Designed Real-time Teacher Augmentation to Combine Strengths of Human and AI Instruction

When used in K-12 classrooms, AI-based educational software such as intelligent tutoring systems (ITSs) allows students to work at their own pace, while also freeing up the teacher to spend more time working one-on-one with students. A common intuition is that, in many situations, human teachers may be better suited to support students than ITSs alone (e.g., by providing socio-emotional support, supporting student motivation, or flexibly providing conceptual support). Yet ITSs are not typically designed to work together with teachers, in real-time, to take advantage of these complementary strengths. ITSs may be even more effective if they were designed not only to support students directly, but also to amplify teachers’ abilities to help their students.

In my work thus far, I have explored how AI tutors might be better designed to work together with human teachers in real-time, during a class session. Working together with 36 middle school math teachers, I designed a form of real-time, wearable cognitive augmentation for teachers called Lumilo: a set of mixed-reality smart glasses that direct teachers’ attention in real-time, during ITS class sessions, towards situations the tutoring software may be ill-suited to handle on its own. Lumilo has been used by teachers and students in 30 middle school classrooms so far. An in-vivo classroom experiment showed that teacher–AI co-orchestration, as supported by Lumilo, enhanced students’ learning compared with an AI-supported classroom in which the teacher did not have such support. Over the course of this research, I have also developed new design and prototyping methods to address challenges in designing data-driven AI systems. To support the use of these methods within education, my colleagues and I have extended an existing technical architecture to support rapid prototyping of data-driven, educational AI applications.

To complete my thesis, I will begin to explore how the concepts embodied by Lumilo might be prepared for wider use, from two angles. First, I will involve students, as well as teachers, in the next phase of design. Using Lumilo as a research platform, I will explore (1) how to design policies for human–AI co-orchestration that support more effective and desirable interactions between students, teachers, and AI agents; and (2) how non-technical stakeholders (teachers and students) can be meaningfully involved in co-shaping the behavior of complex, data-driven AI systems. Second, through a newly-formed academic–industry partnership with Carnegie Learning, a major educational technology company, I will explore (3) how real-time, wearable teacher augmentation might be generalized to work with a broader range of AI tutoring systems and curricula. To demonstrate the generality of this approach, I will work with Carnegie Learning to create a variant of Lumilo that works with their MATHia ITS, and will pilot this variant in live K-12 classrooms.