Chapter 8
Empowering Science Educators in the Age of Generative AI:
Frameworks for Effective Professional Development

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ABSTRACT

This qualitative study addresses GenAI integration challenges for Caribbean Science educators.It investigates teacher pedagogical preparedness and training access, highlighting a significant gap in resource constraint environments. Employing an inductive thematic approach, data from peer reviewed and grey Caribbean literature provided culturally authentic insights. Four themes emerged from the analysis: 1) Efficacious Teachers Embody AI Literacy and Competency Skills 2) Shaping Teacher Disposition and Competency: The Influence of Educational Policy; 3)Adapting Professional Development Models for GenAI Integration for STEM Teachers in Resource Constrained Environment is Elusive and 4) Using Mixed Method Research for GenAI Professional Development Intervention Assessment. These reveal the complexities in teacher agency, readiness, pedagogical shifts and policy.The study proposes an adapted professional framework with 20 practical characteristics for the Caribbean context,emphasizing key design considerations. Gathering contextual data is imperative for progress.

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INTRODUCTION

Contextual Background

This book chapter provides the contextual background reinforcing the increasing significance of Generative AI (GenAI) in education and its specific relevance to science teaching and learning. Gen AI is useful for personalizing education, improving efficiency, fostering engagement, promoting accessibility, and providing valuable data-driven insights (Sultanow et al., 2024; Yadav, 2024). The researcher also chooses to highlight the Caribbean because majority of the literature on Generative AI and its applications is from Developed Countries and mainstream databases unfortunately rarely capture the work from the Caribbean. It is also critical for Caribbean researcher to share their context and contribute to the discussion since our cultural learning and teaching practices may not allow the generalizability from many of the readily available studies (Down, 2024; Jeyaseelan et al. (2025).). With the push for STEM and STEM education in the Caribbean, there is consensus that Science and Technology must be enhanced for Caribbean development through effective education and achieving sustainable goals to impact the lives of every Caribbean person (Sweeny & George, 2024; Keith & Waldron, 2024). Literature emphatically highlights the need for ongoing professional development (PD) to support practicing science educators in adapting to these technological advancements and it also highlights the lag the region faces in developing holistically orchestrated Science teacher professional development frameworks (Devonish et al., 2025). Unfortunately, many science educators may lack the knowledge, skills, and confidence to effectively and ethically, integrate GenAI tools into their teaching practices (Warner et al., 2021). The awkward necessity saw many educators plunged into the technological deep with the onset of COVID and their utility and skill set for Information and Communications Technology (ICT) and just integrated technological enhanced pedagogy to meet the nature of the students was tested. Meanwhile, as GenAI has evolved and continues to grow in its capabilities, its leaps and boundless nature seem daunting though educationally exciting. Therefore, effective integration of GenAI into the science classroom, curriculum and pedagogical approaches requires more than just technical skills; it necessitates pedagogical understanding and critical evaluation. The Caribbean science educator needs to be assisted by data driven policies and contextual information needs to be in mainstream literature for enhanced awareness and collaborative opportunities for learning.