

WHEN TECHNOLOGY NO LONGER ENHANCES LEARNING

by

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Abstract

This article was written in partial fulfillment of the requirements for the degree of Masters of Science in Education - Mathematics at the University of Wisconsin - River Falls. The purpose of this study was to see in the 21st century's classroom if the use of technology was enhance and engaging students in their learning. I wanted to know when having smartboards, iPads, laptops, computers, clickers and other technologies no longer engages students in learning.

The method that I used was to have three different treatments that allowed me to see when and if the technology that I had in my classroom would enhance their learning. For the first treatment the students were not allowed any technology in the classroom. This meant these students had to rely on their own knowledge and ask questions of me and their fellow classmates. The second treatment group was allowed the use of technology fifty percent of the time. These students were given technology half of the time in the classroom. They could ask questions of their neighbors, their teacher, and use some other resources when time was permitted. The final treatment had full use of technology. These students were only allowed to use technology to find the answer that they were searching for. They could ask their teacher some questions but were to rely heavily on their technology for their answers. The results from my study were that second treatment group preformed the best on their posttest. They showed the most gain in their knowledge than the other two groups. The students that are coming to us in our classrooms are much more familiar with the use of computers, iPads, iPods, and other technology that in the years before. I think there is one thing that will never change in learning and that is the need for human contact.

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Introduction

This study was conducted at Robbinsdale School District and was designed to determine when using technology in the classroom has little to no effect on student learning. This project seeks to determine what amount of technology in the classroom is really enhancing student learning against the back drop of the huge push for more technology by the state. The amount of technology used in classrooms should be based off on the extent of learning that is achieved using that technology, for example; smart boards, iPads, laptops, electronic clickers, etc. “As instructors, we know all too well that the same Internet technologies that help facilitate activities learning in the physical or virtual classroom can distract students from learning in the same classroom.” (Rollag and Billsberry, 2012)

One scholar, Todd Oppenheimer thinks we should not remove the computers and devices from the classroom, but that we should be using them in smarter ways (Oppenheimer, 2003). In particular technology is here to stay so we need to figure out a better way to use them to provide our students more differentiation in the classroom that is the use of a wide variety of methods. Differentiation in the classroom is a philosophy for effective teaching that involves providing students different avenues to learn the curriculum, be it through direct instruction, group work, class discussions, etc. Technology can provided teachers with more differentiation in the classroom. Oppenheimer suggests we need to find better ways for technology to provide this differentiation.

I. Lit Review

There have been many different types of technology studies done in the past, all of which have wide varying disposition towards the use of technology in the classroom. Some of these have studied have supported the idea of increased use of technology while others have refuted the idea. One in particular (Barnett, 2006; Crossgove & Curran, 2008; Lincoln 2008) was to see how the use of a clicker and having immediate feedback affects learning. Shawn Keough reviewed sixty-six different studies that had previously performed study to see if the clicker produced high levels of performance (Keough, 2012). Keough's hypothesis that the clicker technology would produce higher levels of performance than those who did not was supported by his data.

The educational theory involved in Keough's study could be argued to be Skinner's Behavioral Theory (Keough, 2012). This is due to the fact that the units are being broken down into smaller tasks so the instructor can see what information the students are retaining. This allows instructors to check work at a faster pace so that students are receiving immediate feedback.

Todd Oppenheimer is a scholar who arrived at a different conclusion; he researched how technology affects student learning (Oppenheimer, 2003), and wrote the book *Flickering Mind: The False Promise of Technology in the Classroom, and how Learning can be Saved*. He argues that computers should not be the center of the classroom but rather be available to assist the teacher when they are properly trained. In *The Flickering Mind*, Oppenheimer talks about how technology companies would trick schools into thinking that they needed their products to enhance their classrooms by first giving them the technology for free. His conclusions were that "technology will

not fix what is wrong with our schools.” (Oppenheimer, 2003) His findings show that “we are using technology too intensely in the younger grades but not intensely in the proper areas, in the upper grades,” such as, our educational system needs to look at how we are using technology in the classroom (Oppenheimer, 2003). One chapter in *The Flickering Mind* discusses that students still need that human touch. They need the interaction with teachers and students in order to fully understand what it is that our educators want them to learn and remember. He also concluded that teaching staffs need to accept that technology is going to be used in our classrooms from now on regardless, which reinforces the idea that teachers need to be trained on how to use technology, and where it is appropriate, so that it effectively enhances student’s learning.

The educational theory within Oppenheimer's work is based on that of Skinner and his behaviorist theories. Skinner thought that by having “teaching machines” in the classroom, students would be able to learn twice as much as in a standard classroom. Oppenheimer's research shows that this is not the case.

Jane Buckenmeyer of Purdue University conducted a study that looked into factors relating to technology adoption to enhance teaching and learning (Buckenmeyer, 2010). Her study addressed two issues; the first was to see the attitude toward technology in the classroom and the second was the use of technology by teachers (Buckenmeyer, 2010).

Buckenmeyer's conclusions from her study were that technology should be adapted in the classroom because it helps student learn. This is, however, only if the teaching staff has the opportunity to be trained on how to use the technology and how to add it into their curriculum. Buckenmeyer concluded that there was a correlation between attitudes towards technology integration in the classroom and training. Teachers who had training on how to integrate technology in the classroom had a much better attitude towards it. Those who did not struggled with how to use it eventually gave up.

The educational theories behind Buckenmeyer's study are like that of Jean Piaget (Buckenmeyer, 2010). Her research studied teachers providing students with an appropriate curriculum that enhances their student's logical and conceptual growth. Students today are surrounded more with technology than ever. Her study tried to identify progress of students in a classroom that enhances their learning.

II. Justification for the development of this project

Technology has made an enormous impact on classrooms. In the US, each and every school district is trying to stay ahead on how to keep students engaged in the classroom. Even two decades ago there was very little technology in my classrooms, perhaps an overhead projector or an LCD projector. Students were taught primarily with white boards while having a lot of one-on-one attention from the teacher. Today's classroom is leaning towards getting away from teacher centered teaching and become more student centered and student driven (Mcleod 2010).

Technology is prevalent in the classroom, with students using iPads, laptops, cell phones, Smartboards, and clickers. Yet, despite all these learning tools that purport to engage and enhance learning, educational achievement was not improving, at least as measured by standard objective measures, when looking at students MAP Test scores. Understanding if the way we taught in years past was any different than how we teach today is a question that needs some answer. School districts are spending vast sums on these different tools to engage and enhance the learning; they need to know that their money is going to good use. The goal of this project is to be able to show that in the case of Robbinsdale School District, whether money is being spent on technology in a way that is helping the students. Also this project will determine the best methodology by which students retain information. Some students need more one-on-one while others are independent learners.

This project is significantly different from the other studies that I have found. These studies have only tested to see how technology can support the role of the teacher to give students immediate feedback. Other studies have looked into why some staff members do not know how to use the technology that they are given to use in the classroom. As Buckenmeyer remarks, "This is an issue because a teacher's goal is to get students to be engaged. Instead, they are having constant issues with the technology and therefore avoid using it to its potential." (Buckenmeyer, 2010) My project will attempt to see what percentage of technology is creating a learning environment that supports learning.

At Robbinsdale High School there is a huge push to stay ahead of the technology game in the classroom. The leading question that arises is to what extent technology is really helping students learn in the best possible way, or it becomes more of a distraction for them to access their online lives. This project examines these issues.

The Minnesota Education Technology Task-force exists to work with schools to develop a strong technology partnership between departments and school districts (MN Department of Education). This task-force's job is to develop a technology plan that includes best practices, technology integration, and infrastructure needs. This project examined whether the state is pouring money into something that may or may not enhance student learning.

This study could benefit similar school district's learning, such as Robbinsdale, which has a similar technology initiative, by showing them how well their money is being spent and how students are using the technology to help them with their learning. Robbinsdale School District is has two high schools, two middle schools and ten elementary schools. As for the technology in our high schools, there is a smart board in every classroom; there are about 192 laptops, about 1,000 desk top computers, about 100 iPads/readers, 300 clickers, and document cameras available for teacher use. The district is continuously purchasing new technology for its classrooms to get students more engaged and to enhance their learning. Yet, I feel that Robbinsdale School District does not offer sufficient training on how to use the technology we have in our classrooms to an extent that, I feel, makes the case for my study all the stronger. A district, such as Robbinsdale, is currently trying to place additional technology tools in our classrooms without providing us any additional training.

III. Design of the Curriculum Development Project

This study is designed to determine when using technology in the classroom has little to no effect on student learning. All of the students in this study are juniors at Robbinsdale Cooper High School enrolled in an Interactive Math class. Interactive Math is a class that is designed to help students who struggle with math; it helps better prepare them for the Minnesota State standardized test. I chose to use these students due to the fact that they all have gaps in their math knowledge, so I could see their actual growth within this lesson. The topic of all three treatments is matrices. The reason for the choice of the topic was that matrices are no longer in the curriculum in the Robbinsdale School District. Matrices are a topic that students would not likely have seen previously in their mathematics courses. A pre-test was given to check their prior knowledge with matrices although I did not expect to detect any prior knowledge. there were seventy-eight juniors that participated in my study. Several more were given the treatment but elected not to have me use their information within my study.

My study consisted of three treatments. Each treatment contained the same information being presented to the students but was presented using a different degree of technology. All three classes are around the same size of 20 students, with **Treatment 1** being administered to first and second hour, **Treatment 2** being administered to third and fourth hour and **Treatment 3** being administered to fifth and sixth hour. The following is a description of each treatment. The treatment is a unit within the class's year-long curriculum.

Treatment 1: Students are not allowed to use any technology. Students were not allowed to use any calculators, computers, or anything electronic. I did not use any technology to instruct students. I used whiteboards and markers.

Students will be asked to learn using just paper, pencil and their prior knowledge. All work was done in class, so students were not able to use their technology at home.

Treatment 2: Students were allowed to use technology fifty percent of the time in class.

They were allowed to use calculators, computers or anything else electronic fifty percent of the time. I used a smartboard, and Compass Odyssey, our online teaching tool, fifty percent of the instructional time to teach them and the other fifty percent I used white boards and markers.

Students were asked to learn using just paper, pencil, their prior knowledge, and fifty percent of the time was allowed to use calculators, computers, clickers, etc. All work was done in class.

Treatment 3: Students used technology one hundred percent of the time in class. Students used their calculators, computers, clickers, and anything that is electronic in class. I instructed them using only technology such as, smart boards, laptops, and clickers.

Students were asked to learn using only things that are electric and technology based. All work will be done in class.

The submission of homework, quizzes and post-test was different for each treatment. The students in **Treatment 1** submitted all homework, quizzes and post-test on paper. The students in **Treatment 2** submitted all homework on paper; their quizzes and post-test were submitted in electronic form. The students in **Treatment 3** submitted all homework, quizzes and post-test in electronic form. They emailed me copies of their homework and taking their quizzes and post-test online.

I instructed four of the six classes that were part of this study received. I administered **Treatment 1** and **Treatment 2**. My colleague administered **Treatment 3** to two of his classes. I wrote the curriculum so that each class received the same information. Each student was given the same examples, the same definitions, and common language when learning the material. I trained my colleague on what to say during the lessons and shared the curriculum for him to teach his class. During my colleague administration of his treatment I helped facilitate him in case he has any questions about how to incorporate the technology.

IV. Results

Before I started the treatments I had 20 students per class, so I had 120 students from whom to take samples.

Through the implementation of this project I was able to see growth in the knowledge of my students as they worked through this unit. Having given three treatments to six classes I was able to see how much my students were engaged in their learning. The pre-test confirmed that my students had never seen any of this material before. Therefore, any knowledge of this topic that they showed at the end of the unit was acquired during the treatment. Moreover, this study showed me that students need to have differentiation, more than one avenue of information being presented, with i their learning to stay engaged and to retain information.

The table 1 shows the mean and median scores from treatments 1, treatment 2 and treatment 3 on their assignments and posttest.

Table 1

Treatment 1	Assignment 1	Assignment 2	Test
Mean	5.4	4.8	6.7
Median	5.8	5.3	7.0
Treatment 2	Assignment 1	Assignment 2	Test
Mean	5.5	3.3	7.0
Median	5.8	4.7	7.0
Treatment 3	Assignment 1	Assignment 2	Test
Mean	3.6	2.7	4.2
Median	2.9	2.0	3.0

Table 2

Treatment 1	Pre-Test	Assignment 1	Assignment 2	Test
Standard Deviation	0.0	0.0	1.3	2.5
Treatment 2	Pre-Test	Assignment 1	Assignment 2	Test
Standard Deviation	0.0	0.6	1.8	2.3
Treatment 3	Pre-Test	Assignment 1	Assignment 2	Test
Standard Deviation	0.0	1.6	1.8	3.2

The results from the table 1 show that **Treatment 2** has the highest mean score for homework and for the test. This group of students seemed the most engaged when I was giving out the treatment. Indeed, since **Treatment 2** offered the most differentiated instruction, we can conclude that these particular students need to have differentiation within their learning to stay engaged.

The students in **Treatment 3** they have the lowest mean and median, it is my observation that is due to the fact that these students shut down when the treatment was being given. As I observed their frustration with the lack of differentiation as the unit went on, their worked seemed to suffer. This is obvious as their scores across the board are the lowest. **Treatment 1** is a close second to **Treatment 2** with their mean being just a little bit off by a few tenths as can be seen in table 2 with the standard deviations only being plus or minus 2 tenths.

When I look at the scores from the daily assignments I can see that **Treatment 1** seems to have the highest mean score for the second assignment by almost a whole point. The standard deviation between these is plus or minus 0.5. This to me is interesting because it shows me that my students in

the no technology group really understood that part of the lesson better than any other treatment. I am not quite sure as to why they scored a few tenths lower than **Treatment 2** on the posttest.

Here, referring again to the table, we see that in the fifty percent technology class those that score higher on their test scores also did much better on their test scores. This might have been because of the fact that they did not bring their calculator or just had missed one of the lessons and had to come in to take their assessment. This might lead me to conclude that the contact with other humans helped the students to retain their information better and having this duality helped them to learn the material better. Also, these students received immediate feedback from program Compass Odyssey.

For the one-hundred-percent-technology class, we can see that these students struggled to stay engaged with their lessons and assignments. Students learning seemed to be shutting down and their retention of what they learn is far less than those that had more contact with their teacher and less with technology.

When comparing my study to one of these three studies done before me, the one that most relates to mine is that of Oppenheimer, who has done considerable research on how technology has changed the classroom, starting in 1922, when Thomas Edison said motion pictures will change the classroom (Oppenheimer, 2003). The study is least like mine is that of Shawn Keough because his shows those students are retaining more knowledge with technology in their classroom.

My results are very similar to that of Buckenmeyer in that students do not flourish in a technology based classroom (Buckenmeyer, 2010). Buckenmeyer concluded that teachers were not well trained on how to use technology. I feel that my results are closely related to hers because my students are a product of staff that has little to no training with technology. So these students have little to no clue how to use the technology they have. That is because I received no training on how to incorporate any of the technology that I have in my classroom. We are learning as we go in our classrooms.

The shortcomings of this study would be that I felt it was not long enough. I felt that I could have gotten more data if I had created a longer unit, so that I could have seen the break down in learning and seen their frustrations. I also felt that it might have been beneficial to have the students take two surveys: A first one to see what they felt their learning styles were, and a second one at the end of the treatment to ask to assess their own level of engagement. I then could have compared what they thought their learning styles were to their engagement in the study.

The following pages are examples of students work.

Post-taken by student 7 in Treatment 1

Matrix Show me what you know!

1) Evaluate $A + B$ when

$$A = \begin{bmatrix} -2 & 8 \\ 0 & 4 \end{bmatrix} \text{ and } B = \begin{bmatrix} 4 & 0 \\ 7 & 5 \end{bmatrix}$$

$$\begin{bmatrix} -2+4 & 8+0 \\ 0+7 & 4+5 \end{bmatrix} = \begin{bmatrix} 2 & 8 \\ 7 & 9 \end{bmatrix}$$

2) Evaluate $-2x$ when

$$X = \begin{bmatrix} -3 & 7 & -4 \\ 1 & -2 & 5 \end{bmatrix}$$

$$\begin{bmatrix} -2 \times -3 & -2 \times 7 & -2 \times -4 \\ -2 \times 1 & -2 \times -2 & -2 \times 5 \end{bmatrix} = \begin{bmatrix} 6 & -14 & 8 \\ -2 & 4 & -10 \end{bmatrix}$$

3) Evaluate $C + D$ when

$$C = \begin{bmatrix} 2 & 6 \\ 5 & 3 \end{bmatrix} \text{ and } D = \begin{bmatrix} 4 & 5 \\ -2 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 2+4 & 6+5 \\ 5+(-2) & 3+1 \end{bmatrix} = \begin{bmatrix} 6 & 11 \\ 3 & 4 \end{bmatrix}$$

4) Evaluate $X - Y$ when

$$X = \begin{bmatrix} -5 & 4 \\ 2 & -6 \end{bmatrix} \text{ and } Y = \begin{bmatrix} 4 & -5 \\ -2 & 1 \end{bmatrix}$$

$$\begin{bmatrix} -5-4 & 4-(-5) \\ 2-(-2) & -6-1 \end{bmatrix} = \begin{bmatrix} -9 & 9 \\ 4 & -7 \end{bmatrix}$$

5) Evaluate $4(Y + X)$ when

$$X = \begin{bmatrix} 4 & -5 \\ -2 & 1 \end{bmatrix} \text{ and } Y = \begin{bmatrix} 2 & 6 \\ 5 & 3 \end{bmatrix}$$

$$\begin{bmatrix} 4(4+2) & 4(-5+6) \\ 4(-2+5) & 4(1+3) \end{bmatrix} = \begin{bmatrix} 24 & 4 \\ 12 & 16 \end{bmatrix}$$

6) Evaluate $\frac{1}{2}A$ when

$$A = \begin{bmatrix} 4 & 6 \\ 3 & 4 \end{bmatrix}$$

$$\begin{bmatrix} \frac{1}{2} \times 4 & \frac{1}{2} \times 6 \\ \frac{1}{2} \times 3 & \frac{1}{2} \times 4 \end{bmatrix} = \begin{bmatrix} 2 & 3 \\ 1.5 & 2 \end{bmatrix}$$

7) Evaluate $A - (X + U)$ when

$$X = \begin{bmatrix} 4 & -5 \\ 3 & 2 \end{bmatrix} \text{ and } U = \begin{bmatrix} 2 & 6 \\ 4 & -3 \end{bmatrix} \text{ and } A = \begin{bmatrix} 1 & 3 \\ 0 & 2 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 3 \\ 0 & 2 \end{bmatrix} - \left(\begin{bmatrix} 4 & -5 \\ 3 & 2 \end{bmatrix} + \begin{bmatrix} 2 & 6 \\ 4 & -3 \end{bmatrix} \right) = \begin{bmatrix} 1 & 3 \\ 0 & 2 \end{bmatrix} - \begin{bmatrix} 6 & 1 \\ 7 & -1 \end{bmatrix} = \begin{bmatrix} 1-6 & 3-1 \\ 0-7 & 2-(-1) \end{bmatrix} = \begin{bmatrix} -5 & 2 \\ -7 & 3 \end{bmatrix}$$

8) Evaluate $C = (A + B)$ when

$$A = \begin{bmatrix} 1 & 7 \\ 2 & 3 \end{bmatrix} \text{ and } B = \begin{bmatrix} 3 & 5 \\ 4 & 1 \end{bmatrix} \text{ and } C = \begin{bmatrix} 4 & -7 \\ 0 & 8 \end{bmatrix}$$

$$\begin{bmatrix} 1+3 & 7+5 \\ 2+4 & 3+1 \end{bmatrix} = \begin{bmatrix} 4 & 12 \\ 6 & 4 \end{bmatrix}$$

9) Evaluate $\frac{4}{3}K + \frac{1}{3}J$ when

$$J = \begin{bmatrix} 2 & 2 \\ 7 & 1 \end{bmatrix} \text{ and } K = \begin{bmatrix} 1 & 4 \\ 5 & 5 \end{bmatrix}$$

$$\frac{4}{3} \begin{bmatrix} 1 & 4 \\ 5 & 5 \end{bmatrix} + \frac{1}{3} \begin{bmatrix} 2 & 2 \\ 7 & 1 \end{bmatrix} = \begin{bmatrix} \frac{4}{3} & \frac{16}{3} \\ \frac{20}{3} & \frac{20}{3} \end{bmatrix} + \begin{bmatrix} \frac{2}{3} & \frac{2}{3} \\ \frac{7}{3} & \frac{1}{3} \end{bmatrix} = \begin{bmatrix} \frac{6}{3} & \frac{18}{3} \\ \frac{27}{3} & \frac{21}{3} \end{bmatrix} = \begin{bmatrix} 2 & 6 \\ 9 & 7 \end{bmatrix}$$

10) Evaluate AB when

$$A = \begin{bmatrix} -2 & 0 \\ 0 & 4 \end{bmatrix} \text{ and } B = \begin{bmatrix} 4 & 0 \\ 7 & 5 \\ 1 & 2 \end{bmatrix}$$

$$\begin{bmatrix} -2 \times 4 & -2 \times 7 \\ 0 \times 4 & 0 \times 7 \end{bmatrix} = \begin{bmatrix} -8 & -14 \\ 0 & 0 \end{bmatrix}$$

Post Test taken by student 45 in Treatment 2

1. [A213K01 HSLQ_A213K01_D]
Evaluate $X - Y$ when
 $X = \begin{bmatrix} -5 & 4 \\ 2 & -6 \end{bmatrix}$ and $Y = \begin{bmatrix} -4 & -5 \\ 3 & -1 \\ -2 & -4 \end{bmatrix}$

A) $\begin{bmatrix} 11 & 9 \\ 3 & 4 \end{bmatrix}$
 B) $\begin{bmatrix} 11 & -9 \\ 3 & 23 \\ -4 & 4 \end{bmatrix}$
 C) $\begin{bmatrix} 4 & 24 \\ 3 & 28 \\ 3 & 17 \end{bmatrix}$
 D) No solution

2. [A213K01 HSLQ_A213K01_G]
Evaluate GH when
 $G = \begin{bmatrix} 3 & 1 \end{bmatrix}$ and $H = \begin{bmatrix} 2 \\ 5 \end{bmatrix}$

A) $[-3]$
 B) $\begin{bmatrix} 11 \end{bmatrix}$
 C) $\begin{bmatrix} 8 & -4 \\ 12 & 6 \end{bmatrix}$
 D) No solution

3. [A213K01 HSLQ_A213K01_F]
Evaluate $-\frac{1}{2}A$ when
 $A = \begin{bmatrix} 4 & -5 \\ 3 & -2 \\ -2 & -4 \end{bmatrix}$

A) $\begin{bmatrix} 8 & -10 \\ 3 & -4 \\ -4 & -8 \end{bmatrix}$
 B) No solution
 C) $\begin{bmatrix} 2 & 5 \\ 3 & 2 \\ 1 & 8 \end{bmatrix}$
 D) $\begin{bmatrix} 2 & 5 \\ 3 & 2 \\ 1 & 2 \end{bmatrix}$

4. [A213K01 HSLQ_A213K01_I]
Evaluate MN when
 $M = \begin{bmatrix} 2 & -1 \\ -3 & 0 \\ 5 & 2 \end{bmatrix}$ and $N = \begin{bmatrix} 1 & -4 & 7 \\ 3 & -1 & 1 \end{bmatrix}$

A) No solution
 B) $\begin{bmatrix} 5 & -7 & 13 \\ 0 & 12 & -21 \\ 11 & -22 & 37 \end{bmatrix}$
 C) $\begin{bmatrix} -1 & -7 & 13 \\ 0 & 12 & -20 \\ 11 & -21 & 37 \end{bmatrix}$
 D) $\begin{bmatrix} -1 & -7 & 13 \\ -3 & 12 & -21 \\ 11 & -22 & 37 \end{bmatrix}$

5. [A213K01 HSLQ_A213K01_E]
Evaluate $4(Y + X)$ when
 $X = \begin{bmatrix} -4 & -5 \\ 3 & -1 \\ -2 & -4 \end{bmatrix}$ and $Y = \begin{bmatrix} -2 & 6 \\ 3 & -3 \\ 4 & -3 \\ 4 & -3 \end{bmatrix}$

A) $\begin{bmatrix} 2 & -11 \\ 3 & 1 \\ -6 & 2 \end{bmatrix}$
 B) $\begin{bmatrix} -8 & 4 \\ 8 & -4 \\ 8 & -4 \\ -8 & 4 \end{bmatrix}$
 C) $\begin{bmatrix} 8 & -4 \\ -8 & 4 \end{bmatrix}$
 D) No solution

6. [A213K01 HSLQ_A213K01_B]
Evaluate $-2x$ when
 $x = \begin{bmatrix} -3 & 7 & -4 \\ 1 & -2 & 5 \end{bmatrix}$

A) No solution
 B) $\begin{bmatrix} 3 & -7 & 2 \\ 2 & -2 & 2 \\ -1 & 1 & -5 \\ -2 & 1 & -2 \end{bmatrix}$
 C) $\begin{bmatrix} 6 & -14 & 8 \\ -2 & 4 & -10 \end{bmatrix}$
 D) $\begin{bmatrix} -6 & 14 & 16 \\ -2 & 4 & -10 \end{bmatrix}$

7. [A213K01 HSLQ_A213K01_J]
Evaluate AB when
 $A = \begin{bmatrix} -2 & -8 \\ 0 & 4 \\ 1 & 6 \end{bmatrix}$ and $B = \begin{bmatrix} -4 & 0 \\ 7 & 5 \\ 1 & 2 \\ 1 & 4 \end{bmatrix}$

A) $\begin{bmatrix} 8 & 0 \\ 8 & 25 \\ 1 & 12 \\ 4 & 12 \end{bmatrix}$
 B) No solution
 C) $\begin{bmatrix} 8 & -54 & -33 \\ 0 & 20 & 8 \\ -4 & 37 & 49 \\ 4 & 4 \end{bmatrix}$
 D) $\begin{bmatrix} 8 & -54 \\ 0 & 20 \\ -4 & 37 \end{bmatrix}$

8. [A213K01 HSLQ_A213K01_C]
Find the dimensions of $A_{5 \times 3} \bullet B_{3 \times 1}$.

A) No solution
 B) 3×3
 C) 5×3
 D) 5×1

9. [A213K01 HSLQ_A213K01_H]
Evaluate JK when
 $J = \begin{bmatrix} 5 & 4 \\ -3 & 0 \end{bmatrix}$ and $K = \begin{bmatrix} 1 & 2 \\ -9 & 2 \end{bmatrix}$

A) $\begin{bmatrix} -31 & 18 \\ -3 & -6 \end{bmatrix}$
 B) $\begin{bmatrix} -4 & 6 \\ 9 & 0 \end{bmatrix}$
 C) $\begin{bmatrix} 14 & 12 \\ 6 & 2 \end{bmatrix}$
 D) No solution

10. [A213K01 HSLQ_A213K01_A]
Evaluate $A + B$ when
 $A = \begin{bmatrix} -2 & -8 \\ 0 & 4 \\ 1 & -6 \end{bmatrix}$ and $B = \begin{bmatrix} 4 & 0 \\ 7 & 5 \\ 1 & 2 \\ 1 & 4 \end{bmatrix}$

A) $\begin{bmatrix} 6 & 8 \\ 7 & 1 \\ -5 & 8 \\ -4 & 8 \end{bmatrix}$
 B) $\begin{bmatrix} 2 & -8 \\ 7 & 9 \\ 3 & -4 \\ 4 & 4 \end{bmatrix}$
 C) $\begin{bmatrix} 6 & -8 \\ -7 & 9 \\ 3 & -4 \\ 4 & 4 \end{bmatrix}$
 D) No solution

Post-test taken by Student 65 in Treatment 3

1. [A213K01 HSLQ_A213K01_J]
Evaluate AB when

$$A = \begin{bmatrix} -2 & -8 \\ 0 & 4 \\ 1 & 6 \end{bmatrix} \text{ and } B = \begin{bmatrix} -4 & 0 \\ 7 & 5 \\ \frac{1}{4} & 2 \end{bmatrix}$$

A) $\begin{bmatrix} 8 & 0 \\ 8 & 25 \\ 1 & 12 \\ 4 & \end{bmatrix}$
 B) No solution
 C) $\begin{bmatrix} 8 & -54 & -33 \\ 0 & 20 & 8 \\ -4 & 37 & \frac{49}{4} \end{bmatrix}$
 D) $\begin{bmatrix} 8 & -54 \\ 0 & 20 \\ -4 & 37 \end{bmatrix}$

2. [A213K01 HSLQ_A213K01_J]
Evaluate AB when

$$A = \begin{bmatrix} -2 & -8 \\ 0 & 4 \\ 1 & 6 \end{bmatrix} \text{ and } B = \begin{bmatrix} -4 & 0 \\ 7 & 5 \\ \frac{1}{4} & 2 \end{bmatrix}$$

A) $\begin{bmatrix} 8 & 0 \\ 8 & 25 \\ 1 & 12 \\ 4 & \end{bmatrix}$
 B) No solution
 C) $\begin{bmatrix} 8 & -54 & -33 \\ 0 & 20 & 8 \\ -4 & 37 & \frac{49}{4} \end{bmatrix}$
 D) $\begin{bmatrix} 8 & -54 \\ 0 & 20 \\ -4 & 37 \end{bmatrix}$

3. [A213K01 HSLQ_A213K01_E]
Evaluate $4(Y + X)$ when

$$X = \begin{bmatrix} \frac{4}{3} & -5 \\ -2 & -\frac{1}{4} \end{bmatrix} \text{ and } Y = \begin{bmatrix} \frac{2}{3} & 6 \\ 4 & -\frac{3}{4} \end{bmatrix}$$

A) $\begin{bmatrix} -\frac{2}{3} & -11 \\ -6 & \frac{1}{2} \end{bmatrix}$
 B) $\begin{bmatrix} -8 & 4 \\ 8 & -4 \end{bmatrix}$
 C) $\begin{bmatrix} 8 & -4 \\ -8 & 4 \end{bmatrix}$
 D) No solution

4. [A213K01 HSLQ_A213K01_E]
Evaluate $4(Y + X)$ when

$$X = \begin{bmatrix} \frac{4}{3} & -5 \\ -2 & -\frac{1}{4} \end{bmatrix} \text{ and } Y = \begin{bmatrix} \frac{2}{3} & 6 \\ 4 & -\frac{3}{4} \end{bmatrix}$$

A) $\begin{bmatrix} -\frac{2}{3} & -11 \\ -6 & \frac{1}{2} \end{bmatrix}$
 B) $\begin{bmatrix} -8 & 4 \\ 8 & -4 \end{bmatrix}$
 C) $\begin{bmatrix} 8 & -4 \\ -8 & 4 \end{bmatrix}$
 D) No solution

5. [A213K01 HSLQ_A213K01_A]
Evaluate $A + B$ when

$$A = \begin{bmatrix} -2 & -8 \\ 0 & 4 \\ 1 & -6 \end{bmatrix} \text{ and } B = \begin{bmatrix} 4 & 0 \\ 7 & 5 \\ -\frac{1}{4} & 2 \end{bmatrix}$$

A) $\begin{bmatrix} 6 & 8 \\ 7 & 1 \\ -5 & 9 \\ -4 & \end{bmatrix}$
 B) $\begin{bmatrix} 2 & -8 \\ 7 & 9 \\ 3 & -4 \\ 4 & \end{bmatrix}$
 C) $\begin{bmatrix} 6 & -8 \\ -7 & 9 \\ 3 & -4 \\ 4 & \end{bmatrix}$
 D) No solution

6. [A213K01 HSLQ_A213K01_C]
Find the dimensions of $A_{5 \times 3} \cdot B_{3 \times 1}$.

A) No solution
 B) 3×3
 C) 5×3
 D) 5×1

7. [A213K01 HSLQ_A213K01_H]
Evaluate JK when

$$J = \begin{bmatrix} 5 & 4 \\ -3 & 0 \end{bmatrix} \text{ and } K = \begin{bmatrix} 1 & 2 \\ -9 & 2 \end{bmatrix}$$

A) $\begin{bmatrix} -31 & 18 \\ -3 & -6 \end{bmatrix}$
 B) $\begin{bmatrix} -4 & 6 \\ 9 & 0 \end{bmatrix}$
 C) $\begin{bmatrix} 14 & 12 \\ 6 & 2 \end{bmatrix}$
 D) No solution

8. [A213K01 HSLQ_A213K01_G]
Evaluate GH when

$$G = \begin{bmatrix} 3 & 1 \end{bmatrix} \text{ and } H = \begin{bmatrix} 2 \\ 5 \end{bmatrix}$$

A) $\begin{bmatrix} -3 \end{bmatrix}$
 B) $\begin{bmatrix} 11 \end{bmatrix}$
 C) $\begin{bmatrix} 8 & -4 \\ 12 & 6 \end{bmatrix}$
 D) No solution

9. [A213K01 HSLQ_A213K01_I]
Evaluate MN when

$$M = \begin{bmatrix} 2 & -1 \\ -3 & 0 \\ 5 & 2 \end{bmatrix} \text{ and } N = \begin{bmatrix} 1 & -4 & 7 \\ 3 & -1 & 1 \end{bmatrix}$$

A) No solution
 B) $\begin{bmatrix} 5 & -7 & 13 \\ 0 & 12 & -21 \\ 11 & -22 & 37 \end{bmatrix}$
 C) $\begin{bmatrix} -1 & -7 & 13 \\ 0 & 12 & -20 \\ 11 & -21 & 37 \end{bmatrix}$
 D) $\begin{bmatrix} -1 & -7 & 13 \\ -3 & 12 & -21 \\ 11 & -22 & 37 \end{bmatrix}$

10. [A213K01 HSLQ_A213K01_D]
Evaluate $X - Y$ when

$$X = \begin{bmatrix} -5 & 4 \\ 2 & -6 \end{bmatrix} \text{ and } Y = \begin{bmatrix} \frac{4}{3} & -5 \\ -2 & -\frac{1}{4} \end{bmatrix}$$

A) $\begin{bmatrix} -11 & 9 \\ -3 & 23 \\ 4 & -4 \end{bmatrix}$
 B) $\begin{bmatrix} 11 & -9 \\ -4 & 23 \\ -4 & \frac{23}{4} \end{bmatrix}$
 C) $\begin{bmatrix} 4 & 24 \\ -3 & 24 \\ 28 & 17 \\ 3 & -2 \end{bmatrix}$
 D) No solution

V. Reflection

My Masters of Science in Education (MSE) coursework helped me to conduct this study. I learned how to conduct an ethical study with test subjects and how to handle their information in an ethical way. The coursework helped me in understanding how to see what trends were happening within the data. These classes helped me to understand when looking through my data how the learning is breaking down and how to create a classroom that is engaging using technology. Since I only had one statistics class in my undergraduate degree, having a second one in my MSE really assisted in the analysis of my data.

Everything that I have learned along the way to earning my MSE has assisted me in some way to prepare and carry out this study. The classes reminded me of some of the curriculum that I have not taught in a long time or at all, and assisted me in choosing a topic that I could see the most growth out of my students' learning. My coursework helped me learn how to properly run a study to treat each and every subject fairly. Other coursework that assisted me in preparing this project were those that addressed curriculum writing. I was able to make sure that I have been writing curriculum that is challenging yet understandable to all students.

Finally taking Educational Physiology was helpful in setting up the lessons. This class taught me how students outside lives really affect how they learn and was helpful in setting up a study that was conducive to learning.

Going forward, there are several changes I would make, were I to attempt future implementation of this project. One change I would make would be to choose more than one topic. I would do this to see how much retention the students had over a longer period of time before giving a post-test.

Another change I would make would be to survey my students about their attitudes towards use of technology. Conducting these surveys would be interesting to me because at the outset, some students already had pre-set views on how they wanted to learn and whether or not they wanted technology.

The last change I would make is to try and get as much of the different technologies involved in their learning. I was unable to access some of what our school had to offer while conducting my study because the students were unfamiliar with how it worked, such as Google docs.

“Learning is the process whereby knowledge is created through the transformation of experience” (Mcleod). The results from my study are related very closely to David Kolb’s learning style. Kolb’s learning style works on four stage cycle of learning and four separate learning styles (Mcleod). The learning cycle is concrete experience, reflective observation, abstract conceptualization, and active experimentation (Mcleod).

The results from my study demonstrate Kolb's Learning Cycle, in which students were given the experience of learning the material through the form of a lesson. After that they were given an opportunity to reflect upon the lesson within their notes and reflect upon what they just learned. Each student had time to conceptualize what they learned through their assignments by practicing different problems. Once students were given time to process everything they learned, they were given a test to show me that they understood the curriculum.

Kolb also has the four learning styles that go hand in hand with the cycle (McLeod). The figure below shows how the two cycles work together (McLeod). As the students work through the learning cycle they are going through the learning styles. The way I gave out my treatment was in a similar design to this. The students were exposed to the curriculum and asked to reflect upon what they had learned within that class period by completing their assignment. The following class they were asked to think and do some practice on their own. Then finally the students were asked to demonstrate their learning by taking a quiz based on what they had learned over the course of a few weeks.

Learning and experimenting with the studies I have researched has helped me develop better ways of incorporating and using technology in the classroom. I have to find a better balance of the technology in the classroom to make sure that all students' needs are being met. My research has helped me to incorporate a better use of the technology for students to get the individualized attention that they need to be successful in their regular math classes. I teach a remediation course

that is designed to help those students who struggle with math by better preparing them to pass the state standards test in Minnesota. My goal is to figure out a better way to increase that personal contact with each student and figure out their best learning styles.

With the results from my study I now know that I need to try to be more traditional with my students, make the curriculum more differentiated, and make sure I know how to teach them how to use the technology. I am trying to find a way to meet all of their individual struggles while using a little less technology in my classroom. I have already made some improvements to the way the classroom is run in order to reassure that they are watching their videos and understanding what is being asked of them. So far my minor changes have improved their MAP test score about seven points. If I make just a few more adjustments to my class I can raise their MAP test scores by ten points per semester.

The types of students that are coming to our schools today are much different than those ten years ago. They are coming to us with years of experience with technology. So my results that show my treatment of fifty percent technology has the best results does not surprise me. Students today need that instant feedback and something to stimulate their minds. I know that as much as students think that they want to be on their phones all day long (**Treatment 3**) they need that human contact. I could see that when, by contrast, I was facilitating the hundred percent treatment. These students in **Treatment 3** started shutting down. Some refused to do the work because they didn't want to be on the computers and were tired of doing the lessons on their own, which supports Oppenheimer's assertion that students need human interaction to facilitate their learning.

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