REDESIGNING MATHEMATICS FOR THE 21ST CENTURY CLASSROOM

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Abstract
To revamp the mathematics classroom, graded online video lectures are combined with algorithmic homework and classroom activities to increase student success in Finite Mathematics, a course with a historically low success rate. This format scales to all class sizes and most other freshman mathematics courses.

Keywords: Course Redesign, lecture video, Finite Mathematics, student success

Introduction

Finite Mathematics (Texas Common Course number MATH 1324) is redesigned to increase student retention, motivation, accountability, and success rates. The traditional lecture is replaced by graded online lecture videos, which students may watch from any computer, whether in a campus computer lab or on a student's personal machine. This frees class time for activities, projects, and group work which makes class more varied, interesting, and ultimately, appealing to students.

Video lectures are assigned as prerequisites or as a follow-up to class activities. To ensure that students view the videos, each contains embedded questions to check for comprehension and completion. Answers to the embedded questions are submitted within the online homework system and recorded as grades. The videos are created by using PowerPoint presentations on Smart Sympodium monitors. The program Camtasia records the presentation and then, at the time of rendering, questions are inserted into the video files.

Assessment is conducted via an algorithmically generated online homework system, in-class exams, and daily grades based on class activities and questions in video lectures. To balance the increased out-of-class requirements, classroom hours are reduced from three

to two per week. This reduction can be used to free classroom space and create the schedule flexibility to offer more course sections with fewer students per section.

Need For Redesign

Freshman mathematics classes typically have low success rates due to several factors. The students may be poorly prepared for college level mathematics, have poor study skill, or be distracted by the transition from high school to college. Additionally, the students often have short attention spans for academic material. In the classroom this translates into low grades, poor retention and a lack of engagement or motivation.

This redesign is intended to address the problems with freshman mathematics by increasing active participation in class. The students spend classroom time working in groups on activities that develop their understanding of the mathematical concepts. The opportunity to solve problems and discuss concepts with peers as facilitated by an instructor encourages faster absorption of the material and a greater depth of understanding. The core lecture content is delivered via online videos as monitored by embedded concept-check questions. The responses to the embedded questions are tracked in the WebAssign online system, however, any SCORM compliant classroom management system would be able to verify the students' viewing of the videos.

Implementation

In the Fall of 2008, four pilot sections were conducted using the model previously described. There were two small classes of approximately 25 students each and two large classes with approximately 100 students each. To compensate for the required videos, in-class hours were reduced from 150 minutes per week to 100 minutes per week. Therefore classes that would normally meet three times per week for 50 minutes met for 50 minutes twice per week and classes that normally met twice per week for 75 minutes met twice per week for 50 minutes.

In a typical week, the students have one or more videos to watch before each class day. These videos will either prepare the students for the day's activity or the video will thoroughly cover a topic that will not be addressed in an activity. Students take a paper-and-pencil quiz once per week. Each week the students complete 10 to 15 homework problems due in WebAssign. Supplemental video tutorials and sample problems are also available but are not for credit. During the 4^{th}, 8^{th} and 12^{th} week of class, students took an in-class exam and the final exam was comprehensive.

The role of the instructor is somewhat different in a redesign classroom. Rather than the talking head at the front of the class, the teacher spends the class time circulating and helping the student groups complete the activities. This method is a very effective because the students receive help exactly when they need it and also gives the students more individual attention then they would otherwise get in a large lecture.

Results

The feedback from the instructors teaching redesigned sections of Finite Mathematics was generally positive. Class time was more enjoyable and the teachers felt they got to know their students better. There are some problems with having the students work in groups that still need to be resolved, but overall the student like spending class time working with other students.

A survey was given to the 182 students in the Fall 2008 pilot sections. Students could choose more than one answer to the questions, so the results may sum to more than 100%. The major findings of this survey are

- Students want some lecture (146)
- Students like working in groups (135) and the people in their groups (127)
- Students do not have time to watch videos when they are optional (122)
- Students met more people than they would in a traditional class (100).
- Students recommend this format (117) with the "Yes" sometimes qualified by "willing to work outside of class."

The success rate (defined as students who get an A, B, or C) was very similar in the redesigned and traditional classes in the Fall 2008 semester as seen in Figure 1.

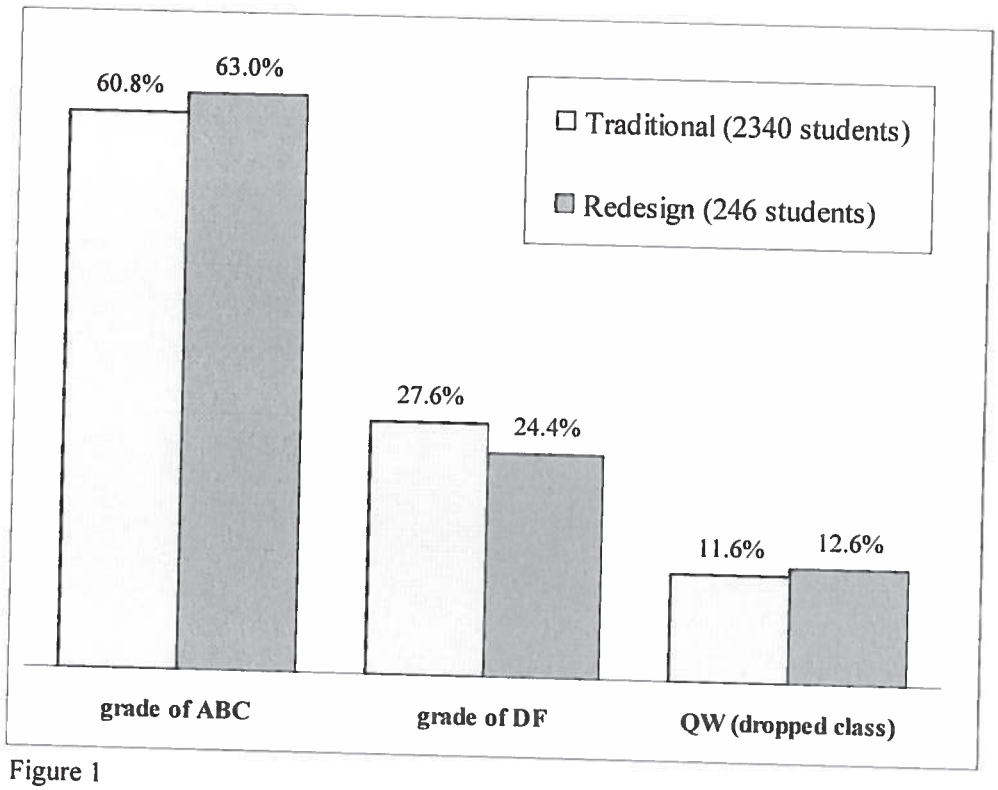

Figure 1

Additionally, the final exams included 20 questions common to all students in the redesign classes and those in traditional classes using the same lecture notes. The traditional students scored 11.7 out of 20 correct and the redesign students scored 11.9 out of 20 correct. Several of the questions on the final exams had been given in past years and the redesign scores were within historical highs and lows.

Conclusions

This model we have developed is at least as effective as a traditional lecture format while allowing for the reduction of in-class hours. The flexibility of this redesign will allow it to be used in both large and small classes and in a variety of ways. Besides the method used (required and optional videos with class activities), the materials could be used in the following ways

- Class time could be spent lecturing and the activities given as homework. Any combination of video lectures and activities is also feasible.
- The video lectures could be played during class. This option is particularly useful if an inexperienced teacher is assigned this class to teach.

For more information on implementation, please contact one of the authors.

Acknowledgements

This redesign was made possible by a grant from the Texas Higher Education Coordinating Board. G. Donald Allen is the PI of this grant.