

## Teaching Time Savers: Activities That Make Every Minute Count

By Matt Elsey, Jeff Meyer, and Vilma Mesa

Has any teacher not introduced and carefully explained a concept, only to find that a few days later students are unable to recall its most basic properties? In the end, we feel that we wasted both our time and theirs during the previous lesson. To make matters worse, we are now presented with a dilemma: should we devote more valuable class time to this concept, or just move on, leaving gaps in our students' understanding? How do we make the material stick the first time so that we don't have to spend time teaching it again?

We propose a simple lesson planning technique that we believe can improve students' initial understanding and retention of concepts. The technique is appropriate for any course in which students have the opportunity to work on exercises individually or in groups during class time. When planning each lesson, first identify the major objectives that you hope to communicate to your students. Then select short activities for the students to work on that reinforce each of these objectives and intersperse these activities into your lesson.

Suppose your objective is that "students should understand the relationship between average rate of change and the derivative of a function." After leading a discussion of this relationship, you might have students work on problems that require them to compute average rate of change from tabular data, compute the instantaneous rate of change via the limit definition of the derivative, and then approximate the derivative via the average rate of change. After students have spent some time exploring and working with the concept, you can move on to a new idea.

Last fall we carried out an exploratory study to observe how effectively and accurately important ideas were transmitted from instructor to student by the end of a lesson. At our university, introductory mathematics courses are taught with emphasis on student group work and dialogue between the instructors and the students. Our study included interviewing the instructors of these courses prior to a lesson, observing the lesson, and then questioning students after the lesson. We saw frequent discrepancies between the objectives of the teacher and the objectives stated by the students in a written response following the lesson. Even explicitly stating the objectives of the lesson (or writing them on the board) was not sufficient. We observed, however, that students more frequently remembered and verbalized concepts that were related to classroom activities, even when these had nothing to do with the instructor's intended objectives.

Since making these observations, Jeff has had the opportunity to try out this technique in his calculus course. Immediately after introducing a new concept, Jeff has his students work in class on a corresponding activity. While students work on the activity, Jeff walks around assisting with students' questions and misunder-

standings. Since implementing this new technique, Jeff has noticed that students typically have a clearer understanding of the concepts and skills he wants them to take away from each lesson.

As an example, we describe a lesson Jeff taught recently on the applications of calculus to economics. His objectives for this lesson were for students to understand basic economic terms (such as cost, revenue, and profit), and to be able to design and optimize functions appropriately modeling these terms. Jeff began with a brief lecture defining standard economic terms. Then, in a five minute activity, the class created its own business, discussed how these standard economic terms manifested themselves in this business, and determined reasonable functions modeling the economic terms discussed in the lecture. Next, he gave another short lecture on how to use calculus to answer economic questions, in particular how to optimize profit. Then, as a 5 to 10 minute group activity, students determined how to maximize the profit of the "class business" and presented justifications for their solutions.

Jeff has found that these activities have benefits in addition to clearly communicating the major concepts to students. His lessons are more focused, which has helped keep class morale high and students engaged during the lecture. Observing students while they participate in activities helps Jeff see which concepts students struggle with, thus allowing him to correct common misconceptions on the spot and improve future lessons. He has had to spend less time reviewing concepts during class time. His current class has been more successful on quizzes and in-class assignments than prior classes, and students have been able to provide more focused responses when asked the questions we used in our study.

**Time Spent:** A one-time expense of as little as five to ten additional minutes of preparation per lesson the first time this technique is implemented.

**Time Saved:** Approximately 15 minutes of review time in each class meeting. Also, presumably, countless hours that students would otherwise spend struggling with material they don't understand well. 🧠

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