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TechQuest Project

Project Description

In mathematics, the most difficult part in learning the material is being able to see what it all means and why it is needed. These two components help students grasp the beauty of math and remember the material. Algebra and Geometry are the roots of math; thus, math teachers need to find ways to help students interact with the lesson. A smart board provides opportunities to have students interact with math. However, just writing on a smart board is the same as writing on a white board. So, I plan to use technology like Geometer's sketchpad and online sites like NLVM to have students interact with math. These technologies explain what each properties means in a visual way. Explaining theorems in words can often confuse the student during a lecture. However, GSP and NLVM are programs that describe theorems and properties using images and animations so the learner can grasp the concept and explain it in their own words. This process of seeing and interpreting is more powerful to learning a new concept as opposed to a teacher just stating a rule. Students become analyzers instead of memorizers.

A goal for next year is to incorporate dual projection. My classroom is set up so that the front of the room has a projector and screen and the back of the room has a projector and smart board. The students sit on the sides and face in so that both the front and the back of the room are visible. The dual projection will allow me to write notes and comments to share with students, and project interactive content on the smart board.

In order to have students interact with the curriculum I am going to structure my lessons to force students to see the idea of math before they write down the rules. For example, the teacher will begin an idea like graphing lines. When introducing the topic, the smart board will have the interactive line grapher projected on it. The students will take turns manipulating the line to see how the parameters change the line. Students will engage in discussion on how the changes can be made into a rule they can write into their notes. Once the rule is created it will be written down in the notebook that is projected on the second screen. This process allows students to be a part of the note process and help them remember the rules of graphing because the students created the rules. It has also been brought to my attention that this process can be used to reinforce rules from students' background knowledge. For example, the concept of parallel lines can be explained through a program like GSP and can reinforce a student's previous knowledge that slope of a line is constant. Seeing previous rules attach to the new concepts will strengthen fundamental skills.

Interactive math is not a new concept. In fact, there is an Interactive Math Program (IMP) that specifically focuses on using interactive math to teach math concepts at multiple levels. "Dr. Norman Webb, of the Wisconsin Center for Education Research, has done several studies comparing the performance of students using the IMP curriculum with the performance of

students in traditional programs. For instance, Dr. Webb has found that IMP students do as well as students in traditional mathematics classes on standardized tests such as the SAT. This is especially significant because IMP students spend about 25 percent of their time studying topics that are not covered on these tests. To measure IMP student's achievement in these other areas, Dr. Webb conducted three separate studies involving students at different grade levels and in different locations. The three tests used in these studies involved statistics, quantitative reasoning, and general problem solving. In all three cases, the IMP students outperformed their counterparts in traditional programs by a statistically significant margin, even though the two groups began with equivalent scores on eighth-grade standardized tests." (http://www.mathimp.org/general_info/intro.html) This study challenges the myth that interactive curriculum does not allow time for all material to be taught. In fact, this interactive curriculum focused on the core elements of the content to strengthen fundamental skills. Consequently, students did better on standardized tests because they used those fundamental skills to expand their learning to higher order thinking.

For this project, some of the pieces will be worked on during this course and it will not be completely implemented until after this course is over. During this class my target is to create the 2 interactive lessons (one with GSP and one with NLVM). The lesson will include 1) discovery with the smart board, 2) student practice with the smart board, 3) discussion questions to establish algebra properties, and 4) a note taking strategy. The lesson will be practiced with my family to look for gaps or "bugs" in the technology. Unfortunately, the lesson will not be implemented into the classroom setting until after the course is over. Thus, I will prepare a questionnaire where students can rate the lesson and provide feedback for further improvement. The reasoning behind creating only a few lessons is so that I will be able to make them more meaningful. If I tried to make several then the lessons could become more average as pointed out by my partner Ethan. I agree with his idea and hope that I can create meaningful lessons and learn throughout the implementation process. My hope is that this new inquiry based lesson will engage students in the classroom and allow them to interact with the curriculum through technology.

Appropriate for Audience

My target audience is the math department at my school site. Thus, any lesson has to correspond to standards and objectives in the curriculum adopted by my school district. My lessons and ideas need to be both compelling and appropriate for the classroom setting if I want my department members to imbed these technology components into the curriculum. The case I have for interactive technology in the curriculum is the direct improvement on students' academic achievement. Proof of these findings is discussed below through my internet research.

The technology I want to implement is Geometer's Sketchpad (GSP) and Virtual Manipulatives. Using these programs is not a new concept. In fact, the use of technology is encouraged to meet the needs of the 21st century student. A case study conducted in 2006-2007 on integrating technology states, "technology is used as a mind tool that can be used to support

the deep reflective thinking that is necessary for meaningful learning". After reviewing my research I decided to limit my scope and create two different lessons. One lesson would use GSP and one lesson would use online virtual manipulatives. I am choosing to complete only two lessons so that I accurately apply the programs to the curriculum. Many statements are made about the misuse and overuse of technology in the classroom because teachers do not apply them correctly to the curriculum and thus, the manipulative becomes obsolete. Therefore, I plan on using the following research to create appropriate representations for each math lesson.

The first lesson will contain a dynamic representation of slopes using GSP. The reason why I chose GSP is because it is able to take complicated conjectures and rules and express them visually in a wide range of situations. Key Curriculum Press states, "The Geometer's Sketchpad is a dynamic construction, demonstration, and exploration tool that adds a powerful dimension to the study of mathematics". Students are able to grasp the understanding of a mathematical idea because they are seeing it. For example, GSP can show that if two lines are perpendicular then their slopes are always negative reciprocals. Instead of making this statement I can visually show two lines perpendicular and my students can make the conjecture of the relationship between the slopes. My research on the case study found results that students who worked with GSP had a deeper understanding of math concepts, showed retention of learning, and students showed creative thinking and active learning. My lesson will begin first with only one screen for the students to interactive with. However, for GSP to work at its full potential for the students, the notion of getting the students into a computer lab is essential for seeing the results I want for each student.

The second lesson will contain the use of a virtual manipulative through a java applet on the National Library of Virtual Manipulatives (NLVM). The site CT4ME defines virtual manipulatives as "an interactive, Web-based virtual representation of a dynamic object that presents opportunities for constructing mathematical knowledge". The site describes why virtual manipulatives are more effective than traditional static models. The traditional classroom manipulatives cannot be manipulated by the user. However, virtual manipulatives can have their representations changed by the learner, provide immediate feedback, generate hundreds of examples, and increase exploration to test hypothesis. One of my favorite virtual manipulatives is found on NLVM and is called the Grapher. The Grapher provides multiple representations of a single graph by manipulating the parameters of the function. My students are able to gain understanding of how each parameter controls a function without any explanation from me. Overall, "virtual manipulatives provide that additional tool for helping students at all levels of ability to develop their relational thinking and to generalize mathematical ideas" (http://www.ct4me.net/math_manipulatives.htm).

In conclusion, CT4ME quotes the words of Douglass H. Clements, "good manipulatives are those that are meaningful to the learner, provide control and flexibility to the learner, have characteristics that mirror, or are consistent with, cognitive and mathematics structures, and assist the learner in making connections between various pieces and types of knowledge-in a

word, serving as a catalyst for the growth of integrated-concrete knowledge". My goal as an educator is to share this research on appropriately integrating technology into the curriculum.

Project Implementation

The lesson I chose to implement first was the Geometer's Sketchpad lesson because it is the program that I have the least experience with in the classroom. So, I chose to focus on this lesson for this part of the project so I could review any surprises and unexpected bumps. My lesson involving GSP was on the slopes of lines. First seeing why slopes are constant, second component being why parallel lines are parallel, and third component being attributes of perpendicular lines. I decided to implement project with my family members including my mom, dad, and sister. I wanted to see how it would work with them before using it in my classroom. The following is what I discovered while implementing the lesson for the first time.

A surprise that I encountered when implementing the project was the file not opening. I am using a computer different than the one at school and my home computer has the student edition of GSP. Thus, the software CD has to be loaded in order for the file to open. So, I had to go back home, grab the CD, and start over with the lesson. Once the file was able to open, I got me lesson up and running for my audience.

Once I started showing my audience my lesson I did have some unexpected bumps. One bump was how low the visual quality was. Granted we were using a home projector and projecting on a white wall, I was disappointed with the quality of the labels. I need to make sure that I am using anywhere from 26 to 30 point font and consider bolding the labels on my points and lines. This would make my labels more visually appealing and stand out more against the sketchpad presentation. Another bump or surprise came when I started using the animation. Some of the animation was not as noticeable or dynamic as I wanted. So I am contemplating going into the sketch and making color changes where the line and point are contrasting colors so that the animation has a stronger effect for the audience. In the end, I want my audience to get a dynamic moment or effect so they can see the math interacting on this technology.

Once the audience and I got past the visual issues I realized that lesson was successful. All the objectives of the lesson were met by my family which makes me confident that my students would also be successful. The lesson also sparked insightful discussion within my audience who are people that are not familiar with math at this level or who are interested in it. In addition, they were inspired to learn the attributes with slopes and interact with the math during the lesson. My favorite part of the lesson is when my dad asked me to repeat one of the animations because even something as simple as a point moving up and down a line made the math more interesting.

As I look back at my lesson I notice that my lesson is primarily students watching the properties on sketchpad and I am considering adding a writing component for the lesson. This would give students an opportunity to write down their discoveries in a structured way. I even added areas for further exploration where students can take what they saw and apply it to an example in

front of them. Students can discuss together what they are learning and have chances to interact with the standards during their practice. Overall I am very happy that I implemented the GSP lesson with my family to get a better feel of the software and how I can take the lessons to the next level. For further reflection I will go back to my family and get their feedback on strengths and weaknesses of the lesson from the student perspective. Getting the opinions of the audience will provide me with insight of how I can tailor the lesson to better meet the needs of the student.

After reading the comments from my partner I am adding blank sketches to the lesson. The blank sketches will give the students opportunities to recreate the properties so that the students can learn the GSP tools and interact with the software. Depending on the experience level of my audience I will need to review some of the basic tools of the software for successful lesson sketches. I am excited to see the full revised lesson in my classroom with the four components: example sketch, recreation student sketch, discussion questions, practice/writing component. The class would conclude with a reflection piece where they can provide feedback and description of what they learned and saw throughout the lesson.

Project Evaluation

After completing the TechQuest project there are a few things that came to my attention. One is that my project is 80% teacher driven. I incorporated technology into my lesson; however, I would like to find a way to implement technology that involves more student interaction with it. Given my technology constraints (not having access to a computer lab) this may be difficult to achieve. Two, I have learned the importance of having constructions premade. This lesson involved three premade construction discoveries which saved a large amount of time. My goal for next time is to experiment with creating a construction during the lesson presentation. I am curious to see if creating the sketch while the students watch would impact them academically. Another idea shared with me is having students investigate the software on their own at home. Providing links for them to practice with at home would provide me with more learning time in the classroom. Another suggestion is to have students work in groups so that there is equitable access to the internet. Then, students could present their findings and demonstrate the work they did at home. This concept could benefit me in other aspects such as reinforcing the idea of homework. Students may be more inclined to do work at home if it involved the internet. Lastly, when approaching the use of a virtual manipulative I would definitely want to incorporate multiple versions using different websites. I feel as though students could grow tired of seeing the same website repeatedly. A change of website may increase attention during the lesson. If students worked on these sites at home, I am confident that they would find sites that I am not aware of and share them with the class.

The biggest lesson learned with both GSP and virtual manipulatives is the attention to visual quality. When I worked on the lessons on my computer everything seemed large enough to the eye. On the other hand, once it is displayed through a projector at a distance, the quality of the graphics and font size diminish. Increasing the computer display or internet font for virtual manipulatives aided in the presentation. For GSP there is a way to change the default font size

so that each presentation can be set for the visual quality that is appropriate for the classroom setting. From both previous experiences and discussions with my partner it is important to be aware of your computer features. The computer needs to have high speed internet and java applications to access most virtual manipulatives on the web. The computer also needs to have Geometer's Sketchpad program installed on the computer to create or open any sketch. In addition, locating these programs is essential.

I would definitely continue to incorporate GSP and virtual manipulatives into my lesson again. However, I would change having all the sketches premade. I want to try constructing a sketch in front of the class so they can see the process. Then have a few students create the same sketch on a new template. This is the technique I used with the virtual manipulative lesson and the students benefit from watching and applying their knowledge. If I had to do this project all over again I would just do one lesson. Splitting my focus between two lessons and two technologies is too much for one project. Overall, I learned a lot from creating both lessons and trying them out one at a time for my family.