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Generative AI in University Programming Courses - A Survey of Student Practices and Perspectives

Mio Tsubakimoto *

Abstract

This study explored the optimal design and execution of programming courses in the era of generative AI. This study was based on a survey of students enrolled in this course. Specifically, this study investigated students' actual use of ChatGPT and their perceptions of the value of learning programming. The investigation targeted students enrolled in an applied course in the Mathematical and Data Science Minor at a comprehensive university. Subsequently, the findings were used to study the implications of the designs of examinations and assignments. The survey revealed that 80% of the respondents had experience using ChatGPT, and the purposes of use varied depending on their prior programming experience. Additionally, students were apprehensive regarding the fairness of evaluating assignments and examinations when generative AI tools are employed. In response, a series of countermeasures has been proposed, including the implementation of in-person assessments that prioritize coding aptitude and reasoning and comprehension skills. Conversely, another counterargument posits that programming education should assess the ability to use AI effectively as a practical tool.

Keywords: AI Literacy, Higher Education, Generative AI, Programming Education

1 Introduction

Generative AI has spread rapidly throughout society, and it is nearly impossible to exclude it from the learning environments of undergraduate and graduate students. Although many types of generative AI exist, the categories that pose problems in most university educational settings are likely text and program code generation. OpenAI's ChatGPT is a generative AI that combines these two functions [1] and has been rapidly adopted globally [2]. In higher education, there is an urgent need to consider learning and teaching methods in a world where ChatGPT exists. For programming-related questions, ChatGPT generates relatively accurate code. Proposals have been made for educational agents to leverage this feature [3], suggesting that the use of ChatGPT in programming education is likely to expand.

However, research regarding how programming learners utilize AI remains insufficient. Furthermore, no study has thoroughly considered how to conduct class assignments and exams in environments in which ChatGPT is freely accessible.

This study investigates the actual use of generative AI by programming learners. It targeted students enrolled in a specific applied course within the Mathematics and Data Science minor program at University A, a comprehensive university in Japan.

* The University of Electro-Communications, Tokyo, Japan

2 Method

The participants were students enrolled in an applied course offered in the fall semester of 2023, as part of the Mathematical and Data Science Minor program at University A. Their academic levels ranged from second-year undergraduate to second-year master's degree. As the course was part of a minor program, it included students from humanities and science backgrounds. The course focused on text-mining techniques using the R programming language and included lectures and hands-on programming exercises.

The survey was created using Google Forms and explicitly stated that it aimed to explore "the use of generative AI (ChatGPT) in university learning." The author (as a teacher) distributed a link to the form via the university's learning management system, and students responded to the survey during class. Although participation was voluntary; students who completed the survey received a small amount of credit for their course grades. To this end, the survey was conducted with students' names attached.

At the time of the survey (fall semester of 2023), multiple generative AI tools were made publicly available. Nevertheless, the questions focused specifically on ChatGPT, which was considered the most commonly used platform among students and faculty members.

3 Results

Twenty students responded to the questionnaire. The results for each survey item were as follows:

3.1 Students' Experience with ChatGPT

Students were asked whether they had ever used ChatGPT. The questions were binary ("yes" or "no"). Consequently, 80% of respondents (16 students) reported using ChatGPT. Those who answered "No" were asked to describe their reasons in an open-ended format. Their responses are as follows:

- "It feels like cheating."
- "I have not had a chance to use it and do not know any convenient ways to do so."
- "As there have been cases in which AI has caused harm to creators (although I am not one myself, I empathize with their position), I avoid using it."
- "I feel that using it would deprive me of opportunities to think for myself."

3.2 Types of Learning Activities for Which ChatGPT Was Used

For students who reported using ChatGPT, the survey asked questions about the types of learning activities in which they used it. Six categories were presented, and students rated the frequency of their use on a four-point Likert scale (4 = very often, 3 = somewhat often, 2 = rarely, 1 = never). These six categories were uniquely developed for this study based on the instructor's regular observations of students and informal conversations with them. The results revealed two central tendencies.

(1) Students tended to use ChatGPT more frequently outside class, particularly for reviewing course materials, completing assignments, and preparing reports or presentation slides, rather than during class sessions.

(2) In addition to class-related learning, some students used ChatGPT for self-study or research activities beyond the course.

The distribution of responses across all six categories is shown in Figure 1.

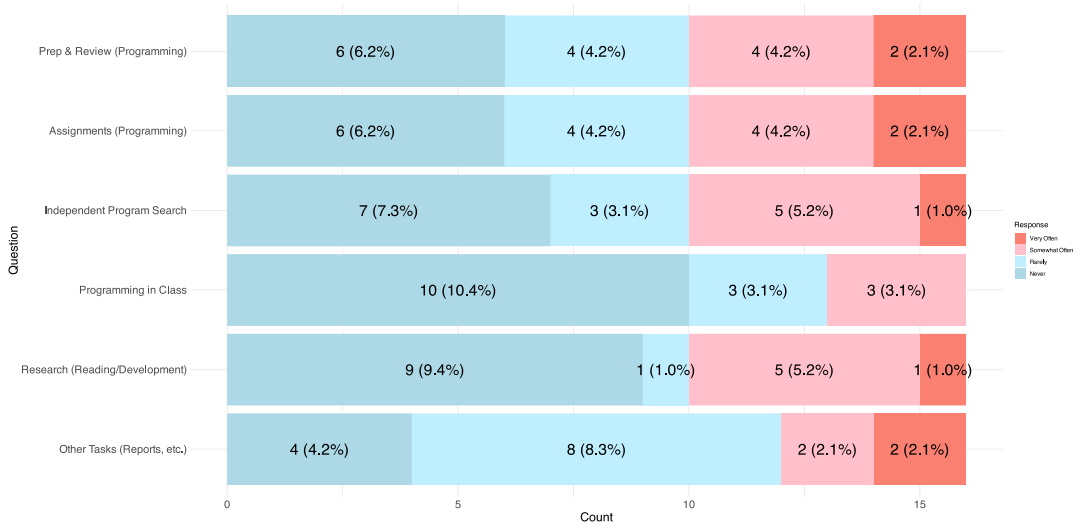

Figure 1: Use Cases of ChatGPT

3.3 Differences in Responses by Programming Experience

Among the students who reported using ChatGPT, responses were further analyzed according to their programming experience: within 6 months (N = 4, Group 1), 6–12 months (N = 8, Group 2), and over 1 year (N = 4, Group 3). For each group, the distributions for the six items described in Section 3.2 were shown in Figure 2. As the number of students in each group was small, the findings should be interpreted with caution. Nevertheless, several trends can be observed in Figure 2.

The students in Group 1 tended to use ChatGPT actively for class-related purposes—reviewing programming lessons, completing assignments, and preparing presentation materials. Students in Group 2 used ChatGPT for course review but showed a decreasing tendency in overall use. Simultaneously, some began using ChatGPT to explore programming languages or code examples beyond what was taught in class—they were using it for more independent and advanced learning outside formal coursework. They used ChatGPT less frequently for preparing reports or presentations. Finally, students in Group 3 tended to use ChatGPT less for coursework and more for research-related contexts, their independent research, and project work.

3.4 Measures Against Plagiarism in Programming Exams and Assignments

In formative and summative assessments conducted in programming courses, students are typically required to write functional programs and present their results. However, when these assessments are conducted as take-home assignments, plagiarism using ChatGPT becomes possible.

To explore possible countermeasures, students were asked to propose ideas freely and respond from the perspective of those who would take and be evaluated on exams or assignments.

The following suggestions were made. As the survey was conducted in a programming-related course, the responses naturally reflected the context of programming education.

- Evaluate students' level of understanding and reasoning ability.
- Provide problems that require students to demonstrate their thinking.
- Require code submission and written explanations, such as "Why is this process necessary?" or "What are the advantages of using this function?"
- Devise alternative methods for administering exams and assignments.
- Conduct assessments in person; if conducted remotely, use screen recording to ensure fairness.
- Award additional credit for original ideas or unique solutions that show independent trial and error.
- Encourage the appropriate use of AI.
- Recognize ChatGPT use as a programming skill and evaluate the ability to utilize AI effectively.
- Design exams and assignments assuming ChatGPT will be used.

3.5 Perceived Value of Learning Programming

Finally, the students were asked an open-ended question regarding the significance of learning programming. Their responses were as follows:

- To cultivate thinking and creativity.
- To fulfill one's social responsibility.
- To prevent the decline of independent thinking caused by overreliance on AI.
- To develop the communication skills necessary for giving precise instructions to AI.

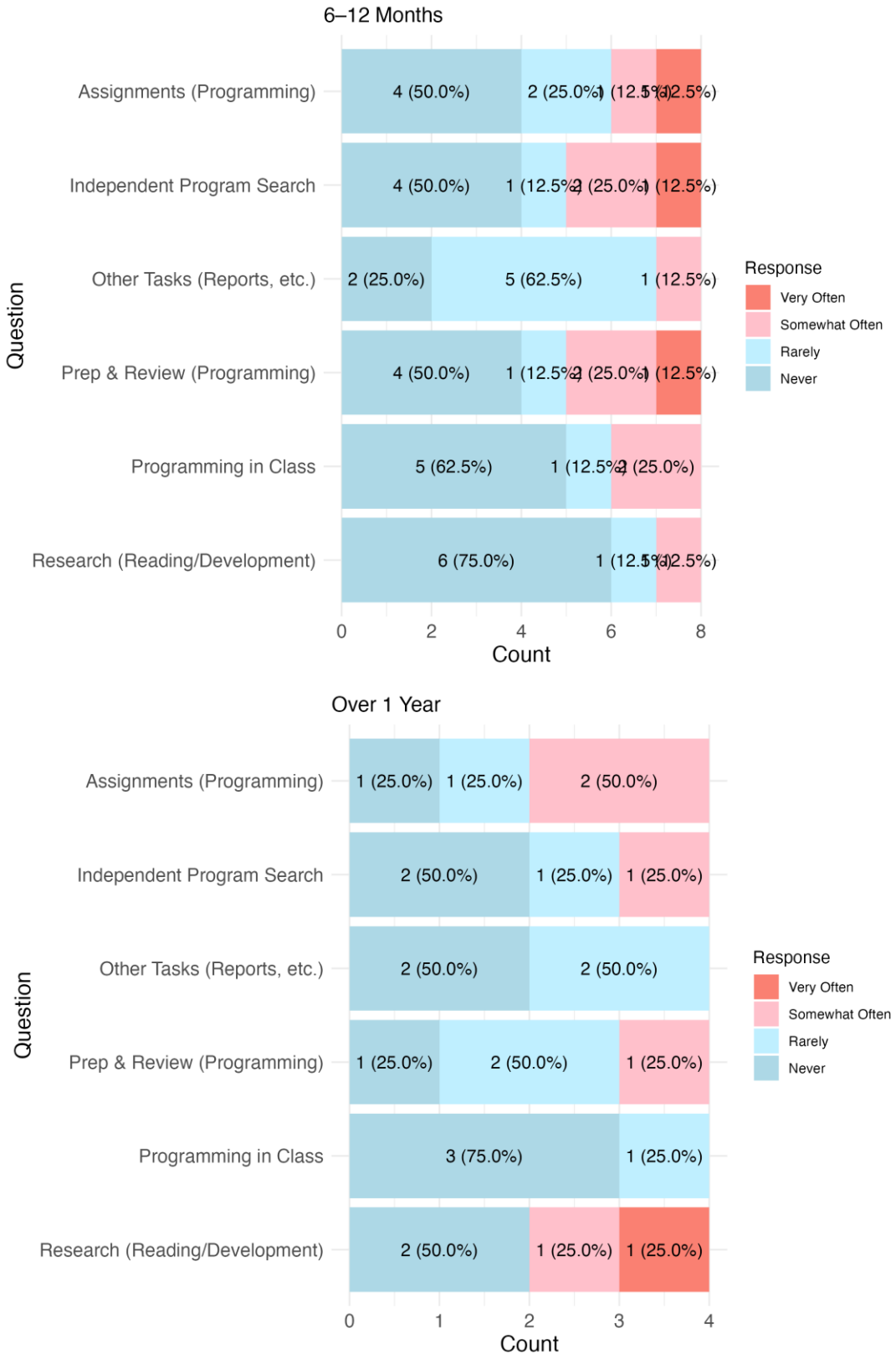

Figure 2: Response Distribution by Programming Experience

4 Discussion

At the undergraduate level, completing assignments and engaging in reviews and preparations are fundamental learning activities. Conversely, at the graduate level, reading academic papers and developing systems are at the core of research practice. The results of this study indicate that students use ChatGPT in the input and output phases of their learning and research. However, this does not suggest a tendency to delegate thinking entirely to AI. Instead, students appear to draw clear boundaries and engage with ChatGPT as users of AI rather than being used by it. This may reflect the characteristics of the sample, as the participants were students enrolled in the Mathematical and Data Science Minor program, who generally possess higher levels of data literacy.

Given the widespread availability of ChatGPT, it is no longer feasible to exclude its use in the classroom or independent learning settings. A more constructive approach would be for instructors to encourage students to consider and practice the "appropriate use" of such tools. For example, instructors and teaching assistants can explicitly demonstrate how to use ChatGPT effectively for programming tasks or report writing within the classroom, allowing students to experiment with these methods under guidance. Providing students with opportunities to use ChatGPT in a supervised environment and share their reflections on the experience could help them learn to use this new tool safely and responsibly, reducing instances of academic misconduct.

Therefore, educators should actively explore, through their teaching practice, how they can safely and productively integrate tools such as ChatGPT into traditional learning tasks.

Acknowledgment

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