

AI-Generated Meta-Feedback in Student Learning & Collaboration

Poster#: 5

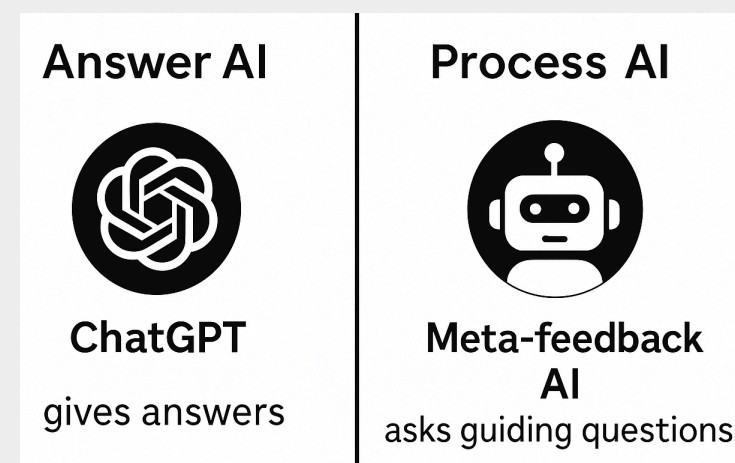
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IRB #: 25-09-32



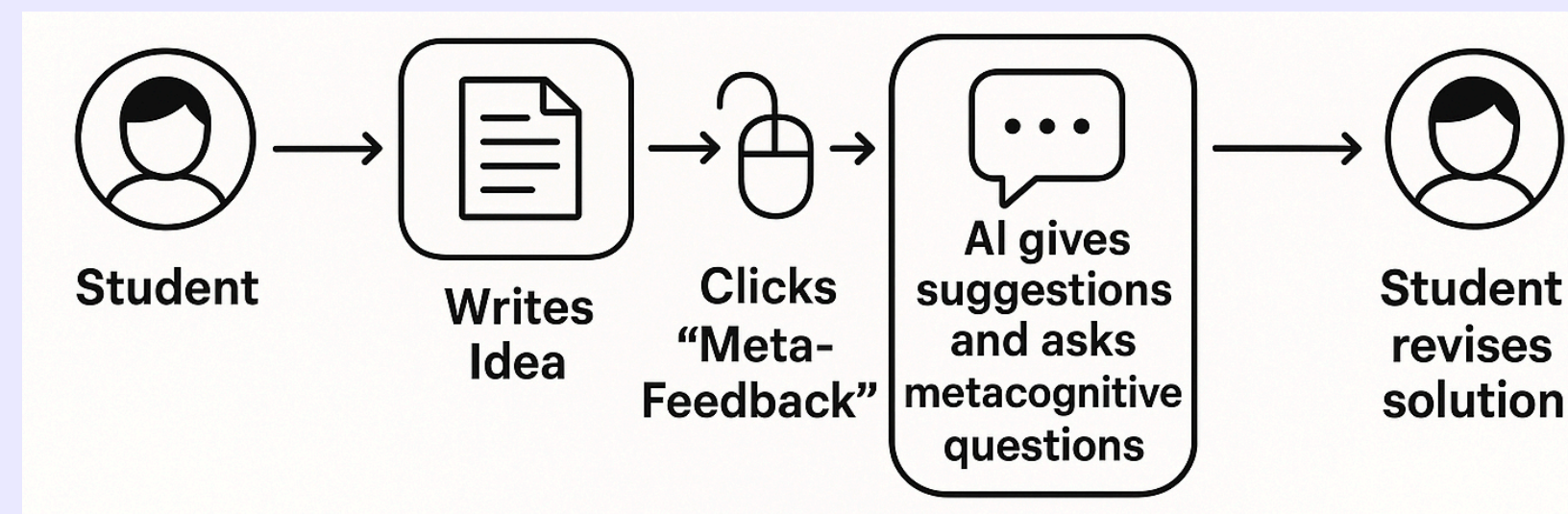
Why Students Struggle in Algorithms Courses?

- Students often ask for answers instead of learning the process.
- Traditional AI tools give content answers → encourages dependency.
- Students lack guidance in how to think, not just what to write.
- We explore how AI-driven meta-feedback can support deeper learning.



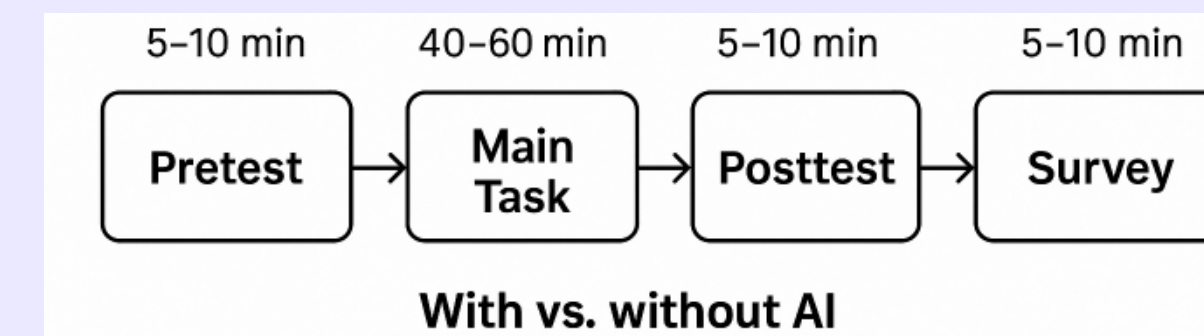
System Design & UI

- Students solve algorithm problems inside our custom UI interface.
- They choose when to request meta-feedback.
- AI provides suggestions and questions only (never answers).
- Feedback is structured according to the 4 cognitive stages.

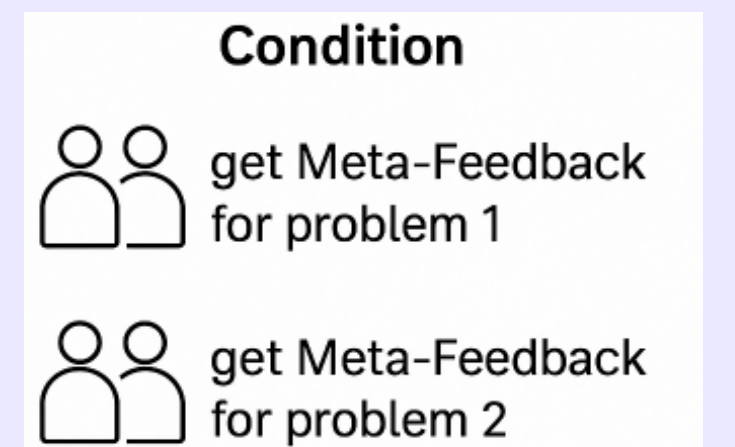


Study Design & Measures

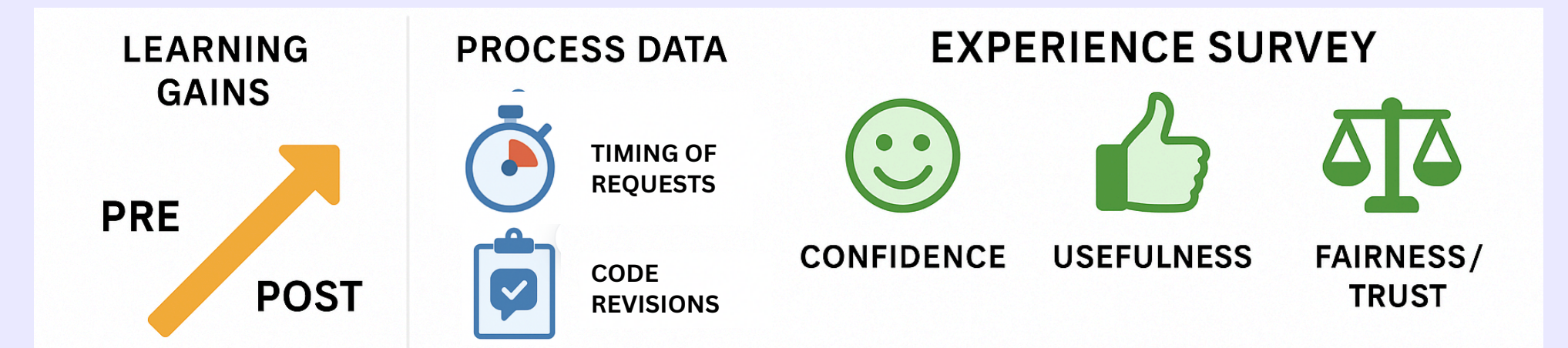
One-Session Controlled Study



With vs. without AI



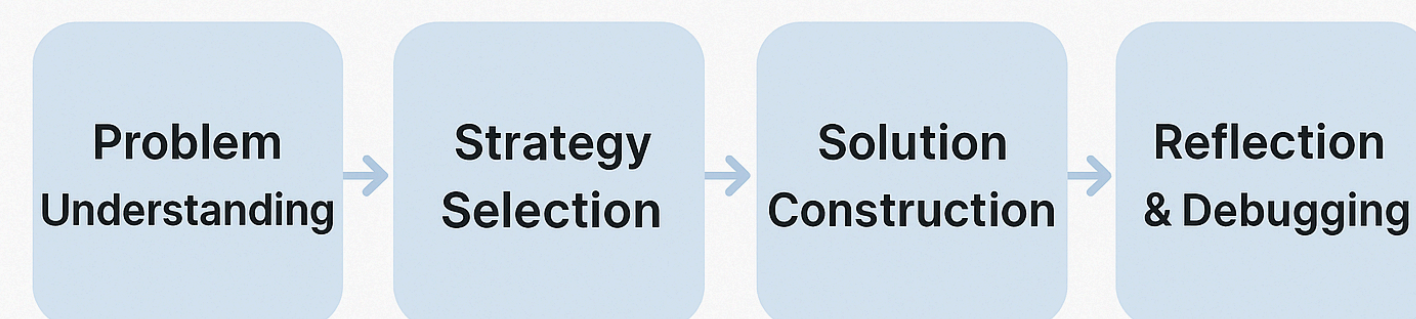
What We Measure



What Is Meta-Feedback?

Meta-Feedback is AI-generated guidance that examines the process behind a student's work, rather than only whether the answer is correct. Meta-feedback forces students to reason, explain, justify, and reflect. Its purpose is to help students better understand their approach, learn from revisions, and strengthen their overall problem-solving skills.

4 Cognitive Stages



Good Meta-feedback Example:

Explain why you chose insertion sort, including its time complexity and advantages on nearly sorted data.
Clarify the key steps of your approach before coding.

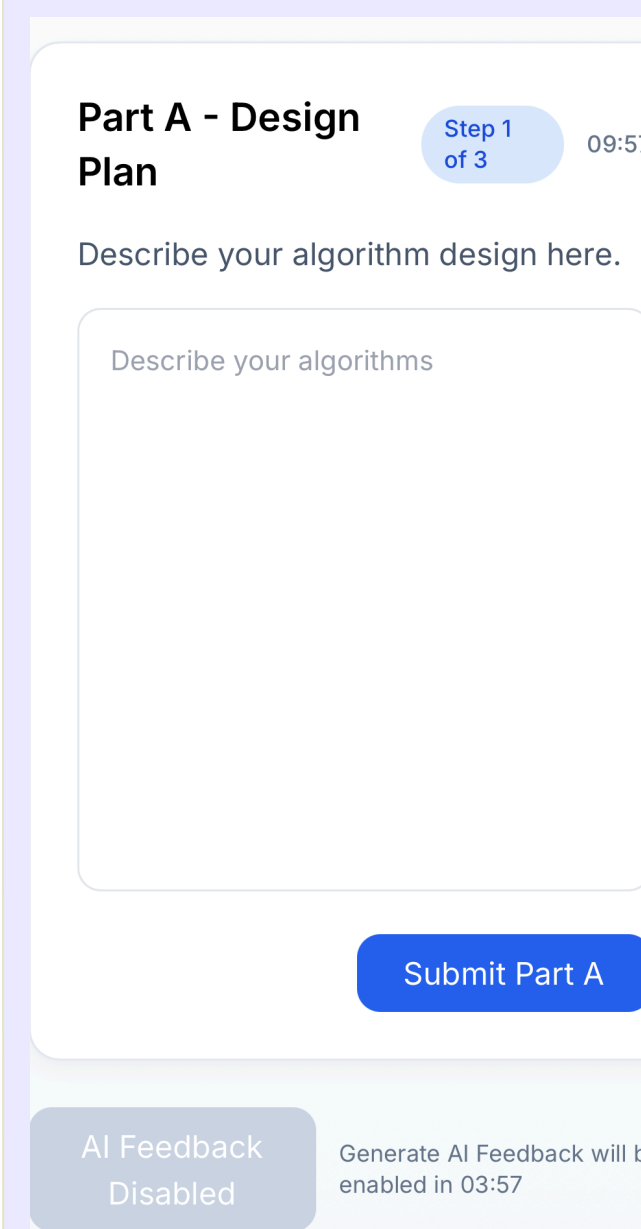
Bad Example:

Use Selection Sort for this problem.

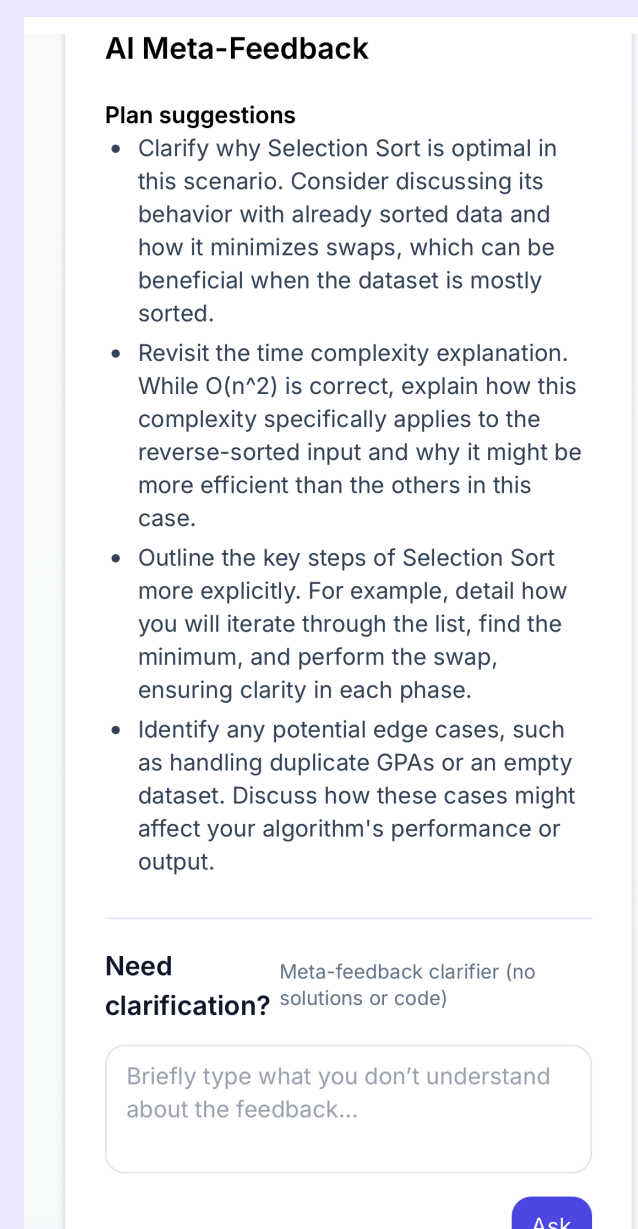
The correct answer is C.

Meta-Feedback Learning Interface

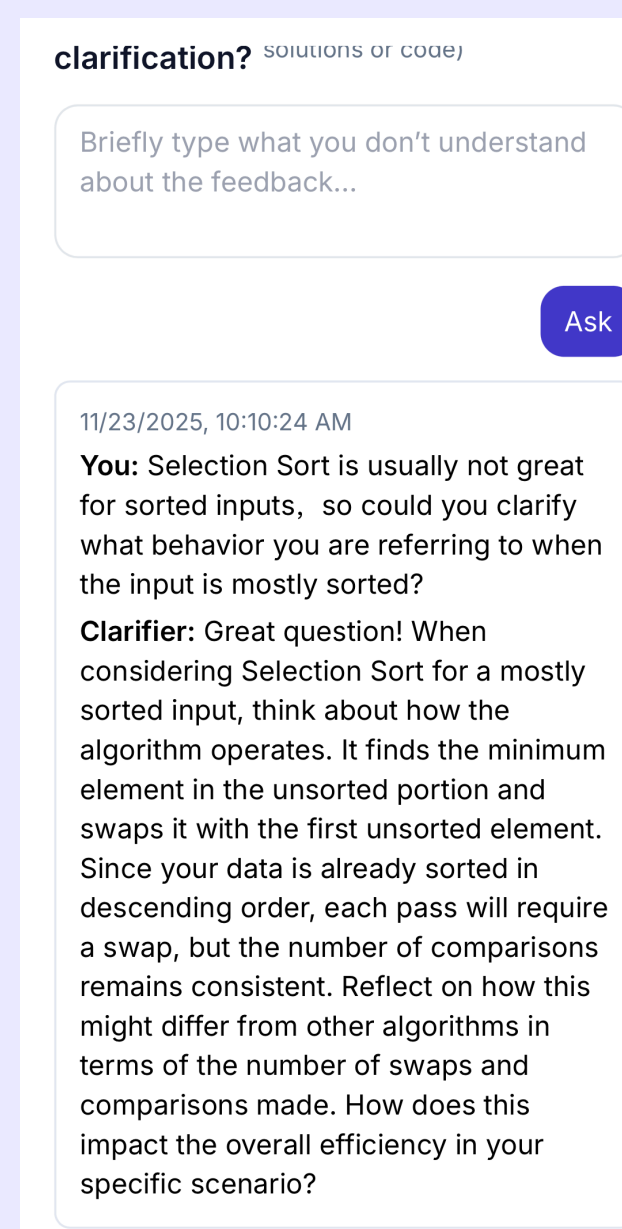
Workspace & Feedback Button



Meta-Feedback Example Interaction Area



Clarification Feedback Example



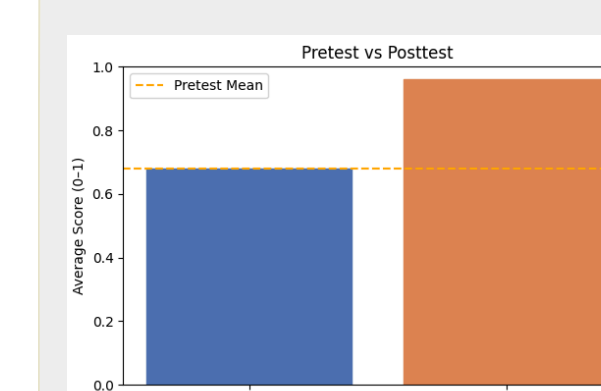
AI Evaluator Example

✗ Incorrect or incomplete. Please revise: The choice of selection sort is not optimal for a reverse-sorted input, as it still has a time complexity of $O(n^2)$, which is not efficient compared to other algorithms like insertion sort that can perform better in this specific case.

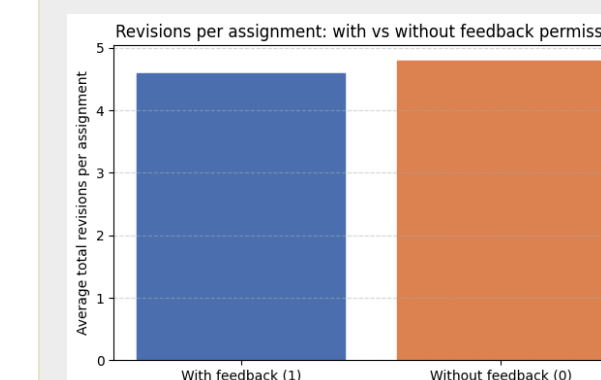
Findings

Study is Ongoing

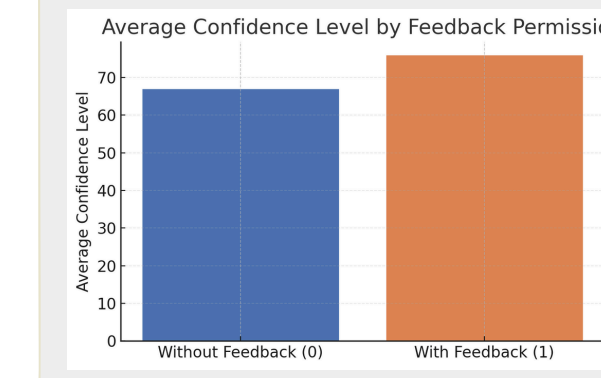
Pretest vs Posttest



Number of revisions



Confidence Level



Insights

- Students who used meta-feedback demonstrated greater learning gains
- Students with access to meta-feedback required fewer revisions before reaching a correct solution
- They also reported higher confidence and clearer problem-solving strategies

Applications section

- Teaching algorithms
- Exam preparation
- Large classes with limited TA support
- Responsible AI adoption in STEM education

References

[1] Xu, S., Su, Y., and Liu, K. (2024). Integrating ai for enhanced feedback in translation revision: A mixed-methods investigation of student engagement. arXiv preprint arXiv:2410.08581.
[2] Zhan, Y. et al. (2025). Students' engagement with chatgpt feedback on ielts writing tasks. Assessment & Evaluation in Higher Education.
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[5] Thomas, P., Fischer, F., Xu, Y., Aroyo, L., and Stumpf, S. (2025). Llm generated feedback supports learning if learners choose to use it. arXiv preprint arXiv:2506.17006