Scenario-based Teaching and Technology in Mathematics Education

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Abstract: I have been engaged in a variety of curricular reform programs that deals with developmental mathematics, calculus, business mathematics, and differential equations. These curricular reform programs address interactive tools, technology, and a variety of real life applications and needs of different areas that are served by mathematics. Traditionally, mathematics courses introduce the basic skills and needed mathematical concepts followed by some applications related to a certain field of study. In this paper, I share my experience in using a variety of curricular reform programs that are scenario –based, and supported by multimedia and technology. I will demonstrate the new material and technology, discuss the challenges and rewards of teaching using these programs, and convey my role of introducing some of these courses to the university core curriculum program.

Key-words: Mathematics, Curricular reform, Technology, Differential Equations, Interactive.

1 Introduction

Most mathematics courses are algebraic or calculus based topics supported by computational tools or abstract theory, [1]-[5]. Students are normally presented with a list of mathematical formulas and rules of algebraic, differential or integral nature. Also, students are given specific instruction on how and when to use these rules and formulas. Frequently, drilling questions are assigned, so that the students are given the freedom to participate in the learning process. A cookbook (e.g. schaums series) [6], [7], on how to use these rules and formulas, is made available at book stores to help students succeed in the course. Such books are useful, but they will not help the students gain deep understanding of the concepts taught, see the real value of the idea presented, and have ownership in the learning process.

2 Early Calculus Curricular Reforms

In early 1990's, Oregon Sate University, Duke University, and other schools started calculus curricular reform programs at their schools and at other experimental sites through the nation. The mathematical community was divided in its reaction to these programs. I was one of the pioneers who got exposed to this revolutionary era in mathematics education. The major contribution of this calculus curricular reform is the introduction of the rule of four presentations of a function: algebraic, numeric, graphical, and conceptual. In the late 1990's, the modeling approach was added and gave a powerful tool to these calculus curricular reforms, [8].

3 Technologies and Mathematics Curricular Reforms

Along with the advancement of computers and the advent of the Internet, the field of mathematics education has taken on new dimensions. This new technology includes internet based research and learning serves well as complimentary tools in math education. In 2001, I developed an interactive web based activities that are aimed at teaching differential equations concepts through applications in physical and life sciences and problem solving to college juniors and seniors, [9]. It involves the development of an interactive web-based learning environment for basic differential equations concepts using the software Mathematica. The major objectives of this work are students' understanding enhancement, problem-solving skills improvement, and instructional theories and methods enrichment.

In order to uncover the potential of Mathematica as a teaching and research tool, the open interprocess communication protocol MathLink is needed. Mathematica employs Math link to interact with external programs such as C, C++, FORTRAN, and others, [10]. MathLink allows Mathematica to be integrated with other packages like Robotica, Prolog, and Discover. This integration process is triggered by the flexibility and usability of outside languages and packages and the computing power and pre-developed algorithms and functions of Mathematica. Several areas of application like Robot Kinematics, Algebraic modeling, and Geometry have been enriched by this development, [11]. Integrating active learning and technology into any course is essential. A curricular change that is based on common pedagogical goals and software will bring more scientific applications into a particular course while strengthening the use of mathematics in science courses. A real-world application of GIS and graph theory for analysis of an optimization problem is presented in [12].

4 Scenario-based Teaching

During spring 2005, two math core courses were approved by the University Core Curriculum Committee effective fall 2006. During fall 2005, I ran a pilot class of one of them using the University of Arizona project. The instruction took place in a lab setting where each student has access to a computer that has Microsoft Office and is connected to the World Wide Web. A lot of emphasis was put on the e-text, team work, and use of the class web page. For more details, please visit my webpage **www.xxxxx.edu/~xxxxx** (the actual address will be revealed after the acceptance of the paper). My future expectations are as follow: high students performance and retention, team teaching with faculty from other colleges, recognition from community business leaders, more collaboration between mathematics faculty and faculty from other departments, systemic changes in the statistics program and upper division courses in other college, and more discussion on importance of working in teams followed by training sessions on teamwork across camps.

5 Conclusions

The experience of Scenario-based Teaching and Technology on my campus is still young, it is a win-win situation for both the mathematics department and other departments. Preliminary results show that there is a great potential for students high performance and students retention. In order to get the full benefit of this program, students need to take a computer application before taking any reformed mathematics class. It is expected that the reformed mathematics program positively impact much larger group of other courses. The implementation of reformed mathematics courses will provide students with a unique blend of quantitative concepts, computer skills, mathematical tools and ideas, and real-life concepts.

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