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The Effectiveness of Electronic Whiteboards and PowerPoint Lessons in the Mathematics Classroom

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The Effectiveness of Electronic Whiteboards and PowerPoint Lessons in the Mathematics Classroom

Abstract

A popular method of teaching in today's k-12 classroom is standardizing lessons on Microsoft office's PowerPoint. Another tool which is starting to become more common in classrooms is electronic white boards, which are similar to smart boards. Attempting to discover the most effective way to teach in the math classroom, I investigated these techniques at a local school.

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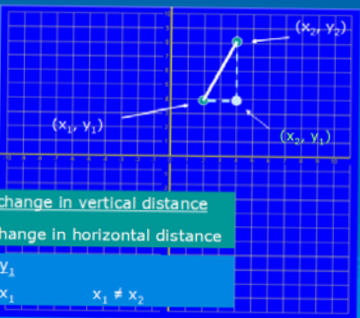
Subject Categories

Education | Science and Mathematics Education

The Effectiveness of Electronic Whiteboards and PowerPoint Lessons In the Mathematics Classroom

By: John K. Feldkamp
Sponsored by: Dr. Joanne Caniglia

How to find slope



$m = \frac{\text{change in vertical distance}}{\text{change in horizontal distance}}$

$$m = \frac{y_2 - y_1}{x_2 - x_1} \quad x_1 \neq x_2$$

EXAMPLE 2 Use subtraction to eliminate a variable

Solve the linear system:

$$\begin{cases} 4x + 3y = 2 & \text{Equation 1} \\ 5x + 3y = -2 & \text{Equation 2} \end{cases}$$

SOLUTION

$$\begin{array}{r} 4x + 3y = 2 \\ -5x - 3y = 2 \\ \hline -x = 4 \\ \hline x = -4 \end{array}$$
$$\begin{array}{r} 5(-4) + 3y = -2 \\ -20 + 3y = -2 \\ +20 \quad +20 \\ \hline 3y = 18 \\ \hline y = 6 \end{array}$$


Abstract

A popular method of teaching in today's k-12 classroom is standardizing lessons on Microsoft office's PowerPoint. Another tool which is starting to become more common in classrooms is electronic white boards, which are similar to smart boards. Attempting to discover the most effective way to teach in the math classroom, I investigated these techniques at a local school.

*I'd like to dedicate this thesis to all the educators
who hope to leave the world better than how
they found it.*

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Introduction

In today's secondary education institutions, one of the most critical tools in a teacher's classroom is their technology. In an ever-changing twenty-first century, students must be familiar with state-of-the-art tools so that they can be competitive in tomorrow's professional world.

Completing my secondary education mathematics degree at Eastern Michigan University, I have worked at various school districts using electronic whiteboards. Collaborating with my teachers and mathematics methods professor, I have assembled a set of Algebra Two PowerPoint lessons to measure their effectiveness on an electronic whiteboard in the high school classroom. Ultimately the goal of this thesis is to create an electronic copy of these lessons so that teachers can have lessons they can use in their classroom and possibly distribute to their students someday. The other motive for this research project is to verify that PowerPoint lessons are a more effective way for student learning than the standard chalk and chalkboard method that teachers have used for decades.

Hypothesis

The null hypothesis for this project is that the use of PowerPoint lessons on an electronic whiteboard in the math classroom will aid student learning. To show this, I will be researching their effects on an Algebra Two class. To determine their effectiveness, this thesis will compare student grades from learning with a chalkboard compared to an electronic whiteboard, examine student and teacher surveys, and provide insight from my field experience in teaching.

My initial belief is that the PowerPoint lessons on the electronic whiteboard will be more effective because the teacher will be able to pay closer attention to the class. The teacher should also be more efficient with their lecture time because they will have the lesson planned out in advance. Another benefit with using PowerPoint lessons is the ability to add graphics to lessons along with being able to change the background and animations in lessons. This should help maintain the class's attention.

A concern with using PowerPoint lessons is that the teacher will rely solely on the electronic lessons. Although these lessons can be beneficial, it would seem plausible that a teacher could run the risk of just clicking the slides and reading straight from the lessons. It will be important for the teacher to elaborate by explaining steps which are not explained entirely in the lesson, and to also provide other examples as necessary for the class to understand the lesson's topic. Considering these initial beliefs, this project aims to test these assumptions by making twenty-five lessons which spanned four sections in an Algebra Two course.

Personal Perspective

When creating lessons for PowerPoint, a teacher must be aware of the extensive amount of time each lesson will take. An effective lesson can take hours to create depending on the amount of animation and graphics involved. For the class that I worked with, my cooperating teacher did not want any of the algebraic steps overlooked. Therefore, whenever a single step was taken when solving a problem, for example solving a linear equation and gathering the variables on one side of the equal sign, it was shown by having the text appear on the screen. For instance, the following would have appeared a line at a time on the electronic whiteboard.

$$\begin{array}{r} 2x + 5 + 7 = 3x + 5 \\ 2x + 12 = 3x + 5 \\ -2x \qquad -2x \\ 12 = x + 5 \\ -5 \qquad -5 \\ 7 = x \\ x = 7 \end{array}$$

An example like this ensures that the students will be able to have everything clearly explained; however, the teacher will run the risk of not being able to be creative during the lesson. Along with that risk, students may stop listening to what the teacher says and just begin to write only what is written on the board. From my experience, I found it very difficult to find the daily time to create a thirty-forty slide lesson because it would take approximately three hours to create a lesson that had multiple examples like this that had every step with custom animation. I would advise that if a teacher wanted to create all of their lessons on PowerPoint and have them explained with elaborate details and graphics that they plan on doing so over a great length of time.

PowerPoint lessons also effect classroom management for the teacher. From teaching in front of the class using these lessons, I realized a teacher can be more attentive watching their classroom because they do not have to have their back to the class as they write. Although it was easier not writing during the lessons, I could not just click through the slides and not interject with any other material. Jeff Wuorio cited in his article, "Presenting with PowerPoint: 10 Do's and Don'ts," that Roberta Prescott of the Prescott Group, a communication firm, states, "Even with PowerPoint you've got to make eye contact with your audience." It was evident that I could not just look at the slides with the class when teaching because they quickly became bored with the lesson. I still had to be engaged with the students during the lecture making sure to supplement the topic with outside knowledge.

By not having to write during the lessons, I could also notice students who were not focusing on taking notes by maintaining eye contact with the students in the classroom. I was able to get through the lessons more efficiently because I could handle disciplinary issues easier by focusing on the class. The teacher I worked with also noted how much faster the lessons went because of having the lessons on PowerPoint and he also had enough time to answer questions on the homework at the end of class.

A disadvantage that surfaced through the course of the project was the extensive writing students had to complete for some of the examples. When a problem involved a significant amount of information, the students took a considerable amount of time writing down the problems and I found myself standing in front of the class just observing. This became frustrating due to the fact that students wrote at varying speeds, and because it became my decision when to move onto the next slide. A possible

solution would be providing students with printouts of all the slides that have an extensive amount of writing. This would save time during the class for the teacher; however, I would be concerned that students would not write anything during the lesson. Nonetheless, the benefit of getting through the lesson faster and providing students with more time to work on their homework would be worth exploring.

Creating PowerPoint Lessons for the Mathematics Classroom

Through my experience with PowerPoint lessons in the mathematics classroom, I discovered there were aspects I enjoyed about using PowerPoint and others that I did not. There are multiple aspects to PowerPoint which make the program efficient, but the ones that do not must also be considered when determining if it is a useful tool in the secondary education math classroom.

Originally in this thesis, I thought it would be best to use the slide design and background which I thought would be easiest to read for all the lessons. However, after student reviews, I found out that the class actually became interested in the variance of design layout. Jeff Wuorio notes in his on-line article, "A striking contrast between words, graphics, and the background can be very effective in conveying both message and emotion." PowerPoint provides multiple backgrounds and styles which are simple to read, but the teacher can also use a different background for each lesson for the week. Because the background can easily be changed, a teacher should consider using varying backgrounds for each lesson. While teaching classes, I could tell by student comments that they anticipated what type of background the lesson would be on that given day.

Like the backgrounds, a teacher has the ability to place varying graphics in their lesson. Through the course of this thesis, it was discovered that placing pictures in the

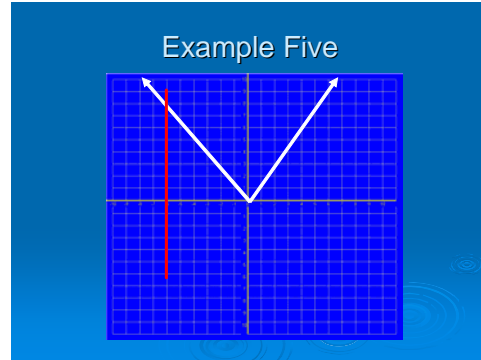
lessons was another easy way to maintain student interest. Wuorlo notes that the use of a variety of images provides the PowerPoint presentations with visual appeal. A goal for each lesson was to provide examples of where the daily material could be applied outside of the classroom, and using graphic images helped me demonstrate these points. To do so, I provided pictures from clipart, images from other programs, or pictures I had taken to help illustrate key concepts or ideas. Using images became critical in the functions and graphs section when classes began to graph linear equations. Being able to see the Cartesian coordinate system benefited the class's learning when graphing equations and finding slopes.

The most helpful aspect of using the PowerPoint lessons surfaced during the course of the thesis. Initially the scope of this thesis focused on learning inside the classroom. However, what became evident was the benefit that the PowerPoint lessons had outside of school. When students missed class the PowerPoints became a tool that students utilized to keep up with their studies. Along with this, parents wanted the lessons e-mailed to them so that they could see what their student was learning in class. Occasionally, students wanted the lessons e-mailed so that they could look over the lesson and pick out information that they may have missed initially in class. Nonetheless, this was something I had not initially assumed in my hypothesis, but was very pleased to see happen.

In class, the aspect that seemed most useful, but also the most difficult part to manage in the PowerPoint lessons, was the custom animation. Being able to have an algebraic step, or a line of text appear as the writer desires was a valuable tool which could be used in the classroom. The most impressive capability that custom animation

provided through the course of creating the lessons was the ability to have a vertical line move across a graph to show that a function was, “one-to-one.”

This assisted in maintaining student interest, and also helped in showing the vertical line test which a chalkboard could not provide.



The difficulty with PowerPoint mostly came from the inability to have a block of text appear one line at a time by a click. This made it so the lessons took an extensive amount of effort. These limitations along with select examples from lessons made it frustrating when designing slides because a simple task could make a slide take upwards

Example Three

Step Two: Solve the equation in terms of y .

$$x = y^2 + 1$$
$$-1 = \quad -1$$
$$x - 1 = y^2$$
$$\sqrt{x - 1} = \sqrt{y^2}$$
$$\sqrt{x - 1} = y$$
$$y = \sqrt{x - 1}$$
$$f^{-1}(x) = \sqrt{x - 1}$$

to thirty minutes to design.

Using the Electronic Whiteboard

Over the course of this thesis, I witnessed the benefits of using an electronic whiteboard as opposed to just a projector and PowerPoint. The electronic whiteboard provided me with the capability to eliminate much of the rigorous and tedious time spent on custom animation by allowing me to interact with the slides in front of the class. For example, when solving a linear equation, instead of writing out each individual step, I was able to just write the initial problem and then write the individual steps with the students. Doing this, the class had fewer “How did you do that?” questions and allowed me to explain the steps and work for each problem easier.

EXAMPLE 2 Use subtraction to eliminate a variable

Solve the linear system:

$$\begin{cases} 4x + 3y = 2 & \text{Equation 1} \\ 5x + 3y = -2 & \text{Equation 2} \end{cases}$$

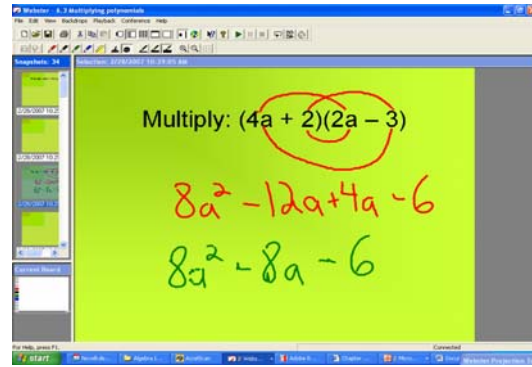
SOLUTION

$$\begin{array}{r} 4x + 3y = 2 \\ -5x - 3y = -2 \\ \hline -x = 4 \\ \hline x = -4 \end{array}$$
$$\begin{array}{r} 5(-4) + 3y = -2 \\ -20 + 3y = -2 \\ \hline 3y = 18 \\ \hline y = 6 \end{array}$$

Electronic whiteboards also have a wide-array of capabilities that became quite useful in class. The whiteboard can use multiple colors on the screen which helps math teachers clearly show different steps in solving problems. Along with this, the electronic whiteboard I used also had a feature called “curtain” which covered up all the screen and allowed the teacher to slowly reveal a problem line-by-line. Using the curtain option became a desired replacement for custom animation, and also made revealing answers more dramatic for the students. At times, the curtain tool became a tool relied upon for comic relief in the classroom.

The best feature about using the electronic whiteboard, however, was its ability to save files created during class. For example, when I would write on a PowerPoint slide during lecture, I could save the manipulated slide as a file and compile the lesson from

class and send it to students. Using this feature allowed me to spend less time creating all the steps in PowerPoint, and still let absent students see everything that they missed in class.



By having the electronic whiteboard in class, the PowerPoint lessons became a much more powerful tool. Although they were beneficial for organization purposes, the electronic whiteboard made it so that they were interactive and more engaging for the students.

Student Response

Most importantly, the student responses to the lessons need to be considered when creating lessons. It will be noticed through the proceeding survey results that many of the students appreciated this aspect because the lessons helped students keep up with the class even if they missed a day. Along with this, it was discovered through student interactions that the parents talked to their students about what they were learning through the PowerPoints. At parent conferences, it was found that guardians appreciated the PowerPoints because they could keep up with what their student was doing in math class.

After the first two sections of PowerPoint lessons, students from two Algebra Two classes were given surveys and asked the following questions. A third survey was distributed, however, only one Algebra Two class was given the survey. Marked under the different responses is the number of students who responded to the corresponding question.

Lesson Survey Results from Equations and Inequalities Section

The power point presentations have been helpful in my learning.

True	False
56	5

I believe that my grade is higher because of the power point presentations.

True	False
27	34

Are there too many slides in each lesson?	Yes	No
	8	53

The lesson is less interesting because it is on Power Point and not being written on the chalkboard.

True	False
15	46

When I miss class, the power point presentations help me learn the lessons.

True	False	Not Used
27	10	24

Along with these questions, the students also provided these general comments through chapter two.

Equations and Inequalities Survey Comments

- ✓ They are helpful to look back on, but aren't helpful all the time.
- ✓ The power points make me more interested
- ✓ Keeps me interested because writing on the chalkboard is boring
- ✓ Writing too small when its not bold
- ✓ Saves time in the day, teacher has time to explain instead of writing on the chalkboard
- ✓ They are informative and help in my learning
- ✓ Give words to copy and is a different outlook from the teacher
- ✓ Make it more interactive with the students
- ✓ They help me understand the lessons
- ✓ Colors and design help maintain attention as opposed to writing on chalkboard
- ✓ A better change in teaching style
- ✓ Don't give as much explanation as they should
- ✓ Hard to decipher when students are done writing their notes from the slides
- ✓ Sometimes lessons are easier on power point, sometimes not
- ✓ Don't know what to write down for notes, and move too fast through slides
- ✓ Some need to be broken down
- ✓ Examples are good to look back on for help on problems
- ✓ Helpful because you can't always see what the teacher is writing
- ✓ Very visual which helps learning
- ✓ I pay attention more

- ✓ A lot of information, should get dittos for notes
- ✓ Helps catch my attention and I learn
- ✓ Colors
- ✓ Boring
- ✓ Visual learner which power point aids
- ✓ Shorten slides and use less words
- ✓ Very helpful if I miss class
- ✓ Use examples using student names and more decorative
- ✓ Print outs would help
- ✓ Helpful b/c they can be e-mailed
- ✓ Sometimes doesn't show enough
- ✓ I love power points

At this point in the semester, it was impressive to see that the students believed that the lessons were helpful in their learning. Along with this, it was nice to see that the lessons were used outside of the classroom. The statistic which we wanted to see go up the most heading into the next section was be how interesting the lessons could be using PowerPoint. Considering this, we attempted to make the Functions and Graphs section more applicable to the students' lives. Since the chapter's focus was graphing linear equations, creating applicable situations for students to use these lessons did not take much effort. Along with this, we wanted to try and make it easier to decipher what students should be writing down and when to just listen to the teacher. The number one goal was to make sure that the lessons could still be useful for students to use at home when trying to teach themselves the subject. After the students had completed the lessons for Functions and Graphs, the following survey was passed out:

Survey II

Functions and Graphs

The PowerPoint presentations have been helpful in my learning.

True	False
55	0

I believe that my grade is higher because of the PowerPoint presentations.

True	False
22	33

I believe that Lesson 3.9 provided me with applicable situations of where linear equations can be used.

True	False
49	6

Lesson 3.9 was more interesting because I was being asked questions.

True	False
23	32

The following comments were also written with this survey:

Survey II Comments

- ✓ They save the teacher time allowing him to work more with students
- ✓ Show all the work on the same slide
- ✓ Put the answer on the same page as the problem
- ✓ We don't like going back and forth between slides
- ✓ It confuses me having problems on one page and solutions on the next
- ✓ Make it more interactive
- ✓ Having the teacher work out the problem step-by-step helps compared to having the problem already completed on PowerPoint.
- ✓ The pictures and graphs have helped my learning

- ✓ Don't go so fast
- ✓ I really appreciate the effort put into the lessons
- ✓ I learn much better when one-on-one with the teacher
- ✓ Questions are very challenging
- ✓ It provides me with a visual
- ✓ The pictures help me understand the problems
- ✓ Having them sent home has helped
- ✓ Hard to know when to write things down
- ✓ The information is too much at one time.
- ✓ Lessons should be shorter so there is time to answer questions
- ✓ It's hard because there is so much to do when the problem is up
- ✓ They are long and drag out
- ✓ Having them e-mailed is helpful
- ✓ Going through the problems step-by-step helps

The most overwhelming comment from this chapter's lessons was dividing up the work to the problems over a number of slides. It became apparent that students had a difficult time tracking the work when it appeared on more than one slide. The difficult part when attempting to adjust to this complaint is making the font too small for students to read. Collaborating with teachers, I attempted to address this problem heading into the next two sections, Matrices and Determinants, and Systems of Equations and Inequalities. The most rewarding result from this survey was finding out that 100% of the students believed that the PowerPoint lessons had helped them with their learning. It was the number one goal to maintain that attitude and hope that students continue to be open to the learning which PowerPoint has provided them.

The next sections also used the electronic whiteboard along with the PowerPoint lessons. Students were asked if they believed it helped in their learning on the survey. As aforementioned, this survey was only distributed to one class.

Survey III

Matrices and Determinants, and Systems of Equations and Inequalities

The PowerPoint presentations have been helpful in my learning.

True	False
31	3

I believe that my grade is higher because of the PowerPoint presentations.

True	False
15	19

I believe that the lessons about matrices have been difficult to understand.

True	False
26	8

I believe that the electronic whiteboard has been a useful tool in my learning.

True	False
30	4

Student Comments about Electronic Whiteboards **(Survey Three)**

- The electronic whiteboard is easier to see
- Electronic whiteboard is better for matrices because you can see how it is done
- The colors help keep my attention
- It really doesn't make a difference to me if the projector or whiteboard is used
- The PowerPoints and whiteboard give me a clear understanding of the lesson
- The whiteboard shows how work is done better
- Seeing how the problem really helps
- The whiteboard can explain more if the PowerPoint does not clearly show something
- Visual presentations help when learning new concepts

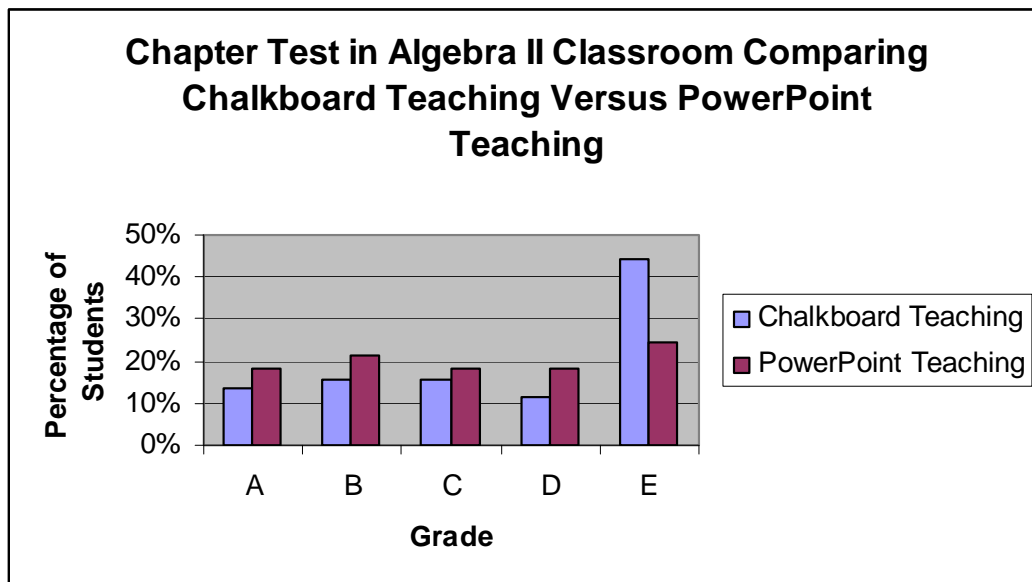
- I like working with the PowerPoints more now that I'm used to them. They help with organization
- The PowerPoint lessons and whiteboard lessons give me more detail with words

Examining these surveys, it is encouraging to still see that many of the students still believe that PowerPoint lessons are helping their learning. From these surveys, along with my personal experience, the sections that were taught using the electronic whiteboard and PowerPoint are not ideal topics. Even though these sections were more difficult, the percentage of students who believed that their grade was higher because of the technology in the classroom approached nearly half of the sample. This was an encouraging sign. Finally, it is evident from the survey that students did enjoy learning from an electronic whiteboard. Seeing comments explaining how the electronic whiteboard explained the material better was an encouraging sign, and supports the statement that electronic whiteboards in the mathematics classroom is beneficial for student learning.

Student Grades

Most importantly from this project, we wanted to see if the student grades would get higher with the use of PowerPoint. We were only able to examine one set of tests that would be able to compare last year's learning, which used chalk and chalkboards, to this year's learning that used PowerPoint lessons teaching the same material. The statistics show tremendous promise however that PowerPoint lessons are beneficial to student learning. Nearly half the percentage of students failed the test this year compared to last year, and the teacher reported that there were significantly fewer students who received very low scores (approximately 20% or less) The following table is a distribution comparing last year's test scores from Chapter Two to this year's. The comparison looks at the percentage of students who received which letter grade on the test.

	Grade	A	B	C	D	E	Total
2005	# of students	7	8	8	6	23	52
	%	13%	15%	15%	12%	44%	
2006	# of students	12	14	12	12	16	66
	%	18%	21%	18%	18%	24%	



There appears to be a significant increase from last year's scores, but probably the most important statistic is that 14% more students received a C or higher compared to the previous year. Evaluating this data makes me believe that the PowerPoint lessons do in fact positively effect a student's learning.

Teacher's Perspective

Teachers must continually look for resources to add to their classroom to aid student learning. Using an electronic whiteboard in a classroom would be a major decision because of having to become familiar with a new method of teaching that did not exist until recently.

Through teacher surveys, it is clear that educators prefer to have this tool in their class. Not only does it allow for more student engagement, classroom activities, and internet access, teachers began to focus their teaching around the board's capabilities. Examining the surveys, the following comments were made by teachers.

Teacher Survey about Electronic Whiteboards

1. Do you believe that the electronic whiteboard has been beneficial in your teaching style? Why?

- It helps with organization, making sure you cover all topics planned for the day.
- Yes. It helps visual learners and also speeds up access to internet.
- Yes. Students love writing on it, it is more fun to use than an overhead and you can save problems and print them for students. It is interactive.
- Yes. It has allowed me to pre-prepare notes for the class and provide students with outlines.
- It has allowed for increased opportunities for student interaction; use of internet resources to enhance instructions.
- Yes. It encourages me to include more technology (power points, geo-sketch pad). It is clearer for students to see and understand.
- Yes. It has made the material more organized as well as "eye catching" for the students.

2. Do you think students enjoy the electronic whiteboard? Have you ever had a student use the whiteboard during class?

- The more colorful usually more stimulating. Yes, but not a lot.
- Yes, students enjoy the whiteboard because it makes lessons more organized, interesting and interactive. I often ask students to use the board during class.
- I have had students enter their lab data during class.
- They do enjoy it and take pride in the fact that they know how to use it. Students frequently are asked to use it. The disadvantage is that only one student can use the whiteboard at a time.

- Yes, students love to use it. I do have them come up and write out their work on the board and they do enjoy it.

3. What activities include the use of your electronic whiteboard?

- PowerPoints, graphing calculators, internet usage, and video streaming
- PowerPoints, notes, discussions
- Timing activities, impromptu questions and answers, presentations, solving problems, showing animations and graphics to the class.
- Notes, problem practice, student examples.
- Warm up assignments, PowerPoint lecture, data table graphs in excel, and student presentations
- PowerPoints and video-streaming

4. What do you not like about the electronic whiteboard?

- The limited space.
- There was not enough instruction on how to use the whiteboard
- I need more training in how to create lessons using the whiteboard
- How you lose your writing outside of Webster. (the software program for the interaction with the whiteboard.
- I need more training with the whiteboard

5. Do you believe that electronic whiteboards have any specific advantages over using a projector and a laptop?

- Yes. It allows the teacher to move around more along with being more animated.
- It is much easier to get on the internet while the board would be much harder for someone to steal.
- Yes. Students can interact with it more, and it has all kinds of “fun” graphics, timers etc, that engage students.
- Yes. The ability to face the class and talk to them directly.
- Primarily space.
- Yes. You are able to write on the power points while still being able to e-mail the lessons to the students with the marked slides.

Conclusion

Through the course of the semester, I have learned quite a bit about how PowerPoint lessons and electronic whiteboards can be effectively used in the classroom. Although there are shortcomings with both the presentation and creation of these lessons, the results show that they are worth both the time and effort.

I would advise teachers to make sure their lessons vary in background design and color because it maintains the student interest. Secondly, be sure that the font is easy enough to read pending on the classroom setting. In the classroom I worked in, students had a difficult time seeing the board from the back of the class. It is important to make sure that they are able to read it, so keep the font as large as possible but keep as much information on each slide too.

Also, if a teacher has the resources where they can print out handouts before the class with large blocks of texts they should do so. This will allow the teacher more flexibility with classroom time, but also help keep students focused on the lesson. Although I was not able to do this in my thesis, other teachers have noted how this helped their classes learn and would be beneficial for students.

Another way to aid student learning is to provide them with plenty of applicable situations through the various lessons. Using this technology allows the teacher to place various picture to situations which should also aid in student engagement and keep them interested in the lesson.

Finally, the most beneficial aspect in having teacher lessons on PowerPoint is sending electronic copies home for student use. This factor I believe is the number one reason why student grades improved during the course of this thesis.

Also from this research, I would encourage the use of electronic whiteboards in the mathematics classroom. The boards intrigue students even more because of the interaction ability the board provides along with having internet access. Students desired the teacher to show the mathematical process in steps, and the electronic whiteboard allows this to occur. Teachers welcomed this tool in their classroom because of its ability to save class notes electronically and also the convenient internet access that the board provides.

Although creating these lessons are very time committing, I believe that they are a critical resource in student learning. I found my initial hypothesis, that the use of PowerPoint lessons and electronic whiteboards would help students learn, to be correct. From personal documentation, student and teacher surveys, and student grades, there is clear evidence that these tools are beneficial in the high school mathematics classroom. This thesis demonstrates what resources a district should begin using today, and be prepared to utilize heading into the 21st century.

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