EDITORIAL

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"Meaning is created in the mind of the student as a result of the student's sensory interaction with her or his world. Because it is created in the mind of the learner, it cannot simply be told to the student by the teacher" (Saunders, 1992). I must confess that when I first read this statement, I was struck by its bluntness. Surely, my students gain meaning from my well-planned and well-presented lectures! As I considered the point made by Saunders, I began to reflect on my own experiences in learning and teaching mathematics.

I have been fortunate to have a number of instructors over the years that challenged me to learn and construct meaning for myself. These instructors used a variety of teaching "styles" and techniques. Likewise, I have had many students who were excellent learners. Again, there were striking differences among these students in approaches to learning. I would like to suggest, however, four common characteristics that I have observed in effective teachers and students.

First, learning with meaning is the responsibility of the individual student. Each student must build meaning for himself/herself. This often requires the student to revise or alter his/her existing cognitive structure so that the new idea will "make sense" or "fit" with what he/she already understands. As we know from personal experiences, modifying what we know, what we believe to be true, and how we know is often a struggle. It took some real effort on my part to build meaning for ideas such as the limit concept or that the rational numbers are countable.

I believe that the struggle is **necessary** for the student to build meaning and that we, as teachers, should not attempt to do this for the student. "The teacher cannot convey or transmit meaning. The teacher can only transmit words. Meaning must be created by the student" (Saunders, 1992).

Secondly, students must be involved in the learning process; the student should be active, not passive. A teacher can structure the environment so as to encourage and enhance student involvement. Classroom presentations can become dialogues rather than monologues. Students can be involved in thinking out loud, brainstorming, developing hypotheses, and designing strategies. "Why?" and "What if?" questions should be prominent. I still recall a question posed to a group of students in a graduate course at the University of Texas. The instructor, Dr. Bill Guy, presented the following to us.

> You are the keeper of the digits. On your way to school, you lose the digit 7. This means every number with a digit of 7 in its decimal representation is also lost. If a real number is chosen at random, what is the probability that it is lost?

The student involvement will take the form of investigation. Rather than the teacher telling the students what to do next, students must decide not only where to go next, but must also investigate a variety of ways to get there. The student must be given time to investigate a particular problem, hypothesis, or plan of attack. The teacher may serve as a resource or facilitator, but not necessarily the dispenser of information. While the "answer" may be useful and/or interesting, the real challenge for the student is **how** to arrive at the answer.

Finally, a student benefits from interaction with other students as well as interaction with the teacher. Interaction with other students in class via discussion and small group activities provides students with further opportunities to enhance and clarify their understanding of mathematics concepts. Working together outside of class (study groups) may also help students to become more involved in learning as well as provide support and feedback for the students.

I am still pondering the significance and implications of the ideas suggested above. We welcome your responses and ideas.

Reference

W. L. Saunders, The Constuctivist Perspective: Implications and Teaching Strategies for Science. *School Science and Mathematics* 92, 136–140.