

DIGITAL LEARNING IN ENGINEERING: A MOBILE APP FOR FLEXURAL MOMENT PRACTICALS FOR CIVIL ENGINEERING STUDENTS AT POLITEKNIK SULTAN

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Abstract

This study aims to address the challenges faced by students in comprehending theoretical calculations within practical learning of flexural moment structures. The primary objective of the research is to develop a mobile application tailored for practical learning purposes in this domain. Utilizing Android Studio Koala as the development platform, the study incorporates a comprehensive methodology that includes designing the application and deploying it among 110 diploma-level civil engineering students. The students participated in flexural moment structure practicals, serving as the target population for this research. We collected feedback on the application through a structured questionnaire, which focused on students' experiences, perceptions, and opinions regarding its utility. The findings indicate that the mobile application demonstrated significant effectiveness, as reflected by a mean score of 3.63 with a standard deviation of 0.39 for its overall impact on users. Additionally, the application's efficiency in time management achieved a mean score of 3.84 with a standard deviation of 0.21, resulting in an overall mean score of 3.74. The results highlight that the application was well-received by students, with most appreciating its speed, accuracy, and stability. Furthermore, the app facilitated a seamless comparison between theoretical and practical results, improving the learning experience. In conclusion, the study substantiates the potential of this mobile application as a tool that not only functions effectively but also optimizes students' learning processes in innovative ways. By addressing the gaps in traditional methods and introducing an interactive digital solution, this research contributes significantly to improving practical education in civil engineering, particularly in the study of flexural moment structures.

Keywords: Flexural moment structures, Mobile application, Practical learning

INTRODUCTION

The integration of digital learning resources into engineering education has transformed conventional teaching methods, promoting increased accessibility, flexibility, and engagement. This is particularly true in disciplines such as civil engineering, where practical knowledge is essential. The use of mobile applications to teach engineering concepts is becoming more common. The use of digital technologies in education offers chances to enhance self-efficacy, promote personalized learning, and assist teachers and students in acquiring critical engineering skills. Flexural-moment practicals are essential for comprehending how structures behave under loading circumstances in the field of civil engineering. For this reason, mobile applications play a crucial role in promoting these developments.

Previous studies have highlighted the growing importance of digital literacy and the impact of digital tools on learning outcomes in engineering education. Chonsalasin and Khampirat (2022) investigate the impact of accomplishment goal orientation, learning methodologies, and digital competencies on the self-efficacy of engineering students in Thailand. The findings indicate that students who effectively utilize digital tools exhibit greater confidence in their abilities, thereby

improving their learning outcomes. Sarsar *et al.* (2018) examine the perspectives of learners and instructors on technology-supported engineering education, highlighting the advantages of mobile applications in enhancing the learning experience through interactive and engaging content. The findings highlight the important function of digital tools in enabling engineering students to acquire essential skills and knowledge.

Students' behaviours and attitudes toward digital learning platforms have evolved, especially in the years following the COVID-19 pandemic. Welsen, Wanatowski, and Zhao (2023) examine the alteration in student conduct concerning digital reading and the persistent reliance on digital platforms post-pandemic, suggesting a permanent transformation in educational methodologies. Wu, Smyth, and Welsen (2021) investigate engineering students' perceptions of digital reading devices, revealing an increasing willingness among students to incorporate digital tools into their educational practices. The increasing acceptance of mobile applications for engineering practical underscores the importance of their effective deployment, as it enhances student involvement and maximizes the benefits of these platforms.

The development of a mobile app specifically for flexural moment exercises in civil engineering is an effective method of connecting theoretical ideas with real-world uses. Students can better understand and use structural analysis concepts by using an interactive, easy-to-reach platform that lets them visualize complicated engineering principles, try out different scenarios, and get instant feedback. The need for flexible, tech-based learning is growing, which shows how important mobile apps are for updating engineering education and giving students the skills they'll need in the future of the field.

LITERATURE REVIEW

Mobile applications, used for digital learning in engineering, have attracted significant attention in recent years due to their potential to improve educational outcomes and effectively engage students. A variety of theories and concepts influence the development and implementation of mobile learning in engineering education, highlighting the importance of innovative pedagogical approaches, motivation, and usability. The constructivist approach is a prominent theory that posits that learners accrue knowledge through their interactions with their environment and experiences. Mobile learning applications facilitate this by providing interactive and context-rich learning experiences. For example, Gezgin *et al.* (2018) emphasize the importance of incorporating mobile learning into computer engineering curricula to encourage active participation and positive attitudes in the design and development of mobile applications. This is consistent with the results of Sarsar *et al.*, who underscore the efficacy of digital tools, including mobile learning, in improving engineering education by incorporating a variety of formats, including augmented reality and simulations (Sarsar *et al.*, 2018).

Moreover, research has demonstrated that the incorporation of mobile applications into engineering education can substantially increase student engagement and motivation. Zulkifli *et al.* (2022) demonstrate that mobile learning applications, particularly those that incorporate augmented reality, can increase learning outcomes by increasing students' motivation and satisfaction. Minichiello *et al.* further substantiate this by arguing that mobile applications can engage students in solving complex engineering problems through simulation and experimentation, thereby reinforcing the constructivist learning model (Minichiello *et al.*, 2020). Mobile applications are also essential for delivering flexible, personalized learning experiences. The development of a learning ecosystem

that incorporates mobile applications can improve the learning process by enabling individualised learning paths and access to resources at any time and location (Thanachawengsakul & Wannapiroon, 2021). This adaptability is essential in engineering education, as students frequently require immediate access to information and instruments to aid their learning.

Furthermore, the usability of mobile applications significantly influences their efficacy in educational environments. Hoos (2014) emphasizes the necessity of a robust IT infrastructure to support the development of mobile applications for engineering, which are complex. Eltalhi *et al.* (2021) emphasize that the usability of such applications has a direct impact on student engagement and learning outcomes, and mobile learning can substantially increase interest and participation in the learning process. A variety of theories and concepts, which prioritise constructivist learning, motivation, personalised learning experiences, and usability, substantiate the incorporation of mobile applications into engineering education. These components collectively contribute to the efficacy of mobile learning in improving the educational outcomes of engineering students.

RESEARCH METHOD

This study employs a structured research methodology to investigate the potential of digital learning in engineering through the design, development, and evaluation of a mobile application. The app was developed using the Design Thinking approach, a human-centred methodology that involves five key stages: empathising with users to understand their needs, defining the problem, ideating potential solutions, prototyping the app, and testing it iteratively to refine its functionality and usability. The development process was carried out using Android Studio (Koala version), a robust platform that supports the creation of user-friendly and interactive mobile applications, tailored to meet the specific educational requirements of engineering students.

To assess the effectiveness of the application, the study adopts a quantitative research design, leveraging a survey-based approach to gather feedback from users. A structured questionnaire served as the primary instrument for data collection, measuring user experiences, perceptions, and opinions about the app's effectiveness in enhancing their learning experience. The questionnaire employed a 4-point Likert scale—ranging from "Strongly Agree" to "Strongly Disagree"—to ensure clarity and precision in capturing respondent feedback without neutral options, thus encouraging decisive responses.

The study population consisted of 110 diploma-level civil engineering students enrolled in a structural practical course, selected as they represent the target user group most likely to benefit from the application. The survey was distributed to the entire population to ensure comprehensive feedback. All completed questionnaires were analysed quantitatively to calculate statistical measures such as mean and standard deviation, providing insights into the app's overall effectiveness, user satisfaction, and areas needing improvement. This methodological framework ensures a systematic, data-driven evaluation of the mobile app's role in enhancing digital learning within the field of engineering, contributing valuable insights to both educational practices and app development for similar contexts.

RESULTS AND DISCUSSION

The findings of the study underscore the multifaceted perceptions users have regarding the mobile application, particularly in the domains of performance, usability, interface design, reliability,

and overall effectiveness. Users expressed a high level of satisfaction with the application's performance metrics, noting quick response times (Min = 3.92, SD = 0.45) and fast loading speeds (Min = 3.85, SD = 0.53). These findings align with previous research that emphasizes the importance of performance in mobile applications, which can significantly influence user acceptance and satisfaction (Thamutharam *et al.*, 2021; Oliveira *et al.*, 2021). The application's capability to facilitate quick answer checking and compare theoretical with practical answers received perfect scores (Min = 4.00, SD = 0.00), reinforcing the notion that functionality is a critical determinant of user satisfaction (Owired, 2019). However, despite the high-performance ratings, users indicated that mastering the application required effort, as reflected in a lower score (Min = 3.40, SD = 1.55). This suggests a potential barrier to user engagement, which is consistent with findings from other studies that highlight the importance of ease of use in mobile applications for enhancing user experience (Johnson *et al.*, 2020). While users appreciate the application's speed, the overall mean satisfaction with time efficiency (Min = 3.48, SD = 0.21) suggests that there is still room for improvement in terms of the application's intuitiveness over time. Users rated the application as user-friendly (Min = 3.97, SD = 0.18) and easy to use independently (Min = 3.72, SD = 0.92) in terms of usability and interface design. However, the interface design garnered moderate feedback (Min = 3.04, SD = 1.30), indicating potential enhancements in visual appeal. This aligns with the findings of Zhao *et al.*, who noted that interaction quality significantly impacts user experience and satisfaction in mobile services (Zhao *et al.*, 2022). Furthermore, the application's stability during prolonged use (Min = 3.68, SD = 0.89) and the general user experience (Min = 3.38, SD = 1.55) indicate that while users find the application enjoyable for learning (Min = 3.76, SD = 0.68), there is a perceived need for improved engagement strategies, particularly in motivating users in practical structure learning (Min = 3.05, SD = 1.25). Regarding accuracy and reliability, users expressed high confidence in the application's results (Min = 3.96, SD = 0.20) and deemed the answers trustworthy (Min = 3.93, SD = 0.27). These perceptions are crucial, as they contribute to the overall effectiveness of the application in educational contexts, where reliability is paramount (Atmajaya *et al.*, 2019). Users rated the application's functionality highly (Min = 3.98, SD = 0.22) and found it suitable for teaching and learning purposes (Min = 4.00, SD = 0.00). The strong willingness to recommend the application to others (Min = 3.95, SD = 0.15) further emphasizes its perceived value among users, which is a critical factor for the sustained adoption of educational technologies (Daniyanti, 2023). In conclusion, the application demonstrates robust performance, usability, reliability, and overall effectiveness, positioning it as a valuable educational tool. However, to maximise user satisfaction and adoption, enhancements in interface design, ease of learning, and user engagement strategies are recommended. These improvements could lead to a more comprehensive and satisfying user experience, ultimately fostering greater educational outcomes.

CONCLUSION

In conclusion, the integration of mobile applications into engineering education, particularly for flexural moment practicals in civil engineering, represents a significant advancement in pedagogical practices. The study highlights the positive perceptions of users regarding the application's performance, usability, and overall effectiveness, indicating that mobile technology can enhance learning experiences and outcomes. Users reported high levels of satisfaction with the application's speed and functionality, which aligns with existing literature that emphasizes performance in educational technologies. Yakar *et al.* (2020). However, the findings also reveal areas for

improvement, particularly interface design and user engagement strategies, which are crucial for maximizing user satisfaction and fostering a deeper understanding of complex engineering concepts. The application's ability to facilitate quick answer checking and its reliability in providing accurate results further underscore its potential as a valuable educational tool. This is consistent with previous research that illustrates how digital tools can promote self-efficacy and confidence among engineering students (Scala *et al.*, 2022). The study's quantitative approach, utilising a structured questionnaire, provides robust insights into user experiences and highlights the necessity for continuous evaluation and refinement of educational applications to meet the evolving needs of students. Moreover, the findings suggest that the successful implementation of mobile applications in engineering education can lead to more personal and flexible learning experiences that cater to the diverse needs of students. As the landscape of education continues to evolve, particularly in the wake of the COVID-19 pandemic, the role of digital technologies in enhancing student engagement and learning outcomes becomes increasingly vital (Yaacob, 2020). Ultimately, this research contributes to the growing body of evidence supporting the integration of mobile learning in engineering curricula, advocating for the development of user-friendly, engaging, and effective educational tools that can prepare students for the challenges of the future. Continued exploration of innovative pedagogical approaches and the incorporation of user feedback will be essential in advancing the effectiveness of mobile applications in engineering education.

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