Misconceptions about learning mathematics

1. With a math problem, you either know how to do it or you don't.

The intended meaning in the above is that in trying to solve a math problem on an exam, if you don't see how to do it at once, you will not be able to recognize how to do it after thinking about it. This attitude presumes that all problems on an exam will be at the surface of the material being tested. While that may be the experience of many students in high school, there is no reason to presume it will persist in college. The student may well have to think and decide what to do on a problem, and may need to do an involved calculation or consider alternate approaches.

2. In a calculus course, theory is irrelevant, for what's really at stake is doing the problems. The lectures should just show the student how to do the problems.

We want you to be able to do problems—not just particular kinds of problems—to which the methods of the course apply. For that level of command, the student must attain some conceptual understanding and develop judgment; thus, a certain amount of theory is very relevant!

3. The purpose of the classes and assignments is to prepare the student for the exams.

The real purpose of the classes and homework is to guide you in achieving the aspiration of the course: *command of the material*. If you have command of the material, you should do well on the exams. On the other hand, some students act as though the exam problems have been decided in advance, and expect the lectures and assignments to be leading up to performance on *those* problems, or ones just like them. The latter would constitute the avoidance of our goal.

4. Students learn best when everything they have to know is presented slowly in the classroom.

If everything the student has to know is presented slowly in the classroom, the total amount of material in the course will be rather little. Thus, students actually learn *least* that way.

5. It is the teacher's job to cover the material.

As covering the material is the role of the *textbook*, and the textbook is to be read by the student, the instructor should be doing something else, something that helps the student *grasp* the material. The instructor's role is to guide the students in their learning: to reinforce the essential conceptual points of the subject, and to show the relation between them and the solving of problems (cf. #2).

6. A good teacher is one who can eliminate most of the struggle for the student, making the material easy to learn.

Of course, it is possible to direct the students toward correct ways of thinking, but a certain amount of struggle is inevitable. Experience cannot be taught! Moreover, many topics are inherently difficult so they cannot be understood either passively or quickly. Eliminating the struggle can only be achieved by excising substance from the course (e.g., constricting the scope of the course, or reducing the means for recognizing where the methods of the course apply). Then the fraction of the material that remains could well be easier to learn, but the student will be acquiring diluted skills.

7. When the students are happy with the instructor's lectures, they learn the material better.

This statement is wishful thinking. There is much more at stake than just remembering what was done in class. Once threshold requirements are met the perceived quality of the instructor makes little, if any, difference in learning. (One sees this when common exams are given.) What makes a real difference in learning is appropriate effort *by the student*. The best thing that an instructor can do, in order to get the students to learn better, is to hold high yet reasonable expectations of them.