# **ISAT** Snapshot

#### NSF AI INSTITUTE FOR STUDENT-AI TEAMING

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# In Brief...

## A quick look at our activities this quarter!

- 1. Professor of Human Systems Engineering and Strand 2 iSAT team member Jamie Gorman accepted a new position at Arizona State University's Polytechnic School. With this change, iSAT's University partnerships expands to include ASU.
- 2. An institute-wide team designed an early version of an interactive display of collaborative learning metrics based on automated analysis of student speech in the classroom.
- 3. Strand 3 expanded its Games Unit, which included Professional Learning for several teachers this summer who will now implement the 9-lesson unit in their classrooms this fall.
- 4. We entered into our third year as an Institute after wrapping up year two with our Annual Evaluation with the National Science Foundation.
- 5. Our Community Hub planned and executed a workshop Interdisciplinary Approaches to Getting Al Experts and Education Stakeholders Talking - at the AIED conference this summer.
- 6. We had a busy summer presenting at two International conferences.



Mariah Bradford and Paige Hansen present their poster at the International Conference on Educational Data Mining

# Congratulations iSAT Recent Awards:

Best Paper HCI 2022 Thematic Area: Multimodal Semantics for Affordances and Actions by James Pustejovsky and Nikhil Krishnaswamy

Finalist Best Full Paper EDM 2022: Investigating Temporal Dynamics Underlying Successful Collaborative Problem Solving Behaviors with Multilevel Vector Autoregression by Guojing Zhou, Robert Moulder, Chen Sun and Sidney K. D'Mello

Best Interactive Event AIED 2022: iSAT Speech-based AI Display for Small Group Collaboration in Classrooms by Rachel Dickler, Peter Foltz, Nikhil Krishnaswamy, Jacob Whitehill, John Weatherly, Michal Bodzianowski, Margaret Perkoff, Rosy Southwell, Sam Pugh, Jeff Bush, Michael Chang, Leanne Hirshfield, Daeja Showers, Ananya Ganesh, Zeqian Li, Elita Danilyuk, Xinlu He, Ibrahim Khalil Khebour, Indrani Dey, Sadhana Puntambekar, and Sidney K. D'Mello

# From the PI



t's been quite the summer. We kicked it off with our Year 2 Annual Evaluation with the National Science Foundation (NSF). This entailed an intense three-month (April-June) period iSAT and with our External Advisory Board, an External Site Visit Team (SVT) appointed by the NSF, and the NSF program officers. The evaluation provided us with an opportunity to tell our story - our goals, values, achievements, challenges, and aspirations - in a structured format aimed at It was an awe-inspiring experience to highlight iSAT's accomplishments and to receive positive and encouraging ing quote: "The SVT agrees that the institute is making significant progress on a very difficult set of problems, to lead such an amazing team who performed double duty of advancing throughout the evaluation period.

The evaluation also provided iSAT with actionable feedback and opportunities for improvement. We've spent July and August reflecting on how we can incorporate aspects of this feedback to transition iSAT into a more mature and impactful institute. For instance, we're developing new management and evaluation structures, providing new leadership opportunities, identifying creative approaches for knowledge transfer to external stakeholders, and strategically working towards making iSAT a nexus point for collaborative efforts. We're excited to implement these new initiatives in the fall, which will also be a critical period of testing student- and teacher- facing AI Partners in the classroom. Indeed, iSAT's Y3 is already shaping up to be quite an adventure.

# Al Partner v1: A Speech-Based AI Display for Small Group Collaboration in Classrooms

ocio-collaborative learning is key to students' development of deep conceptual understandings, but it can be challenging for educators to monitor and orchestrate the collaboration occurring within each group in the classroom. iSAT aims to expand the scope of what can be sensed in the classroom to provide actionable information to both teachers and students. An institute-wide team designed an early version of an interactive display of collaborative learning metrics based on automated analysis of students' speech in the classroom. We implemented a technical architecture designed for real-time data collection and



Version one of the iSAT Technical Infrastructure

analysis of small group collaborations, including audio, video, and activity logs. The system allows for flexible incorporating of different AI-based collaborative analysis components as well as displays for different stakeholders (e.g., researchers, students, teachers). In this version, a team's audio/video data is captured through a custom-designed web-based application and streamed to a cloud-based secure data repository in short 10-second chunks. The audio data is processed through an AI pipeline to automatically characterize and display the collaborative processes exhibited by the teams. Here, the audio is processed through a Classroom Activity Perception Engine, which includes Google's automatic speech recognition engine as well as customized speech diarization models. The resulting diarized transcript is processed by the Intelligent Inference Engine, which computes speech, conversation, content, and collaboration metrics, which are presented through the Visualization Engine in the form of an interactive display.

Visualizations in the Main Display tab are organized across five categories including: Acoustic (e.g., signal to noise ratio), Conversation (e.g., verbosity or the number of words spoken by a team over time), Content (e.g., what students are saying), Task/Topic (e.g., degree of task and topic related talk in the student conversation), and Collaboration (e.g., classifiers for the degree that students are engaging in shared knowledge construction, negotiating and coordinating, and maintaining a positive team dynamic). The initial versions of the iSAT technical infrastructure and corresponding display were designed for noisy classrooms with multiple teams of middle school students collaboratively learning. Currently, the team is designing interactive displays for teachers and students through participatory design processes and with a lens of Responsible Innovation, which attends to ethical questions and responsiveness to the needs of teachers and students. A demonstration video of the early version of this v1. AI Partner won the best Interactive Event Award at the Artificial Intelligence in Education Conference.

The team aims to conduct user tests with student- and teacher- facing interactive displays in the Fall. This is an important step towards iSAT's goal of using Al to make classrooms more effective, engaging and equitable learning environments by helping teachers and students harness the power of collaborative learning.



The Intelligent Inference Engine computes speech, conversation, content, and collaboration metrics all displayed here

# Let the Games Begin Strand 3 Launches Games Unit in a Partner School District

fter many months of designing and planning, Strand 3's co-designed unit "How can we make video games that reflect the world we want to live in?" launched in May. Implemented by two math teachers at one of our partner schools - iSAT's co-design team supported the roll out as the teachers taught and adapted the unit over the course of three weeks. Designed to focus on teaching Al through investigating causes of racism in gaming and what to do about it, the unit is organized as a sequence of nine lessons. It focuses on how computers learn through AI, how that compares to how we learn, and the societal impact of AI. Intended as an interdisciplinary unit, with strong connections to topics and standards in English language arts, social studies, and STEM, the co-design team met with the teachers before, during, and after the launch to provide support and answer questions about the unit. Their feedback, including their adaptations and data collected, informed the design of the team's week-long Professional Learning workshop held in June.

## **Teaching the Teachers**

The June workshop aimed to prepare a new cohort of teachers to adapt and implement the Games Unit this

fall. The goal was to support new teacher participants with a specific focus on the socio-political dimensions of technology and expansive forms of collaboration. In attendance were two partner school administrators, two education techs, and five teachers from four different local schools, including one online school. Also in attendance were the two pilot teachers from the initial implementation in May, providing a great perspective of being able to share their first-hand experiences with the new teachers. Feedback after the workshop was overwhelmingly positive from all in attendance. The attendees were able to expand their thinking about issues such as race and justice and how these can be present in technology.

One teacher shared, "I have learned more about the landscape of video game design and production over the course of the workshop. I've learned that even innocuous and kid-focused games like Minecraft can be surrounded by racist communities sometimes."

Another said, "I feel like I have a much better grasp of technological injustices and that I have a better grasp on how to have these conversations in the classroom and navigate the the discussions for the students in an age appropriate and healing way."



Our partner school district teachers go over lessons in the Games Unit during a Professional Learning workshop



iSAT members Bill Penuel and Arturo Cortez lead Professional Learning for teachers

#### **Expanding Implementation**

With the successful Professional Learning workshop fresh in their minds, the new cohort of teachers will implement the Games Unit in their classrooms this school year. The iSAT co-design team is continuing to work with the teachers to identify opportunities for adapting and improving the unit. To this end, iSAT will support teachers by offering office hours in August and September and develop a professional development pathway within the district to support new teachers in implementing the unit next spring. The iSAT team will also conduct classroom observations at strategic timepoints in the curriculum to capture variations in how teachers are utilizing these curriculum materials and the degree to which these modifications promote collaboration.



Students at a partner school work together on one of the lessons of the Games Unit



A teacher explains one of the unit's lessons to her students

## Data Collection and Cross-strand Collaboration

The co-design team has also been hard at work analyzing data to help answer one of the team's core research questions: In what ways can inclusive co-design processes empower stakeholders with diverse identities to envision, co-create, critique, and apply AI learning technologies for their schools and communities? Their efforts include analyzing data from both the curriculum implementation and the teacher learning workshop and outlining the research questions and potential data collection strategies for partner district teachers who will be implementing the Games Unit in the 2022-2023 school year.

Strand 3 and Strand 2 members are also designing and implementing lab studies that promote cross-strand collaboration. The focus has been on taking the components of lesson 6 – of the 9-lesson Games Unit - and modifying it to a 5-part lab study that could be used for two purposes: 1) to generate high quality collaboration data that could support machine learning towards automated analyses of collaboration, and 2) to provide empirical grounding for revising components of lesson 6.

The co-design team is also working with an Institute-wide Classroom Data Collection team to facilitate collection of high-quality, multimodal data as the unit is being implemented in classrooms. These data serve many purposes - analyze the implementation of the unit, train machine-learning models, and support foundational research into collaborative learning. Together, these analyzes will inform the design of the Al Partner, which will support collaborative learning with the unit.



iSAT records valuable data in a classroom while students work through a lesson in the Games Unit

This fall is going to be an exciting time for Strand 3 and the co-design team at iSAT!

# Foundational AI

#### Strand 1

Strand 1 researchers are working to answer the foundational question: What AI advances are needed to understand and facilitate collaborative learning conversations? These team members enable our AI Partner to recognize the various complexities of human speech – essentially creating the "eyes" and "ears" of the Partner.

#### Advancing AI Components

Over the last several months the team has been advancing the performance of the individual AI components, especially in the context of classroom conversations with the Sensor Immersion curriculum unit for which we collected hundreds of hours of data in the past year. These components include: (1) Automatic Speech Recognition, (2) Abstract Meaning Representations, fine-tuned on a small classroom training set of annotations, (3) Behavioral Engagement in the form of on-off topic/task classification (On-Topic/Task) trained on classroom annotation, and (4) Academically Productive Talk classification with no domain specific fine-tuning.

The team also compared the performance of the Abstract Meaning Representation parser on both human transcription and Automatic Speech Recognition transcription, as well as On-Topic/Task, with encouraging results noting only a 20 percent performance drop. Additionally, they tested other components on comparable test sets including Speaker Diarization, tested on Abstract Meaning Representation headset data, and Eye Gaze Detection, tested on YouTube classroom data. Strand 1 is also making good progress on two novel research areas where they are in the process of defining new annotation schemes. These include (1) Dialogue Dependency Acts: applying standard Dialogue Act and Rhetorical Structure Theory annotation to classroom dialogues and (2) Integrating Gesture Detection and annotation with Abstract Meaning Representation parses, a multimodal integration of speech and gesture.

#### Gesture Abstract Meaning Representation

Over the next several months, the focus will be on continuing to improve Speech Processing and Diarization by mapping the impact of background noise more accurately and piloting Speech Diarization in the classrooms. The team will also fine tune the Abstract Meaning Representation parsing and pursue more annotations of training data and more formal comparison of Abstract Meaning Representation /Academically Productive Talk/On-Task/Topic performance on human transcripts versus Automatic Speech Recognition output. Another major focus will be developing Gesture Abstract Meaning Representation - Strand 1's situated grounding system – for integration of gestures with a focus on representing the distinction between "content-bearing gestures" and "ampliative or co-suppositional gestures" in the Gesture Abstract Meaning Representation notation. This includes distinguishing between nonverbal actions that involve situated grounding through pointing or iconic gestures (that block, grab/pick up), from co-speech gestures that often reflect speaker sentiment, attitude, or epistemic state. When the actual gesture is nearly identical, it is crucial to know how to disambiguate the top-level type. This fall, the team has multiple sites carrying out and recording collaborative interactions, which will provide video data for the modeling dialogue acts and gestures, as well as aspects of content analysis.



This experiment helps Strand 1 with key focuses including object detection, joint detection, and grounding



Strand 1 collecting data to help with developing Gesture Abstract Meaning Representation

# Human-Computer Interaction

## Strand 2

The foundational question for Strand 2 is: What advances in theories, interaction-paradigms, and frameworks are needed to orchestrate effective student and teacher interactions with AI partners? Building on their accomplishments over the winter and spring, the Strand 2 team focused their attention on three main goals over the summer: 1) measuring and modeling Collaborative Problem Solving, 2) understanding teacher orchestration and scaffolding within the Sensor Immersion curriculum, and 3) conducting experimental studies to help inform the design and development of an AI Partner aimed at supporting Collaborative Problem Solving.

#### Collaborative Problem Solving

Working towards the goal of measuring and modeling Collaborative Problem Solving, the iSAT Lab Experiment team collected multimodal data from 20 small-groups (dyads and triads) as they completed a series of Collaborative Problem Solving tasks. The team collected a range of data including task performance, surveys on team processes, self-reported social, cognitive, and affective states, as well as speech, webcam video, eye tracking, and Kinect video during the collaborations. They are in the process of conducting initial analyses on the data and are excited to begin writing up the results in the fall.

#### Analysis Beyond Speech

In efforts to improve understanding of teacher orchestration and scaffolding within the Sensor Immersion curriculum, Strand 2 developed a coding scheme to analyze non-verbal aspects of communication, such as eye gaze, joint attention, working with technology tools, etc. This analysis is aimed at understanding how indicators other than speech will help the team at iSAT understand collaborative processes. Additionally, they are also examining how peers scaffold each other during group work. Together, these two projects will foster greater understanding surrounding how to support students working in collaborative groups.

#### **Cross-strand Collaboration**

Strand 2 team members have also begun planning several studies for the fall including a collaboration with Strand 3 that will test lessons from the Games Unit curriculum in the iSAT lab. Additionally, team members will support a trainee-led project on the role of an agent in supporting learning of computer programming and debugging. Furthering the team's cross-strand collaboration efforts, Strand 2 will continue to collaborate with both Strand 1 and Strand 3 in exploring designs for interactive displays that will be tested in the lab this fall prior to the classrooms. Strand 2 will continue to work closely with the other strands in the coming months to consider implications for design decisions and how to best support teacher and student needs.



Working towards the goal of measuring and modeling Collaborative Problem Solving, the iSAT Lab Experiment team collected multimodal data from 20 small-groups (dyads and triads) as they completed a series of CPS tasks.



Rachel Dickler presents version one of iSAT's AI Partner at AIED 2022 in July and iSAT is awarded Best Interactive Event!

# Engaging All Learners

Strand 3 is tasked with answering the foundational question: In what ways can inclusive co-design processes empower stakeholders with diverse identities to envision, co-create, critique, and apply AI learning technologies for their schools and communities? It's been another busy summer! The co-design team successfully implemented the Games Unit with two pilot teachers in May as well as held a Professional Learning workshop with seven teachers from partner schools in June. You can read all about their accomplishments in the feature on pages 4 and 5.



The Strand 3 team leads Professional Learning for Teachers on the Games Unit, which will be implemented in classrooms this fall

#### Sensor Immersion Professional Learning

The Sensor Immersion group continued to build on its momentum from spring by onboarding 20 new teachers and welcoming them along with cohorts of return ing teachers in two of our partner school districts. The new teachers participated in the workshops over the summer and will soon be implementing the new Sensor Immersion curriculum with several collaborative structures, strategies and tools. The Sensor Immersion team will continue co-design with teachers with plans to build out a curriculum unit on self-driving cars and possibly one on empathy robots in the coming months. The teachers implementing Sensor Immersion in the classrooms are also providing feedback that can be used by other strands in the development of the AI Partner.



Strand 3's Quentin Biddy leads Sensor Immersion Professional Learning for a new cohort of teachers



Teachers work with a soil moisture sensor as part of the Sensor Immersion training

#### Learning Futures Workshop

The Learning Futures Workshop group is busy taking their data from previous workshops and collaborating with Strand 1 (the behavioral engagement classification working group) and with Strand 2 (student and teacher display co-design) to be responsive towards the workshops' findings. The team will continue to work with the Strand 2 display team to "close the loop" with youth and test out concrete design prototypes. Additionally, the Learning Futures team will begin planning another workshop to answer questions about stakeholders' expansive dreams and hopes towards collaboration.



# Learn more about our members! Ashieda Mckoy Strand 3 Student Researcher

Name of advisors: Dr. Arturo Cortez

Research focus: Learning Sciences & Human Development, Teacher Learning, Research, and Practice

#### What are you working on?

This summer, as part of Strand 3's curriculum co-design team, we developed and held a Professional Learning workshop for middle and high school teachers to introduce, adapt, and prepare them to teach a curriculum around Al in video games. This unit helps students and teachers think about both the technical and ethical implications of AI as well as how they might reimagine this technology toward more just and equitable futures. We are now focused on studying the implementation of the curriculum into pilot classrooms.

#### How does your work contribute to iSAT?

As iSAT is committed to Responsible Innovation, my work helps contribute to ethical technological design and implementation particularly through regular and robust collaboration and insight from community partners.

Fun facts: I have a MFA in Poetry and was lucky enough to have one of my favorite poets ever (Nikki Giovanni) on my thesis committee. I think lemon bars are superior to every other dessert and whenever I fly home to D.C. I have to get one, even if that means driving two hours out of the way.



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# Jake Whitehill Strand 1 Multimodal Analysis

Jake is part of the Strand 1 ASR (automatic speech recognition) and Speaker Diarization (inferring who is talking when in an audio) working group. He also organizes the iSAT Trainee Grant program (something that, in a similar form, he benefited from many years ago as a graduate student at a similar NSF-funded center), that aims to empower iSAT students and postdocs to conceive of, propose, and pursue their own research ideas.

#### Q: What does your research focus on?

A: Broadly speaking, my group works on machine learning-based approaches to audiovisual perception of human behavior, especially in educational contexts. I am also interested in AI-enabled training methods, including how human workers and AI systems can work together. Within speaker diarization, which is my current research focus for iSAT, we are focusing on aspects of the diarization problem that are particularly important for analyzing classroom speech, e.g., multiple overlapping voices, people interrupting each other, harnessing both visual and auditory information to improve accuracy.

Q: What is the coolest thing about your research?

A: I am most excited when an application-driven research problem uncovers a more fundamental research question with broader potential impacts. For example, when tackling the diarization of speech with multiple overlapping speakers, we stumbled onto a new kind of clustering problem: how to partition a dataset into clusters that need not be independent of each other, but rather can have compositional relationships with other clusters (e.g., an image set consists of rectangles, circles, as well as combinations of rectangles and circles). Casting a real-world problem into an elegant abstract description enables so many techniques from machine learning, reinforcement learning, and other fields to be brought to bear.

# Q: What are your hobbies and interests outside of work?

A: I am learning to paint in watercolor. I love languages (I speak fluent German, some French, a little Afrikaans, and a bit of Vietnamese) and how they open new possibilities to communicate with people we otherwise would not know. In graduate school, I wrestled (freestyle) for 5 years in a community league (no, I was not any good), which was a great and intense experience.



# Working Together A Vist from Postdoctoral Researcher Michael Chang

Michael Chang, a Postdoctoral Researcher with Strand 3 from the University of California Berkeley, plays an integral role in the Learning Futures Workshop and utilizing those findings in the development of data infrastructure platforms. His novel data privacy framework is central to the mission of iSAT and the design of iSAT's Al Partner. This summer, Michael visited iSAT team members at the University of Colorado Boulder and collaborated in person with Strands 1 and 2. He met with the Strand 2 Student / Teacher Display Co-design team to identify ways to "close the loop" between the workshops' findings and the actual display being developed. He also spoke at a Strand 1 research meeting to collaborate on concrete ways iSAT can bridge the gap between the dreams and hopes of youth around the use of AI in the classrooms and the technical tools iSAT has engineered so far. His visit promoted a great deal of cross-strand collaboration and a wonderful atmosphere of community among iSAT team members!

# New Quarter, New Faces!

Growing our team and our impact.

e're excited to welcome three new members to our team!

Research Scientist Mon-Lin Monica Ko brings extensive experience in designing and facilitating professional learning for teachers. Through her work at iSAT, and as a Research Assistant Professor at the Learning Sciences Research Institute (LSRI) at the University of Illinois Chicago, Monica focuses on promoting and studying classroom interactions that support students' engagement in the disciplinary practices of science.

Research Scientist Jason Reitman studies how teams distbute cognitive work to achieve common goals. He has a lot of fun talking about connections between teams of competitive gamers, air traffic controllers, doctors and nurses, and motorsport pit crews. Jason has also conducted research into the social benefits and hurdles inherent in communicating and competing online, including learning outcomes for students in school-affiliated esports programs and work on extremism in online gaming communities.

Professional Research Assistant Nancy Hoang's interest is focused on designing student-centered curricula and implementing equitable teaching practices in STEM education. During graduate school, she assisted in collecting & analyzing video data from different classes to help identify effective equitable teaching strategies used in Teachers' Professional Development workshops.

Welcome, Monica, Jason, and Nancy!



Monica Ko Research Scientist



Jason Reitman Professional Research Assistant



Nancy Hoang Professional Research Assistant

# Knowledge Transfer and Impacts

SAT goes to the UK! We had a big presence at two flagship conferences at the intersection of the computing and learning sciences. Our students and scientists presented eight papers, posters, interactive demonstrations, and workshops at the International Conference on Educational Data Mining (EDM) and the International Conference on Artificial Intelligence in Education (AIED), both held in Durham, UK.

Rachel Dickler and Peter Foltz attended AIED in person and presented the iSAT Speech-based AI Display for Small Group Collaboration in Classrooms (AI Partner v1) and were awarded Best Interactive Event! Their presentation generated a lot of interest around the interface, the underlying AI methods, and the display of the full analysis pipeline of the first version of the AI Partner. At EDM, our paper "Investigating Temporal Dynamics Underlying Successful Collaborative Problem Solving Behaviors with Multilevel Vector

Autoregression" by Guojing Zhou, Robert Moulder, and Sidney D'Mello was a finalist for Best Overall Paper Award.

In addition, team members Nikhil Krishnaswamy and James Pustejovsky's paper, "Multimodal Semantics for Affordances and Actions", won the Best Paper Award at the international conference on Human-Computer Interaction (HCI) Thematic Area, held virtually in late June.

iSAT team members also engaged the community with several talks and discussions . For example, PI D'Mello welcomed the incoming student cohort of the AWARE-AI NSF Research Traineeship (NRT) with a keynote talk: Reimagining AI in Education: Perspectives from the Institute for Student-AI Teaming. He also presented and discussed iSAT research with young entrepreneurs committed to the interaction of technology and social good as part of Impact Labs annual Impact Summit in New York.

#### **Published & Submitted Papers**

Abitino, A., Peacock, C., Pugh, S. & D'Mello, S.K. (2022). Eye to Eye: Gaze Patterns Predict Remote Collaborative Problem Solving Behaviors in Triads. Artificial Intelligence in Education Conference AIED – 2022

Bush, J. B., Dey, I., Chang, M. A., & Perkoff, M. (2022). Envisioning a classroom AI as a community builder. Artificial Intelligence in Education Conference – AIED 2022.

D'Mello, S. K., Tay, L., & Southwell, R. (2022). Psychological measurement in the information age: machine-learned computational models. Current Directions in Psychological Science.

Ganesh, A., Scribner, H., Singh, J., Goodman, K., Hertzberg, J. & Kann, K. (2022). Response Construct Tagging: NLP-aided assessment for engineering education. Proceedings of the 17th Workshop on Innovative Use of NLP for Building Educational Applications.

Manley, C., Booth, B., & D'Mello, S. K. (2022). Toward argument-based fairness with an application to Al-enhanced educational assessments. Journal of Educational Measurement.

Mawasi A., Cortez A., McKoy A., Penuel, W. (2022). "It disrupts power dynamics": Co-design process of Al literacies curricula as a space for intergenerational learning with distributed expertise. The International Conference of the Learning Sciences – ICLS 2022.

Southwell, R., Pugh, S. E., Perkoff, M., Clevenger, C., Bush, J.B., Lieber, R., Ward, W., Foltz, P., & D'Mello, S.K. (2022). Challenges and feasibility of Automatic Speech Recognition for modeling student collaborative discourse in classrooms. International Conference on Educational Data Mining – EDM 2022.

Whitehill, J. & Erfanian, A. (2022). How to Give Imperfect Automated Guidance to Learners: A Case-Study in Workplace Learning. Artificial Intelligence in Education Conference – AIED 2022

Zhou, G., Moulder, R., Sun, C., & D'Mello, S.K. (2022). Investigating temporal dynamics underlying successful collaborative problem solving behaviors with multilevel vector autoregression. International Conference on Educational Data Mining – EDM 2022.

#### Presentations

Dickler, R., Foltz, P., Krishnaswamy, N., Whitehill, J., Weatherly, J., Bodzianowski, M., Perkoff, M., Southwell, R., Pugh, S., Bush, J., Chang, M., Hirshfield, L., Showers, D., Ganesh, A., Li, Z., Danilyuk, E., He, X., Khebour, I. K., Dey, I., Puntambekar, S., & D'Mello, S.K. (2022). iSAT speech-based AI display for small group collaboration in classrooms. Interactive event at the Artificial Intelligence in Education Conference - AIED 2022 - Awarded "Best Interactive Event"