

Implementing the AI-Lab Framework: Enhancing Introductory Programming Education for CS Majors

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ABSTRACT

The study explores the integration of the AI-Lab framework, which guides the ethical and effective use of ChatGPT, in data structures and algorithms courses for Computer Science and Data Science majors, impacting nearly 400 students during Spring 2024. By enabling students to develop conceptual questions and C++ and Python programs while iteratively correcting AI-generated errors, the framework promoted skill development without compromising academic integrity.

Feedback from focus groups and post-intervention surveys indicated positive experiences, with students appreciating AI's assistance in non-major tasks and professors' guidance on best practices, which mitigated concerns about academic dishonesty and fostered a supportive learning environment. Despite recognizing the risks of overreliance on AI, students valued its practical utility. The study underscores the need for structured AI training to balance technical proficiency and ethical AI usage, offering insights for broader educational applications.

PREVIOUS WORK

Research specifically studying the impact of GenAI on student learning is still in its infancy:

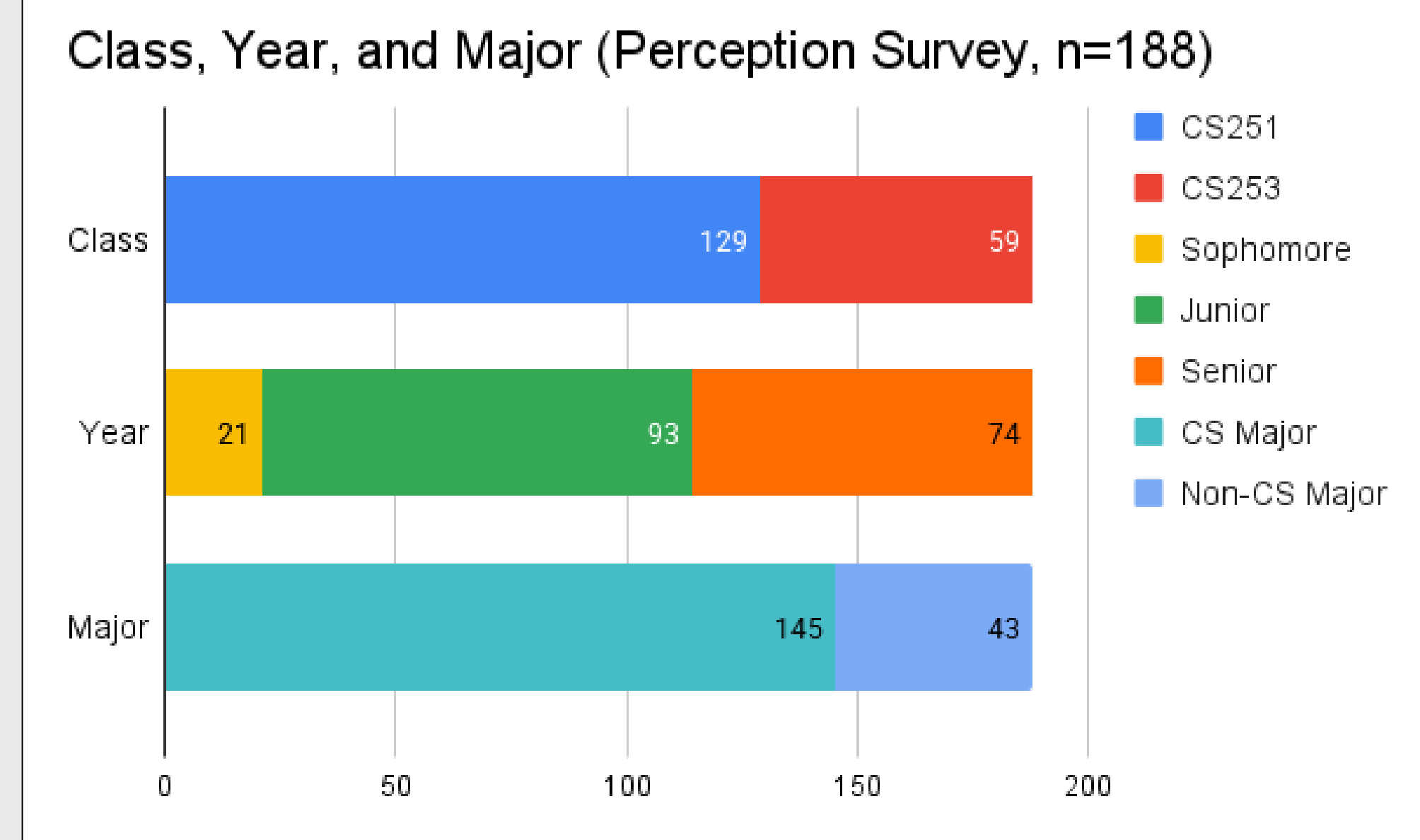
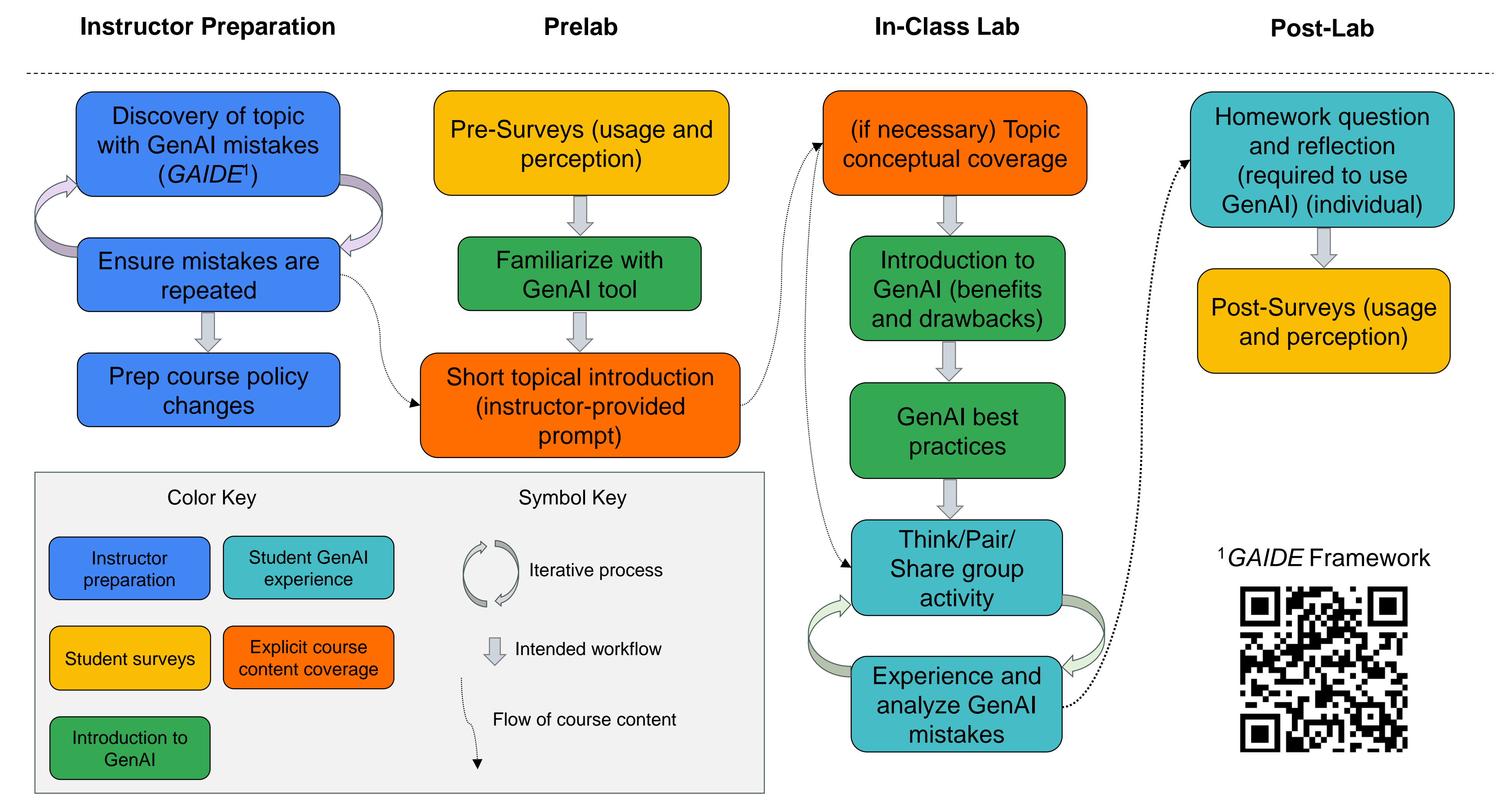
- A survey by Codio revealed frequent use of AI tools among students in computing courses, although the sample was skewed towards older participants (71% were 30 or older) [1].
- Habib et al. investigated the effect of GenAI on student creativity, noting both negative impacts on creative confidence and potential support for creative thinking [2].
- Yilmaz and Yilmaz found that GenAI positively influenced computational thinking, self-efficacy, and motivation, making it an effective tool for teaching programming [3].

AI-LAB

The AI-Lab framework is designed to integrate GenAI tools into educational settings to enhance learning outcomes. The primary goals of the AI-Lab are to familiarize students with the effective use of GenAI, highlight its limitations, and stress the importance of developing robust skills that extend beyond the capabilities of AI assistance [4]:

- Encourages students to use GenAI to answer course-content-based questions and deepen their understanding of course material.
- Introduces more complex problems that GenAI cannot solve accurately, illustrating the risks of over-reliance on AI tools and emphasizing the need for fundamental skill development.
- Concludes with a session where students reflect on their experiences, critically assessing the limitations of AI and the implications for their learning.

AI-LAB FRAMEWORK



DISCUSSION

The AI-Lab framework effectively integrated GenAI tools, particularly ChatGPT, into the learning process, receiving positive feedback from students who reported increased openness, willingness, and comfort with using these tools for academic assistance.

This structured approach demystified AI and ensured active student participation, demonstrating that with thoughtful implementation, GenAI tools can enhance education while maintaining essential skills.

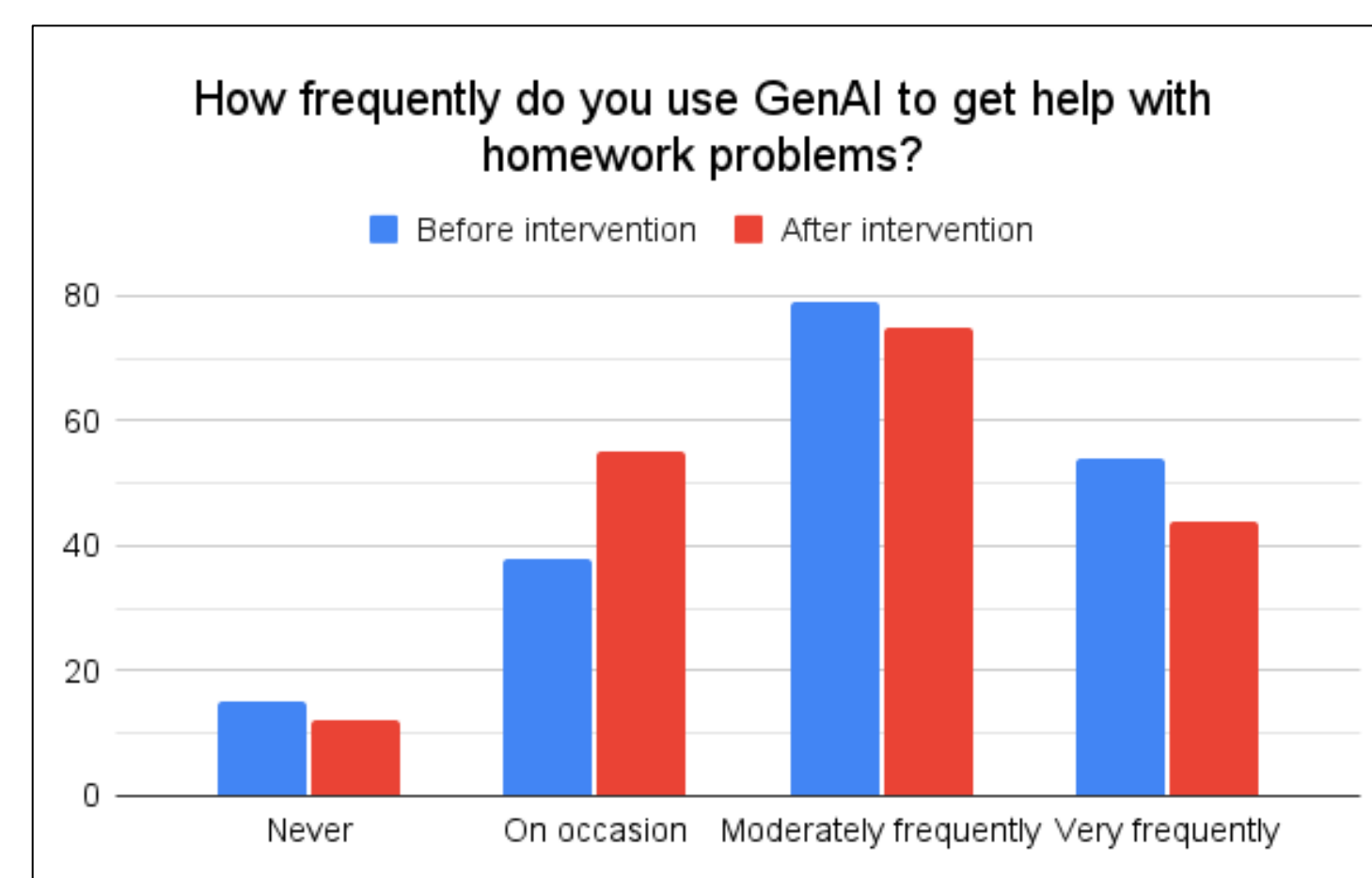
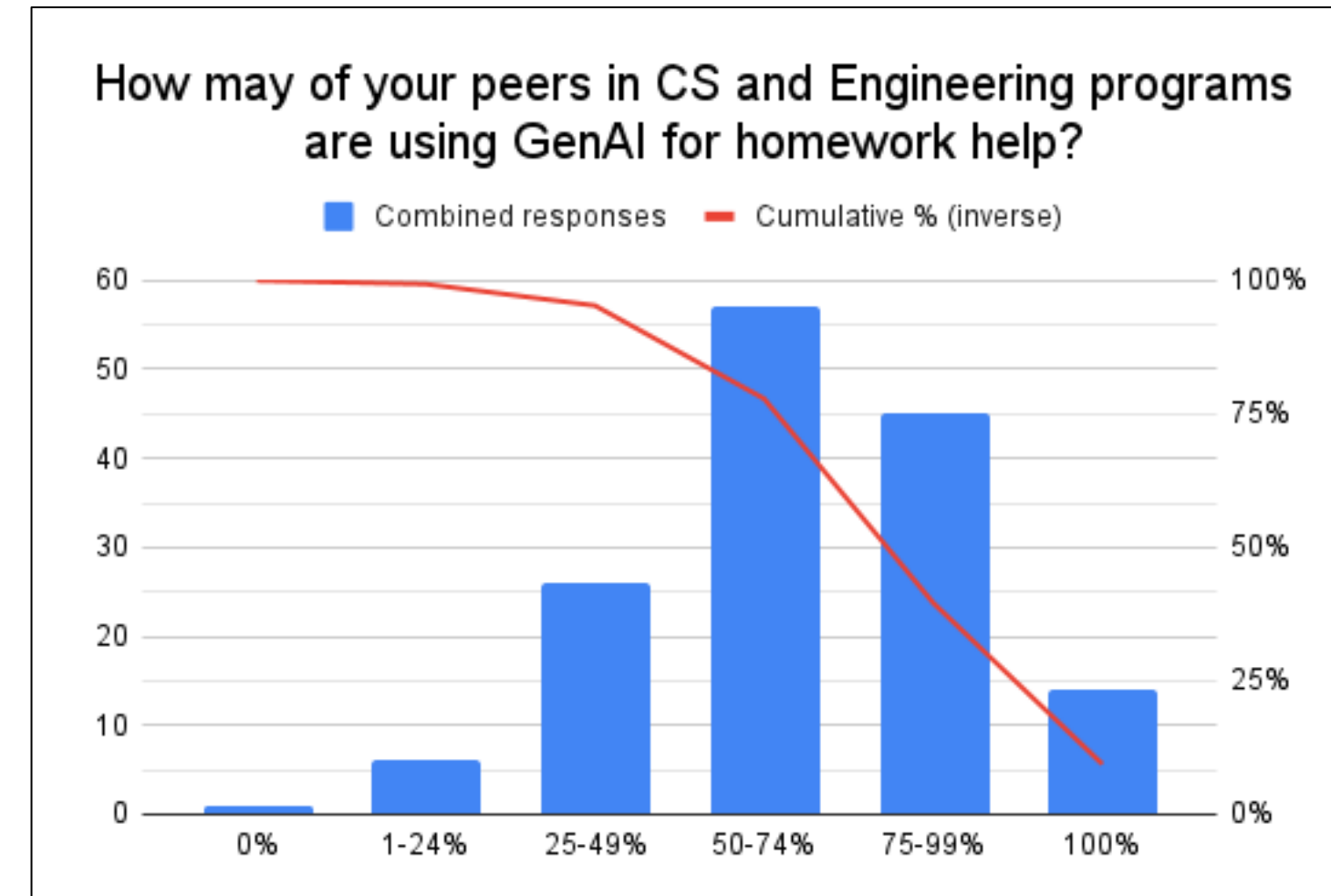
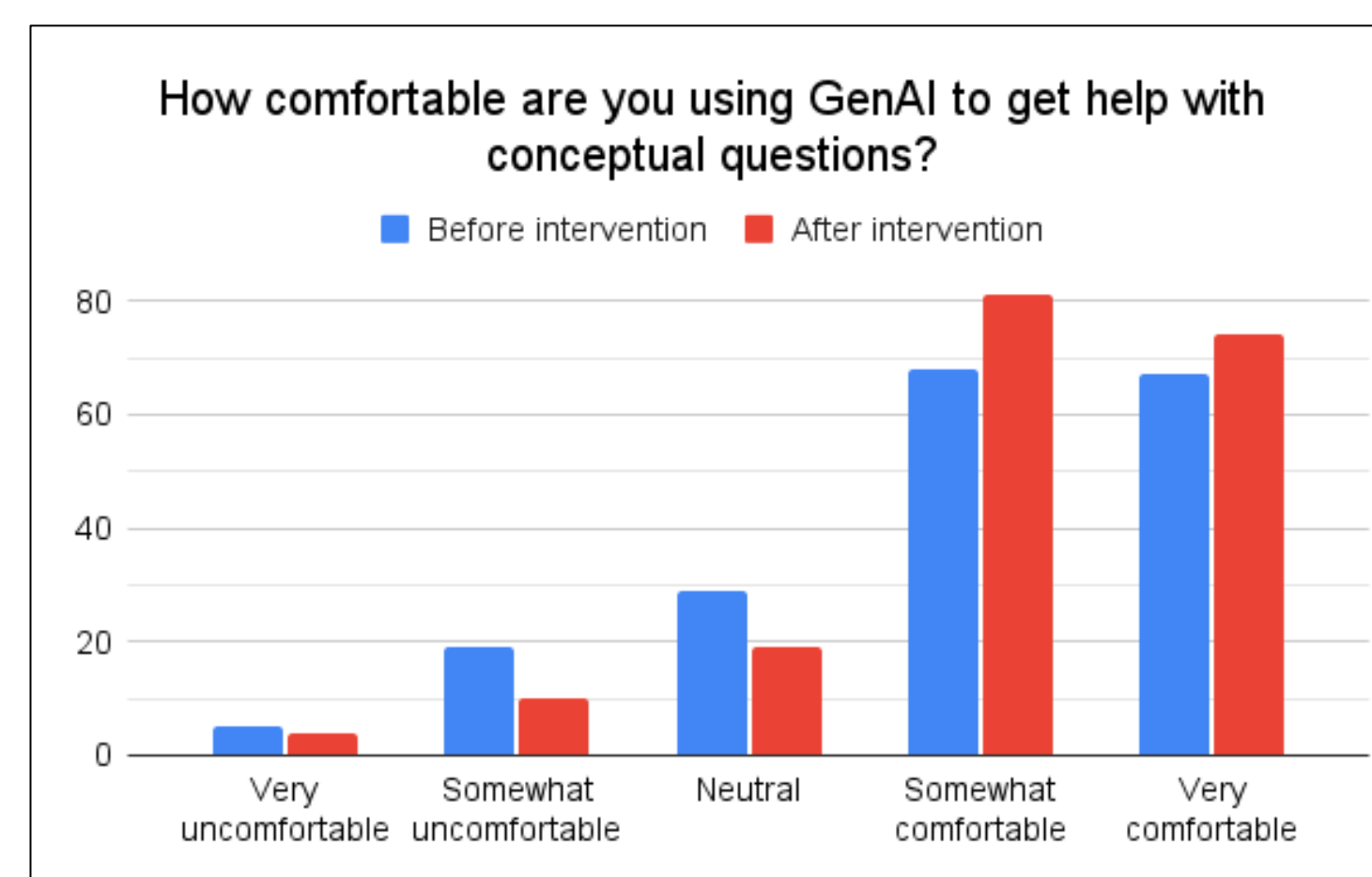
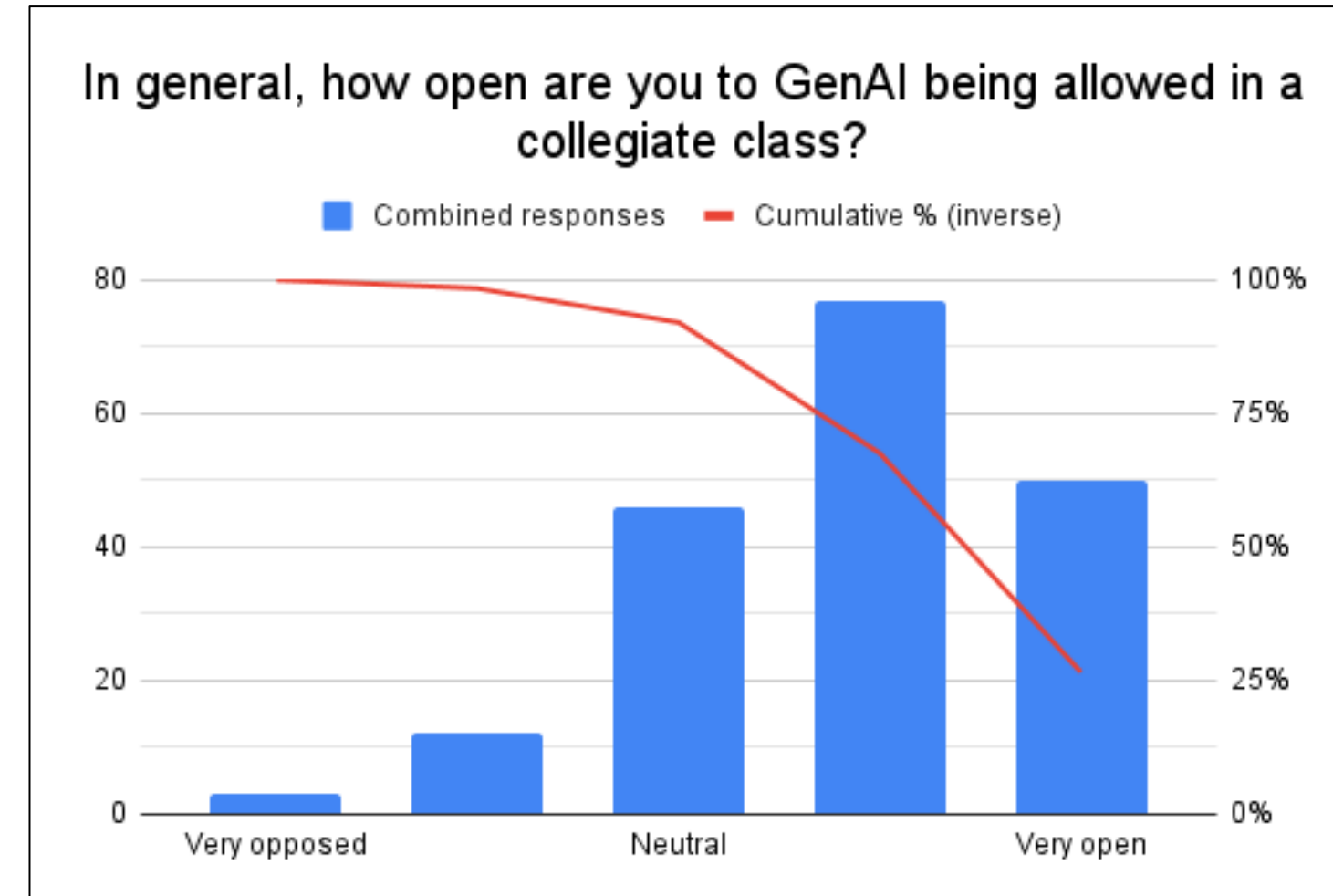
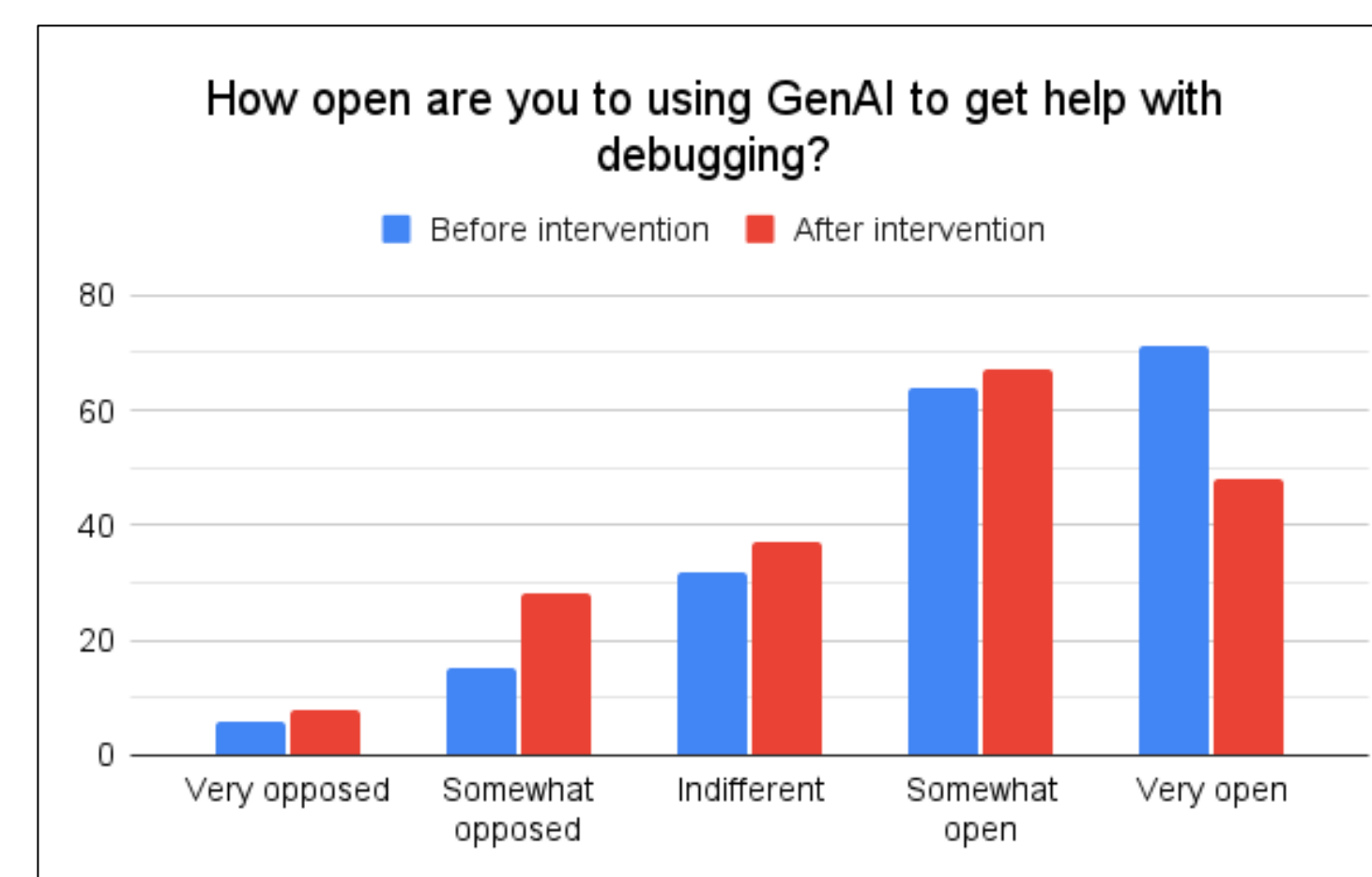
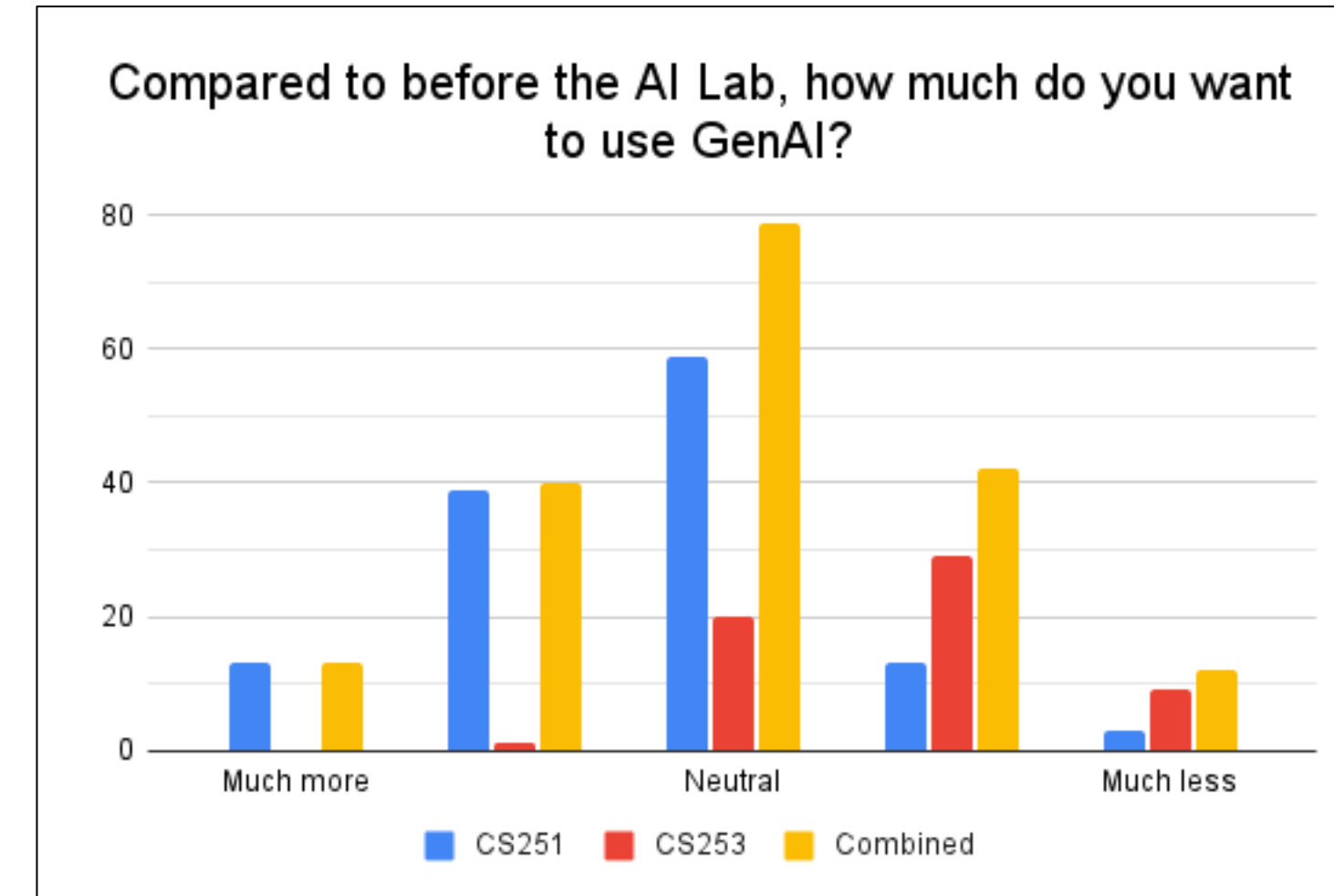
The AI-Lab experience provides a valuable model for integrating AI in programming courses, preparing students for a future where AI is integral to their academic and professional lives.

AI-LAB EXPERIENCE WITH CS AND DS STUDENTS

188 students (out of 381) completed all the required activities. Students were enrolled in Data Structures courses (CS251 and CS253) during Spring 2024. Students were mostly second years in CS and DS majors.

Tests revealed no correlations across measured demographics. Students were provided a bonus for completing all 4 surveys (2 pre, 2 post), but were not required to do so.

The results highlight changes in student perceptions and usage of generative AI tools before and after the intervention.



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