



Exploring the Research Gap: Generative AI and Learning of Python Programming among Post-Primary Students

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ABSTRACT

The introduction of Leaving Certificate Computer Science (LCCS) in Ireland in 2018 signifies a notable advancement in post-primary education. Moreover, developments in generative Artificial Intelligence (GAI) in education, are gaining prominence, yet we do not understand its value or how best to implement it in post-primary educational settings. Despite a growing international body of research in this area, my scoping review highlights that many aspects of these topics have yet to be explored, particularly in the context of post-primary students in Ireland. My study will begin to bridge this gap by exploring how a purposeful sample of LCCS post-primary students in Ireland engage with GAI tools, such as ChatGPT, during their initial experiences learning Python programming. These findings, when approached through the lens of Human-Centred Artificial Intelligence (HCAI), can help enhance pedagogical strategies and lead to improved learning experiences for students.

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SCOPING REVIEW AND CONCLUSION

The initial stage of my research relies on a scoping review of the literature pertaining to "learning," "programming," and "AI". A PRISMA chart was used to exclude studies relating to AI in non-education contexts, AI/machine learning fundamentals, AI for assessment purposes, and virtual reality. Out of 255 studies identified, 10 were selected for detailed review and further analysis. My review reveals the rapid growth in research on the integration of AI into programming education. In an examination of the effectiveness of Intelligent Tutoring Systems (ITS) for teaching computer programming, one study found enhanced learning outcomes compared to traditional instruction [2]. Another study examined chatbots in a multimedia programming course, which improved students' academic performance and engagement [4]. A range of position papers emphasise responsible GAI use in education, shifting teachers to roles facilitating students' critical thinking and independent research skills [1, 5, 6]. Other studies examined AI code generation

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tools in programming education highlighting benefits and ethical concerns [3, 7, 9]. A final study examined the use of large language models (LLMs) for programming error messages, making them more understandable for beginners [8]. In summary, these studies highlight significant advancements and challenges with respect to the use of GAI for programming education. My scoping review underscores that research in this area is still relatively limited, with much further investigation needed. A common conclusion across the ten studies is that educators should adapt their teaching strategies to leverage the benefits of AI while also promoting critical thinking and problem-solving skills among students. I found no prior research examining Irish post-primary students' learning experiences of programming with GAI. Embracing the concept of HCAI, this presents an opportunity for future research in the area, focusing on the ethical integration of GAI tools into post-primary computer science education. My research will particularly focus on student experiences, attitudes, and dispositions, aiming to empower them in their learning of Python. The poster will provide an overview of my scoping review process and my core findings, paving the way for my future research path in this area.

REFERENCES

- [1] Brett A Becker, Paul Denny, James Finnie-Ansley, Andrew Luxton-Reilly, James Prather, and Eddie Antonio Santos. 2023. Programming Is Hard - Or at Least It Used to Be: Educational Opportunities and Challenges of AI Code Generation. In *Proceedings of the 54th ACM Technical Symposium on Computer Science Education V. 1*. 500–506.
- [2] Konstantina Chrysafiadi, Maria Virvou, George A Tsihrantzis, and Ioannis Hatzilygeroudis. 2023. Evaluating the User's Experience, Adaptivity and Learning Outcomes of a Fuzzy-Based Intelligent Tutoring System for Computer Programming for Academic Students in Greece. *Education and Information Technologies* 28, 6 (2023), 6453–6483.
- [3] Paul Denny, Viraj Kumar, and Nasser Giacaman. 2023. Conversing with Copilot: Exploring Prompt Engineering for Solving CS1 Problems Using Natural Language. In *Proceedings of the 54th ACM Technical Symposium on Computer Science Education V. 1*. 1136–1142.
- [4] Harry Barton Essel, Dimitrios Vlachopoulos, Akosua Tachie-Menson, Esi Eduafua Johnson, and Papa Kwame Baah. 2022. The Impact of a Virtual Teaching Assistant (Chatbot) on Students' Learning in Ghanaian Higher Education. *International Journal of Educational Technology in Higher Education* 19, 1 (2022), 1–19.
- [5] Ryan Fisk. 2023. The Rise of ChatGPT and Generative AI and What it Means for Schools. *AASA Journal of Scholarship & Practice* 20, 1 (2023).
- [6] Gwo-Jen Hwang and Nian-Shing Chen. 2023. Editorial Position Paper: Exploring the Potential of Generative Artificial Intelligence in Education: Applications, Challenges, and Future Research Directions. *Educational Technology & Society* 26, 2 (2023).
- [7] Majeed Kazemitabaar, Justin Chow, Carl Ka To Ma, Barbara J Ericson, David Weintrop, and Tovi Grossman. 2023. Studying the Effect of AI Code Generators on Supporting Novice Learners in Introductory Programming. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–23.
- [8] Juho Leinonen, Arto Hellas, Sami Sarsa, Brent Reeves, Paul Denny, James Prather, and Brett A Becker. 2023. Using Large Language Models to Enhance Programming Error Messages. In *Proceedings of the 54th ACM Technical Symposium on Computer Science Education V. 1*. 563–569.
- [9] Michel Wermelinger. 2023. Using GitHub Copilot to Solve Simple Programming Problems. In *Proceedings of the 54th ACM Technical Symposium on Computer Science Education V. 1*. 172–178.