Learner-Centered Exemplar

CARNEGIE LEARNING

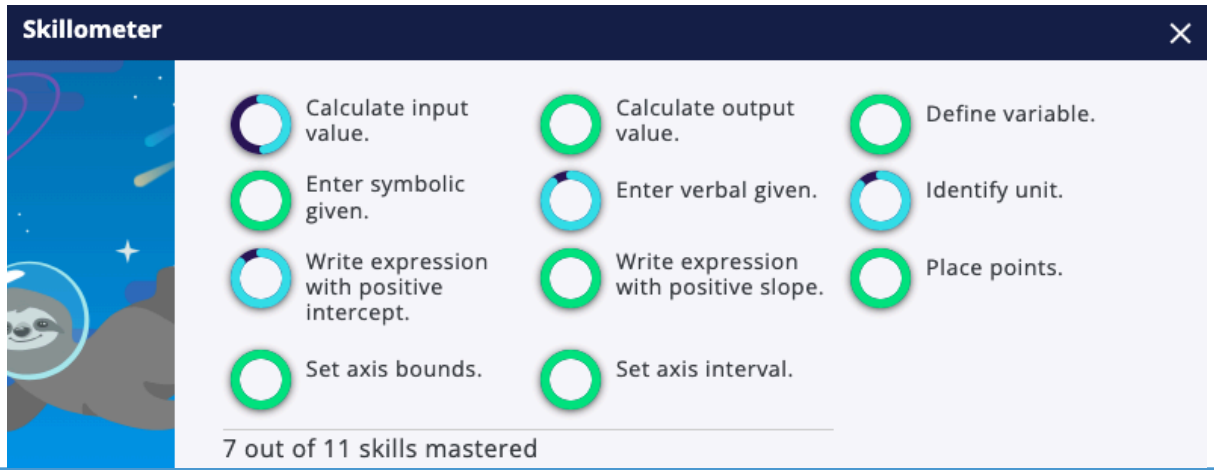
Who We Are & What We Do

Carnegie Learning has been a leading provider of K-12 core curriculum and professional learning solutions for over 25 years. Carnegie Learning's products are built on decades of cognitive science research and deliver proven results for over 2 million students and educators. Born out of Carnegie Mellon University, the company maintains a 30-person research team to explore cutting-edge solutions to major challenges in education, producing dozens of peer-reviewed publications in the past decade. Carnegie Learning's suite of products are used as part of the core curriculum in thousands of schools nationwide and cover topics related to math, English Language Arts (ELA), and world languages. Carnegie Learning's flagship adaptive math software, MATHia, is an intelligent tutoring system serving over 700,000 students annually across grades 6-12.

How We Think About Learner-Centered in Our Design Process

Progress in MATHia is based on mastery learning principles, in which each lesson is associated with a number of skills students must master to advance. MATHia works behind the scenes to ensure students are delivered problems with the skills they need to practice. These models rely on decades of research—including a gold-standard RAND study—and the resulting algorithms have been widely published by our researchers and university partners. We prioritize ensuring our methods and conclusions are peer reviewed and align with the rigorous expectations of the learning science community.

Our model makes decisions regarding whether or not a student has mastered a lesson, what problem they should receive next, and whether or not continued practice will help the student or be counterproductive. **Making these decisions transparent to the student helps them take a more active role in their learning**. MATHia provides students with a skillometer to visualize the models for the student. Using the skillometer, students see how close they are to mastering all the skills in the workspace.



This gives students insight into why they are continuing to receive problems, how much more practice they might need, and areas where they might be struggling, supporting metacognition. It also allows teachers to provide students with more targeted help.

As we develop new tools that rely on generative AI, we ensure that there is choice in if and how learners engage with these tools. Parents are informed that their child will have the opportunity to engage with a tool using a large language model (LLM) and have the opportunity to talk to their children and opt out of (or in to) using these new tools. **The ability to provide opportunities for parents to opt out relies upon having an equivalent non-AI option and an infrastructure that can optionally deliver an AI or non-AI experience**.

We believe student agency is supported by incorporating student input into the models and design of the tool. **We build tools in collaboration with students and teachers, and their input informs the product and model**. For example, we are testing multiple fine-tuned LLMs as tutors for helping students with homework from their textbooks. We tell students they are interacting with an LLM and seek their feedback on each response. If students like the response, we deliver this model more often in the future. In developing a generative AI-powered tool that helps students write culturally-responsive math word problems, student feedback has informed which aspects of the process are controlled by the students versus the AI, which allows us to develop a tool that mitigates bias in LLMs. We view these co-design opportunities as spaces to learn from the students to ultimately center the students in the learning experience.

Why Learner-Centered is Important in Our Product

Learning can be opaque to students. We take steps in all of our products to **ensure students understand what they are doing and why**. In MATHia, students begin each year by completing a lesson that focuses on concepts like growth mindset to **develop students' metacognitive understanding**. The skillometer then gives students a window into their learning, allowing them to visualize their progress. Understanding the goals and how they are being measured gives students the opportunity to be active participants in their learning.

Increasing student agency has been and remains an ongoing priority at Carnegie Learning. Agency, even when the mechanism is not directly related to the learning task, also has the ability to stimulate student interest in education. **Our work with generative AI is targeted at enhancing student agency**, whether that is the agency to seek out a deeper understanding, get more targeted help through our AI tutor, or ensure novel math word problems reflect a broad range of interests, including their own. We're using AI to give students more control over their education.

"AI [in] the MATHia platform provides individualized instruction based on my students' needs as they progress through mastery of each skill level. MATHia provides just-in-time support and gives students hints when they are stuck."

— Sofiya Padela, 6th grade teacher