Improving student performance in math courses: a practical review of different SMART technologies complete with data and results

Abstract

As instructors, we have probably noticed that the attention span of our students is getting shorter every year. We may have looked over the notes the students are taking and realized the mistakes that they have made from copying material from the board. There are numerous video recordings of math lectures available on YouTube and other websites that students access to watch examples or lectures. Many of my students complained that those video clips were not aligned to what we were doing in class. Even a small change in method would throw the average/weaker student off track. The goal of this paper is to provide insight for instructors considering use of technology in the classroom as a method of delivering lectures. In this paper, different types of technologies used in math classrooms are compared. These technologies include the SMART pen, SMART board, and SMART monitor. A brief survey of the technologies available through the university is done. Background information, cost, simple instructions, advantages, and disadvantages are discussed and compared. Student and professor opinions of these technologies are included as well as final exam data comparing students whose professors did and did not utilize this technology.

Keywords: SMART technology, mathematics, teaching

Introduction

In 2010, I applied for a grant to use technology in math classrooms with the idea that by making video recordings of the lessons taught in class, I could help student learning by making these video clips accessible to them. Thus began my journey into using different technologies for the math classroom.

At first, I asked the media department to come and record a college algebra class that was in session. There were many complications. The students were uncomfortable with an outside person there and of being recorded, the instructor was self-conscious of her appearance, a lot of noise was recorded and because the classroom size was not that big, the visuals were not of good quality. This experience showed me that I was looking for a more discreet and noninvasive way to record class lectures.

The university had contracts with WIMBA, which is a great method for teaching hybrid classes. The software used required intensive training. My goal was to have an easy way for instructors to use technology without them feeling overwhelmed. In addition, instructors in mathematics prefer to write on a board as they teach. Setting up the technology each day before class is not appealing to most instructors. Knowing the limitations on time that instructors face, the importance of finding a more user-friendly technology became apparent.

In this paper, I will discuss the different technologies that we used in our math classes at our institution and compare them in three different areas: 1. How the new technologies are used, 2. Which technology was easiest for the instructors, and 3. Provide comparative data to show the difference in departmental exam grades between the groups who had lecture notes from class available for download and those who did not.

Introducing the new technologies

SMART pen

After attending the International Conference on Technology in Collegiate Mathematics (ICTCM) conference in March 2011, I was introduced to a technology tool called the SMART pen. Livescribe has developed a new low-

cost, mobile, computing platform that enhances productivity, learning, communication and self-expression for anyone that uses pen and paper. The Echo and Pulse SMART pens link audio to handwriting. Here is an image of the pen and the notebook:

The SMART pen is the easiest tool that we have used. The SMART pen and notebook have the same feel as a regular pen and paper, however, there is the capability of recording while writing and talking at the same time. There are record and pause buttons at the bottom of each page that can be used to start and finish the video. You can write before recording or write as you are recording. After the video is completed, there is a cradle on which the pen rests and is connected to the computer. The video can then be transferred to your computer, email, Evernote, Facebook, Google Docs, Google sites, MyLivescribe, and to your mobile phone, or can also be saved as a .pdf. Students can then access the notes and the video clips from any of these sites. The pen is set up very intuitively and is quite user friendly. Professors who use this technology would simply need to be handed the pen with a short explanation of how to use it (ie: identify location of the record, pause, and end buttons). If they wanted to view/listen to their clips, they would need to download software from MyLivescribe. This software would allow them to view clips on their computer, as well as save and send them in various file formats.

SMART board

Writing on the SMART board is very similar to a white board with the exception of its interactive capabilities. Similar to a whiteboard, there is a pen with an option of color, and an eraser, which acts like a regular eraser. The SMART board, however, has an option of saving what is written on the board as a .pdf file, which can be uploaded to the professor's preferred means of communicating with students, such as email or any other virtual resource. There is also an option of audio recording as you teach, which then shows as a video when students watch it. There are many tools that are stored in the SMART board software may be used in the class, such as pictures, interactive multimedia, notebook files, backgrounds, and themes in several different subjects. I particularly enjoy using the various background themes, such as graph paper and the polar graph paper. The interactive tools were very helpful in showing plotting and translations of graphs. The capabilities depend on how much time the instructor is willing to spend outside the classroom getting prepared for the classroom lectures. An instructor may also decide to only save the lectures, which is still helpful for students because they can access the notes after class.

SMART monitor

The SMART monitor is basically a tablet that has the capabilities of a SMART board. A screen and projector would be needed in a classroom that has a SMART monitor.

Advantages and disadvantages of each tool

SMART pen:

The best advantage of the SMART pen is the ease of use. It can be used as a good tool during office hours. I have used it when students ask questions during my office hours and then posted the solutions on my course page for all students to get access. It is very useful for recording lectures before class and having students watch the lectures in their own time. This saves class time by having students come to class ready to ask questions or do problems. Additional advantages include its excellent clarity when transferring audio and video to different file formats. Additionally, the pen is not limited to any subject, so it is available to use for various classes. With its ease of use, its only limitations are in the hands of those using it. The cost of a SMART pen is less than $200.00, with additional equipment including Livescribe SMART pen notebooks, which totals less than $4 a piece, and ink cartridges, which totals less than $5 for a pack of four.

Disadvantages become more noticeable after the clips have been recorded, in the transferring stage. To get the clips on MyLivescribe, all that needs to be done is to connect the cradle to the computer (via USB port) and lay the pen on the cradle. If Livescribe is installed on the computer, it will launch automatically and immediately begin transferring new files. This process takes anywhere from a couple of minutes to an hour, depending on the number of clips being transferred. At this point, the files are available to be uploaded or sent. The disadvantage with this system is that regardless of where you're sending the clips or which platform you're uploading to, the clips will continue to be viewed through MyLivescribe, who maintains ownership of the clips. If you choose to transfer the clips to another platform not available through Livescribe, you must change the format of the files, which in our case, included outside software. Through this software, we were able to convert the format of the file and upload the clips to an individual, independent server. It should be noted that this is a multi-step process and can be very tedious and time intensive. The main disadvantage is that it cannot be used in the classroom and does not interact with a computer when the notes are being recorded. Another disadvantage is that the pen is very sensitive to the sounds of writing and picks up the sound of the pen writing on the paper.

SMART board

The advantages of the SMART board are that students don't need to take notes while you are giving a lecture or solving problems. This will allow them to focus on the lecture and try to learn the material in class. Giving the students a peace of mind in knowing that the notes are available immediately after class. Doing audio recordings is very helpful to students who learn by listening since they can listen to the lecture more than once. Once one institute buys the software, it may be installed on several tablets and each tablet PC can act as a SMART board. This will enable the instructors to develop useful pieces of their notes before class. The SMART board interacts with the Internet, PowerPoint, word documents, and any other tool that is on the computer. The biggest disadvantage is the cost of installing a SMART board in a classroom. There is a lot of electrical work that needs to be done. The cost of the SMART board with a projector is less than $5500, the electrical work, other equipment including a desktop computer, speakers, and presentation podium, and labor and installation costs us approximately $7000.

SMART monitor

The SMART monitor has all the advantages of the SMART board except that it does not have the ease of writing on a board. As instructors, we are used to holding a pen or chalk and writing on a board and the idea of writing on a monitor is not attractive at first. The writing space is limited. On the other hand, it makes teaching students with

visual disabilities a lot easier as the projected image is much larger than most instructors would write. By writing on the SMART board, an instructor can have more eye contact with the students and not stand with their back to the class. The other big advantage is the SMART monitor costs less than the SMART board. You would however still need to purchase a projector, speakers, and microphone. The SMART monitor costs less than $2500, the projector and electrical costs us approximately $3000.

Survey Results

In a survey done at TSU, the following results were found.

1. Do you download the notes your professor provides?
   Yes: 117No: 32

2. Do you find the notes helpful?
   Yes: 118No: 6

3. Do you find the technology your professor uses in class to be helpful?
   Yes: 128No: 12

4. Do you prefer the traditional style of teaching (blackboard/chalk) to a teaching style, which uses technology?
   Yes: 45 No: 100

Test Results

The measure used for comparison was the departmental final exam. The reason we used this is because it is uniform and all of the classes take it at the same time. None of the instructors teaching the course see the final exam before it is distributed. All the questions are multiple choice and are graded by a scantron machine. The term "instructors who used technology in the classroom" refers to those instructors who utilized the smart board or smart monitor and posted the notes on the internet in some form for their students to access.

Course/Grade	A	B	C	Comparison*
Pre-calculus I	75%	33	36	22%
Pre-calculus II	0	50	20	14%
Calculus I	20	64	57	25%
Calculus II	100	100	88	33.5%

The numbers are found using the following formula: # of students whose instructors used the technology earning the grade indicated/ total number of students who earned that grade.

*Numbers in the comparison column are found as follows: The percentage of students passing the departmental final with a C or above in classes whose instructors used technology minus the percentage of students passing the departmental final with a C or above in classes whose instructors did not use technology .

Conclusion

With the data that we analyzed, we reached the conclusion that if the instructors posted the class notes on the internet for students to access, a higher percentage of the class earned passing final exam grade. Though this data may be enough motivation for many instructors to consider using technology in their classrooms, it may not be enough for others. The traditional instructor still believes that the blackboard and a white chalk is the best means to

transfer information. Motivating instructors to implement these technologies is another topic that needs to be investigated.

Reference List

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