Investigating procedural knowledge and conceptual knowledge of grade 12 students of Delhi schools in fundamental calculus

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Abstract

Promoting '21st-century skills' has become a key focus in education. These skills include critical thinking, problem-solving, and logical reasoning and often associated with mathematical ability. In India, studies suggest that prevalent pedagogy for mathematics, particularly in higher grades, involves explicit instruction, such as step-by-step problem-solving techniques in calculus. Calculus, typically taught at the senior secondary level in India and considered challenging, finds extensive applications in various disciplines including physics, chemistry, economics, and more. Procedural problem-solving procedures are restricted in scope and lack generalizability, whereas conceptual knowledge allows for more flexible problem-solving. Students require a solid conceptual foundation to develop higher-order thinking abilities, such as using calculus in multiple disciplines, thus it is critical to assess their present level of procedural and conceptual knowledge before adopting treatments. This study investigates the procedural and conceptual knowledge of grade 12 students of Delhi schools in fundamental calculus. A test based on the procedural PCK taxonomy was developed and administered on 65 subjects in Delhi schools. The results show that there is no significant difference between the procedural and conceptual knowledge of grade 12 students in fundamental calculus. Moreover, the relations between students' procedural knowledge, conceptual knowledge and their knowledge to integrate both were not found to be significant. The results also show that students face particular difficulty in adapting known procedures to solve similar problems with unfamiliar elements as well as to effectively integrate procedural and conceptual knowledge to solve real-world calculus problems

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