Misconception in Calculus-I: Engineering students’ misconceptions in the process of finding domain of functions

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Received October 25, 2008; revised December 23, 2008; accepted January 5, 2009

Abstract

The purpose of this study was to investigate students’ misconceptions in the process of finding domain of a composite function. The participants were 1500 engineering students in a state university in Istanbul, Turkey. The Calculus course is required course for all engineering students. Data analysis revealed that students’ misconceptions fall into five categories. First category was domain and ranges are mixed up. Second Category was students used derivative of function. Third category was using union of functions instead of intersection of domain of each function. Fourth category was application of delta-epsilon technique. Fifth and final category was irrational function and denominator.

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Keywords: misconceptions in mathematics; domain; functions, calculus

1. Introduction

First year in college is a significant time in students’ mathematical understanding and development in which they start to crystallize their understanding of mathematical concepts and to see engineering application of problems in various university mathematics courses starting from Calculus I. At this stage students also get confuse due to unnoticed misconception built upon their high school mathematics. The objective of this study to create an informative resources for University Instructors about common misconception exhibited by first year engineering students’ finding domain of a composite function.

Misconception as research domain has gained all areas of school subjects (i.e. Biology, Barrass, 1984, Statistics, Hand, 1998). The limit concept is fundamental to understanding of calculus. According to Tall(1992) ‘The idea of limit signifies a progression to a higher level of mathematical thinking’ (p. 495). Other concepts like derivative or integration (i.e. Riemann sum) is basically application of limit concept. The number of studies (Davis and Vinner, 1986; Tall, 1992; Jordan, 2005) has shown that students’ understanding of limit concept is problematic area, Jordan(2005) list the potential reasons that cause the problem. One of the such reasons is that ‘..the idea of a limit as the first mathematical concept that students meet where one does not find a definite answer ‘(p.21). Second mozkan@yildiz.edu.tr and hunal@yildiz.edu.tr
potential reason was related to the concept of limit being abstract and students abstraction levels. Another reason might be conceptual v.s. procedural understanding. In the recent study Unal and Ozkan (2008) explored the engineering students misconception about the application of L’ hospital rule. They found out students forms four main type misconception when they find the limit using L’ hospital rule.

2. Study

Participants were engineering students (1500) in a state university in Istanbul, Turkey. For the purpose of this study students were asked to find the domain of function problem with written explanations. Data matrix built based on the following categories: True answer, blank paper, and solutions that carry misconceptions. Data were analyzed jointly by the researchers. Followings were the problem used in this study

\[ f(x) = \sin(\ln x) + \frac{\tan x}{\sqrt{1-|x|}} \]

Composite function \( f(x) \) which was consists of: Trigonometric functions, natural logarithmic function, irrational function, and absolute value function.

From the data analysis five main type of misconception has been identified. First category was domain and ranges are mixed up. Second Category was students used derivative of function. Third category was using union of functions instead of intersection of domain of each function. Fourth category was application of delta-epsilon technique. Fifth and final category was irrational function and denominator. In the following section samples were given:
Figure 1: Second type misconception

As it is shown in the Figure 1 students were trying to find the domain of function by using the derivative of the function.

Figure 2: First type misconception

In the first category students mixed by the definition of domain and range as shown in the Figure 2 above.
In this type of misconception students used delta-epsilon technique which was subject of definition of limit.

In this type of misconception students just concern about the rational functions. However for the domain characteristics of each function should have been investigated.

The purpose of this study was to identify the misconception in the process of finding domain of functions. The analysis revealed that five main types of misconceptions occur. For each type of misconception as an educators we need to find cure for each type misconception.

Reference


