The Impact of 1:1 iPads on Teachers and Teaching

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Abstract

This study examined the effects of how 1:1 iPads (1 student to 1 iPad) impacted preparation, delivery and feedback for teachers. In particular, this study investigated delivery, efficiency, student engagement, assessment/feedback, and intervention and how 1:1 iPads allowed for new approaches to lesson delivery that would otherwise be difficult to impossible without 1:1 iPads.

This study showed how in the 2013-14 school year in a Midwestern Suburban 7th grade Pre Algebra classroom the teacher graded and analyzed the class's work far faster than previously possible. Once the teacher started to become more efficient, the teacher had an opportunity to update teaching practices to match the needs of the classroom. The teacher prepared for lessons in a way that was not previously possible, including meeting with each student with more frequency and improved accuracy of what students needed help and with what topics. The teacher became so efficient that he was even able to run a hybrid classroom.

Introduction

I have searched for ways to improve my teaching since I entered the profession. Many theories I came across seemed more like a flavor-of-the-month than a tried-and-true method to improve teaching. I found lots of gimmicks, gags, and candy bars, but no substance. When I actually took the time to think about my quest, I realized that I wanted to save time on mundane tasks so I could have more time to analyze my students' work. With the time that I saved I could paint my students and their parents a better portrait of the achievement and proficiency levels the student had reached, and more importantly why their child is at those achievement and proficiency levels. I found great satisfaction when I could specifically say to a student exactly what concepts they were missing, instead of generalizing topics where more work was needed. I wanted to be able tell students things similar to, "You're very good at finding the coordinates of two points, but not the slope of the line that contains those two points." Or to tell their parents, "Your child can solve equations just fine, but it's negative numbers that mess them up, and that's why they seem to get every problem wrong." - the type of information that parents and students can use. I finally realized what I had been searching for. It wasn't necessarily to be a better presenter, it was to provide better feedback and use that feedback in a more productive way.

After a few years of overworking myself I found at least part of the solution: 1:1 iPads at my school for the 2013-14 school year. 1:1 iPads meant every student has an iPad, thus a 1 to 1 ratio of iPads to students. With 1:1 iPads, I could now do the practices I had wanted to implement and those practices could be done better and faster with more accuracy. I could finally now attempt all the practices I had been wanting to do because I knew they were better but which I didn't have enough time to implement fully, grade quickly, or analyze properly. With 1:1 iPads in my students' hands, I set out

to find a way to prepare and deliver lessons better, grade faster, and give feedback more efficiently to parents and students.

IPads helped me succeed in every aspect of my quest. I could do many teaching-related tasks in a fraction of the time I previously could without 1:1 iPads. The extra time I saved allowed me to analyze student data to help my students in ways that were otherwise impossible. Eventually the functionality of 1:1 iPads transformed my teaching career.

Literature Review

Most studies I came across regarding technology in the classroom focused solely on the effects on students. I wanted to find out how 1:1 iPads would affect my teaching. Rarely had a study reflected on the changes in planning and delivery a teacher has to make, or the feedback a teacher can receive, or the speed in which that feedback happens in a 1:1 iPad school. One study did "focus on various changes that occur with one-to-one computing including changes to teachers' experience" (Swanson, 2013). The main reason why I wanted to research how 1:1 iPads would affect my teaching is to become a better teacher for my students. I wanted to do things I previously couldn't do at all or didn't have enough time to do prior to 1:1 iPads. Attard (2012) found that if teachers had the time and the resources to do an "exploration of uses of a range of mobile technologies to enhance teachers' practices," teachers could reach their full potential.

The school district I worked for had an initiative called Transforming Teaching through Technology, nicknamed T^3. "T^3 is about putting the world in students' hands. It's a learning initiative aimed at providing all students with personalized learning experiences" (Transforming, 2013). My school district was far from the first district to commit to 1:1 technology. One to one technology in schools, a piece of technology in every student's hands, has been around at least since 1989 in Melbourne Australia (Stager, 1995). Institutions such as Winona State University have had some type of 1:1 technology program for years (Digital, 1997-2014). The district for which I worked was going to provide me with a tool and I needed to find out how to best use it.

Different institutions had different goals in mind when they went to a 1:1 technology model. Some viewed it as a way to improve upon what is already being done. Dunleavy (2007) stated, "The goals and intentions of the 1:1 laptop program were

not related to major changes in the philosophy of teaching and learning at the school, but viewed as a way to increase the efficiency of their current curricular and instructional processes in order to achieve greater success by traditional indicators". In a paper written 5 years later Dunleavy found some institutions view 1:1 technology as a major philosophy change as Brown, Papert and Stager had previously found. There are institutions that "have hailed 1:1 programs as having the promise to transform education as we know it" (Dunleavy, 2012; Brown, 2003; Papert, 1980, 1993; Stager, 1995). I believed the answer lies somewhere in the middle, namely, a philosophy change with plenty of improvements for what teachers already did.

Advocates of 1:1 technology did agree on one thing and my school district followed suit: "As a part of the T^3 initiative, students will be empowered to learn anywhere at any time, strengthening their creativity, communication, collaboration and critical thinking skills" and allows for "experiences that stimulate creativity and imagination as well as maximize learning opportunities" (Transforming, 2013). This description of T^3 led me to believe that a lot would be changing in my profession for years to come.

When I was told that my students would all have iPads the following year I wanted to learn about how to use them in the classroom. Some of what I found had to mainly do with what applications (apps) to use, but not necessarily how to incorporate the benefits of iPads into my classroom or what those benefits were. Previous studies have examined the pitfalls of 1:1 technology in the classroom. When teachers, like myself, found out their school would be a 1:1 technology site many feared "there [was] a danger of the technology driving pedagogy, rather than pedagogy driving the technology" (Attard, 2012). On the contrary, "when good pedagogy drives the incorporation of technology into" classes, the transition is almost seamless (Attard 2012). Lam and Pong (2012), Sanders and Gale (2012), and Kay and Lauricella (2011) all

found that 1:1 technology in the classroom can be distracting in one form or another; however, these same studies and many more mentioned in this paper have researched how 1:1 technology affects students in a positive academic way. I did not want to focus on how 1:1 iPads would affect students; I wanted to know how it would affect my teaching.

"Provision of technology and professional development results in implementation of new practices" (Bielefeldt, 2012). I believed one of the best uses of technology to provide new practices was to offer more personalized learning. Personalized learning required changes to the mass production education model in many ways, most notably the feedback students received and the speed of getting that feedback. iPads provided a terrific avenue for personalized learning in my classroom.

It was worthwhile for me to invest my time learning how technology can perform in the classroom because of how prevalent a role mobile devices play in our everyday life. "In Hong Kong...there were 14.58 million subscriptions of mobile cellular services in 2011…(however)...the Hong Kong population was only around 7 million" (Lam, 2012). Swanson (2013) tells us that technology can change a plethora of teaching aspects, for instance, "changes in teacher pedagogy, effect on student learning experiences, impact on classroom behavior management, potential for improved communications, suggestions to address professional development needs".

I never had enough time to do the things I wanted to do for my students. Once iPads were in the hands of my students I could do various tasks much faster than before. A variety of applications allow "students to record their voices as they write. Imagine asking a student to show and explain how they work out a computation" without having to be at their side (Attard, 2011). Prior to 1:1 this task took hours of class time, but now it happened much faster or at a more convenient time for the teacher and student. Students having 1:1 technology "can save their teacher hours of wondering

about a child's unusual responses to mathematics activities" (Attard, 2012). I now had the time ask the student about their responses in class that very day instead of the following class time.

I found grading to be substantially faster within a 1:1 classroom. "The main savings is in transcription which in the case of paper forms can take as long as the original collection" (Bielefeldt, 2012). Simply stated, grading can now be done much faster than before when it took as long to grade an assessment as it took the student to take it. "Web tools are now available to quickly gauge student comprehension and adjust teaching" (Spires, 2011). This type of interaction "draws more from students and allows the instructor a better idea of where the students are with course content" (O'Brien 2011).

When participation and feedback happened quickly, it happened more often as well. "At the school level, as teacher and student relations begin to shift in one-to-one environments, it appears that overall communication tends to increase" (Spires, 2011). When communication increased, then more personalized feedback increased. "One-to-one environment in the classroom pushed teachers toward instructional personalization through triage, or the sorting and prioritizing of students' needs" (Spires, 2011).

Using more and more student data, collected and analyzed quickly, allowed teachers to adjust if, when, and what is needed for the class and individual students. One to one technology "increased opportunities for students to ask questions of their teacher, particularly for students who might have been shy in class" (Spires, 2011). "Research revealed that the use of digital devices in a ubiquitous computing environment was capable of facilitating faculty-student interactions and in-class participation, which in turn enhanced engagement and active learning" (Lam, 2012). As a teacher I wished that students would be more engaged and active in learning, and 1:1 technology helped with that (Lam, 2012). Technology made it easier to effectively teach

a large number of students and have them feel like they are in a small group of students (Saunders, 2012). I have found that if I am allowed to focus on a small number of students I am more effective with them.

Aside from increased speed and communication, another perk of having taught in a 1:1 classroom is the diversity of ways a topic can be covered. Teachers can accomplish a great deal if every student has access to knowledge, tools, and communication. "Technologies offer much more in terms of allowing students access to a broad range of tools that have the potential to enhance teaching practices" (Attard, 2012). For instance, in 1:1 classrooms, there is an increased use of software tools for creating products like webpages, storybooks, interactive timelines, podcasts, and video conferences across the world. (Spires, 2011; Bebell, 2010; Lei, 2008; Mouza, 2008; Attard, 2012; O'Brien, 2011). Students creating products is the highest form of learning (Bloom, 1956).

Justification

Last year some schools in the district in which I worked received a grant so that all students of those selected schools would have an iPad. My school was one of those selected schools to pilot a 1:1 iPad program. The district categorized my school as a T^3 school and as a result my school was to get "focused on creating a more personalized and engaging learning environment, enhanced through the use of digital devices" (Transforming, 2013). I didn't know how this would affect my teaching. I wasn't given much training and mostly had to either teach myself or learn from colleagues who were doing the same. With everything that I did I felt like my colleagues and I reinvented the wheel: redefined what a textbook really is, relearned how and where to type a paper, reevaluated how students could turn in work, and rediscovered that the limits of our classroom lie well beyond those four walls. I had hoped to find a way to do all the things for my students that I had wanted to do, but didn't have the time or means to do.

The district where I worked eventually wanted *all* students to have some type of device available to them in class and to take home, not just select schools. This might mean a district-issued iPad, or his or her own tablet from home, or his or her own cell phone. Funding is the main reason why the entire district didn't go 1:1 this year. The hope is that in the next few years enough funds can be secured, along with having enough kids who buy their own, so that every student has a device.

The school district adopted the SAMR model. SAMR stood for Substitution, Augmentation, Modification, and Redefinition. These were different levels of technology integration in my teaching. "Substitution" simply meant replacing the traditional medium with a new technology medium, like pencil and paper was being replaced by an app, Notability. "Augmentation" was using more functions with the same old tasks because we now had that ability. An example of "Augmentation" would be importing pictures into

class notes. “Modification” meant changing something significant about my classroom teaching and student learning, as when a group of students collaborate to get vocabulary terms on the same spreadsheet and then import them into another app. “Redefinition” meant doing something in my classroom that was otherwise impossible to do before the new technology. These steps move from enhancing student learning to transforming it. My district wanted to be “a leader in technology and innovation” (Strategic, 2013), and I hoped to transform my teaching.

I did not find studies very similar to mine to help me with this process. Some had similar aspects but are more student-centric than my teacher-centric study. The studies similar to those by Lam and Pong (2012) talked about the benefits of 1:1 classrooms for students. However, 1:1 classrooms were a relatively recent phenomenon and the vast majority of the research was on the challenges of technology in the classroom or how 1:1 technology affected students (Sanders, 2012). I focused on how 1:1 can impact teachers and teaching.

The studies I read about had ranged from reporting on new teachers being weary of their students having technology in the classroom to documenting the improvement of standardized test scores because of the use of technology in the classroom (Lam, 2012; Dunleavy, 2007). When Bebell (2010), Kay, and Lauricella (2011) referred to “technology” in the classroom, it only referred to computers along the sides and back of the classroom, or an interactive whiteboard, or college students being permitted to use their smart phones in the classroom. However, some studies worried about the detriments of technology in the hands of students (Sanders, 2012). Many explored the benefits that came with learning from a student perspective in a 1:1 environment. However relatively little research had been done to find the benefits for the teacher in a 1:1 classroom. If a teacher benefited, then his students would benefit as a result. I believed that if each student were to have a computing device, then, theoretically, a

teacher could teach more students, grade more tests, give more feedback, and affect so many more lives than previously possible.

I took it upon myself to use the iPads in class every day from September through June. I started off by using the iPads for simple things in the classroom, mostly just substituting pencil and paper for the iPad. After I felt like I had mastered that change in my classroom I would venture into other things I felt I could do. I was certain our district would do all they could to continue to secure funding and probably expand the use of 1:1 technology. Since I had been planning on teaching for another three decades I had better learn how to use this now because it's not going away.

Since I wanted to make things easier for myself in the long run while improving my teaching, I wanted to try to figure out how 1:1 technology can speed up the mundane tasks and improve the feedback I give to students. Doing this will require me to change preparation for lessons and delivery of those lessons. It was and is my hope that there will be things that I can teach other teachers and others can teach me.

As I learned more and more about how 1:1 iPads aided my teaching I discovered that the changes fall under two broad categories: 1) preparation and delivery of instruction and 2) efficiently giving feedback and results to students and getting feedback from my students. These ideas were intertwined. Being able to provide timely feedback to my students allowed for better and more accurate preparation of lessons and a more specific delivery to specific students.

My school district wanted to "Provide students with a more flexible, self-directed approach to learning where teachers encourage student interest and choices" (Transforming, 2013). I thought I could give that hope to all my students in a more manageable fashion if they all had iPads. I knew I could save myself and other teachers a lot of time in class and in planning.

Process and Results Part 1: Additions and Upgrades to the Classroom

In September of 2013 I needed a starting point to begin implementation of iPads into my classroom. I took a cue from my school district and started with "Substitution" on the S.A.M.R. model. From there I steadily moved from "Augmentation" to "Modification" and I approached "Redefinition" with a hybrid classroom.

My experience had shown me that the note-taking process is essential in order to become a successful student. The way I had students take notes was no different than when I was their age. The first thing I wanted to use the iPads for was to take notes. I wanted to see what the possibilities were for the note-taking application called Notability.

Notability was a note-taking application with many capabilities; many different writing colors, highlighters, keypad-text entry, voice-to-text entry, audio recording, shape drawing, image importing, document importing, and exporting to email, Google drive, social media, or many other mediums. There was storage in Notability as if it were a binder full of folders and paper. The students wrote their notes in different colors, typed their notes, and highlighted as needed. Students recorded audio as they wrote and the stylus strokes are saved in conjunction with the audio, thus making a little video of how to do a problem. There are many different electronic-paper options for Notability. Users chose from blank paper, lined paper, and grid paper, to name a few. IPads allowed any user to take any picture or document and import that into a note in Notability. Any note that is in Notability could be shared out to any number of external mediums.

The benefits of Notability were more than just interesting features on an iPad. I could post the notes from any lesson on my website. I prepared worksheets and had the class upload it to Notability instead of passing out papers. Similarly, I did not need to pass out graph paper because the students have graph paper in Notability whenever they need it. I took problems and paragraphs the class is working on and put those directly into the notes because of Notability's import capabilities. Once those problems

were in Notability I wrote directly on the text, which could not happen in a traditional textbook. I used the talk-to-text feature to quickly write a sentence, and at the same time show students how to troubleshoot grammar, punctuation, and spelling. This was especially helpful when a sentence or a paragraph needed to be committed to 'paper'.

The amount and speed of feedback I got from students increased dramatically when the class took notes with the iPad. Students took screenshots and asked me questions in emails; in response I answered their question as soon as possible. Sans iPads only the bravest of students would ask a question in class, but with the iPads more students felt comfortable asking questions. Saunders and Gale (2012) found similar results. When each student had a device in hand they were more likely to give suggestions in class because their anonymity was enhanced by their iPad. When I had students answer questions on regular paper only about five or so students participated. When I had students presenting their ideas anonymously I received twenty responses. This gave me a much better picture on how the whole class was doing with a topic, and allowed me to make a quick formative assessment on something that I never could have done before.

One of my main objectives was to increase speed and efficiency, especially with mundane tasks. Importing problems for notes when I was preparing for the next days' notes had saved me fifteen minutes per day. Not having to send items to the print center saved time and hassles. Not having to pass out worksheets in class saved a lot of time as well. Time was further saved when I added up the time students didn't need to spend sharpening pencils, finding a pen, getting out paper, or turning to the next page for notes. All that extra time gave me more time to teach and reach my students.

When it was time to correct homework I used to stand at the front of the class and read off the answers. This did not allow me to effectively see which students needed my help. Also, I didn't know whether a student understood that homework topic

until later that day or the next. This was unacceptable because each day builds off of the previous day's work. Right after note taking I knew that I needed to find a way to reach out to those students who needed my assistance, but didn't know it.

With my iPad I took a picture of the correct answers and projected it up on the board, or sometimes I emailed that picture to the students. Both required the students to grade their own homework, but with 1:1 iPads I was free to go about the room and conference with students who needed my help.

In these little conferences I caught problems students were having much faster than before, I helped my students before any misconceptions allowed them to layer their mistakes. This would have been otherwise impossible or time consuming before I had an iPad. If I happened to miss anyone that had a problem, I announced each day that if there was a problem to screenshot it and email it to me. There were a few times that I would make an online survey and the students would fill it out regarding what problem(s) they would like me to go over. All this flexibility allowed me to help more students sooner.

I was not the most creative teacher; I knew I could do better. I knew there were activities I could have my students do that would allow them to learn better. The fact that my school was a T^3 school allowed me to address both of these concerns.

One of the first terms I learned when I first got my iPad was "app". App was short for application and an iPad was not as powerful without apps. Many teachers were searching all summer for nifty apps that they could use in their classroom. An app was just a program for the iPad. There were many apps and mobile websites that worked well in my classroom (Appendix 3). There were mobile website and apps that helped me make review games, let my class collect data quickly and efficiently, and allowed for more creation to happen in my class.

According to Bloom (1956), creation was the pinnacle of student display of

knowledge. However, students didn't create much of anything in my class prior to iPads. Post 1:1 my students did a variety of things my former non-iPad students never got the chance to do. With 1:1 iPads our class created instructional videos for each other, games to test each other, and funny skits to remember how topics are connected. Students made podcasts, were news anchors, made movie trailers and posters, and many other creative ways to express their knowledge of a particular topic. Also, some apps were set up like games so students felt they were playing a game when really they were learning.

When students used apps to learn, they shared their results with me so I had a record of how each student has fared. If I noticed a student needed some more guidance, I knew right away instead of days later. This helped me formatively assess where my class was and where I needed to focus next.

Later in the fall of 2013 when I wanted students to do some activity with flashcards, they would have take 15 minutes to make the flashcards before they used the flashcards. Students could only use the flashcards for one purpose: look at one side of the card and try to remember what was on the other side. But with gFlash+ the students made them in seconds and did much more with them than just the traditional basic function of flashcards. The gFlash+ app set up matching games and multiple-choice quizzes for the students to test themselves or each other. This not only saved 15 minutes of my class time, but it allowed me to quiz my students without having to take the time to make another quiz.

As I learned more and more about the different functions that an iPad can have in my classroom I realized that students quickly changed from one task to another. Previous to 1:1 iPads, students had only enough space on their desks to have a notebook and a textbook. When I would ask my students to get out different materials for different periods of class I had to allow a certain amount of transition time which was

wasted academic time. When I wanted them to use flashcards, dice, or other manipulatives, I also had to allow extra transition time.

Once I learned more functions an iPad could do in my classroom I began to realize that the time savings could come in small increments. The few minutes I was required to allow for transitions between different class materials and tasks nearly disappeared because everything I needed was only a few clicks of the iPad away. Sometimes If I needed to answer a quick phone call or take some other type of break in class I would tell the students to practice their flashcards we had already set up. When I was done with the pause in class then I could get the class back on pace with minimal transition time. Eventually I broke my class into very small 10-15 minute periods and had the students do a different task or rotate to a different station for each of those periods.

I had students study their notes in one app, review their flashcards in another, review or retry problems from a previous quiz, and/or take a pretest on the internet all in 10-15 minute increments as the students were working independently. This allowed me to go to specific students who needed more of my attention.

Prior to 1:1 iPads I feared the act of grading tests and quizzes. A classroom set of tests used to take me 4-5 hours to grade; even a small quiz took me a half an hour per class to grade. Much of this time was wasted by flipping through pages, searching for where a student put an answer, and tallying up student scores. After all that work I had only a faint idea about what questions were difficult for my class and I didn't know what students needed help with. Grading was taking too much time and wasn't giving me enough information about my class. 1:1 iPads in my classroom allowed me to drastically cut the time I spent on grading and allowed me to learn a lot more about what my classes knew.

The vehicle that allowed me to decrease grading time and get more feedback

about my classes was a Google account that each student and myself had. A Google account allowed users to save their work similar to a hard drive that can be accessed anywhere there is internet access. With a Google account came an email, storage, and a variety of other applications. Google Forms was what I used to make quizzes, tests, and surveys for my students (Appendix 2). Google Forms could be used to collect any kind of data that one would like to collect. Google Forms collected the students' answers for me and the add-on-script named Flubaroo graded it for me. I had to make the key by taking the assessment myself, then Flubaroo checks for exact same responses. I did still look at every student's answer and I reformatted an answer if I needed to so that it would match the answer key. I asked students the same type of questions using Google Forms as I used prior to 1:1 iPads.

In these Google Forms assessments I had accurate and colored pictures, tables and graphs which are much better than the fuzzy black-and-white, double-printed copy of a copy that my district's print center usually gave us. Those were some nice benefits to the previous ways but the most beneficial turned out to be something I called a "looping" test, which I developed through the winter of 2013-14. A looping test is a test that loops back to a previous question if it is not answered correctly. I set up the Google Form so that if a student answered a particular question incorrectly the test would bring the student back to that question with instructions to see the teacher for a brief reminder. If a student got the problem correct then they just moved on to the next problem like any other test.

Looping tests allowed me to get feedback from my classes that I never could get before. I usually started each assessment with a looping question or two. I always chose a low-level question for the looping question. This was so I could reteach or point out small errors or switches that students occasionally made. There had been many times when my students knew the material the day before a test, but on the day of the

test the students mixed up two ideas and did much worse than they deserve to. I was a firm believer that learning can happen even while a student is taking a test. These two ideas collided and inspired me to make what the looping test. If my student marked the wrong answer, a screen pops up to tell them to see the teacher right away. At this point I gave these students some last minute advice, but the student then had to answer that question correctly eventually to move on to the rest of the test. It was my hope that this refreshed topics I have taught without giving them the answers and they would carry that refreshment throughout the remainder of the test. I emailed students their results on every test when they were given on an iPad. In these emails I gave students much better feedback that they previously would have gotten from me regarding what type of question they got correct and what the correct answer was.

Looping tests more accurately assessed what students knew rather than remind the students that they mixed up the two main ideas on the test. This saved me from having to re-teach students who failed and then grade their retake. It used to take me about four hours to grade a test, but with the help of Flubaroo I could grade a class set of tests in 40 minutes. Quizzes used to take 30 minutes to grade without 1:1 iPads, but I could get the quizzes graded in only five minutes. That was a lot of saved time and energy that I have poured into other aspects of my teaching. I gave practice tests to the students then graded it and sent it back to them in a matter of minutes. I went over the most frequently missed questions as a class, then allowed time for individuals to ask me individual questions about their practice test. This sounds like a very basic and traditional teaching strategy, and it is, but I did it all in one class period instead of a day or two later. I sent the correct answers to the students in an email because this saved me quite a bit of time when students could see that they were actually very close to the correct answer. Lots of time has been saved because of 1:1 iPads and it has lead me to explore better ways to teach my students and learn more details about them.

Process and Results Part 2: Hybrid Classroom – I.S.O. Model

By March of 2014, after having saved a lot of time by eliminating mundane tasks and taking that time to create new ways for my students to learn, I was still yearning for more. All of the changes I implemented throughout the year had to culminate into something transformative. I made changes in preparation, delivery and providing feedback to my students. Some changes were large, but nothing to the scale of what I next undertook. I wanted to use the iPad as more of an independent learning tool; I wanted to partially flip my classroom. A flipped classroom is the learning model where students initially learn at home, usually through a tutorial video or looking over prepared notes. After the students learn academic material at home, the following class day is spent on asking the teacher questions and doing some type of formative assessment. I wasn't confident that my 7th graders were ready to learn entirely independently so I didn't feel comfortable with a fully flipped classroom, but I still wanted students to learn at their own pace.

In preparation for a hybrid classroom, which I named Independent Study Opportunity (I.S.O.), I needed to make a pretest for the students to take. I also made a quiz and a quiz retake for each topic. The posttest I had prepared at the same time as I prepared the pretest. I also needed to make or find on the internet videos that explained each topic I expected the students to learn and then the ensuing homework for each section. The final item I prepared ahead of time was enrichment ideas for students that worked at their own pace and finished early. I planned out ahead of time how many days the whole unit would take, from pretest to posttest. The number of days my classes were to spend learning via the I.S.O. model is the same amount as I would plan for a traditionally taught unit. The speed and efficiency of having 1:1 iPads allowed I.S.O. to become a reality.

I first had the students take the pretest on their iPads. I quickly graded and

analyzed each student's pretest. I was looking for an 80% minimum benchmark for any topic. Meaning, if students earned 80% or better on any individual topic then that student was exempt from the homework and quiz from that topic, automatically earning 100%. Once I had this information I could email the results to my students so the next class period they knew what sections they were exempt from. I could do this in a matter of seconds instead of spending a decent portion of a class period meeting with students to tell them simple information (Appendix 1).

If a student met the 80% benchmark for all sections then that student earned a 100% on all quizzes for that chapter and could start to study for the posttest. That student would be assured of the pretest score being the minimum grade earned on the posttest and would attempt to improve upon that grade when taking the posttest. At the time of this publication that feat had not been accomplished.

After the pretest day the students were instructed to learn each topic, complete homework for each topic, check that homework with the answer-filled teacher textbook, and then come see me. Students could learn each topic by watching the videos on their iPad or sitting in on a mini lesson. I knew that many students did not want to learn by watching videos and possibly some weren't capable. I provided a mini lesson or two each day on different topics. I defined a mini lesson as a short 20-minute lesson on a topic in a small group setting. Normally only eight students were in each mini lesson which is a very comfortable learning environment for many of my students. Some days I only had time for one mini lesson, but most days I gave my students two mini lessons, each on a different topic. This allowed my students to get a traditional lesson from me if they desired. This also allowed me to help the advanced students who were already ahead of the rest of the class. Some of my students preferred to watch the videos and partake in the mini lessons. Once done with the mini lesson many students would start on the homework.

Students could complete any topic in any order they chose. I did tell them what might be the best order or which sections needed to be done prior to others, but ultimately the choice was theirs. Once a student was done with the homework portion of a section and came to me I would spot-check a few problems on the completed homework to be sure students really did understand that topic. When I was satisfied that they could move on to the quiz for that section, I would email them the link for the quiz. The student would take the quiz at a desk.

Once completed with the quiz I graded it in seconds and sent the student an email with instructions to either continue onto the next section or to come and see me because the 80% minimum benchmark was not met. When students did not meet the 80% minimum benchmark I reviewed each incorrect problem with them and even made sure they truly understood the problems that they got correct. This allowed me to help my students as soon as possible before they continued making mistakes on other topics. Once the quiz had been reviewed to my satisfaction then I instructed the student to take the retake quiz I had just emailed. Students could work at their own pace and after a couple class periods many students were on a variety of different topics all learning independently with frequent checks by myself.

As students completed all of the topics and passed above the 80% benchmark for all the quizzes then those students were ready to take the posttest. They could study on their own, review with me, or retake the pretest as practice. Many students chose to either review with me or retake the pretest with near immediate feedback from myself. Both of these methods allowed me to personally assist my students right before they took the posttest. I would then email the posttest to the students and they would take it. Just as any other assessments given, I could grade and analyze so much faster with students taking the Google Forms tests.

After students took the test I instructed them to do test corrections and the

students also got to create a media presentation of some kind for their peers, with some incentive from me of course in the form of points. Students made music videos, news bulletins, commercials, and interactive highway signs. My students made some terrific enrichment projects that helped their classmates learn as well. Any student who made an enrichment activity was required to share it with the rest of the class before I recorded a grade for the enrichment.

Independent Study Opportunity (I.S.O.) revolutionized my classroom and my perception of what my roll as teacher was going to be. I knew that I wouldn't be able to run I.S.O. for every unit, but I now had the opportunity. I could do so many great things because my students had 1:1 iPads. Saving time is something I needed to do in order to do more of the things I wanted to do for my students. The only way for me to save time was to increase my efficiency as much as I could. Technology has helped with that immensely. All this time saving allowed me time to do and try things I never would have had time for in the past. The time saved in class allowed me to check up on and help more students than I ever had been able to in the past.

Times in the following table reflected a standard unit for one class of 30 students that contained one pretest, twelve days of study for six different topics, each with formative quiz and quiz retakes, one review day, and one testing day for a total of 15 days to complete the lesson.

Task	***Time spent prior to 1:1 implementation***	***Time spent after 1:1 implementation***	***Time saved because of 1:1 implementation***
preparing the next day's notes	15 minutes per day for 13 days = 195 minutes	1 minute per day for 13 days = 13 minutes	3 hours and 2 minutes
grading the pretest	4 hours	40 minutes	3 hours and 20 minutes

grading the posttest	4 hours	40 minutes	3 hours and 20 minutes
helping students who failed a test because they mixed up two main ideas (but still knew the material well), avoided with 'looping' questions	20 minutes of one-on-one tutoring plus 15 minutes to grade the retake, per student. Average 2 students like this per unit = 70 minutes	Avoid failures because they mixed up two main ideas = 0 minutes	1 hour and 10 minutes
Making, printing, stapling, and organizing test materials	60 minutes to make each test and 30 to print, staple, and organize = 180 minutes	60 minutes to make each test, but no time to print, staple, or organize = 120 minutes	1 hour
Passing out papers	including passing out paper versions of the 2 tests and 6 quizzes there are 8 to 10 times where papers would be passed out, using 9 as the average and 2 minutes per pass out = 18 minutes	3 clicks on an iPad for each of those 9 pass outs total 1 minute	17 minutes
Making, printing, stapling, and organizing quiz materials	10 minutes to make all 6 quizzes and 10 to print, staple, and organize = 120 minutes	10 minutes to make all 6 quizzes, but no time to print, staple, or organize = 60 minutes	1 hour
grading each of the 6 quizzes	30 minutes each = 180 minutes	5 minute each = 30 minutes	2 hours and 30 minutes
students finding their notes, opening up their textbook, and finding a pencil	3 minutes per day times 13 instructional days = 39 minutes	1 minute per day = 13 minutes	26 minutes
making flashcards	15 minutes once in the unit	1 minute in class for students to download vocabulary and 5 minutes for me to type up the definitions the day before = 6 minutes	9 minutes

Total Time			***16 hours and 14 minutes over 3 weeks of school***

Times in the above table reflected the quantity, quality, and speed of feedback to students with and without 1:1 iPads. As can be seen, in 15 school days over 16 hours of time was saved, that is over one hour per day. I thought of all the good a teacher could do with an extra hour of time.

The type of feedback was improved as well. When I used the same model as the above table indicates, a standard unit for one class of 30 students that contains 1 Pre Test, 12 days of study for 6 different topics, each with a formative quiz, 1 Review day, and 1 Testing day for a total of 15 days to complete the lesson.

Task	***What feedback consisted of prior to 1:1 implementation***	***What feedback consisted of after 1:1 implementation***
Pretest	Questions were marked right or wrong without knowing what the correct answer is. Most students just looked at their score. Students got their results back the next day or two days later.	Questions are marked right or wrong, but the students know now what the correct answer is. Because they can see the correct answers, most students do look to see what problems they got correct and incorrect. Students get their results back within class time or later that afternoon. Students also get personalized feedback written by the teacher.
Posttest	Same as Pretest	Same as Pretest
Quizzes	Same as Pretest	Same as Pretest
Writing Papers	Students would have to meet with the teacher individually and review their paper or turn in a copy of their paper for the teacher to peruse.	Students can meet with teacher on how to improve their paper because the teacher has access to their paper through Google Drive.
Classroom discussions	Students talk, teacher tries to remember who said correct and higher order comments and who didn't. When class ends, the discussion is over.	Students talk, teacher directs good comments to a blog or timeline, all the while, other students can comment via text, but not talk out loud. All students have access to the blog and can continue it at home or reference it at home.

Reflection

At University of Wisconsin, River Falls I started to see how technology could make all of our mathematical lives a lot easier. I used Wolfram Alpha, R, and Geogebra to do mundane tasks quickly so I could analyze and solve higher order problems. I connected ideas faster because I could see the results faster.

Maslow's hierarchy stated that people required their basic needs met first, but once that was taken care of, they wanted to be recognized for their achievements and mastery of topics and challenges. Once at that plateau, students wanted to be creative, fulfill their wonders, and pursue their talents. If I as their teacher allowed them to leap forward beyond their classmates, then they had a chance to be creative with the topics learned in class. They searched for their talents and related them to what we have learned in class.

We as a society need to "shoot for the moon" when it comes to education, because most of our workforce won't be doing manual labor in factories and farms where conformity is the norm. We will need free thinkers who are hard working, self-motivated individuals to come up with creative ways to solve the problems of the future and fix the problems of the past.

The school year following my study I plan to attempt to teach more units using I.S.O. This will allow for me to focus on individual students from the commencement of the year. Many of the benefits I have seen will be multiplied because of the knowledge base I have built this year. Hopefully many of my students will be able to realize their talents and creativity can be honed in school and out.

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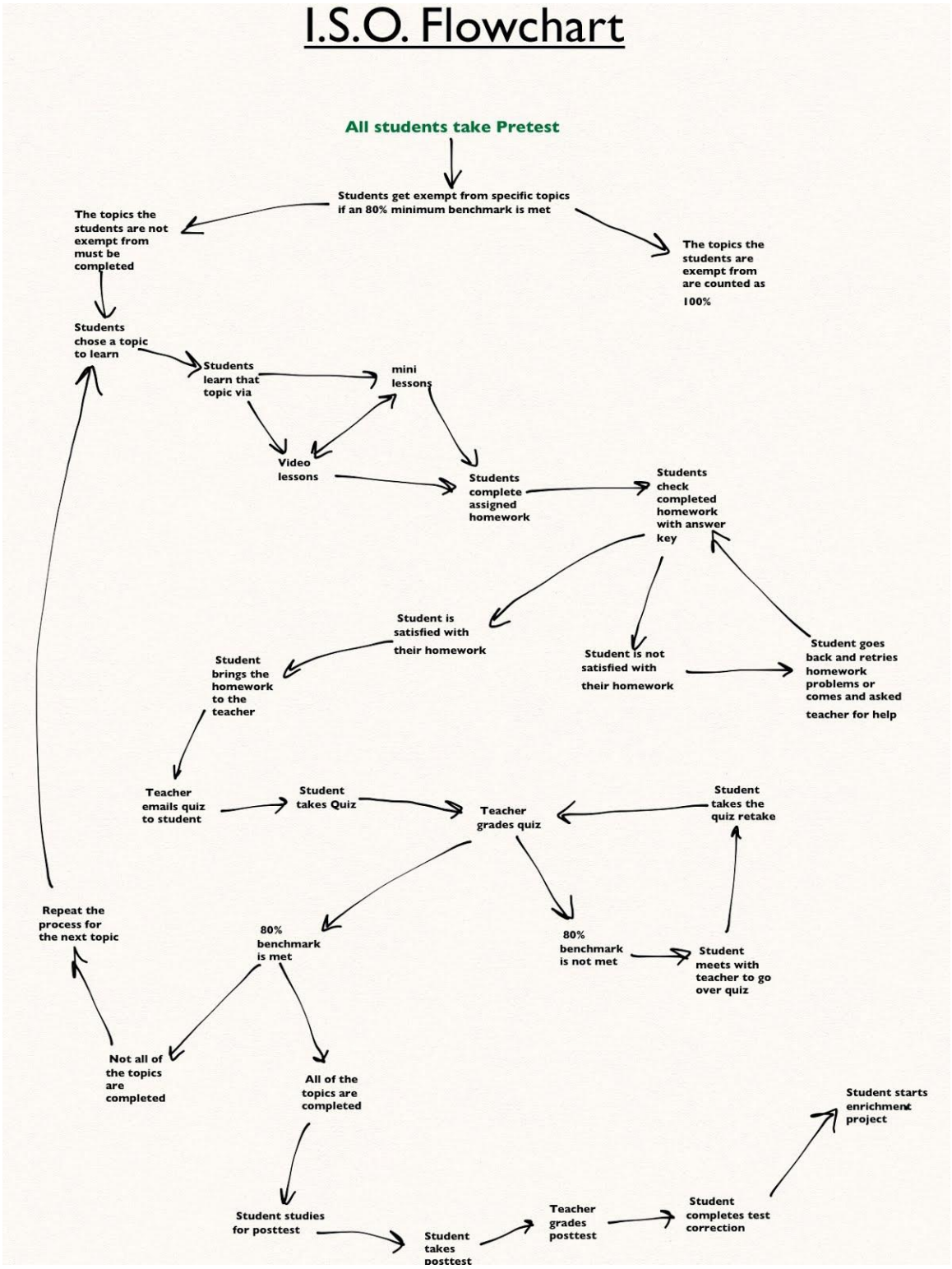
Appendix 1

Flow Chart Explaining I.S.O.



Appendix 2

Google Form Quiz (Tests look the same).

Appendix 3

A portion of the apps used in my class