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Hands-on Learning in Database Programming Education: Exploring Student Experiences Through Thematic Analysis of Project Reflections

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Abstract

This study explores the challenges and experiences of students undertaking a database programming project that integrates database systems with web applications, utilizing a project-based learning (PBL) approach. Through a thematic analysis of 80 student reflections, five key themes were identified: Web Application Development Challenges, Difficulty of SQL and PL/SQL Mastery, Time Management, Teamwork and Communication, and Technical Support and Resources. The findings reveal that students faced significant technical hurdles, particularly in integrating diverse technologies and mastering complex database languages. Many students had to self-learn web development technologies, indicating a gap in foundational knowledge. The study also highlights the importance of structured support, practical experience, and robust technical

assistance in PBL environments. Students demonstrated resilience and adaptability, leveraging teamwork and communication to overcome technical challenges. The study underscores the need for enhanced scaffolding, mentorship programs, and curated learning resources to improve pedagogical approaches in database education. Addressing these challenges allows educators to cultivate a more nurturing and productive learning space, effectively preparing students to meet the demands of the technological world. © 2025 IEEE.

Author keywords

database programming; project-based learning (PBL); SQL; student reflections; thematic analysis

Indexed keywords

Engineering controlled terms

Computer systems programming; E-learning; Education computing; Engineering education; Human resource management; Students; Teaching

Engineering uncontrolled terms

Database programming; Hands-on learning; Programming education; Programming projects; Project based learning; Project-based learning; Student experiences; Student reflection; Thematic analysis; WEB application

Engineering main heading

Database systems

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