about how to work the programs such as how to login or how to find the current assignments. I decided that to make the program worthwhile I would need to do a specific lesson on how to use the devices and the specific programs. I had to take time to specifically teach students how to log on to their account and find assignments, study guides, and extension activities. I had to show them how to play specific games, how to fix errors within the game, and how to use online resources such as help buttons. One of the technology usage mini lessons conducted was over all of the different tabs available on the home page and what they do. For these mini lessons I would project the website onto the screen from my computer and have students watch or follow along on my instructions about how things work. For better practice students should also be given time after a mini lesson on personal device usage to try out what was covered in the lesson.

Personal Devices Can be a Temptation for Distraction

As much as I wanted the students to enjoy the educational devices and sites, I found that the technology temptation was too much for some students to handle. Students were more likely to switch to non-math based games instead of staying on the online math practice. I recorded in my notes over five times within a two-week period that different students were switching between the required task and online apps and games that were not school approved. Students waited until the teacher was not near them and opened a new browser which they could easily minimize and get back to the assessment when the teacher came around to check. These students lost the privilege to use the personal devices within the classroom once discovered.

Students would rush the questions to get to the games portion of the math sites. Both sites used for this study allowed students to play games depending on their shown competency for a question or standard. With every question correctly answered the student was given access to a mini game that earned them points which they could use to decorate their character or earn other bonus items to help them in other games. Students would try to rush through questions and guess answers just to play the games. Sometimes the program would not allow the student to play the game until they answered the question correctly, while other times the student would be granted access to the game. Either way, the students cared more about getting to the game then correctly answering the questions. Overall, students did not show an understanding of the importance of the program. All they cared about was getting to the games on the programs or using the personal technological devices to play other unapproved games.

The amount of students who enjoyed using technology in class improved between the pre and post survey which is shown in the following graph. Even though students enjoyed using the programs, it does not mean that the programs were worthwhile for their understanding and comprehension of the math content. Students may have responded with a positive response due to the games on the programs versus understanding that the programs were made to help the students understand the math content better. This shows that students need to be informed of the importance of the personal device usage in the classroom toward their mathematical competency and that there needs to be clear expectations and standards established for the uses of personal technological devices within the educational setting.

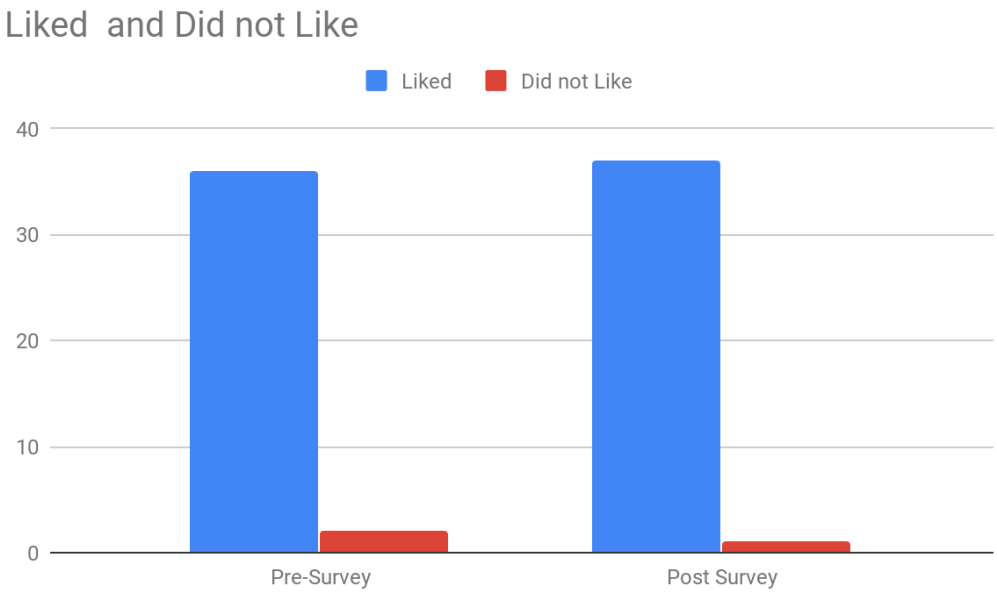

Figure 4 Liked and Did Not Like

Conclusion

This study shows a variety of ideas that the research field has previously addressed over the concept of personal devices being used in a mathematics classroom. First, the use of technology within an educational setting does show signs of improvement on scores; but the improvement cannot solely be attributed to technology since educators are constantly utilizing other strategies to assist students. Personal devices within the classroom setting can be used as one of the many intervention strategies to assist students with the content, but it should not be the only intervention strategy. Online programs and devices can also be used to support what is taught by the teacher to help students receive more interactive practice on the concept being studied. I realized in my years of teaching after that I needed to include online and in person intervention strategies to truly help my students grow. I would allow for technology time, but also include games and activities on paper that I could interact with the students using. Second, students need to be taught how to use the personal devices and sites or apps explicitly within

class. In this day and age there seems to be an assumption that students know everything there is to know about technology and how to use it. This study shows that this is not the case. Students only know what they have been exposed to at home or in other classes. Students need to be explicitly taught and given practice time with the personal devices and how to use the sites and apps the teacher would like. There needs to be specific lessons where these skills are targeted so that students do not waste time when they are actually trying to utilize these resources for learning. Most sites have a tutorial video and I know play these videos for the whole class within the first few days of school. We then take time practicing logging in and finding assignments before even addressing the content. We also take time to go over how to turn on the devices and fix simple problems such as a dying battery. This prevents my students from wasting time in class since they can now trouble shoot some of the simple problems that may occur. Third, students need to know why they are utilizing the personal devices in their education so they do not stray away onto other sites or activities. Students thrive when they know and understand the why behind an activity. They want to know the reason for the activity so they have some "buy in" or real interest in it. The better they understand the why behind an assignment, the more likely students will stay on task on the personal device. I now tell my current students how the activity will impact their understanding or prep for other concepts each time they have something assigned online. Overall, personal devices can be used in classrooms as a positive intervention strategy or learning activity; however, students need to know why they are using them and how to use them to make the best use of their learning time within the classroom setting.

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