Zany Projects
The Art of Mixing Compass with Computer

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Abstract

Construction, using the compass and straightedge, is becoming a lost art. Exercises involving these tools are commonly omitted within the Middle School curriculum as well as within Upper School geometry classes. Computers and lack of time are the usual responses for the dropping of these explorations. This paper describes activities used by my class over a ten week period which allow my students to experience the wonders of the tools, both hand and technology related. Significant understanding emerges from the engagement of the students with the explorations. Interesting artistic creations result.

Introduction

The use of compass and straightedge has all but become a lost skill for students. Thus when my principal asked me to provide a topic for an elective for Middle Age students, I suggested geometric constructions. From Euclid's time to the present, constructions are an important activity allowing students to see how and why for many concepts.

My plan for the class contained three parts. We first start by making constructions using the compass and straightedge. Students are introduced to the basic constructions such as line segments, angles, and triangles applying proper terminology and symbols. How is an angle constructed? What is meant when we bisect? What angles are formed when lines are perpendicular? How many angles does a triangle have? What is the sum of these angles? Equilateral, obtuse, acute, scalene, isosceles, and regular are just a few of the terms that are explored through hands on constructions. How does inscribe differ from circumscribe?

The second part of the class involves the computer, using Geometer's Sketchpad. Students are introduced to the software; they are shown the tools and the pull down menus. How does draw differ from construct? A simple exercise having students perform these tasks helps to clarify the difference. Students very quickly learn that the computer is much easier to operate than the compass and straightedge. They go through the same tasks as they did by hand, except I allow them to play and experiment with the tools. Play time is an absolute must for students to become proficient with the use of the software. After they are comfortable with the software, I introduce them to the transformation menu. We first do a simple reflection. After first constructing a line, they reflect a circle and then a triangle over that line. They are then assigned to come up with a construction they may use as a wallpaper design. This basic design is reflected to fill up a whole page. A second project uses rotations and reflections. Students create their own checkerboard by starting with a piece of the board and using rotations and reflections to generate the entire board. The third part of the class involves using cabri software on a TI-89 graphing calculator. This is quite challenging for the students but useful in the sense that they now must apply these assimilated techniques from both the hand and computer constructions necessary for calculators. So in addition to knowing the hands on constructions, they now need to know how to use the computer representations for the graphing calculators.

The Exploration

While this topic started out to be a simple idea for a class, I soon realized that we had started on a journey with far reaching applications and discovery lessons on which the students would embark. The connections with geometry and art were recognized and perused as we progressed through only ten weeks of class. Once the students started this class they wanted to create. The first project I assigned was tiles made from wood. Designs of figures would be transferred onto these tiles, then painted, and mounted; these completed tiles from the entire class now form a border for my classroom door. Within their designs, students were to utilize geometrical shapes and facts that we had talked about. These creations were to be made by hand or designed on the computer. I was amazed with one group at the perspective and optical illusions that they created when given a particular medium with which to work. The art teacher helped here by supplying insight and suggestions as to their work. Thus I not only had the students doing exploratory work with math, but now they were working on an interdisciplinary project with both the mathematics department and the art department.

The computer allowed more advanced and in depth ideas to emerge. While we talk about reflections and rotations within algebra and pre-algebra, students do not necessarily visualize what actually happens. Once we started reflecting figures, the students soon realized that a reflection is similar to a 180 degree turn. They then started to experiment with 90 degree and 30 degree rotations. By doing the rotations and reflections with a circle and a triangle, they now could see what actually happens with a reflection and a rotation. Though translations and dilations were not presented at this time, I found students searching to move figures and to make figures larger or smaller. Once the students felt comfortable with reflections and rotations, they tackled translations and dilations on their own discovering the unique attributes that these transformations brought to their drawings.

A final project was required for the students to complete. They could choose several options among which could be hand drawings, computer drawings, power point presentations, or a design made out of some medium approved by both the art teacher and me. Guidelines were given as to how many drawings, how many slides, and the length of time involved. The students also had to use techniques and topics we had covered in class. They could not just draw a unique figure, but had to construct that figure using the mathematics covered during the class. One student chose to make paper figures that he could cut out then connect by tabs that he incorporated into his drawing. He constructed an octagonal prism, an airplane, a helicopter and a pair of glasses to name a few. He was able to visualize where he needed to connect the figures and then incorporate the necessary connection pieces. Another student chose to make a three dimensional wall plaque made out of wood. He constructed the shapes in such a way to show depth by inserting pieces of wood to layer the shapes which also gave interest by different shading that occurred by the placement of the pieces. Two others chose to make power point presentations where they captured the essence of their explorations into creations that they constructed using their software knowledge. Several others chose to make a binder with constructed figures by hand and by the computer.

Conclusion

Although this class began with a simple goal, to provide expertise using construction tools for geometry, the connections between mathematics and art, providing visualization of the ideas, significantly exceeded my expectations. Understanding was the key here. The students demonstrated their understanding about bisectors, perpendiculars, parallels, midpoints, triangles, circles, and tranformations through the artistic projects that they completed. To see, to feel, to make is to understand.