EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

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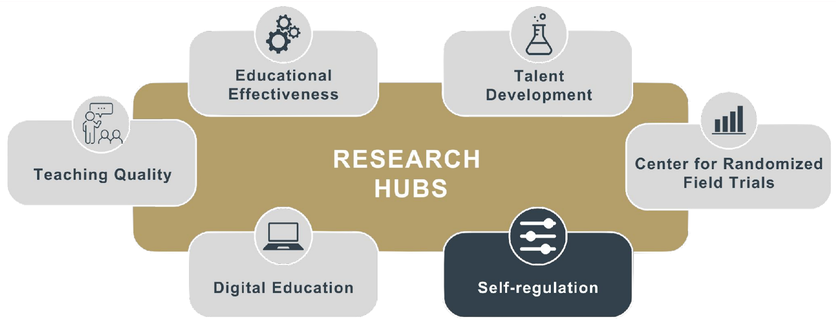
From Prompting to Epistemic Proactivity: Temporal Trajectories of Student–AI Interaction in Mathematics Learning



Rania Abdelghani[1], Peter Kaiser[1,2], Kou Murayama[1]

[1] The Hector Institute of Educational Sciences and Psychology, University of Tübingen, Germany
[2] Department of Mathematics, Faculty of Sciences, University of Tübingen, Germany

Background

- Students are increasingly using (Generative AI) GenAI independently to do learning tasks. However, little is still known about which interaction patterns / strategies can help rather than compromise their active learning.
- For this use to be pedagogically useful, we suggest the need for **epistemic proactivity during AI use:**

- Regulation of the AI towards one's epistemic needs,

- Help-Seeking strategies that seek to support rather than replacement of cognitive work,

- Domain-specific proactive engagement.

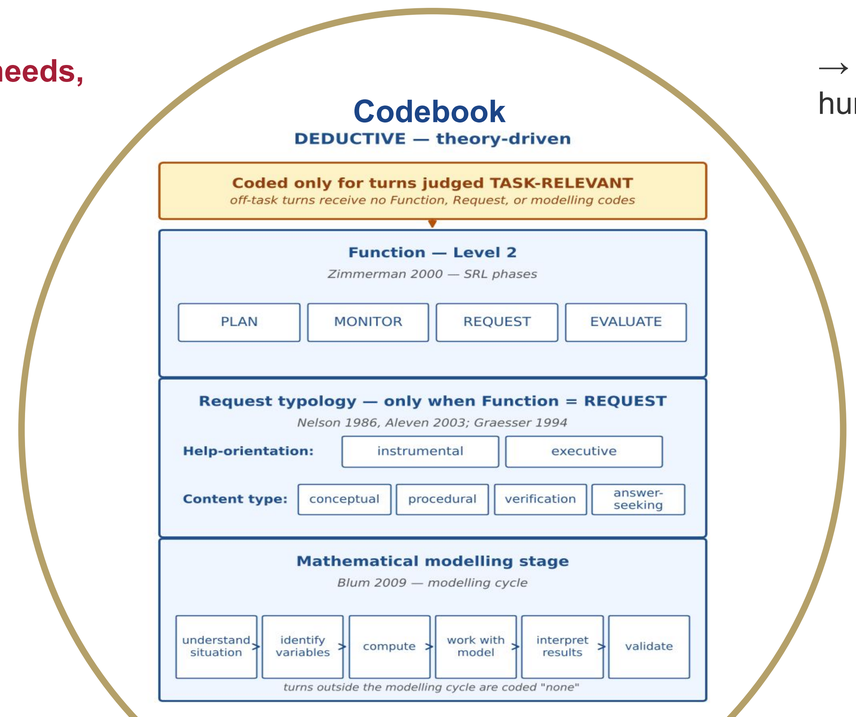
Research Questions and Analysis Method

RQ1: How do students **seek information** and **regulate** their use of an LLM tutor while learning a mathematical-modeling skill?

RQ2: What features of these interactions impact their **independent tasks outcomes**?

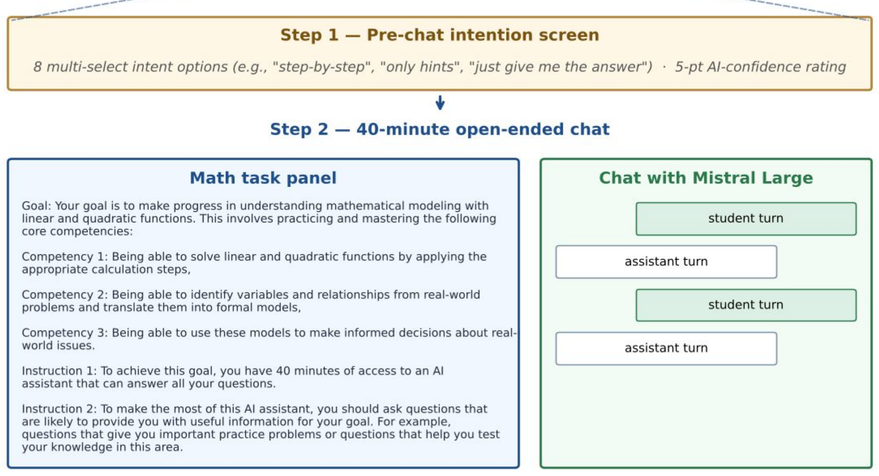
→ We use LLMs to code (cross-validated with human-expert codes):

- **Presence of Self-regulation functions,**
- **Help-Seeking strategies content,**
- **Mathematical modelling activity**

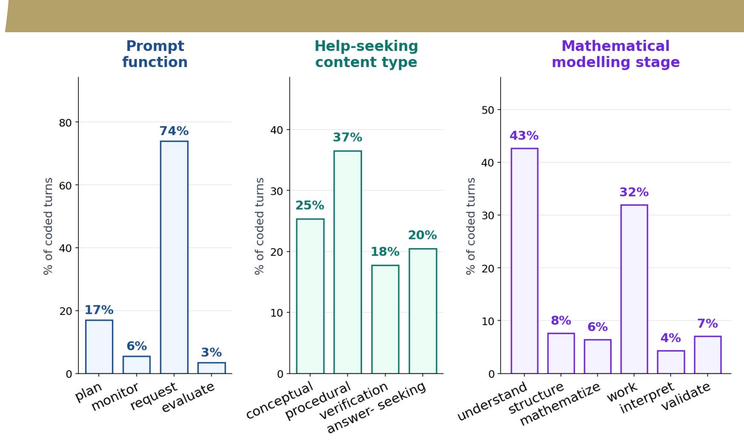


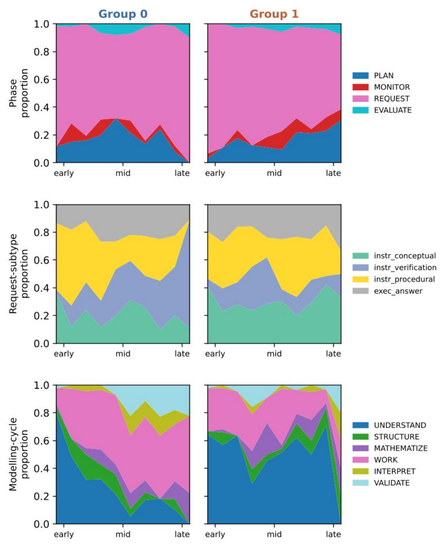
Study Design

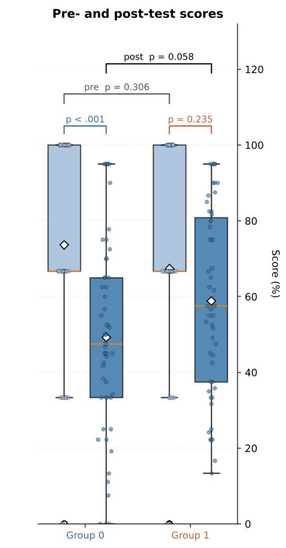
- German schoolchildren (age = 14-15) interact with an AI tutor (Mistral Large) to practice a mathematical skill by asking questions.
- Several measures are also collected: domain knowledge, cognitive load, metacognitive skills, AI knowledge.



Main Results (N= 112)







- Students post-interaction scores were rather low (M= 53.2%; sd=26.4%).
- Students lacked regulation behaviors: planning or monitoring needs, evaluating the AI's answers.

Discussion

Students who were able to keep a **balance** between epistemically-proactive and reactive behaviors, across the whole session, or who were successful in developing such behaviors over time, were the ones with better performance scores.

→ Temporal developments in help-seeking and domain-specific strategies should be monitored during AI use, to better understand students' AI-supported learning.

- They tended to start the interaction with **high-quality help-seeking** and **mathematical modelling** strategies, but shifted toward more **mathematical validation** and **executive answer-seeking** towards the end (i.e less epistemic proactivity).
- These two **temporal shifts** were associated with their learning performance post-interaction (OLS model: F= 8.98, adj-R^2 .3 = , p <.0001).

References

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