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#### Reciprocal Teaching and Problem Solving

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#### Abstract

#### This paper argues that reciprocal teaching is a method that helps teachers teach problem solving, the signature pedagogy of mathematics. The paper will discuss the issues students have with problem solving, how reciprocal teaching can help fix these problems, and give information about how using this method works in a classroom. There are references that help explain reciprocal teaching, and give evidence and examples of the success of this method.

#### In mathematics, students need to learn concepts and memorize formulas, which is something that many teachers have no problem doing. However, even more important, and harder to teach, is how to be a good problem solver. You probably have heard math being referred to as the “universal language” which is why while I was researching what my signature pedagogy should be, I became very interested in the strategy known as reciprocal teaching. If you have heard of reciprocal teaching, you might be familiar with it being used to teach reading comprehension. However, since mathematics is a language as well, with some slight modifications, it is the perfect tool to help students understand the mathematical language and problem solve. Mathematics in real life is solving problems. Teachers need to have students realize how important mathematics is in the world by giving them confidence in using their math skills to solve problems that relate to their lives. This paper argues that reciprocal teaching is a strategy that helps teachers teach students how to problem solve.

#### One might still question how a strategy for reading comprehension can be a signature pedagogy of a math teacher. Robert M. Capraro, Mary Margaret Capraro, and William H. Rupley(2011), created an article that helps explain the relationship between mathematics and reading cognition:

#### Metacognitive training within reading-enhanced problem solving should facilitate students developing an awareness of what good readers do when reading for meaning in solving mathematical problems enabling them to apply these strategies. (p. 1)

#### The problem with students solving problems most of the time is not understanding what the questions is asking. They do not comprehend what they are supposed to do. Which is why these strategies can help the students solve problems. This article also talked about why it is important to teach this skills in the math classroom as well:

#### Teachers need to think less about students deriving an answer and more in terms of facilitating students’ application of the cognitive components of reading and mathematics. Thus, teachers can implement reading-enhanced problem solving in mathematics when students struggle, rather than having to manipulate their local curriculum. (p.1)

#### Math teachers sometimes only know how to teach concepts, but it is important for them to also be able to teach the students how to understand and solve problems. An article by Kylie Meyer gives good insite about why students struggle with comprehending mathematical problems:

#### Other challenges in comprehending mathematical word problems include the need to identify sufficient, insufficient and extraneous information and the highly technical vocabulary and multiple meanings of some everyday words in a mathematical context Mathematical vocabulary includes technical, sub-technical, general and symbolic terms and knowledge of these can assist teachers to understand the cognitive demands(p. 8)

#### With reciprocal teaching, these issues can be solved. It helps the students become more literate in math, understand problems, and figure out how to solve them.

Now that you know why this strategy is useful to mathematics, I am going to describe what exactly this strategy is, how a teacher should use it, and what the students need to do. Reciprocal teaching has four stages: predicting, clarifying, questioning, and summarizing. Teachers help students learn how to lead discussions about texts and understand them using those stages. However, for mathematical problem solving, it can be revised as predicting, clarifying, solving, and summarizing. Each stage not only helps the student solve a particular problem, but it helps improve their mathematical literacy and problem solving skills which will help them be more confident and successful problem solvers. In order for this to be successful, the teacher needs to model the four stages, and help the students be able to think that way on their own while solving problems. After the teacher models this, the students should be put into groups while solving problems to practice it on their own. The students learn and teach one another each time improving their skills.

The first stage is predicting. A teacher will need to teach the students what kind of predictions they should be making before solving a problem. While solving problems in a classroom, the teacher should discuss with the students predictions on that particular problem as an example of what they should be predicting while solving future problems. Although this strategy is used a lot in word problems, it can be used to solve any mathematical problem. What type of question is being asked? What prior knowledge do I have about this problem? What should my answer look like? What can I use in the question to help me figure out the solution? This first stage may be difficult, but it has the student begin thinking about what knowledge they have that can be used to solve this problem. The teacher should emphasize to have the students think about prior knowledge they have when making these predictions. Having students write down their predictions or discuss their predictions with others are ways to check that the students are able to make predictions about the problem to be solved.

The second stage is clarifying. This stage is very important. It helps the students back up their predictions or throw out ones that are not relevant. This is also a stage where working in groups is very beneficial. According to an article by Yvonne Reilly, Jodie Parsons and Elizabeth Bortolot there are three parts to this step:

During the clarification stage the learner is required to list three groups of information.

The first list contains words they are unfamiliar with, the second states all the facts they

know, i.e. generally statements or values from the mathematical problem

The last list requires a higher order of mathematical thinking and asks the students

to compile a list of the information they have yet to determine in order to successfully solve the problem. (p. 185)

Each one of these steps are important. The first step might not only be words that the student does not know, but since this is math it may also be symbols. This is helpful to the students because they can make sure to figure out the parts that confuse them, but it is also helpful to the teacher because they can see which terms are confusing students which will probably be terms that are important to build mathematical literacy. Sometimes, teachers assume the students know the words and are having trouble with the mathematical parts, but this step helps the teacher see what terminology they have to explain better to have students that are mathematically literate.

The second step is to list the information from the problem that they know. In word problems, it would be listing information given to them and identifying questions asked of them. However, every problem will have things that you know, and things that you need to find. This is where the students will identify this information. A teacher can help the students learn to do this, by pointing these things out before solving problems in class. The teacher should ask the students the information they know from the question and make sure all the important information is included. The third step is to have the students list what they still need to determine in order to solve the problem. This is important for multi-step problems. Students will see what steps they need to do in order to get a final answer. It is somewhat like the prediction stage, but now with more evidence behind it and more precise.

The problem a lot students have with problem solving is that they are not able to identify everything they need all the time. These first two stages help them find the information they need in order to problem solve. The reason it is helpful for students to work in groups is because One student can pick up on something another student might overlook, or one student might understand some terminology another student might not understand. By being able to discuss these steps with others, it is more likely that students will pick out all of the important information and find meaning in the problem.

The next stage is solving. Now that students have completed the first two stages, this stage becomes a lot easier. It is important for the teacher to require students to show all of their work while solving a problem. Math problems can be solved in different ways, and while solving a problem, there are many opportunities where a student might make mistakes. When a student shows their work, it allows the teacher to see where a student made a mistake, and it allowed the student to go back and look over their work and see where their mistakes were made. The students can use pictures, words, numbers, and diagrams to show their work. Let the students know it is important that other people can look at only their solving stage and still be able to understand exactly how they solved the problem. The better the student completes the first two stages, the easier this stage will be.

The last stage is summarizing and it is important in order to help the students learn from this process and be able to become better problem solvers. The student should individually reflect on how they contributed to the problem being solved, and any help that they received to solve the problem. Teachers should encourage the students to be able to justify their answer, and think about what they have completed. They students should be able to feel proud of the problem they solved, understand how and why they solved the problem, and see how solving problems this way can help solve other problems. A famous quote from John Dewey is “We do not learn from experience... we learn from reflecting on experience”. This stage of summarizing allows the student to be able to really review what they did in order to solve a problem, and helps their general problem solving skills to expand.

One argument against reciprocal teaching is that it takes too much time. Although it may take longer to go through these stages before solving a problem, it is beneficial to helping the students become better problem solvers. A study by Yvonne Reilly, Jodie Parsons and Elizabeth Bortolot that split two groups of students into solving the same problems. One group used the reciprocal teaching method and the other group could solve the problems however they wanted. The results were that less than one-third of the non-reciprocal teaching group correctly solved the problems and three quarters of the reciprocal teaching group had correct responses (p. 187).Also, this method is about building students mathematical literacy and problem solving skills, not solving a particular problem in the moment. Many students never gain these skills, and it has them think that they are not good at math. Being able to solve problems is the most important thing about math. Using this method allows the students to become better problem solvers which will help them not just for these particular problems, but solving any problem they made need to solve in and out of mathematics.

References

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