ASSESSING THE IMPACT OF CALCPAD ON STUDENT LEARNING IN CIVIL ENGINEERING

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ABSTRACT

This study evaluates the use of CalcPad, a free and open source computational tool, in civil engineering education. The aim was to examine its influence on students' understanding of engineering concepts and their problem-solving efficiency. CalcPad provides transparent symbolic and numerical calculations, automatic formatting, and professional report generation, making it suitable for courses that require structured mathematical reasoning. A survey was conducted among 35 undergraduate and graduate students who used CalcPad in coursework and seminar assignments. The questionnaire measured usability, learning support, and efficiency, and included open-ended questions. Descriptive statistics and non-parametric tests were used to analyse responses. Students reported high satisfaction with CalcPad's usability and its contribution to reducing calculation errors and improving workflow clarity. Frequent users and senior students expressed stronger positive perceptions, indicating that familiarity and task complexity influence perceived value. While contributions to theoretical understanding were moderate, students highlighted improved transparency and confidence in analytical procedures. Challenges included an initial learning curve and unit handling. Overall, CalcPad shows strong potential as an accessible digital tool that enhances accuracy, documentation quality, and digital competence. These results suggest that free, transparent computational tools such as CalcPad can strengthen students' procedural competence and digital literacy when meaningfully integrated into engineering curricula.

Keywords: CalcPad, engineering education, learning software, digital tools, student perceptions

INTRODUCTION

The growing integration of digital and computational tools in engineering education aims to enhance analytical reasoning, support structured problem-solving, and align academic learning with digital engineering practice. Transparent computational environments help students follow mathematical logic, verify results, and create professional documentation - essential competencies in civil engineering. This shift aligns with global priorities promoting access to digital learning technologies and the development of computational skills [1]. Free and open tools reduce financial barriers and support inclusive participation in STEM programmes [2]. Prior research confirms that symbolic and computer-aided environments can improve problem-solving accuracy and reduce procedural errors [2], while interactive systems encourage engagement and

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