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Introduction

I truly believe learning mathematics can be a fun experience for children of all ages. It is up to us, the teachers, to present math as an interesting application. The addition of computers into our ever-changing world has given us an important tool, which can assist us on our journey to teach math in new fun and interesting ways. The Program Geometer's Sketchpad© is one of many mathematic programs we as teachers can use to better help kids understand different geometric concepts. I would like to use Geometer's Sketchpad© in my classroom to help teach my students about circles and the different algorithms that go along with them. Having the students create circles on the program helps them better visual a concept and helps with the learning process in general. It allows them to get away from their desks for a while and explore both computing and mathematics. It actually makes learning math an enjoyable and exciting process.

I want the children to see how an algorithm is made. Creating a circle on sketchpad, finding its center, and then finding the radius will help them better visualize the process. After proving several small algorithms, I hope my students understand algorithms are not just created through trial and error. An algorithm is a systematic procedure used to accomplish an operation. I hope visualizing the algorithmic process helps them better retain the knowledge as well. I also hope the students become more comfortable using this program so we can use it in future geometry problems.

The activities I have chosen to do on Geometer's Sketchpad© addresses several of the National Standards for Mathematics. Out of the 13 mathematics standards for grades 5-8, the lessons I have proposed addresses roughly 9 of them: Standard (1) Mathematics and Problem solving, Standard (2) Mathematics as Communication, Standard (3) Mathematics as Reasoning, Standard (4) Mathematical Connections, Standard (6) Number Systems and Number Theory, Standard (7) Computation and Estimation, Standard (9) Algebra, Standard (12) Geometry, Standard (13) Measurement (NCTM Standards, 1989).

Literature Review

I have such a strong stance on the use of Geometer's sketchpad to help enhance a students learning experience. Therefore, I chose two articles to review that dealt with the integration of the program into the curriculum. The first article I read was A *Classroom Use of the Geometer's Sketchpad© in a Mathematics Pre-service Teacher Education Program* by Medhat H. Rahim. Students can read books until they are blue in the face. Does this mean they understand what they are learning or are they just memorizing what they read or are taught? This article argues that computers can become a valuable learning resource which can help students better understand geometry. Software such as Geometer's Sketchpad© can create an environment where the students explore geometry and make conjectures about different geometric properties. Learning geometry would then be turned into a sequence of part-part, Part-to-whole interrelationships discovery of geometric figures (Rahim, 2002). I agree, and if you look at my lesson plans, I try to follow this approach using geometer's Sketchpad©. This article also includes responses from students and it is clear after reading some of these responses, students would much rather learn geometry using a program such as Sketchpad.

The next article I read concerning the implementation of computer programs in math curriculum was *Do Mathematics with interactive Geometry Software.* By Tingyao Zheng. This article hit's the nail on the head! "Students need many mathematical abilities to solve problems. These abilities include being able to detect a pattern, conjecture, make generalizations and abstractions, perform inductive and deductive reasoning, and make analogies. These skills can be nurtured through solving rich problems, experiencing appropriate classroom discourse, and using technology," (Zheng, 2002). This article simply states that we as teachers need to do more than just generalize mathematics by giving our students algorithms and saying that is they way things are and that is that. We need to give the children an opportunity to prove these theorems and programs like Geometer's Sketchpad© can help them achieve this.

Another article I chose to review is titled *An Angle on Circles. It is an article written by Mary Alice Hatchett* and expresses the importance of including writing in math curriculum. She basically gives an example of a writing activity dealing with circles. It is yet another angle that can be taken to further spice up a math lesson. "In writing, students organize their thoughts and reflect on how to communicate them. Math experiences can thus be "captured" for later recall in making logical connections between strands of mathematics, connections to other content areas, or as a spring board to content extensions," (Hatchett, 1995).

The next two articles I chose to review are about activities dealing with circles done without the use of Geometer's Sketchpad©. The first article is titled *The straight side of sliced circles.* It is an article I found in the Science news. It is an article written about a Hungarian mathematician named Mikolos Laczkovich and his theory that if you cut a circle into a finite number of pieces, you could rearrange them to make a square. I found this article fascinating and would like to challenge some "talented" kids to recreate this on sketchpad.

The next article I have chosen to review about activities dealing with circles done without the use of Geometer's Sketchpad© is titled *The Function Box and Fourth Graders. Squares, Cubes, Circles*. It is an activity having the kids derive rules for figuring the circumference and area of a circle using pairs of measurements. They do this finding various patterns. This is yet another activity that can be easily recreated using the program Geometer's Sketchpad©.

The final two articles I chose to review deal with the ever expanding π. One of the articles, *What is pi, and how did it originate?,* defines pi and gives a brief history of the origin of this seemingly mystical number. I found it amazing that the importance of pi has been recognized for at least 4000 years (Bogart, 1999). I feel this would be an interesting article to present to the kids before they begin their journey on Sketchpad. A possible report could be written about the history of pi and this could be a valuable reference the kids can turn to if needed.

Another article I found interesting and would like to present to my class before they begin their circles quest on Sketchpad is *Finding the Value of Pi.* Although fairly short, this article is rather interesting. It gives a brief summary as to the history behind the notion of Pi (π) and how it was conceived. It also includes a chronological chart of the values of Pi through time beginning with the Babylonians in the year 2000 B.C. and ending with the CDC 6600 in 1967 (Math Forum, 2003). The value of Pi has remained close for nearly 4000 years. It also shows how the notion of pi was discovered and why it is important. It goes on to state:" the significance of this discovery is clear: Circles are everywhere- in the sun, the moon, the pupils of our eyes, the most basic religious rituals and the earliest man-made structures," (Math Forum, 2003). I felt this article was significant because it is a brief summary proving several different proofs of the

formula π=C/D. I want the students to witness proofs before they begin proving algorithms themselves so they can see the significance.

Because the students will work together in groups, the following lessons cover standard 2: Mathematics as Communication. The students will also have an opportunity to explore the World Wide Web and research how algorithms are created. Specifically, I will ask the students to try and find a proof of the algorithms D=2r, C=2πr, and π=C/D. Once they have done some research, students will write a small report about what they found. The students are asked to make a connection between the algorithm and the activity on sketchpad as a way to prove the algorithm D=2πr therefore, this satisfies standard 1: Mathematics as Problem Solving. These are a recreation of activities presented in the article *Circles*. They are doing simple computations and estimations throughout this lesson so standard 7 is satisfied. They measure in this activity, and this is a geometric exercise, so standards 13: Measurement, and 12: Geometry are met respectively.

All in all, this lesson covers most of the mathematical national standards. Using Geometer's Sketchpad© enhances the learning process by giving the kids the opportunity to prove these algorithms visually on a computer. The articles *Do mathematics with Interactive Geometry Software* and *A Classroom Use of the Geometer's Sketchpad in a mathematics Pre-Service Teacher Education Program* stress the importance of this. Teachers can only "preach" so much. We need to get the kids more involved in the proof of mathematical algorithms. The visual stimulation, along with the step-by-step process of proving algorithms, can only help facilitate the learning process. As a future teacher, I am a huge advocate of Howard Gardner's theory of Multiple Intelligence. He says that not all children learn in the same capacity. Programs like Geometer's Sketchpad© can help those Visual Kinesthetic learners that may have problems with math otherwise.

Activities

Activity 1

Objectives

The students will use Geometer Sketchpad© to construct a circle and find its center. When they find the center, they will find the radius. They will then make a conjecture about the diameter, and prove the algorithm D=2r.

Materials:

- ✓ Geometer's Sketchpad©
- ✓ Computer

Go For it!!

- Selecting the point icon, plot any two points (A and B). Next select these two points and go to construct, and click on a segment. Now, double click A and then select the segment. Now, go to construct again and create a circle using the center + radius. A is the center of the circle.
- Now, select the segment and go to measure. Click on length and the two points will now have labels and the measurement should be displayed near the circle.

- We are now going to bisect the circle in order to get a diameter. Select the point on the circle and the center point. Go to construct and select line. This bisects the circle. Create a point on

the circle that includes the circle and the new line and label it C. now click on C and B. Go to Measure and click on distance. This is the measurement of our diameter.

- Next, go to measure and select calculate. Type in 2 and then *(multiply) and select the measurement near the circle. This answer should be the measure of your diameter (D=2r).
- Let's prove this. Let's make another segment connecting the center of our circle and another random point on the circle. Create a segment between the new point and the center. Go to Measure and click on length. Now add these two segments together. The sum of the two segments should equal the diameter.
- Create a new circle and try this again. Does it work? Did we prove the algorithm D=2r?

Activity 2

Objectives:

The students will use Geometer's Sketchpad© to prove the circumference of a circle equals two times pi times the radius ($C=2\pi r$) and, $\pi=C/2r$.

Materials:

- ✓ Computer
- ✓ Geometer's Sketchpad©

Go for it!!

- Plot any two points and label them A and B. Make a segment connecting these two points. We will make B the center of our circle. Double click on B and then select point B and the segment. Next, go to construct and create a circle using center + radius.

- Now we have our radius! First, click on the radius and select measure distance. This will tell us in cm how long our radius is.

- What else do we need? We need to know our circumference. First we will have the computer measure it for us. Select the circle (should be highlighted blue) and go to measure and select circumference. Now we know Two parts to our algorithm…our radius and our circumference. $\pi=C/2r$

- Now we'll calculate Pi. Go to measure and select calculate. Now click on the circumference measurement and divide it by 2 times the radius measurement. What number did you get? Is it around 3.14? This is Pi(π).

- Let us now prove the formula $C=2\pi r$! Go to measure and select calculate. Now type in 2 times your Pi times your radius measurement. Does it equal what the computer measured your circles circumference to be? Is it close?

Repeat this process again with another circle. Did you get the same results? Is this enough information to prove these algorithms?

Conclusions and Implications

In conclusion, there are wonderful tools we as teachers must utilize in our classroom in order to help our students better understand the concept of algorithms and how they are derived. Geometer's Sketchpad© is a terrific and fun way to get the children excited about math! Having students create circles on the program is one of many ways, which can help them visualize a concept and most definitely help the learning process in general. It allows them to get away from their desks for a while and explore both computing and mathematics. It actually makes learning math an enjoyable and exciting process.

After proving several small algorithms, I hope my students understand algorithms are not just created through trial and error. An algorithm is a systematic procedure used to accomplish an operation. I hope visualizing the algorithmic process helps them better retain the knowledge as well. I also hope the students become more comfortable using this program so we can use it while exploring future geometry problems.

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