

# Collaborative AI Prompting as a Driver of Metacognitive Awareness and Epistemic Agency in Higher Education

Fabrizio Barpi<sup>1</sup>[0000-0001-8371-5690], Annamaria Miranda<sup>2</sup>[0000-0003-3210-7964], Loredana Saliceto<sup>2</sup>[0009-0009-1601-3870], Alessandro Ciasullo<sup>3</sup>[0000-0001-6271-2554], Gabriella Casalino<sup>4</sup>[0000-0003-0713-2260] and Davide Taibi<sup>5</sup>[0000-0002-0785-6771]

<sup>1</sup> Politecnico di Torino, Turin, Italy, [fabrizio.barpi@polito.it](mailto:fabrizio.barpi@polito.it)

<sup>2</sup> University of Salerno, Fisciano, SA, Italy, [amiranda, lsaliceto@unisa.it](mailto:amiranda, lsaliceto@unisa.it)

<sup>3</sup> University of Naples, Federico II, Naples, Italy, [alessandro.ciasullo@unina.it](mailto:alessandro.ciasullo@unina.it)

<sup>4</sup> University of Bari Aldo Moro, Bari, Italy, [gabriella.casalino@uniba.it](mailto:gabriella.casalino@uniba.it)

<sup>5</sup> CNR-Institute for Educational Technology, Palermo, Italy, [davide.taibi@cnr.it](mailto:davide.taibi@cnr.it)

## 1 Introduction and Theoretical Framework

The growing diffusion of generative AI in higher education has shifted attention toward learners' capacity to formulate, evaluate, and refine their interactions with AI systems [1, 2]. From a Knowledge Building perspective [3], AI functions as a mediating artefact for collaborative knowledge construction, provided learners exercise epistemic agency, the capacity to identify problems, set inquiry goals, and advance knowledge [4], both individually and collectively [5]. Equally central is metacognitive regulation: planning, monitoring, and evaluating one's own cognitive processes [6–9] becomes critical when students must assess AI outputs against authoritative sources and revise strategies accordingly. Given limited research on this intersection, the study asks: *How do metacognitive regulation and collective epistemic agency emerge during collaborative prompt formulation, evaluation, and revision in AI-supported higher education?*

## 2 Methodology

Undergraduates from different Italian institutions joined a shared AI-guided activity across disciplines. The underlying premise was that AI should not replace human reasoning but serve as a tool for critical discussion, deepening understanding of course content and facilitating exam preparation. Working in teams, students used Google NotebookLM to deepen a lesson using course materials, including slides, excerpts, exercises, and videos, as well as self-identified resources, documenting the process in a collaborative logbook. A pre/post Metacognitive Awareness Inventory, MAI-C [8,9], adapted for the project, tracked changes in metacognitive awareness across the activity.

The activity followed a structured iterative cycle. Each student first completed the MAI-C individually and then independently formulated a prompt for the AI, specifying the question, the expected response type, and the strategy they would use to verify the answer. Teams then compared their individual prompts, negotiated a shared version, submitted it to NotebookLM, and critically evaluated the response against course

materials, discussing clarity, completeness, and relevance. Based on this evaluation, they refined and resubmitted the prompt, recording both the revised prompt and the improved response. The cycle closed with individual reflection on any shifts in AI use strategy and a final MAI-C administration. Preliminary analysis examined Salerno students' logbooks, using each group's prompt selection, AI-response evaluation, and revision cycle as the unit of analysis. Researchers iteratively coded the data using Knowledge Building [3] and shared epistemic agency concepts.

### **3 Preliminary Findings**

Episodes showing groups' shared control of the inquiry were coded as collective epistemic agency. Three patterns emerged from the Salerno logbooks. The first concerns metacognitive planning: before querying the AI, teams discussed and evaluated alternative prompts, anticipating learning goals and establishing criteria for assessing responses, engaging in planning and goal-setting regarding the direction of inquiry. One group explained: "We chose this question because it was the most general of the three and would help us gain a better understanding of the other two topics as well."

The second pattern involves monitoring and regulation: after reviewing NotebookLM's output, students identified omissions, insufficient explanations, and missing connections with the content, then revised their prompts, using prompt refinement as a mechanism for monitoring understanding and regulating subsequent learning actions.

The third pattern concerns critical evaluation of AI-generated information: several students shifted from immediate trust toward a more critical stance, progressively treating AI outputs as resources requiring validation against disciplinary knowledge and external references. One student noted: "Before, I used to trust the answers immediately; now I pay much more attention to the quality of the information".

### **4 Conclusions**

Preliminary findings indicate that educational value resides not in AI-generated responses per se but in the collaborative processes of prompt negotiation, evaluation, and revision. Students collectively set learning goals, assessed knowledge claims, identified limitations, and progressively reoriented their inquiry, treating prompts as shared epistemic objects around which knowledge-building processes were organised. Consistent with [1], these findings link collaborative AI questioning to engaged, agentic learning and highlight prompt evaluation and revision as collective mechanisms for validating knowledge and redirecting inquiry. In this sense, the activity generated forms of collaborative prompting that combined metacognitive awareness with collective epistemic agency: rather than consuming AI-generated information passively, students actively negotiated the direction of inquiry and assumed responsibility for evaluating its outcomes. These results position collaborative AI prompting as a promising pedagogical approach, with future analyses set to deepen these findings by integrating logbook evidence with MAI-C data, comparing contexts, and assessing whether changes persist.

## References

1. Rigo, D. Y., Pascual, A., & Guarido, G. (2025). Formular preguntas a la IA para aprender de manera comprometida y agente: Una experiencia en educación superior. *CITAS*, 11(2), 54–74.
2. Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education. *International Journal of Educational Technology in Higher Education*, 16, Article 39.
3. Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 97–118). Cambridge University Press.
4. Scardamalia, M. (2002). Collective cognitive responsibility for the advancement of knowledge. In B. Smith (Ed.), *Liberal education in a knowledge society* (pp. 67–98). Open Court.
5. Damsa, C. I., Kirschner, P. A., Andriessen, J. E. B., Erkens, G., & Sins, P. H. M. (2010). Shared epistemic agency: An empirical study of an emergent construct. *The Journal of the Learning Sciences*, 19(2), 143–186.
6. Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, 34(10), 906–911.
7. Schoenfeld, A. H. (1992). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics.
8. Ciasullo, A., Casalino, G., Miranda, A., Saliceto, L., Barpi, F., & Taibi, D. (2025). From reflection to regulation: A pilot study on Metacognitive Awareness Inventory and the use of generative AI tools in higher education. In *Book of Abstracts HELMeTO 2025, 7th International Conference on Higher Education Learning Methodologies and Technologies Online* (p. 229). University of Naples Federico II.
9. Ciasullo, A., Casalino, G., Miranda, A., Saliceto, L., Barpi, F., & Taibi, D. (in press). Exploring metacognition in math with generative AI: A pilot study of the MAI-C in higher education. *Communications in Computer and Information Science*.