

Students' Difficulties With the Understanding of the Concept of the General Solution to a Differential Equation: Can We Teach It Better?

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Differential equations find numerous real-life applications in natural and social sciences, economics. Teaching of differential equations to undergraduate students in mathematics, physics, engineering has a long history, and the content of the courses did not change much, paying attention primarily to the use of analytic techniques for finding closed form solutions. Recent advances in technology prompted changes to the syllabus of the courses in differential equations at many universities with a shift towards graphical and numerical approaches for the analysis of differential equations and understanding of the behavior of solutions, “the move away from a “cookbook” course to one that emphasizes modeling, qualitative, graphical and numerical methods of analysis” (Rasmussen & Wawro, 2017, p. 555). However, the research on teaching and learning of differential equations is scarce, “researchers are just beginning to form models of students’ learning of differential equations” (Stephan & Rasmussen, 2002, p. 460).

Recent empirical research indicates that students face difficulties with the understanding of the concept of a differential equation itself and to the concepts of the general and particular solutions (Arslan, 2010; Camacho-Machín et al., 2012; Raychaudhuri, 2014). The authors analyzed tasks suggested in the literature for assessing conceptual understanding of solutions to differential equations, concluding that only one task out of five was stimulating students’ reflections about the concept (Rogovchenko & Rogovchenko, 2022). Our analysis of students’ work on non-routine problems that required understanding of several important theorems and notions including that of the general solution suggested that the explanation of the concept and its use in the course textbook could be one of the reasons for student difficulties.

The research question we address in the paper is: *How was the concept of the general solution introduced in the textbooks on differential equations during the last hundred and fifty years?*

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