iLabCS: An Interactive Web-Based Learning Platform for Developing Practical Computing Skills

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Abstract

Limited access to physical laboratory facilities can widen the gap between theoretical knowledge and the practical skills required in Computer Studies education. This study aimed to develop and evaluate iLabCS: An Interactive Web-Based Learning Platform for Developing Practical Computing Skills, designed to provide College of Computer Studies (CCS) students at EARIST with accessible, interactive, and practice-oriented learning opportunities despite limited laboratory resources. The study is significant in providing a cost-effective and flexible learning intervention that supports practical skill development, student engagement, and quality education, particularly in resource-constrained academic environments. The system was developed using the Agile Software Development Life Cycle, incorporating iterative development, continuous feedback, and user-centered design. It utilized HTML5, CSS3, JavaScript, React, Vite, Node.js, MySQL, Docker, and Phaser.io to implement interactive learning activities, coding exercises, drag-and-drop simulations, quizzes, dashboards, notifications, and progress tracking. The system was evaluated by 323 BS Computer Science students, BS Information Technology students, and faculty members using the ISO/IEC 25010 Software Quality Model across eight software quality characteristics. Results demonstrated a very high level of acceptance, with an overall composite mean of 4.37 (Strongly Agree). Compatibility obtained the highest rating at 4.42, followed by functional suitability at 4.40 and portability at 4.39, while reliability received the lowest but still favorable rating of 4.29. Significant differences were also found among the assessments of BSCS students, BSIT students, and faculty members across all eight quality characteristics. The findings establish iLabCS as a functional, usable, secure, adaptable, and sustainable virtual learning platform that addresses practical learning gaps in Computer Studies education. The study contributes to the growing body of research on web-based, interactive, simulation-driven, and gamified learning by demonstrating the potential of virtual laboratory environments to supplement conventional laboratory experiences. Practically, iLabCS provides educational institutions, particularly those with limited laboratory resources, with a scalable and accessible platform to enhance hands-on learning. Future improvements may prioritize system reliability, usability, and continued optimization for wider institutional adoption.

Keywords: Web-based Learning; Virtual Platform; Computing Skills