

The influence of Computer Algebra System (CAS) in teaching Applications of Derivative concept and problem solving abilities

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Introduction

According to constructivist learning theory, if an individual construct a concept through acting an active role while experimenting, conjecturing, proving and applying in learning environment, this learning can be called acquiring more than only receiving the information. By using CAS (Computer Algebra System) students have an active role in mathematics classrooms.

Computers can perform time-consuming tedious and laborious activities (e.g., drawing graphs, solving complex equations, and finding derivatives) theoretically making it possible for students to solve more realistic problems and develop understanding of calculus concepts.

Since the early 1980s numerous general claims have been made about the likely benefits of using computer tools to improve understanding of calculus concepts See [1], [4], [6], [9] and [10]. For example, Heid (See [4], p.4), commenting on a body research conducted during the previous ten years, states “Computing devices are natural tools for the refocusing of the mathematics curriculum on concepts.” Subsequent research also supports this claim (See [2], [3] and [7]).

Reporting informally on a remedial teaching program (for 22 college students) that integrated a CAS (Maple) into a course of calculus Hillel (See [7], p.46) observed benefits to student learning: students coming out of it had acquired different types of insights and knowhows than the traditionally- prepared students - insights and knowhows which we felt were closer to the essence of calculus. (See [8])

Methodology

In this study, teaching of the derivative, the key concept of the Calculus has been studied. This study explores the effect of CAS in the development of problem solving abilities of first year undergraduate mathematics education students.

In order to teach the derivative concept, student-centered activities have been designed. While designing these activities, Maple software has been used as a computer algebra system. In this study the experimental research design were used. Sample of this study contains 43 first year students of mathematics education department. The calculus potential test was administered to students in order to determine control and experimental groups' students. 22 of the students (experimental group) were taught in a computer based learning environment and 21 of the students (control group) were taught in a traditional classroom environment.

In both of the groups, students have been studied either as groups, which include 3 students, or individually. Then students have been studied on certain problems which help to discover the mathematical concepts. Teaching the derivative concept has been designed as two consecutive steps: At first step; students studied on the concept of derivative as rate of change. At this step real life problems about rate of change have been given to students. By solving these problems students have discovered the concept of the derivative and its applications. At second step, activities have been designed as geometrical, numerical and symbolic (algebraic) representations of derivative concept.

In experimental group activities, which were designed by researchers before, used in computer learning environment for procedural and conceptual learning of the derivative concept. These activities administered with interactive worksheets prepared with maple, animated and non-animated graphics, plotted by maple, special applets in maple called maplet. By using interactive maple worksheets and animated graphics, students have found the opportunity of numerous experiments that provide well understanding for them. To provide conceptual and meaningful understanding for the student, a maplet has been designed to see, geometrical application of derivative as slope of the tangent line.

In control group same activities, which were used in experimental group used in constructivist learning environment. Students used paper and pencil while they had been constructing the concept of derivative.

At the end of the treatment, students' understanding of derivative was elicited through written tasks administered to all students. For this exam, students were given the opportunity, but not required to use the computer to solve the problems. These problems were considered to be "computer neutral". Students were presented with tasks that assessed their conceptual understanding and representational methods of solution of derivative.

The open-ended written tasks used in the examination instrument were mostly adapted from Girard (See [5]) common tasks used to assess student understanding of derivative, in Calculus I courses and found in most textbooks or adapted from other studies concerning student understanding of derivative concept. The tasks were evaluated by a panel of mathematics instructors (two university level) for the reasonableness of the question for university Calculus I students. Recommendations from the expert panel were examined and changes were made to the instrument accordingly.

Conclusions

The analysis of students' written responses revealed significant information regarding the nature and characteristics of students' understanding of derivative concept. The distribution of the scores for the questions according to twenty-point scale. Each question in the exam was graded by one of the four categories: correct (4), partially correct (3), incorrect (2), and missing (1).

Students in the experimental group showed better understanding of the concept of the derivative (such as the meaning of the derivative) than the control group and there was little difference on a final exam of routine skills. Their learning of concepts greatly improved and the students performed almost as well in routine skills as the control group. Specifically, they were able to express ideas in their own words and their conceptualizations were broader, clearer, more flexible and more detailed than students in the control group. These results can be interpreted as evidence that students can understand calculus concepts, without prior mastery of basic calculus

skills, showing that it was possible to reorganize the order in which calculus is taught to students, to focus on concepts prior to teaching procedures.

The students reported feeling that the computer relieved them of some of the manipulative aspects of calculus work, that it gave them confidence on which they based their reasoning, and it helped them focus on more global aspects of problem solving. During the instruction the students were involved in discussing ideas and were required to make sense of calculus related language, including terminology and symbols.

In the experimental group the students were able to tackle problems in a variety of different ways. Researcher spent less class time dealing with algebraic problems and, in consequence, we were able to spend more time discussing calculus concepts with the students. Researcher strongly recommends use of CAS (Maple) to minimize the detrimental effects of students' poor algebraic backgrounds.

The students overwhelmingly reacted positively to the idea of using computers in a calculus class. A recognized drawback is that there is not enough time for both calculus and computers. In most cases, though, a compromise is thought possible. A significant number of students would like to expand the time spent on computers and their applications. It was observed that the use of computers served not only to facilitate and deepen the understanding of certain concepts but also produced changes in students' attitudes toward the subject.

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