

Chapter 2

A Blended Learning Approach in Mathematics

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ABSTRACT

In this chapter we present our work aimed at interweaving e-learning and face-to-face learning in Calculus courses for undergraduate engineering students. This type of blended learning (BL) contains the best properties of e-learning and face-to-face learning and helps overcome many obstacles in traditional teaching. We use our approach in order to improve students' conceptual understanding of theorems. We describe online assignments specifically designed to help students better understand the meaning of a theorem. These assignments are given to students in addition to traditional lectures and tutorials with the objective that they can learn to learn on their own. Students "discover" the theorem and study it independently, by using a "bank" of examples and a lot of theoretical exercises we supply. The assignments are built in such a way that students receive feedback and instructions in response to their Web-based activity.

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INTRODUCTION

Using today's advanced computers and Internet networks, a wide spectrum of different ways of learning and teaching are being developed: from supplying students with learning materials in traditional universities through to studying in new purely online universities. We are Mathematics lecturers in a traditional engineering university where face-to-face teaching is prevalent; however, some elements of online learning are widely used. Almost all courses have websites through which the lecturer stays in touch with students and uploads different materials for them in addition to face-to-face lectures, tutorials and office hours. In attempting to resolve problems related to our face-to-face teaching (for details, see the "Problems and Trends" section), we exploited the opportunities offered by the worldwide web. We knew that our students needed additional special material to supplement our lectures. They were simply not getting enough "face time" with us in class, owing to the shortage of lecture hours. Moreover, we wanted our students to get used to learning theory independently.

In order to overcome these problems we developed a web-based learner-centered approach as a component of BL, which has thus far been implemented in Calculus courses.

We constructed online theoretical assignments to help students better understand the meaning of a theorem. These self learning assignments are of an unusual type and given to the students in a special order to turn them from passive receivers of knowledge into active partners in the learning process. During our face-to-face teaching we used these assignments to complete the learning process.

We called our approach the Self Learning Method (SLM). SLM has three main parts that are presented in detail in the "Description of the Method" section.

In the first part of SLM students learn how to formulate a conjecture. We use the Integral

Mean Value Theorem as an illustration. Students "discover" the theorem independently, by using a "bank" of examples we supply.

In the second part students study assumptions and conclusions of theorems. We illustrate this part by means of Lagrange's Mean Value Theorem. Students conduct their own research by using a set of especially composed assignments.

The third part of SLM focuses on proving a theorem. Three Calculus theorems were used to illustrate different types of assignments: "scattered puzzles", "fill in puzzles" and "puzzles". The main aim of these assignments was to teach students that a theorem's proof has a logical order, and each its step is based on information given in a theorem's assumptions.

In the "SLM Implementation and Some Results" section we describe our positive experience in operating SLM as a part of BL.

As an Internet self learning environment, we used the Webassign system (see www.webassign.net). Webassign was developed at North Carolina State University, and it is used by more than 300,000 students at over 1,500 institutions. In our teaching we apply the version that was adapted to Hebrew. Here we present examples translated from Hebrew to English.

PROBLEMS AND TRENDS

We teach different Mathematics courses designed for engineering students. One of these courses is Calculus, which is an important part of the curriculum of most of the students in our university. Usually, this course consists of a four-hour weekly lecture (standard frontal teaching) and a two-hour weekly tutorial, plus homework assignments. Students take midterm and final pencil-and-paper exams.

In our teaching we encounter problems that are difficult to solve in a face-to-face teaching framework. Many of our students are not interested in Mathematics: they are not intending to

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