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 when further problem-solving practice may be ineffective). Yet ITSs are not typically designed to work together with teachers during a class session, to take advantage of these complementary strengths.

This dissertation explores how AI tutors might be better designed to work together with human teachers in real-time, to amplify teachers’ abilities to help their students. Working together with 36 middle school math teachers, I conducted the first broad exploration in the literature of teachers’ needs for real-time analytics and orchestration support in AI-supported, personalized classrooms. As part of this work, I worked with teachers to design a form of real-time, wearable teacher augmentation called Lumilo.

Lumilo is a set of mixed-reality smart glasses that direct teachers’ attention during a class session, towards situations the tutoring software may be ill-suited to handle on its own, and support teachers in deciding how best to respond. Lumilo has been used by teachers and students in over 40 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 the co-design, experience prototyping, and evaluation of data-driven AI systems. To support the use of these methods within the area of education, my collaborators and I have extended an existing technical architecture (CTAT/TutorShop) to facilitate rapid prototyping of data-driven educational AI applications.

In the final chapters of this dissertation, I explore how the concepts embodied by Lumilo might be prepared for wider use, from two angles. First, I involve students, as well as teachers, in the next phase of design to better serve the needs and respect the boundaries of both stakeholder groups. Second, through a newly-formed academic–industry partnership with Carnegie Learning (a major educational AI company) I begin to explore how real-time, wearable teacher augmentation might be generalized to work with a broader range of AI tutoring systems and curricula.