Teaching Mathematics at the Collegiate Level

The problems that students taking mathematics courses at the collegiate level face are often the result of deficiencies and misconceptions. The student may have carried these erroneous ideas around for years. What goes along with misconceptions is a nagging feeling of failure and an inability to get the right answer. Worst of all, the student often has no idea where the problem lies.

This semester we investigated these gaps and misconceptions. Strategies were introduced for successfully identifying and eliminating these gaps and correcting misconceptions. We also came to understand through discussion and research that our job as mathematics educators has changed somewhat and that addressing deficiencies adequately is of vital importance to the individual, the schools they attend, and the employers who hire them.

Successful methods include creating an inviting atmosphere, one in which the students feel free to explore, ask questions, and express concerns. The students must actively participate in their mathematics education by doing homework, participating in discussions about problem solving methods, and using calculators and other technologies available. Use of technology has been linked to better performance and understanding at these levels.

Using the number line and other methods, the student can best learn how to add and subtract signed numbers. The number line is useful throughout mathematics as a way to help the student understand order of numbers, fractions, decimals, and opposites, as well as groups of numbers (natural, whole, integer, rational, irrational, real, complex).

Prime factorization is important to teach the student a systematic method for simplifying fractions and later rational expressions. Prime factoring is used extensively in higher

mathematics and is critical to success. In learning how to multiply and divide fractions, prime factorization is important, and so is simplifying before multiplying. Explaining the true meaning of multiplication and division of fractions is important, and use of manipulatives or software applets can aid understanding.

One of the most important things for an educator to do is to connect information one wishes to convey with information the student already knows, or can easily understand. For example, if one wishes to learn how to find the solution to $10 - x = 1.5$, the instructor can ask the student what the answer to $5 - x = 2$ is. The instructor ought to probe, ask how the 5 and the 2 relate to each other, and how the x can be found using these two numbers. The number line would be very handy here to demonstrate how to get to the answer. Then, the teacher connects the work done on the easier problem to show the student how to get the answer to more difficult problems. Thus, the student needs not memorize rules that seem disconnected, they need only to think of a simpler problem to either recreate the rule or figure out the solution.

Factoring polynomials tends to be a big problem area for students. To effectively teach the factoring of polynomials at the college level, one must show all the steps necessary. Following a step-by-step method and showing how the distributive property is being reversed or undone is important. Beginning by showing many multiplications and reversing the process and showing the connection between the signs, the multiplications, and the additions, is all important to thorough understanding.

Development of critical thinking skills was covered in the class and as it is a process it requires time and a breakdown of student resistance. This can be accomplished by breaking down problems into components that the students can work on, step-by-step. There are no quick answers when developing critical thinking skills.

One of the ways to work on critical thinking skills is to work on word problems. These can be broken down and analyzed to demonstrate a good thought process. It is important to know why the answer works using evidence or steps as proof. And, proofs and other logic skills can be used to help the student develop critical thinking skills.

The concept of undoing was discussed as a way to work backwards to get to the answer. The idea of opposites (multiplication/division, addition/subtraction, integral/derivative, inverse functions, inverse matrices, square roots/squares, nth roots/powers, reciprocal, additive inverse, trigonometric functions/arctrigonometric functions, logarithm/exponents, distributive property/factoring, etc) was introduced and connections to solving and greater mathematical understanding were discussed.

Aside from the specific ideas about how to correct misconceptions, the best thing I came away with is my conviction as a teacher of mathematics. It is my job and my obligation to do everything I can to enhance mathematics education for the sake of the students and the educational institutions. A sound foundation in mathematics increases opportunities for the students, improves critical thinking skills, and builds confidence that the students can take with them into all areas of life.