

A Review of AI-Driven Intelligent Tutoring System for Enhancing Problem-Solving Skills through Personalized Programming Instruction

MWITA MWITA Charles^{1#} and LP Kalansooriya²

^{1,2}Department of Computer Science, Faculty of Computing, General Sir John Kotelawala Defence University

[#]39-bse-6508@kdu.ac.lk

Abstract

Traditional programming education often employs uniform instructional methods, neglecting diverse learner needs in terms of prior knowledge, learning styles, and pacing. These limitations lead to disengagement and inconsistent outcomes. To address this, the study introduces an AI-enabled Intelligent Tutoring System (ITS) designed to deliver personalized programming instruction. This ITS employs machine learning, collaborative filtering, and deep learning to dynamically adapt content, including tailored exercises and real-time feedback based on learners' progress and performance. A distinctive feature of the proposed ITS is its immediate feedback mechanism, enabling students to identify and correct mistakes, fostering deeper understanding and mastery of concepts. Personalized exercises are generated to address specific learning gaps, strengthening problem-solving skills while keeping learners engaged. Additionally, the system supports peer collaboration, connecting students with similar proficiency levels to enhance learning through teamwork. The dataset comprises diverse programming students across academic institutions and online platforms. Collaborative filtering techniques recommend relevant exercises, while deep learning models extract patterns from learner interactions to refine personalization further. Experimental results demonstrate that students using the ITS perform 25% better in problem-solving and retain 40% more knowledge compared to traditional methods. This ITS bridges gaps in traditional systems by offering scalability across varied programming environments and providing adaptive learning paths supported by real-time analytics. Its innovative approach ensures greater learner independence, engagement, and skill acquisition, positioning it as a transformative tool in programming education. Future research should focus on optimizing computational efficiency for real-time scalability and exploring cross-domain applications. This study underscores the potential of AI-driven ITS to revolutionize programming education, paving the way for personalized learning and enhanced educational outcomes in a technology-driven world.

Keywords: *Personalized Learning, Intelligent Tutoring Systems, Programming Instruction, Collaborative Filtering, and Deep Learning*