Enhancing Computer Programming Education using ChatGPT: A Mini Review

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ABSTRACT

This paper aims to provide insights into how ChatGPT enhances computer programming education by synthesizing existing studies using rapid review. We analysed 13 articles published in 2023, where studies focused on different aspects of basic programming education. The results indicate that 21% of these studies demonstrate that ChatGPT served as a tool for code explanation and handling complex topics. However, 36% show that ChatGPT had difficulty answering non-text-based and code-related questions, revealing reliability and accuracy issues with these tools. Another 36% of the studies showed that blindly over-reliance on ChatGPT affected critical thinking, student creativity, and problem-solving skills in programming education. 46% of the studies indicated the need to provide clear guidelines and employ plagiarism-detection tools to instruct students effectively. We suggest that educators should adopt diverse approaches to integrating ChatGPT as an educational tool while highlighting ethical considerations and model limitations.

CCS CONCEPTS

• **Computing Education → Programming Education, Chat-GPT, Computer Programming, AI chatbot**.

ACM Reference Format:

1 INTRODUCTION

After ChatGPT was released in November 2022 [9], it quickly became a versatile tool widely accepted in various industries including the educational sector. The artificial intelligence (AI) chatbot has been applied to language understanding, content generation, including customer support, medical diagnosis, legal analysis, and financial forecasting [12]. In education, ChatGPT's role is a topic of contention as educators and researchers grapple with the varied ways in which it can be integrated into the learning process. It has been argued that ChatGPT has the potential to reshape pedagogical approaches by offering on-demand assistance, facilitating adaptive learning experiences, and creating interactive and engaging learning experiences [6]. Concerns have also been raised about reliance on AI, potential biases in generated content, impact on quality of education, and raise ethical issues related to plagiarism and cheating [13] [10]. This ongoing debate highlights

the complex and evolving nature of ChatGPT's impact on education, making it a subject of considerable interest and investigation within academic circles.

In the computing education context, a few studies have emerged that explored using ChatGPT to teach and complete different programming courses and exercises. These studies have mostly shown that ChatGPT accurately generates programming solutions despite concerns with organization or issues specific to a programming language, among others [5] [16]. While we recognize that more work is needed to understand how GAI tools can support learners in programming education, synthesizing existing research will be valuable for future direction. Hence, this study investigated how ChatGPT has been utilized to enhance the learning of programming in literature.

2 METHOD

Review approach: The rapid evolution of ChatGPT requires a review of recent developments and findings especially in computing education to identify gaps and build on existing results. To perform the study, we followed a rapid review approach [16].

Database and Literature Search: The search was performed in Scopus and ACM databases on August 1, 2023, using the search terms "ChatGPT" AND "Education". Initially, a total of 179 records were extracted. After removing duplicates and screening based on abstract, keywords, and titles, 143 studies remained. Using inclusion and exclusion criteria, 57 studies were deemed eligible for full-text assessment. Finally, 13 studies were included in this study for synthesis, which answered the research question.

Content Analysis: To extract and synthesize data from the reviewed articles, we used a systematic approach using a codebook to minimize reviewer differences and avoid bias. The inter-rated agreement shows K=74.5% and conflicts were discussed and resolved using consensus. Relevant information was collected and coded using a codebook. The extracted data includes the type of article, publication year, and aim of the study, and findings are grouped with similar themes.

3 RESULT AND CONCLUSION

Descriptive statistics of included studies: A total of 13 studies were included in this study. All the included studies were published in 2023, where 7 were conferences and 6 were journal articles. The reviewed studies were framed into four categories: reliability and accuracy of ChatGPT, effects of using ChatGPT in programming education, use of ChatGPT in programming education and collaborative skill development, and finally, ethical considerations and awareness of using ChatGPT (See Fig. 1).

RQ. How does ChatGPT enhance learning of programming education? Our findings have identified eight fundamental ways ChatGPT enhances computer programming education, improves motivation, and offers support to students and educators. Studies indicate ChatGPT assists learners in programming education by 1) simplifying complex programming code and making intricate concepts more accessible to learners. 2) helps Beginners in introductory programming courses by improving their task completion rates. 3) serves to boost students' motivation for programming courses and learning, fostering engagement and interest. 4) enhances students' programming self-efficacy by providing valuable guidance and support in

coding tasks, including issue identification. 5) ChatGPT serves educators as self-directed learning in high student-to-teacher ratio programming classes. 6) support students in practicing code reading and explanation. 7) serve as a pair programmer in review and provide code, 8) serve as in explaining complex programming concepts such as data structure and algorithms. The finding indicates that this assistance of ChatGPT makes it an indispensable tool in computer programming education.
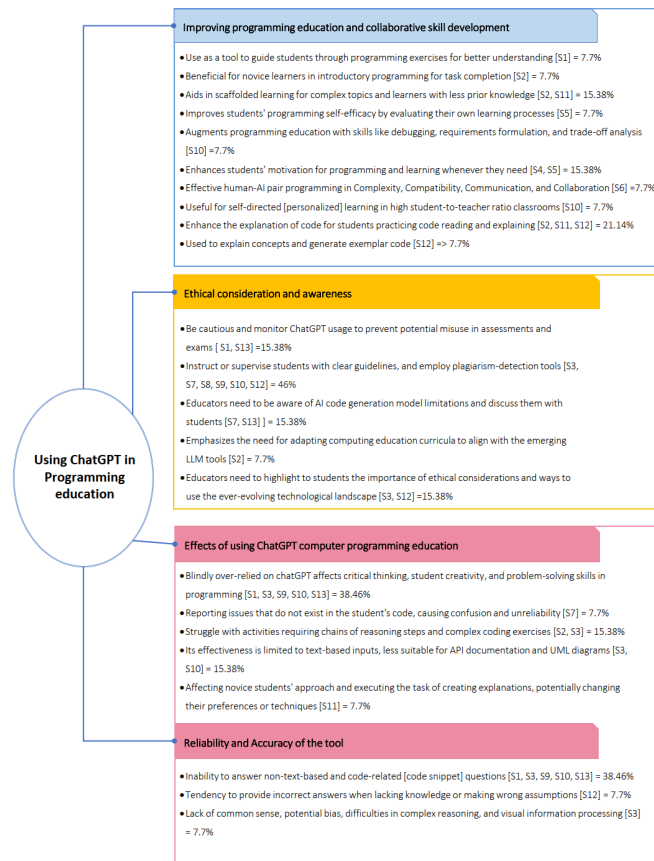

Figure 1: Overall result of findings

In conclusion, this study explored educational benefits and ways Chat-GPT enhances programming education and identified required ethical considerations and awareness. We found eight educational benefits of using ChatGPT in computer programming education. We also identified several educational impacts, particularly the blind reliance on generative tools' effects, critical thinking, creativity, and problem-solving skills in programming education. Additionally, we found issues related to the reliability and accuracy of GAI, such as ChatGPT's inability to answer code-based questions. Finally, we identified five fundamental ethical considerations and awareness that educators and students should be aware of while using ChatGPT in computing education.

Appendix: Reviewed studies with Study ID S1: → [5], S2: → [7], S3: → [11], S4: → [1], S5: → [18], S6: → [17], S7: → [4], S8: → [2], S9: → [15], S10: → [10], S11: → [8], S12: → [3], S13: → [14]

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