New Pedagogical Models for Instruction in Mathematics

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Summary. A computer emporium is a large ensemble of computers accessible to students and faculty, where courses and coursework can be addressed. A model of emporium instruction of mathematics, developed at Virginia Tech, will be described. The model was initially created to deal with instruction under the burden of increased class sizes and increasing demands on faculty time. It has turned out to be an effective pedagogical method with particular advantages for instruction in less developed nations. In this article, we will describe the emporium model: its structure, software development and impact on pedagogy.

1 Setting

With approximately 20,000 undergraduate students and 5,000 graduate students, Virginia Tech is the largest university in the state of Virginia. Because of its large College of Engineering, with more than 5,000 students, and because of the requirement that every undergraduate student take a mathematics courses, the number of students serviced by the Department of Mathematics is typically in excess of 10,000 in each semester.

The reduction of government support for higher education, which has occurred in Virginia over the past 15 years, has significantly increased faculty teaching-loads. Although the Mathematics faculty numbers about 60 professors and instructors, the burden of teaching so many students has motivated the Mathematics Department to build a Mathematics Emporium. This somewhat whimsical term extends the definition of emporium as an open market place: the Mathematics Emporium should be a place where the market of ideas would be freely exchanged among students, faculty and computers. Despite having initially viewed the project as a response to the need to teach very large numbers of students, we have found that teaching mathematics in an emporium style has a number of advantages for the students over traditional lecture courses.

The Emporium itself contains a large ensemble of computers, located in a now-defunct supermarket building adjacent to campus. A particular style
of designing and presenting mathematics courses has been developed both to
deliver expository information and to provide quizzes on material the student
is expected to have mastered. It is this style of course development that is the
topic of this presentation.

At the present time, the Mathematics Emporium is available to every stu-
dent enrolled at the university in any disciple, and to the faculty of every
department and institute. In fact, however, while there is utilization of the
Emporium by nearly all departments of the university, the largest segment of
its use is by the Mathematics Department. Indeed, at present, three math-
ematics courses with annual enrollment of approximately 4,500 students are
taught entirely at the Emporium (i.e., no classroom component), and half a
dozen additional courses handling more than 5,500 students each year have
major segments of the course taught at the Emporium. A great number of the
remaining courses in mathematics have occasional Emporium assignments.

In this article, we will describe two emporium models: their structure,
software development and impact on pedagogy.

2 Program Structure

In the United States, the vast majority of university courses consist of a
set of weekly lectures, with weekly or periodic homework. Homework, for
example in mathematics courses, consists of a set of problems based on the
current lectures, which the student is expected to work out independently
on his own time and submit for grading. Then periodically there are written
examinations based on a collection of homework sets, and generally a written
final examination at the end of the semester, based on all homework sets. The
students grade is determined by his performance on the homework sets, the
periodic exams and the final exam. (In some courses, especially upper level
courses, the only examinations may be a written mid-semester exam and the
written final exam.) Oral examinations are much rarer in the United States
than in many other countries. Office hours by the faculty member, where
students can get help with their course, are scheduled by the faculty member
at a frequency determined by him to be adequate.

The chief burden on the faculty member, in addition to the preparation
and delivery of the lectures, is in grading: homework, exams and the final
examination. With increased class size, many faculty members have considered
the burden to be onerous.

The notion of an emporium was first considered as a response to these bur-
dens [4]. However, our experience with several models of instruction indicate
that emporium instruction not only relieves the faculty of much of this burden,
but is in fact an improvement for the student over the conventional methods
of pedagogy used for generations at American universities. We begin with a
description of the two models we employ at the mathematics emporium.