PEER-LED TEAM LEARNING
LEADER TRAINING

WHEN KNOWING THE MATERIAL ISN'T ENOUGH - PROBLEMS WITH WORD PROBLEMS

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As a chemistry workshop leader this semester, I observed a strange pattern among many students in my workshop. Many students understood the material very well, followed whatever was being discussed in workshop, earned near perfect scores on the workshop quizzes, and then did poorly on the class exams. How can this phenomenon be explained?

It was apparent to me from this phenomenon that students needed to know something more than the chemistry material taught in lecture and workshop. Some other skill was necessary for students to excel in the chemistry class. But what? After leading a few workshop sessions with this thought in mind, I discovered the skill: the ability to solve word problems. Chemistry questions are often worded in a way that requires students to decode the language and turn the sentence into the kind of chemistry equation they are used to seeing in their textbook. Thus, to excel in chemistry, a student need not only know chemistry material; he or she must also be a proficient solver of word problems.

We have now isolated the problem, but unfortunately that is not nearly enough. Word problems, which have a long history within the annals of educational literature, are difficult both to learn and teach. They require a complex web of skills including good reading, critical thinking, and accurate computing skills (Forsten, 2004). Additionally, there is a more fundamental problem with word problems. Word problems present situations where a goal is to be attained but a direct route to the goal has been blocked (Kilpatrick, 1985). This means that there is no clear, textbook method to solving a word problem. Word problems challenge students to think on their feet and figure out on their own how to get from the question to the answer.

Although each word problem presents a new challenge that cannot be summed up in a textbook, there are basic steps and strategies that can be employed to help solve them. George Polya, in his groundbreaking work How to Solve It, identifies four basic steps of problem solving: understanding the problem, making a plan, carrying out the plan, and looking back. By following these four steps, students have a blueprint to solving all word problems and needn't feel discouraged after reading a question that seems to be unanswerable

Let us take a closer look into the four steps of word problem solving, identifying the skills necessary to performing each step:

Understanding the Problem: The student must read the question carefully, figure out what has been asked and what information has been given that might assist him or her in finding an answer to the question. In order to accomplish this, the student must have a good vocabulary in the subject matter.

Making a Plan: After the student has understood the problem, he or she must make a plan to solve the problem. This means the student must take the information given to him or her and figure out how to use that information to produce an answer to the question. In chemistry, this is generally accomplished via some equation that states that one property is related to another quality by some rule. A difficult problem might require making a plan that incorporates multiple equations over several steps. The planning stage requires a knowledge of equations and formulas, and the wherewithal to realize that applying such and such formula or equation will give the answer. There are many different strategies that can be used to make a plan, and only with practice and familiarity with the subject matter can students learn when to use which strategies. Most often, this is the most difficult stage of problem solving.

Carrying Out the Plan: Once the student has devised a plan, he may now carry out the plan. This stage is mostly straightforward and requires good computing skills. When calculators are involved, it requires a proper knowledge of how the calculator works. (This point might seem silly, but it is something that too often leads students to incorrect answers.)

Looking Back: This is certainly the least popular of all stages, though not the least important. After the student has arrived at an answer, it is important to make sure that he or she really arrived at what he or she had intended to arrive at. Sometimes, it is possible to check work by solving the problem through an alternative method. However, when that isn't possible, the student should at least think about the answer to make sure it makes sense. For example, if a student is solving for temperature and gets some ridiculous number like 53,422 degrees, the student should realize a mistake has been made, and redo the problem. Similarly, if a student is solving for a distance and gets a negative number, the student should realize that such an answer is nonsensical, and rethink the problem.

It is important to note that problem solving isn't always a linear process. It is often a more dynamic process where the four steps of problem solving can lead into one another in complicated ways (Wilson, 1986).

In conclusion, problem solving is a difficult process to learn and teach because there isn't one way to solve all problems. However, knowing the four stages of problem solving can be helpful for students in giving them a method to approach word problems. Therefore, it is important for peer leaders to have an awareness of the challenges of word problems and the skills necessary to solving them in order for peer leaders to be best equipped to help students achieve. However, no matter how good peer leaders are at problem solving, practice by students is essential in order for students to be familiar with chemistry vocabulary, types of problems, and different strategies that can be used to solve problems.

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