# How Do I Love Thee: A Synthesis in 3 Parts

As a child wonder and amazement was seen in the world; curiosity was welcomed and encouraged. Where and when do we lose this inquisitive nature and how can we maintain it? Creative, as defined by Webster's Dictionary is: "The ability to transcend traditional ideas, rules, patterns, relationships, or the like, and to create meaningful new ideas, forms, methods, and interpretations." The goal of education is to prepare students for life after schooling and to positively impact society. Without focusing on these seven cognitive tools of creativity: perceiving, patterning, abstracting, embodied thinking, modeling, and playing, students are not developing their creativity and not really understanding what is being taught. "The purpose of education should be understanding rather than simply knowing; its focus should be the active process of learning and creating rather than the passive acquisition of facts" (Root-Bernstein, p 316). Education must allow students to actively engage in their own learning by exploring and discovering all different aspects of a topic. This allows for a deeper overall understanding and a foundation that is solidified for future study. Education needs to emphasize invention, intuition, imagination, innovation, and interdisciplinary study. The only way to accomplish this is to stress the cognitive tools of creativity within the classroom.

Cognitive tools of creating creativity can be used in a variety of activities in the classroom. Many of these creative ideas can be incorporated into my classroom by allowing students to question and explore. This culture needs to be part of the classroom environment. A few of these cognitive tools stand out as applicable to developing foundational understanding in mathematics. This quote from the class wiki states the importance of the cognitive tool of patterning; "The whole object of mathematics is to create order and structure from chaos and disarray"( ch 3). How we do this impact how much students learn. Developing this order allows students to explore, inquire, and try different patterns.

My students will explore the importance of slope-intercept form through creating different patterns. Students' must develop and maintain the ability to recognize and make predictions out of things that seem to be arbitrary. It comes from something we know and expect that gets changed into the unexpected. Mathematics has a lot of patterns and specific strategies for solving problems. Many students learn the formulas for mathematics, but do not understand the concepts behind why the formula works. For example the pattern of writing equations in slope-intercept form before graphing on a coordinate plane is a pattern most students follow. Looking at writing linear functions in a form other than slope intercept allows students to grasp the concept in a more foundational way. Writing all linear functions in this new pattern will not give students the correct graphs to match the equation, but the goal would be for students to grasp an understanding of why the y - value cannot have a coefficient. In order for this to make sense to the students an example needs to be given that has a coefficient in front of the y ( $2y + 4x = 16$). Students can follow the original pattern and create their own patterns to determine understand the common mistakes of writing the equations in slope-intercept form.

**Original Pattern:**

$2y + 4x = 16$

$-4x \quad -4x$

$\frac{2y}{2} = \frac{-4x}{2} + \frac{16}{2}$

$y = -2x + 8$

Slope: -2

y-intercept: 8

**New Pattern:**

$2y + 4x = 16$

$-4x \quad -4x$

$2y = -4x + 16$

$-16 \quad -16$

$-16 + 2y = -4x$

slope: -4

y-intercept: 8

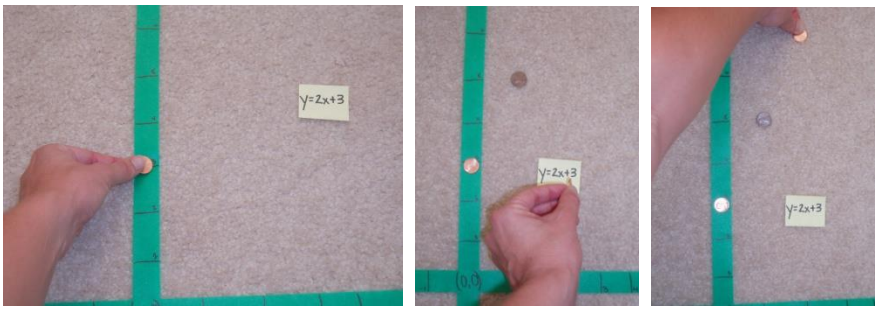
From these different patterns students are able to notice the coefficient explains the difference that is seen between the slopes and y-intercepts. The comparison of these different patterns can highlight one of the more common mistakes that middle school students make while graphing linear functions. Without this exploration of common mistakes with slope intercept form students are expected to remember an arbitrary rule without understanding the application. This foundational understanding will be the building block for continued slope study and is important for future mathematics study as well.

Experiences and visuals can lead to deeper understanding of concepts. Tapping into students' experiences not only ignites their interest, but allows actual knowledge to be applied to something that makes sense in the world. In math, many of the concepts students are working with a very abstract and difficult to understand; "Sometimes the simple challenge to think concretely about abstract concepts can be effective" (Root-Bernstein, p. 64). On a coordinate plane slope is an abstract mathematical concept without much meaning. Applying the idea of slope to concrete objects or activities that students are able to visualize allows them to grasp what slope means and how it impacts a linear function. Looking at this picture

we see a downhill skier. This picture can bring up thoughts of winter, snow, big hills, trying to keep your balance on the skies, and the wind nipping at your face as you quickly float down the hill. None of this is relating to a linear function or a graph of any sort. Looking at just the skies of this picture you can see that they are creating a straight line that could be transposed on a coordinate graph and used to represent a linear function. Take it one step farther and apply that the skies are usually on a snowy mountain. These different mountains are different heights and have different "slopes" to them. Similarly these ideas also can also be transposed onto a coordinate graph and represented by lines. Students can be assigned the task of coming up with other real life examples that would not normally be seen as a linear function.

Another important means of developing creativity involves embodied thinking. "Mind and body are one, and we must learn how to facilitate and make use of the interconnections" (Root-Bernstein, p. 174). Linear functions offer an opportunity to incorporate mind and body movement with the concept of graphing and slope. If students

are given the opportunity to physically graph linear functions the impact of slope becomes more apparent. I chose this method not only as a way for students to move and interact with the information, but also as a way for students to feel the differences in slope. With a coordinate grid tapped to the floor student place pennies to graph linear functions. Feeling the slope versus drawing and saying the slope will connect differently in the students mind. The ideas of positive slope, negative slope, and steepness can be developed, questioned and explored.




Students are also able to play with the idea of slope by creating different ramps using a variety of materials. This idea of play allows the education in my classroom to be more inquiry based. Students are expected and given a chance to explore and try concepts. The only instructions are to create a useful ramp that will allow the marble to successfully roll down the ruler. Once the ramps have been created the groups rotate and test out each. A comparison is made of the different ramps and results.

- Marble rolls down the ruler the quickest.
- Marble rolls down the ruler the slowest.
- Marble rolls the farthest amount of distance on the ground after leaving the ruler.
- Marble rolls the least amount of distance on the ground after leaving the ruler.
- One you would want to use for snowboarding.
- One you would want to use for skateboard jump.

Lastly groups must decide how or if they would change their ramp to create a snowboarding jump. The application of this play to real life situations gives students the opportunity to create a different understanding of the concept. Not only are students more interested in the material with these play activities they are more likely to remember the application with the foundational understanding of the concept.

These different types of cognitive tools and development of creativity require a classroom environment that is conducive to this type of learning. In order to create this type of classroom environment it is necessary for mistakes, different ways of thinking and different ways of solving to not only be welcomed, but to also be encouraged. One way to help create this culture is for students to see the teacher exploring and trying different methods.

These are three examples of the ways that I am looking to incorporate more modes of creativity into my classroom. There is a desperate need for freedom to explore concepts and discover new truths. “The huge difference between the number of synesthetic children and adults clearly suggests that the typical educational focus on unisensory experiences and expression stifles an early and natural association of perceptions” (Root-Bernstein, p. 310). Traditionally the education students receive teaches through one form. This form in turn focuses on one dimension of the concept being taught. Students are only ever expected to think unisensory with their minds. As educators we are squashing the curiosity of students by forcing them to think in one mode. What is the importance of education? That students can regurgitate information onto a piece of paper or that students are able to apply, adjust, and create new information?