



Chapter 10

Pedagogical Promise and Peril of AI: A Text Mining Analysis of ChatGPT Research Discussions in Programming Education


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ABSTRACT

GenAI systems such as ChatGPT are increasingly discussed in programming education, but the ways in which the research literature conceptualizes and frames their

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role remain unclear. This chapter applies text mining to publications indexed in a leading academic database to map scholarly discourse on ChatGPT in programming education. Term frequency analysis, phrase pattern extraction, and topic modeling reveal four dominant themes: pedagogical implementation, student-centered learning and engagement, AI infrastructure and human–AI collaboration, and assessment, prompting, and model evaluation. The literature prioritizes classroom practice and learner interaction, with comparatively limited attention to assessment design and institutional governance. Across studies, ChatGPT is positioned both as a learning aid that supports explanation, feedback, and efficiency and as a pedagogical risk linked to overreliance, unreliable outputs, and academic integrity concerns. These findings support responsible integration and highlight the need for stronger assessment and governance mechanisms.

INTRODUCTION

Programming remains one of the most demanding subjects in computer science education. Despite continued curriculum and pedagogical reforms, many students still struggle to learn programming effectively. Studies across multiple institutions report failure and withdrawal rates ranging from 30 to 50% in introductory programming courses (Margulieux et al., 2020; Simon et al., 2019). Students often describe programming as abstract and mentally challenging because it requires logical reasoning, syntax accuracy, and problem decomposition (Dirzyte et al., 2023; Malik & Coldwell-Neilson, 2017). These challenges lower confidence and increase anxiety, which frequently result in disengagement and attrition (Dirzyte et al., 2023; Garcia, 2024). These persistent difficulties motivate educators to seek approaches that provide timely feedback, guided practice, and individualized support for novice programmers.

Earlier responses to these difficulties included intelligent tutoring systems and automated assessment platforms. These tools adapted feedback and evaluated student work through structured mechanisms. They improved performance in topics such as loops, recursion, and data structures (Crow et al., 2018; Kouam & William, 2024). However, they were limited in scale and unable to support complex or open-ended programming tasks. The steady growth of class sizes in computer science programs reduced the capacity of instructors to deliver individualized assistance. This situation created a need for scalable systems capable of providing interactive and immediate instructional support.

The emergence of large language models, particularly ChatGPT, redirected this pursuit. ChatGPT produces explanations, examples, and code corrections through natural conversation. Instructors now integrate it into lessons to help students

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