Research and Applications of Calculators in Mathematical Fields

Enhancing Conceptual Understanding in Calculus Using Class Pad 300

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Abstract: World over, Computer Algebra Systems (CAS) have greatly influenced mathematics teaching and learning. The last two decades have witnessed extensive research in this area and Mathematics educators have been investigating various ways of integrating CAS with classroom teaching to develop a balanced curriculum, which lays less emphasis on paper-pencil techniques and focuses more on understanding concepts. Computer Algebra Systems such as Mathematica, Maple, Derive etc. provide powerful dynamic working environments. However the availability of CAS in the form of handheld calculators such as the Casio Class Pad 300 has brought the power of visualization and exploration right into the hands of the student.

This paper describes a research study conducted with 40 students of year 11 in a traditional teaching environment where the prescribed curriculum emphasizes on mastery of paper-pencil skills and using technology is not a general practice. Two exploratory lab modules in calculus, one based on understanding of limits and the other on application of derivatives to optimization problems, have been discussed. These modules utilize the graphic, numeric and symbolic manipulation capabilities of the Class Pad 300 to facilitate conceptual understanding.

The study revealed that CAS provided opportunities for resequencing concepts and skills thus making it possible to teach concepts and applications before manipulative skills. The easy graphing capability of the Class Pad lead to a 'geometric' approach, which allowed the students to visualize and explore concepts. The study also showed that CAS led to the constructivist approach where the learning environment was transformed from the traditional teacher-centered classroom to a student-centered laboratory where the students discovered mathematical ideas for themselves.

1. Introduction

The past two decades have witnessed extensive research related to the use of Computer Algebra Systems (CAS) in mathematics instruction ([1],[3] – [7]). The primary concern of mathematics educators has been to study the relevance of paper-pencil skills in an environment equipped with CAS and reforming the curriculum so as to make appropriate use of this technology [10]. The mid-1980s witnessed the Calculus Reform Movement when researchers began to focus on the implications of CAS in the calculus classroom. They claimed that CAS could improve conceptual understanding, enable students to explore more complicated problems, reduce the burden of tedious calculations, improve exercise and test questions and overcome limitations imposed by poor algebraic skills [11]. Their graphic, numeric and symbolic manipulation capabilities allow students to visualize and explore concepts, make and test hypotheses and discover mathematics truths for themselves [2]. With CAS now available in handheld form through devices such as the Casio Class Pad 300, the power of visualization and exploration has been brought to the palm of the hand. These devices allow students to explore mathematical concepts graphically, numerically, symbolically and geometrically [9]. This

