

Investigating the Efficacy of Mastery-Based Tests in Fostering Effective Self-Regulated Learning Behaviors in CS1 Courses

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Motivation

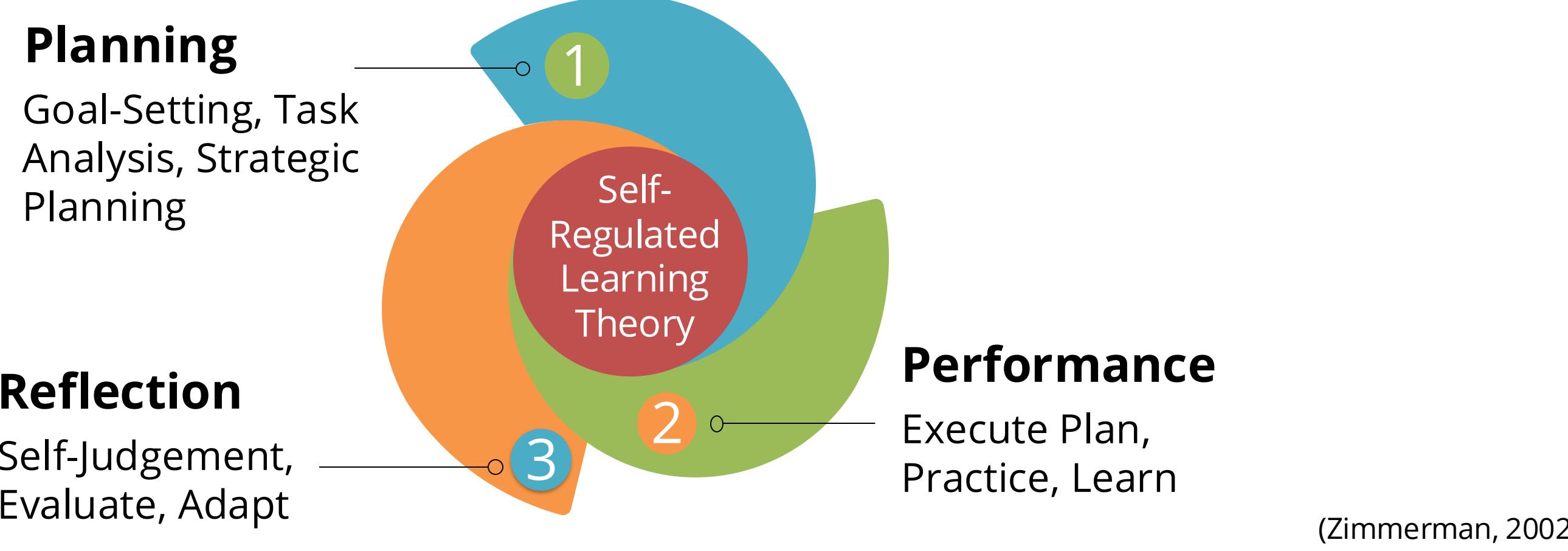
Computer Science (CS) is hard (Bennedsen & Caspersen, 2019).

Students struggle to not only learn how to code, but also identify their own knowledge gaps and study effectively (Luxton-Reilly et al, 2019).

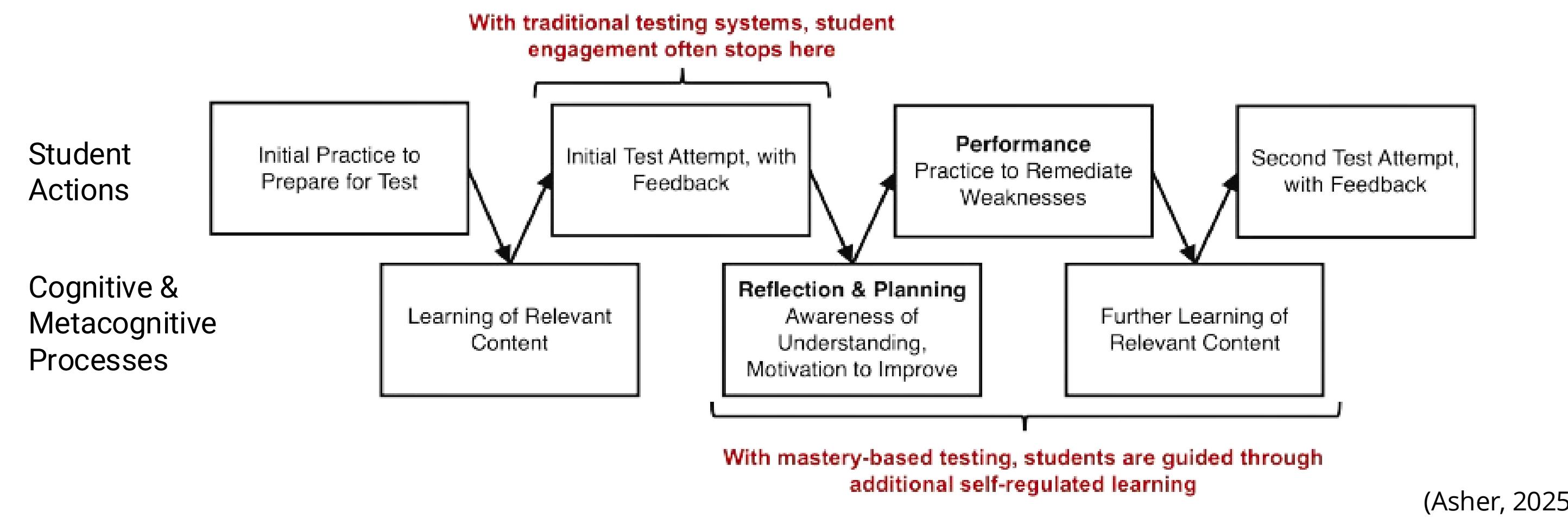
This can lead to inefficient study behaviors and poor learning outcomes (Alvarez et al, 2024).

While MBTs have shown promise in improving student learning outcomes, the causal link between MBTs and underlying student behaviors remain underexplored.

The Cycle of Self-Regulated Learning (SRL)

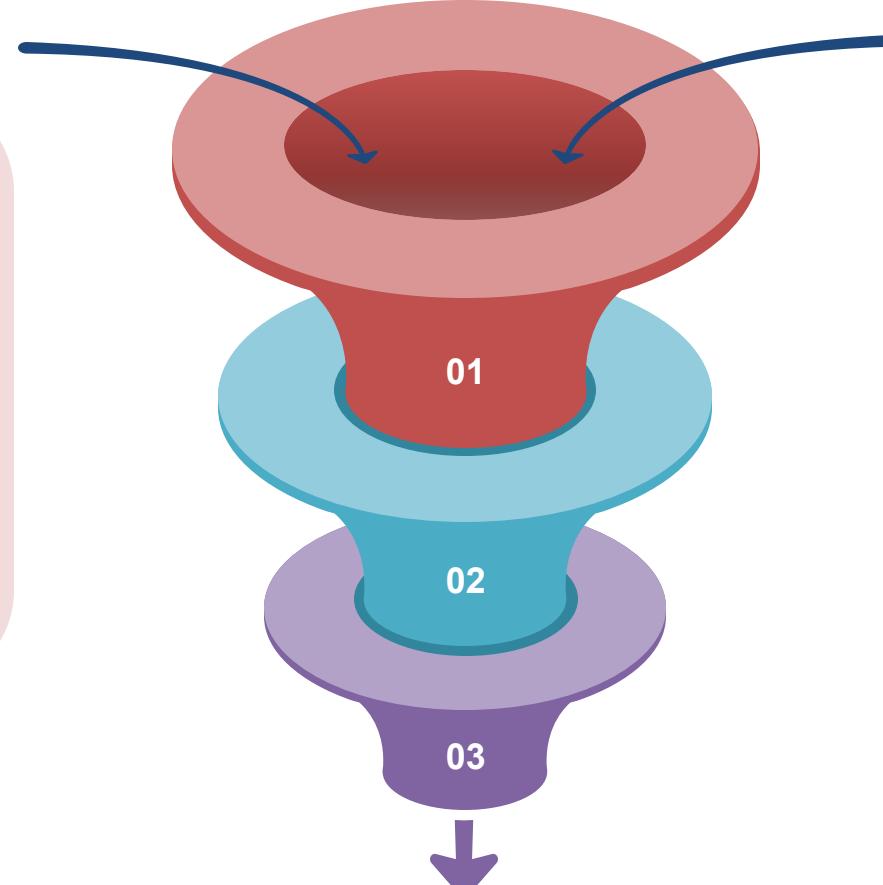


Mastery-Based Testing Model



Core Idea

Problem:
Novice learners struggle with self-regulated learning.
(Arakawa et al, 2021).



Tool:
Mastery-Based Tests (MBTs) show promise in intro CS courses.
(Sindre & Hansen, 2024).

Potential Solution: Use MBTs as an external metacognitive scaffold to help students foster efficient self-regulated learning behaviors.

Predicted Outcome:

(1) Study more efficiently by focusing on difficult topics. (2) Achieve higher post-test scores. (3) Demonstrate more accurate metacognitive judgment.

Related Work

Students who took an MBT did better on a later CS1 exam, but authors cautioned about its generalizability due to probable self-selection bias (Capovilla et al, 2015).

Behavioral evidence that MBTs can effectively motivate SRL, but the study relied on correlational methods and was conducted in a chemistry setting (Asher et al, 2025).

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How does providing an MBT as an external metacognitive scaffold reshape students' SRL behaviors in CS1 courses?

Does this, in turn, lead to better learning outcomes?

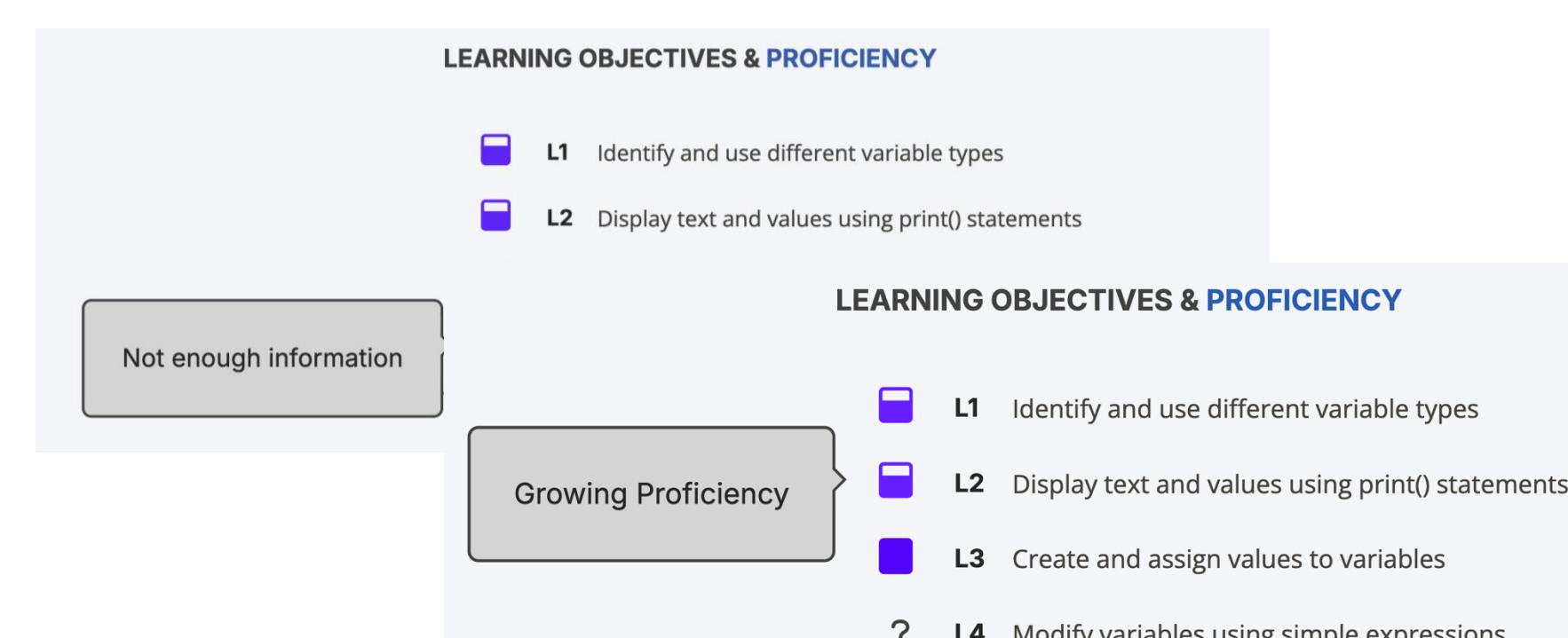
How does this affect students' metacognitive understanding of their own learning?

Learning Module: Intro to Programming in Python

OLI Torus

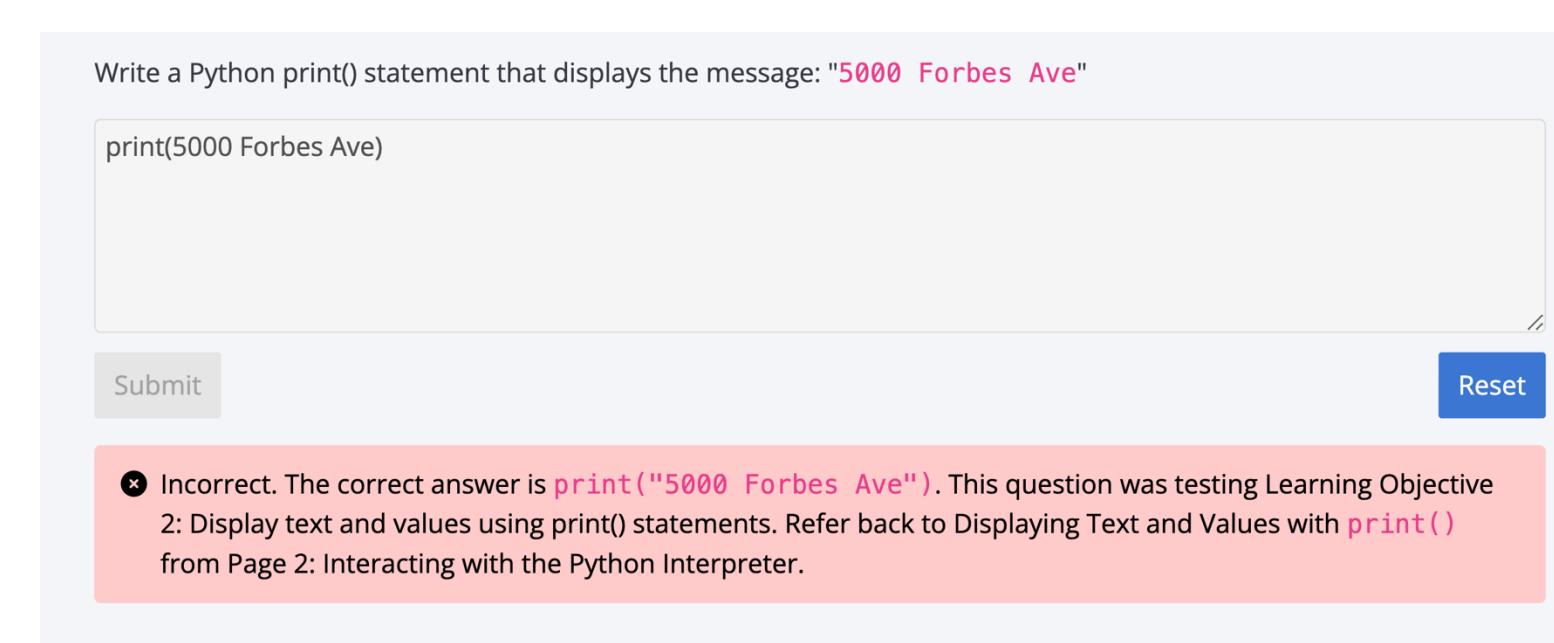
Objective-Forward Pages

Each page of our learning module displays the relevant learning objectives at the top, coupled with a bucket-style mastery progress tracker



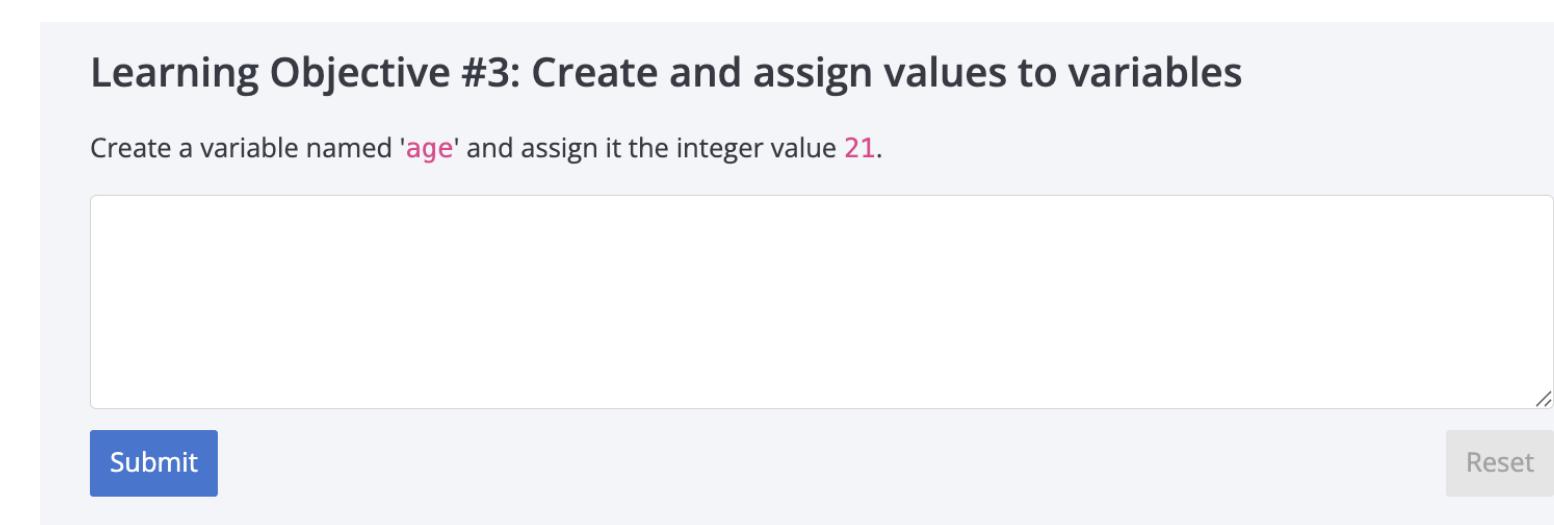
Objective-Linked Feedback

After each question, students receive personalized feedback that points them towards the associated learning objective and course material



Objective-Organized Practice

Practice questions are grouped by objective, allowing students to engage in deliberate practice by targeting areas of weakness



Pilot Study Results

Though pilot scale, the experimental group shows:

1. Higher metacognitive accuracy
2. Higher post-test scores
3. Self-reported productive SRL behaviors

"I used the test questions that I did not have a clue on."

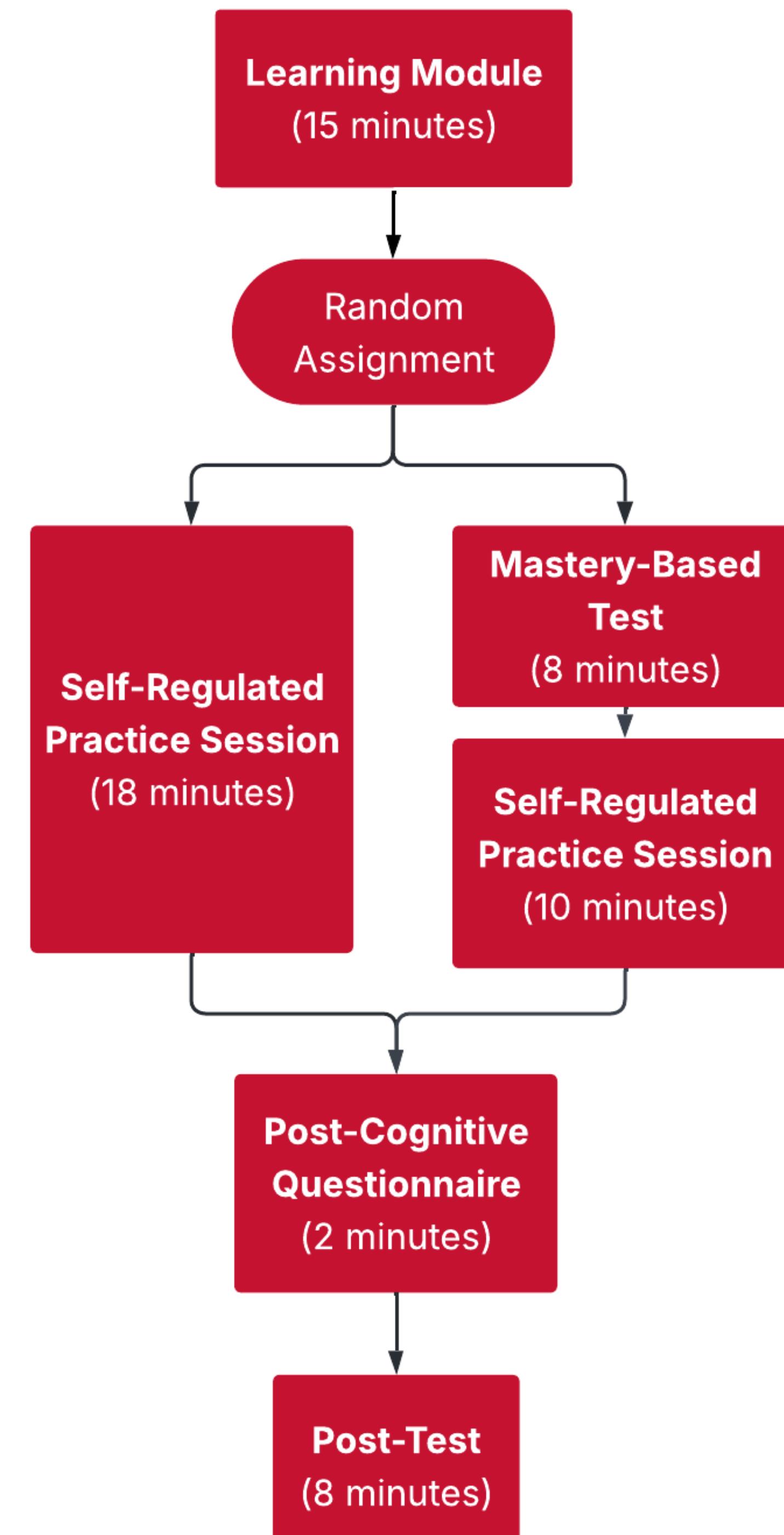
- User #1 from the Experimental Group

"I knew I needed to work on understanding modifying variables based on the feedback from the test."

- User #4 from the Experimental Group

Experimental Study Design

Between-Subjects Design (N = 6)



Future Work

Conduct a longitudinal study in an authentic classroom setting over an academic semester with a larger sample size to draw more definitive conclusions

Evaluate the long-term effects of the intervention on student learning behaviors and outcomes

