

Encouraging Patient Problem Solving: Scaffolding Student Metacognition in Physics

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Introduction:

High school physics students struggle significantly with problem solving when problems are “ill-structured”, or open-ended, in nature. These types of problems do not present a direct path to a correct answer, may provide less than enough or excessive information, and do not provide “steps” along the way in order to finish. Working in industry I observed employees solving these very types of complex problems on a consistent basis. The purpose of this action research was to help structure student thinking and increase student persistence in the face of challenging real-world problems.

I developed a problem solving procedure with input from my students to help structure their thinking during problem solving and improve their ability to solve ill-structured tasks representative of those found in industry. Students participated in a one-week interactive lesson about problem solving. During the lesson students developed a meaningful problem solving procedure to use and practiced each step of the process separately and in detail. Before and after the lesson students completed the same ill-structured task and completed surveys with questions addressing attitudes toward and perceptions of problem solving and student ability.

Findings:

I found that participating in the problem solving unit increased the sophistication and complexity of the problem solving strategies that students reported using. The number of steps that students reported on surveys increased from the beginning to the end of the year and the steps that they chose to include were more meaningful. Student understanding of ill-structured tasks also increased as a result of the intervention. Student scores on six of the seven problem solving steps increased, students spent more of their time on tasks related to solving the problem and less time on tasks related to understanding it, and students reported greater confidence in their work after the intervention. High achieving students reported increases in positive attitudes toward problem solving as well as their own ability and feelings of success, while average and low achieving students reported decreases in each area. Interestingly, low-achieving students reported the highest initial attitude towards problem solving and the lowest final attitude indicating that students may have misunderstandings of what problem solving is.

Plan of Action:

In the future I will focus on problem solving strategies at the beginning of the year with an introductory unit focused on solving problems reflective of those found in industry. I will also develop a form similar to what was used in my physics classroom for use in my engineering classes reflective of the engineering practices I observed in industry. Finally, I will work to develop a grading procedure that rewards persistence and an understanding of the problem solving process over “correct” answers in order to help improve student attitudes toward problem solving and their own abilities.