G-TEAMS: Utterback Middle School

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Our Goals

Kathryn, Kyle and Shane came to this partnership with different goals. Kathy wanted and wants to prepare her students for their high school ciriculum. Shane is looking for ways to engage and interest students in Mathematics. This specifically includes changing the perception of mathematics as a bunch of rules that are memorized, to a creative exercise which allows for the discovery of relationships that would otherwise be hidden. Kyle is begining his teaching journey and searching for the tools that will make him an effective teacher early in his career. These goals mostly overlap and occasionally oppose each other but have and continue to produce learning opportunities for everyone involved.

Variations on Bingo

Kathy and I found competition was a useful motivational tool. However weaker students weren't engaged when they thought they were going against a more adroit student. There was also a stigma associated with math as being uncool.
To circumvent this stigma and ensure that weaker students felt they could compete, we developed multiple variants of BINGO.
This easiest variant was order of operations bingo. Students had bingo cards with the numbers -15 to 15 on them. We gave the students mathematical expressions. The students had simplify the expressions using the appropiate order of operations to get a number. That number was the number that was called. We have a more challenging variation where the problems include fractional answers and students get both the numerator and the denoinator as called numbers.

Other variations included:

- ⋆ Substitution bingo. This had expression with variables in them being called and preset values for the variables. The students had to sustitute letters for their corresponding numbers and evaluate the expressions.
- ⋆ Linear equations bingo.
- ⋆ Future variations will include inequality bingo and absolute value bingo.

Implementation:Shane wrote a computer code to generate the equations for the inequality and linear equations bingo so that the game could be played multiple times without having to recycle problems. Also each game had a cooresponding worksheet where students had to show their calculations.

Cyphers and One time pads

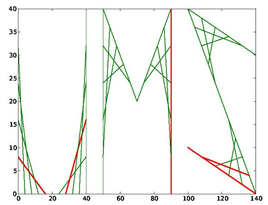
Another tool we used were puzzles that required mathematics to solve them. We introduced a puzzle where all the pieces were perfect squares. The sides had equations or expressions and the goal was to match sides that had the same solutions. This gave the key to solving a cyphered text.

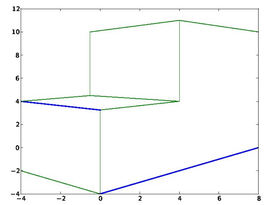
Students were introduced to different types of cyphers in the explanation of the assignment. They also learn why simple substitution cyphers are weak and how math can crack the codes. Then they see how much harder it is to crack the key word cypher.

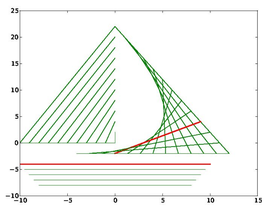
Then to solve the puzzle they get practice evaluating expressions, solving equations and inequalities.

Line art and Perspective

Linear equations and linear functions dominate a large part of the curriculum. Utterback is also an arts Magnet school. Therefore we decided to incorperate these two elements to use mathematics behind lines to create art.







The Twin Goals of engagement

Every teacher knows that getting students engaged and excited about a subject makes the process of actually teaching much easier. If students are interested and invested in a concept they will devour it and work on it and think about it without prompting.

The course requires the introduction of new concepts and the practice with mathematical manipulation so that those and prvious concepts feel natural and easy to work with. To that end, we have implemented a two pronged strategy where we worked on ways to make practice more fun and introduced concepts in interactive setting.

Game theory, Probability, and Algorithms

One of the goals of our course is to identenify appropriate methods and techniques. We introduced using flow charts to organize concepts ideas and strategies. We used this in a wide variety of scenarios. We began with algorithms for class procedures. This incorperated some formal logic and conditional statements.

Then we used the concept of an algorithm to define a game strategy. We introduced a probability game called pig. In this game students roll a pair of dice. Each round the students can roll dice as many times as they wish. The students gain points for each roll not containing a one. If they have a roll with one one, then they lose all the points for that turn and the turn ends. If a student gets both dice as ones they lose all their points. Students first played the game several times and developed some inuition for the game. Then the students had to develop a strategy for playing the game. They had to express their strategy as an algorithm. In many cases this made the student aware that their was a gap in their strategy. There was some scenario which was not covered. We then programmed some of the different strategies and simulated thousands of games to see which strategy was better.

Future work will include adopting algorithms for computer programming in kid friendly software.

The Math Science connection

The students were learning some basic physics this year and we developed a project that allowed them to explore and generate models for a simple lever. The students had a balance constructed from a yardstick, a stand, some plastic ware stings and binder clips. This homemade system allowed them to connect the concepts of linear, directly proportional and inversely proportional. The experiment consisted of four phases. Students started with balanced system with the fulcrum equidistant from both ends. Students immediately saw this as a simple balancing scale.
The second setup was an initially balanced system with the fulcrum not at the center. This generated a directly proportional model and allowed us to introduce the concept of slope.
The third setup was an initially unbalanced system and this produced a linear system with non-trivial intercept.
The final setup involved varying the lever length and adjusting the weight to keep the system balanced. This gave an inversely related model