Habits of Mind for Mathematicians

The **Common Core Standards for Mathematics** list eight Habits of Mind that Mathematics educators should develop in their students. I will focus on the first of these habits, ***Make sense of problems and persevere in solving them****,* which is reproduced below*:*

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

This habit of mind is the approach professional Mathematicians take when solving a real-world problem.

Discussion Strategy: Adapted Structured Academic Controversy

I will ***adapt*** the Structured Academic Controversy (SAC) discussion strategy described in *Building Academic Language, 2008*, by Jeff Zweirs. I decided to use this discussion strategy because it lends itself very well to the habit of mind described above as it helps students consider alternative perspectives and engage in a shared decision making process.

Students will be given a real-world word problem with different possible "entry points" and they will discuss which entry point they will follow to arrive at a solution. The specific word problem will be a system of linear equations. Systems of linear equations can be solved by several methods: graphing, using tables, and algebraically. Each method can be considered an entry point.

A group of six students (divided into three pairs) will discuss how to arrive at a solution. Each pair in the group will first be assigned one method, and given the task to brainstorm both the pros and cons of the method in arriving at a solution to the system of linear equations. After each pair has come up with ideas, all three pairs in the group will get together and discuss these different methods by following the habit of mind described above, *Make sense of problems and persevere in solving them*. The reasons to start with pairs first are to:

(i) break down the problem into smaller manageable parts so that each pair only needs to consider one part,
(ii) provide the opportunity for all students to participate, and
(iii) provide students in a pair to practice the 'habit of mind' and adhere to the rules (listed below) for the SAC, before joining the other two pairs to form the larger group of six.

Each pair will present their perspective on one method (drawing a graph, creating a table, or solving algebraically) and together all three pairs will analyze the problem comparing and contrasting all three approaches. There is no obligation on any pair to defend their method, unless they specifically want to. The objective is for all six students in the group to provide their input, even on a method that was assigned to another pair. The students will adhere to the following rules (Zweirs, 2008):

1. I can tactfully criticize ideas, but I don't criticize people.
2. I listen to everyone's ideas, even if I don't agree.
3. I appropriately ask for clarity.
4. I try to understand all sides of an issue.
5. I change my mind when evidence clearly indicates I do so.

6. I encourage everyone to participate and to master all the relevant information.
7. I will help the group focus on coming to the best possible decision, not on winning any argument.

The final goal is for the entire group to analyze all the three methods, and come up with which one (or more) would be best suited for finding a solution to the system of linear equations.

Some example questions and statements that I expect students to say are:

1. Can you elaborate on that?
2. What do you mean by … ?
3. Can you be more specific?
4. What do you think?
5. I would add that… .
6. For example … .
7. In other words … .
8. To expand on your point about … .
9. I (dis)agree with that because … .
10. Let's summarize what we have discussed so far.

My Support: I will support students by being a moderator (facilitator) to make sure they follow the rules for the SAC, and also to provide *modeling* or *scaffolding* as needed. Finally, I will debrief on the SAC, and discuss with the group(s) on how well did the discussion:

- ✓ Teach you about the issue.
- ✓ Give you a deeper understanding of other viewpoints.
- ✓ Successfully lead to informed decision making in your group.