


Chapter 5

Developing Teaching Competencies for AI-Enhanced Learning: Teachers' Evolving Roles in Intelligent Tutoring Systems

Seoyeon Park

 <https://orcid.org/0000-0001-5024-9435>

University of Nevada, Las Vegas, USA

Wenting Weng

Johns Hopkins University, USA

ABSTRACT

Digital transformation demands new teaching competencies for AI-enhanced learning. This study analyzes teachers' roles in intelligent tutoring systems to inform competency frameworks for pedagogical innovation. Through systematic analysis of 71 studies from the International Journal of Artificial Intelligence in Education (1997-2021), we identified three competency domains: domain expertise (32%), active user capabilities (46%), and developer skills (2%). Teachers function as essential partners in AI-enhanced ecosystems, contributing specialized knowledge and orchestrating technology-integrated experiences. Successful integration requires competencies spanning technical proficiency, pedagogical innovation, data interpretation, and ethical decision-making. Results show AI transforms rather than replaces teaching roles, creating personalized instruction opportunities while challenges persist including technology anxiety and resource constraints. This analysis provides foundation for competency-based professional development programs supporting educational technology integration.

DOI: 10.4018/979-8-3373-7729-2.ch005

INTRODUCTION

Teachers who once worked primarily with textbooks and chalkboards now find themselves collaborating with computer systems that can track how students think through problems, adjust lessons based on each student's learning style, and provide individualized feedback that used to require expensive private tutoring. This isn't just about adding computers to classrooms—it represents a fundamental change in what it means to be an educator.

Intelligent tutoring systems (ITSs) have extensively evolved and contributed to the flourishing of artificial intelligence (AI)-supported education over the last 25 years. ITSs have gained attention for their various learning advantages, such as the ability to capture students' progress in real-time, provide a knowledge example model, and offer timely scaffolding that is not limited to cognitive, metacognitive, or emotional scaffolding (Ma et al., 2014; VanLehn, 2011; Cen et al., 2007). ITSs have been actively applied to K–12 and higher education levels in a variety of areas, such as language, mathematics, sciences, and reading comprehension.

Even though ITSs have been successfully and widely used in diverse subject domains, their effectiveness on students' learning has been a topic of controversy. Many studies strongly contend that ITSs are effective tools for student learning by providing students with highly adaptive and interactive learning environments (Aleven et al., 2009; Koedinger et al., 2004; Blessing et al., 2009; Kodavali et al., 2010; Devasani et al., 2012; Kodaganallur et al., 2005; MacLellan et al., 2014). For example, VanLehn (2011) found that ITSs have a high impact ($d = .76$) on students' learning in STEM areas, making ITS comparable to human tutoring. Xu et al. (2020) also presented that using ITS can significantly increase students' reading comprehension in K–12 classrooms ($d = .60$).

However, several rigorous meta-analysis papers have revealed that ITSs have negative or a very small positive effects on students' learning compared to traditional classroom instruction (What Works Clearinghouse, 2010; Steenbergen-Hu & Cooper, 2013). These papers pointed out that the effectiveness of ITS can vary based on many other factors, such as the degree of technology implementation, the context of implementation, or students' prior knowledge levels or metacognitive skills. For example, Belland et al. (2017) contend that low achievers are more likely to struggle with learning content using computer-based learning environments like ITS because they have less prior knowledge, metacognitive skills, or motivation. Ceci and Papiero (2005) also emphasized that using educational technology can result in unwanted learning gaps between different student groups if teachers use these technologies without caution. Steenbergen-Hu and Cooper (2013) found that ITS can have no or very little impact on students' learning when researchers have

24 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/developing-teaching-competencies-for-ai-enhanced-learning/393770

Related Content

Unstructured Road Detection Method Based on RGB Maximum Two-Dimensional Entropy and Fuzzy Entropy

Huayue Wu, Tao Xue, Xiangmo Zhao and Kai Wu (2022). *International Journal of Ambient Computing and Intelligence* (pp. 1-18).

www.irma-international.org/article/unstructured-road-detection-method-based-on-rgb-maximum-two-dimensional-entropy-and-fuzzy-entropy/300801

Personalized Learning Through Gamification: A ChatGPT Approach to English Language Learning

Sabahattin Yeilçnar (2023). *Transforming the Language Teaching Experience in the Age of AI* (pp. 44-64).

www.irma-international.org/chapter/personalized-learning-through-gamification/330375

Traffic Responsive Signal Timing Plan Generation Based on Neural Network

Azzam ul-Asar, M. Sadeeq Ullah, Mudasser F. Wyne, Jamal Ahmed and Riaz ul-Hasnain (2009). *International Journal of Intelligent Information Technologies* (pp. 84-101).

www.irma-international.org/article/traffic-responsive-signal-timing-plan/4040

Integrating Machine Learning, Artificial Intelligence, Deep Learning, and IoT in Remote Patient Monitoring

Ajay Sharma, Devendra Babu Pesarlanka and Shamneesh Sharma (2025). *Future Innovations in the Convergence of AI and Internet of Things in Medicine* (pp. 285-318).

www.irma-international.org/chapter/integrating-machine-learning-artificial-intelligence-deep-learning-and-iot-in-remote-patient-monitoring/368931

Secure Software Engineering for AI-Powered HyFlex Learning: Building Trustworthy and Engaging Educational Platforms

Hanh Le (2026). *AI-Powered HyFlex Learning for Student Engagement* (pp. 331-360).

www.irma-international.org/chapter/secure-software-engineering-for-ai-powered-hyflex-learning/411314