

University students' self-efficacy and achievement in derivative concept

Fulya Kula^{1a}

¹Amasya University, Amasya 05100, Turkey

Abstract. The purpose of the current study was to explore the relationship between self-efficacy and achievement in the derivative concept in university level. University students from education, engineering and science faculties attended the study. 1660 students' data were gathered and the study has demonstrated that there is a moderate and positive relationship between university students' self-efficacy levels and their achievement in derivative concept. It is suggested that university level students' self-efficacy levels be addressed when considering their achievement in the derivative concept.

Keywords: Derivative; derivative achievement; university students

1 Introduction

Calculus is seen to be one of the great achievements of the human mind and has widespread applications in natural and applied science, [1]. Calculus constitutes a major part of modern mathematics education in the high school and university years. The considerable applications of calculus concepts make it a major and requisite course for many departments. Teaching mathematics, particularly calculus to university students has taken interest by university instructors, researchers and other professionals. The issues concerning university students' mathematical education have been addressed by researchers, [3], [7]. These studies reported university students' difficulties in concepts of mathematics, their mathematical background, their understanding of mathematical concepts and their attitudes and approaches to mathematics, [7], [9], [11].

Derivative, one of the core concepts of calculus can be thought of as how much one quantity is changing in reaction to changes in some other quantity. Mastery in derivative is profitable for university students all along their careers. Studies dealing with the achievement of derivative in both high school and university levels make it clear that derivative is a relatively abstract and difficult concept of mathematics, [6], [7]. The reasons of consistent difficulties in the derivative concept remarkably arouse interest, [4], [8], [10], [12], [13].

^a Corresponding author: fulya.kula@amasya.edu.tr

Students' achievements in derivative have been proved to be a universal case by the previous research studies, [2], [3], [7], [9], [11]. However university students' achievement in derivative in Turkey has not been studied in enough detail together with the relation to their self-efficacy in derivative. The relation between students' derivative achievement and self-efficacy in derivative need to be explored. The aim of this study is to determine university students' knowledge in derivative concept with a focus on their self-efficacy levels.

2 Methodology

2.1 Research design and procedure

The data of the current study were collected through the survey method. The survey includes Derivative Self-efficacy Scale (DSS) and Derivative Achievement Test (DAT). The intact groups were used in the study. The survey was administered in one course hour which is approximately 40 to 50 minutes.

2.2 Sample

The sample of the study consists of 1660 university students in Turkey who had taken calculus courses in 2012 spring semester. These students study in the faculties of science, engineering, and education as in these departments, derivative constitutes a major role in many phases along the graduate instruction. In the current study the convenience sampling was used.

2.3 Instrumentation

The instruments used in the current study were Derivative Self-efficacy Scale (DSS) and Derivative Achievement Test (DAT) both of which were developed by the researcher in line with the suggestions of the literature. The aim of DSS was to measure university students' self-efficacy beliefs towards derivative. DSS is a Likert-type scale, including 5-point response categories ranging from not competent at all (1) to extremely competent (5). The sample items of the DSS are given in Appendix A. Expert opinions were gathered for the items of the DSS. The Cronbach's alpha reliability of the scale for the data of the current study is 0.89. on the other hand the aim of developing DAT was to measure university students' achievements of the derivative knowledge. The DAT includes 14 questions with open-ended and restricted-response formats. The DAT includes the following sub-topics: derivative taking rules, limit definition of derivative, secant and tangent lines, graphical interpretations of derivative, and minimum/maximum problems. Opinions of four experts were gathered during the development of DAT and the test was pilot tested with Cronbach's alpha as 0.79.

3 Results

The sample in the current study includes 1660 undergraduate students in university level. To show an overall picture of students' ages and success are presented. The Cumulative Grade Point Average (CGPA) of the mentioned students are presented in Table 1. On the other hand, Table 2 illustrates the age ranges of students.

Table 1. CGPA of the students.

CGPA (out of 4.00)	Frequency	Percentage (%)
0.12 – 1.38	96	5.78
1.39 – 2.02	287	17.29
2.03 – 2.69	589	35.49
2.70 – 3.34	492	29.63
3.35 – 4.00	196	11.81
Total	1660	100

Table 2. Age range of the students.

Age (Year)	Frequency	Percentage (%)
Between 18 and 20	595	35,84
Between 21 and 23	869	52,35
Between 24 and 26	158	9,52
27 and older	38	2,29
Total	1660	100

As it can be seen in Table 1, most students' CGPA were between 2.00 and 3.50 out of 4.00. Table 2 shows that most of the students were in between 20 and 23 ages. The relations between students' self-efficacy in derivative and their derivative achievement were calculated using Pearson correlation coefficient (r). The correlation between derivative achievement and self-efficacy in derivative for university students is found as $r(1557) = 0.49, p < .05$. This result shows that there is a moderate positive correlation between students' derivative achievement and self-efficacy of derivative.

4 Discussion and conclusion

This study aimed to show an overall picture of the university students' achievement and their self-efficacy in derivative. Most of the students who took part in this study had Cumulative Grade Point Average in between 2.00 and 3.50. Students' age differed from 18 to 30. Most of the students were aged between 20 and 23. There was found a positive and moderate relationship between students' derivative achievement and self-efficacy of derivative. This finding means that as the students' self-efficacy levels increase, they show better success in derivative achievement. This finding is interesting as part of the students' affective variables such as self-efficacy and motivation has not been widely shown to interact their success in achievement in the graduate level, [5]. Hence the affect of self-efficacy in derivative on university level students' achievements in the same concept is worth considering. That the students' achievement increases in line with their self-efficacy is a significant finding of the current study for the university level instructors. However the self-efficacy mentioned is context specific, i.e. specific to derivative. With this result, it can be said that students' self-efficacy in derivative need to be encouraged. It is also among the suggestions of the current study that educators and counselors identify students with low self-efficacy in derivative and implement methods to raise the low student self-efficacy levels.

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Appendix A. Sample items of DSS scale

- I feel competent in taking the derivative of various functions
- I feel competent in interpreting derivatives geometrically
- I feel competent in finding examples of derivative in daily life

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