POSTER

Investigating the Use of ChatGPT to Support the Learning of Python Programming Among Upper Secondary School Students: A Design-Based Research Study

IRENE STONE, Dublin City University, Dublin, Leinster, Ireland

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Irene Stone
Dublin City University
Ireland
irene.stone2@mail.dcu.ie

Abstract

This study investigates how ChatGPT can be used to support the learning of Python programming among upper second-level students in an Irish classroom. It addresses critical gaps in the literature, such as the lack of research at secondary level, the need for human-centered studies conducted over time, and the absence of guidelines for integrating ChatGPT into introductory programming education. Employing a design-based research methodology, this study aims to understand student engagement with ChatGPT and investigates how to support their use of prompts when learning to program. The research involves students as co-creators alongside their teacher, who is also the researcher, in developing a pedagogical framework that integrates ChatGPT into Python programming education.

CCS Concepts

• **Computing methodologies → Artificial intelligence**; • **Social and professional topics → Computing education**; **CS1**; **Computer science education**.

Keywords

AI; artificial intelligence; ChatGPT; CS1; design-based research; generative AI; human-centered; LLMs; novice programming; pedagogical practices; programming; python; student-centered

Methodology

In programming and generative AI research, there are calls for human-centered approaches [8] that explore student perceptions and studies conducted over longer timespans [3, 7]. In defining human-centered research, UNESCO advocates that its use should be "co-designed by teachers, learners, and researchers" [6]. A Design-Based Research (DBR) methodology is thus adopted in this study.

A "participatory and principled" approach [4], it engages second-level students, as co-participants [2] in the research process, and contributes to theory-building through the development of prototype frameworks [4]. Aligned with DBR principles [1], this research is conducted in a classroom setting, focuses on designing a framework supporting Python learning with ChatGPT, utilises a mixed methods approach, and involves iterative phases of exploration, construction, and reflection [5]. In the first phase, the researcher, a second-level Computer Science teacher, is immersed in the classroom to understand student needs and contextual factors. The second phase involves developing prototypes of a pedagogical framework integrating ChatGPT with introductory programming learning, with students as co-creators. The final phase evaluates the framework to refine and enhance it. This iterative approach aims to create an adaptable resource that educators can "adopt and adapt" for their specific teaching contexts [4].

This research contributes significantly to introductory programming education by (i) understanding student engagement with ChatGPT and investigating their use of prompts when learning to program and (ii) developing a pedagogical framework that integrates ChatGPT through a human-centered approach. The poster provides an overview of the research design.

References

[1] Terry Anderson and Julie Shattuck. 2012. Design-Based Research: A Decade of Progress in Education Research? *Educational Researcher* 41, 1 (Jan. 2012), 16–25. https://doi.org/10.3102/0013189X11428813

[2] Sasha Barab and Kurt Squire. 2004. Design-Based Research: Putting a Stake in the Ground. *Journal of the Learning Sciences* 13, 1 (Jan. 2004), 1–14. https://doi.org/10.1207/s15327809jls1301_1

[3] Ritvik Budhiraja, Ishika Joshi, Jagat Sesh Challa, Harshal D. Akolekar, and Dhruv Kumar. 2024. "It's not like Jarvis, but it's pretty close!" - Examining ChatGPT's Usage among Undergraduate Students in Computer Science. In *Proceedings of the 26th Australasian Computing Education Conference (ACE '24)*. ACM, New York, NY, USA, 124–133. https://doi.org/10.1145/3636243.3636257

[4] Tony Hall. 2020. Bridging Practice and Theory: The Emerging Potential of Design-based Research (DBR) for Digital Innovation in Education. *Education Research and Perspectives: An International Journal* 47 (2020), 157–173.

[5] Susan E. McKenney and Thomas C. Reeves. 2019. *Conducting educational design research* (second edition ed.). Routledge, London ; New York.

[6] Fengchun Miao and Wayne Holmes. 2023. *Guidance for generative AI in education and research | UNESCO*. UNESCO. https://www.unesco.org/en/articles/guidance-generative-ai-education-and-research

[7] Brad Sheese, Mark Liffiton, Jaromir Savelka, and Paul Denny. 2024. Patterns of Student Help-Seeking When Using a Large Language Model-Powered Programming Assistant. In *Proceedings of the 26th Australasian Computing Education Conference (ACE '24)*. Association for Computing Machinery, New York, NY, USA, 49–57. https://doi.org/10.1145/3636243.3636249

[8] Irene Stone. 2024. Exploring Human-Centered Approaches in Generative AI and Introductory Programming Research: A Scoping Review. In *Proceedings of the 2024 Conference on United Kingdom & Ireland Computing Education Research (UKICER '24)*. Association for Computing Machinery, New York, NY, USA, 1–7. https://doi.org/10.1145/3689535.3689553