

SOTL GRANT REPORT

Teaching Undergraduate Mathematics For Relational Understanding

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The purpose of the study was to investigate the teaching of one MAT 130 instructor (Albert Otto) and the learning of his students. The questions that were addressed were: How did the MAT 130 instructor encourage learning for understanding? How did his teaching affect the students' learning mathematics with understanding? What other factors affected the students' learning?

The data collected during the study include: notes taken during the 130 class; videotapes of the class; student work; and tapes of interviews with six of the students. We are still in the process of synthesizing and analyzing the data. We are able, however, to give some preliminary results.

First, we can report on the methods used by the instructor. He required students to solve problems in several different ways, including using concrete objects and pictures, as well as mathematical symbols. He also required that students present their solution strategies in class, explain the reasoning underlying those strategies, and justify their reasoning to their classmates. Further, the students were expected to listen to and attempt to understand the strategies used by other students and to challenge those students when they did not understand. Finally, students were expected to communicate their reasoning both orally in class and in written form on homework and tests.

Second, we can report that there was great variation in the learning of the students in the class. Although there were students who did extremely well on tests and quizzes, there were many who did not. Initial analysis of the interview data provides some possible reasons for this. Students report that the instructional methods in Math 130 are considerably different from those they have experienced in previous mathematics courses. In the past, they have been shown how to solve exercises and then mimicked the methods shown them by the teacher to solve other similar exercises. However, they have not engaged in true problem solving in which they are expected to understand a complicated problem, formulate a strategy for solving the problem, carry out the strategy, and describe and justify both the strategy they used and the solution they

found. As a consequence, some of these students reported that they frequently “didn’t know where to start” when solving problems. They spent little time on homework, because they looked at problems, decided they were too difficult, and gave up. In addition, students reported that they didn’t know how to “study” math. In the past they had always done any assigned homework problems, but that was the extent of their studying. They didn’t know how to analyze problems to determine important mathematical concepts and synthesize the concepts from several problems to arrive at a more complete understanding of the mathematics. For both of these reasons, many students did not spend the amount of time out of class that was necessary to succeed in the class.

Third, the students who were interviewed indicated that they understood and appreciated the reasons for the approach taken in the class. They recognized that their previous mathematics education was founded on memorization rather than understanding. They realized that they need to understand the mathematics they will teach if they are to be effective elementary teachers. In addition, they reported that they were only beginning to realize that mathematics is something that can be understood, that there are reasons for the algorithms that they had previously memorized (and, for many of them, subsequently forgotten), something they had not known.

These preliminary findings have already had an impact on how the course is taught. The instructor has begun collecting more homework in an effort to encourage the students to put more effort into solving the problems. Both researchers now spend more time encouraging students to talk about how they analyzed problems and decided on a solution strategy. Because the instructor is the course coordinator and conducts weekly meetings of all the course instructors, these suggestions are passed on to others who are teaching the course. Therefore, the results of the research have an impact on many of the large numbers of students who take the class.

Finally, we will be presenting a paper about the course at the Annual Meeting of the Association of Mathematics Teacher Educators in January. We have organized and will be presenting as part of a panel on innovative mathematics content courses for future elementary teachers. Dr. Otto has also written, and is seeking a publisher for, a book for other educators based on the principles underlying the course.