

We will be piloting two studies in Spring 2027 with relatively fixed study designs, so that we can first demonstrate the functionality of our testbed built for the Terracotta Research Network, and then afford more customized research studies in the longer term.

The two pilot studies will examine the multimedia learning effect (using a combination of text and visualizations in the instruction is more helpful than text alone) and student's agency/autonomy in AI-assisted learning experiences. Below are some more details on what these two studies do, and what an instructor's role would look like in these studies.

If you are interested in participating in one of these two pilots, please feel free to submit a form on the Terracotta network webpage, or directly reach out to our research coordinator, Noah Fletcher, nfletcher@iu.edu. We are happy to chat!

Multimedia Study

The multimedia learning effect is a well-established educational theory that using text combined with visualizations is often more effective than only using text instructions ([Mayer, 2002](#)). However, whether this effect holds true depends on a lot of things – the subject or learning topic, the way the visualization is designed, the students' background and previous learning experiences, etc. How well would this multimedia effect generalize across drastically diverse classrooms in the real life?

Also, the multimedia effect has mostly been demonstrated in lab settings with a strictly controlled learning task and a very different experience for the student compared to a realistic classroom. In other words, the students would individually come into a lab space that looks and feels very different from a real classroom and do a series of tasks that are different from how they usually study their course materials. How well would the results of such studies translate to realistic learning settings?

The purpose of the multimedia study is to adapt the general idea of multimedia learning into various forms of real-life learning experiences and test its generalizability across diverse contexts. The instructor will collaborate with the research team to design multimedia and text versions of the same instruction content that they plan to deliver in their original course and contrast the learning outcomes.

AI and Learning Agency Study

It is becoming inevitable that students have access to AI tools to help them with coursework. In the near future we could even see built-in AI learning assistants or companions in their Learning Management System such as Canvas or Brightspace. However, the effectiveness of such AI learning companions depends on the way it is deployed. How do we design the AI companion to maximize its positive influence? Specifically, can we deploy the AI learning companion so that the students actively reason about the learning topics, and preserve the deep thinking that is beneficial, such as reflecting on one's own learning progress?

This study examines whether prompting students to proactively reflect on their understanding before seeking help from AI would help preserve students' agency in an AI-assisted learning experience, and whether having an AI companion who probes the student to explain their understanding would improve students' learning outcome.

In this study, students will be assigned to three conditions: student-first condition, AI-first condition, and control condition. The context is an online assignment where students read learning materials and practice what they just learned with some questions. In the student-first condition, students are instructed to reflect on what they do not understand about the materials and questions and reach out to a built-in AI learning companion for help. In the AI-first condition, the students will receive messages from the AI learning companion that probe them to explain the materials and the questions. Finally, the control condition does not involve any AI. The students simply read the materials, practice with the questions, and see the correct answers.

The Instructor's Role

In both studies, the instructor would work with our research team to modify their existing materials so that we can contrast the effectiveness of different versions of the materials. The dosage of modification will be relatively small and microscopic, e.g., only changing the format of the materials for two or three concepts introduced in the course.

Experiment setup and consent process. In the beginning of the semester, the research team will help the teacher setup the experiment structure by using Terracotta on their LMS course site (e.g., the Canvas course site). Students will have the option to sign up to participate in this study through a Canvas assignment, and their decision to participate or not participate will not be visible to anyone else. In the later stages, the students who decided to participate will be automatically assigned their conditions/treatments, and this is also handled by Terracotta anonymously. This setup process should only take one or two brief Zoom meetings, no more than half an hour in total. We have a script for the instructors if they need a template on how to announce the study to their class.

Modifying and implementing learning activities. During the semester, the instructor and the research team will finalize the modified learning materials and implement them inside an online assignment. This assignment would look similar to a typical online assignment, except that it went through Terracotta at the backstage. They can receive their scores and/or see feedback normally, all depending on **the instructor's preferences**. This process typically takes several email exchanges and 1-2 brief Zoom meetings per assignment to finalize the design and set it up on your course website.

Outcome measures. The outcome measure (where we test the effectiveness of our treatments) will be some questions in the formal assessment(s) of the same course, such as your midterm or final exam. These questions are the ones covered by the learning materials modified by our study. For example, if the students learned concepts A and B in the modified assignments, the questions in their final exam on the concepts A and B will be used as our outcome measure and part of our research data. Again, with Terracotta, all outcome data will be de-identified, no one will see the students' grades other than the instructor. This part of setting up and exporting anonymized test results typically takes ~ two brief Zoom meetings, where our research team will help you use a local tool to format your students' grades, upload to Canvas, and then de-identified and exported through Terracotta.