

Chapter 12

Enhancing Teacher Readiness and Retention in STEM Education Through PCK Development

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ABSTRACT

STEM education is a constantly expanding area that proposes a holistic approach to teaching science and technology in order for students to gain crucial 21st-century skills. This approach's inception highlighted the educator's readiness to adopt new or alter current teaching techniques. The multiple issues and obstacles that starting teachers confront in their early careers, as well as new teaching requirements, have exacerbated the already high rates of attrition and turnover, making the function of STEM pedagogical content knowledge (PCK) more important than ever. As a result, the goal of this chapter is to provide a review of the literature on the potential of STEM-PCK to improve teacher preparation and retention. Taking into account new educational data after the outbreak of the pandemic, the chapter suggests and demonstrates projects based on transnational collaborations that would facilitate the exchange of best practices in higher education to support teachers.

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INTRODUCTION

The development of Science-Technology-Engineering-Mathematics (STEM) education as a distinct pedagogical field began in 2013 and quickly gained international prominence. Central to this educational approach is the emphasis on both the quantity and quality of teachers, as they play a pivotal role in delivering STEM education effectively. However, many educational institutions face challenges in recruiting teachers with advanced pedagogical content knowledge (Hutchison, 2012). This shift in educational focus has spurred research interest in assessing teacher readiness at various educational levels.

The COVID-19 pandemic, with its resultant social distancing measures, further underscored the importance of teacher readiness, now viewed as a multifaceted concept encompassing knowledge, skills, abilities, teaching practices (Christensen & Knezek, 2017), institutional support, and self-efficacy (Hung, 2016). In this context, the recruitment and retention of competent STEM teachers have become crucial globally. Allen and Sims (2017) stated that science teachers, especially those in their first year or with backgrounds in physics or engineering, are more prone to leave their positions compared to their non-science counterparts. Notably, new science teachers have a 35% higher likelihood of leaving their first school within five years.

Koehler et al. (2013) examined the career trajectories of STEM professionals transitioning into teaching roles, particularly in high-demand areas. While alternative certification programs have shown promise in addressing the shortage of STEM teachers in needy urban and rural schools in the U.S., they are not a complete solution. Wang et al. (2018) found that at the upper secondary level, STEM teachers often express more concern about student behavior than non-STEM teachers, who focus more on distributed leadership and collaboration. These STEM teachers also tend to leave their positions if they lack adequate support from their schools. Post-pandemic, one of the significant hurdles for teachers implementing distance education has been their readiness, especially in managing new technologies for virtual learning environments, a crucial aspect for STEM educators.

Alongside the critical development of STEM-PCK, the concept of a teacher's professional identity emerges as equally pivotal in STEM education. This identity, rooted in an educator's personal beliefs, values, and attitudes, significantly influences their approach to teaching. It affects not only their methods and effectiveness in the classroom but also their commitment and longevity in the teaching profession. Therefore, understanding and nurturing this facet of teacher identity is essential. It plays a key role in enhancing overall teacher readiness, effectiveness, and persistence in the increasingly demanding and dynamic field of STEM education.

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