

Student Usage of Metacognition-Promoting Tool in a CS2 Course and its Relationship with Performance

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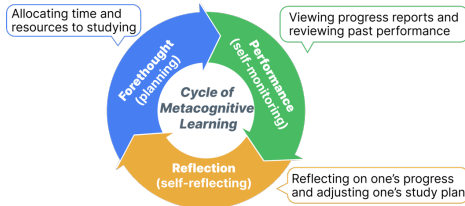
MOTIVATION

Metacognition in Computing:

- Metacognition means "thinking of thinking".
- Metacognitive activities including **planning, self-monitoring, and self-reflecting**.
- Metacognition is correlated to student **outcome improvement** in computing.

Current Challenges:

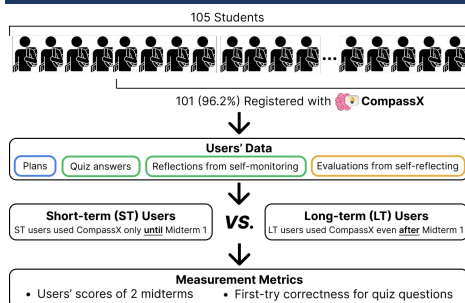
- Metacognitive strategies are rarely taught explicitly in higher education.
- Empirical interventions of metacognition lag behind foundational research.
- Current tools focus on offering cognitive activities but not concept understanding.
- Existing metacognitive interventions do **NOT** promote all three phases of metacognition.



RESEARCH QUESTIONS

- RQ1:** Do students actually engage with different metacognition-based features throughout a course?
- RQ2:** How is student engagement with different metacognition-based features related to their learning outcomes?

METHODS



OUR SOLUTION: CompassX

Self-Monitoring

Customized Quizzing

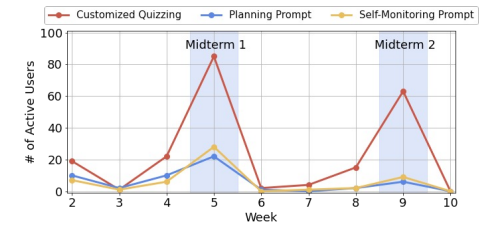
- Creating a custom quiz - selecting topics and # of questions.
- Quiz includes both code tracing and conceptual questions.
- Quiz analytics page helps track learning progress over time
- The quiz analytics page provides past quiz questions, reflections, and performance comparison charts.

Reflection prompt

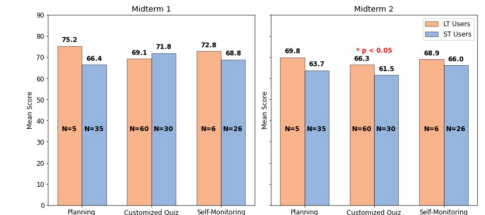
- Users will self-monitor on incorrectly-answered questions by **reflecting** on misconceptions.
- Direct reflection on performance of a single question has been found to be **beneficial to student learning**.

RESULTS & FUTURE WORK

- Students **engaged most** with the Customized Quizzing feature (94/101 users).
- Usage of the planning, self-monitoring, and self-reflecting features was significantly lower.
- Active users for all features **spiked** in the midterm weeks (week 5 & week 9).



- Records indicate that CompassX feature usage and learning outcomes are **correlated**.
- Long-term users of quizzing received **higher scores** in midterm 2, but not in midterm 1.
- Long-term users of planning and self-monitoring also **performed better** than Short-term users
- LT users have **higher first-try quiz correctness**



DISCUSSION

- CompassX is perceived as a **self-assessment tool** for exam preparation
- A **positive relationship** between feature usage and learning outcomes is observed despite overall low engagement
- Positive effects of the metacognition tool might be obscured by low engagement
- CompassX can serve as a **measurement tool** that reflects students' level of metacognition

Future work:

- Encourage more frequent use of CompassX.
- Measure behavioral data more accurately.

Planning

- Users create a **weekly study plan** using the planning prompt.
- Low-performance students tend to study at night and are driven by impending deadlines.
- The planning prompt aimed to help users better **allocate time and resources** to studying.

Self-Reflecting

- Self-reflecting prompt provides a **progress report** and an **evaluation form**.
- Users review their study plans and performance.
- Users are prompted to compare their study progress with their previously set goal in-depth.
- Users **adjust their strategies** and **start a new plan** for the following new phase.