iSAT Snapshot

NSF AI INSTITUTE FOR STUDENT-AI TEAMING

Winter 2023

In Brief . . .

A quick look at our activities this quarter!

1. Strand 3 researcher and St. Vrain Valley Schools District (SVVSD) partner Axel Reitzig and his team of SVVSD students won first place in the 2022 World Artificial Intelligence Competition for Youth.
2. Strand 1 researcher Shiran Dudy was named one of the 100 Brilliant Women in AI Ethics by Women in AI Ethics (WAIE).
3. iSAT launched an intranet site for its members called the iSAT Hub. This tool will strengthen our multidisciplinary and multiorganizational community, streamline project planning, and facilitate internal knowledge transfer.
4. The Executive Committee created our iSAT Publications Authorship Guidelines to raise institute-wide awareness of our various papers, to adopt a more inclusive view of authorship, and to foster accountability among authors.
5. iSAT's technical team, demonstrated some of iSAT's technology to seven NSF Program Officers, kicking off an excited and lively discussion about our future work.
6. iSAT and Arizona State University's Center for Human, Artifical Intelligence, and Robot Teaming (CHART) held the iSAT-CHART Data Jam at ASU during which researchers and students analyzed and shared ideas on iSAT lab-collected collaboration data.

Top: Students, researchers, and staff enjoying a fun night during an iSAT social hour this winter at the Boulder Social.

Bottom: Researchers and students from iSAT and Arizona State University gather to share ideas and conversation during the iSAT-CHART Data Jam.

From the PI

It's been a cold, snowy, but busy winter. We submitted about 15 papers for peer-review while also making significant progress on our AI Partner development. We are eagerly anticipating lab and classroom testing of one of our AI Partners in the next quarter. iSAT also organized two exciting in-person events. Strand 3 postdoc Michael Chang organized a two-day in-person workshop on Equitable Talk in Classrooms in Boulder immediately after Thanksgiving. Several cross-strand iSAT members along with two members of our External Advisory Board brainstormed how AI Partners can support equitable collaboration to deepen learning outcomes. At the end of February, Strand 2 members Leanne Hirshfield, Jamie Gorman, and myself organized a "Data Jam" with the Center for Human, Artificial Intelligence, and Robot Teaming (CHART) at Arizona State University (ASU). The premise was simple—to pool diverse theoretical perspectives, analytic techniques, and creative insights to jointly analyze a rich, multimodal dataset of student collaborations collected in the iSAT Lab. An equally important goal was network building both within iSAT membership and between iSAT and CHART. This two-day in-person event held at ASU was attended by a highly multidisciplinary team of iSAT students and scholars from Boulder, Brandeis, Worcester, Wisconsin, Georgia Tech, and ASU.

We're now gearing up for the busy Spring season of reporting and evaluation. To kickstart this effort, we updated our Strategic & Implementation Plan (SIP) to incorporate new learnings and feedback from the previous evaluation. Our new and improved SIP is double the length of the previous version and reflects iSAT's evolution from an emerging Institute to a mature and impactful one. The next quarter also reflects the midway point of our five-year performance period. As I reflect on where we stand now compared to those early days of the Institute launched in the throes of the pandemic, I'm so grateful and proud of our team for their positive energy, dedication, ingenuity, and commitment to our students and teachers. Thank you iSAT team!

An Equitable AI Partner

Championing Divergent Thinking

Equity is one of iSAT's guiding principles in all our research practices. To stay aligned with this goal, iSAT hosted an in-person Equitable AI Talk Workshop toward the end of 2022 at the University of Colorado Boulder. The development and facilitation of the workshop was jointly done by iSAT and CIRCLS, as shared postdoc Michael Alan Chang spearheaded the effort with support from leaders in both projects. The workshop brought together 18 iSAT researchers from all three strands, and the institute-wide team, including a mix of students, postdocs, and faculty. In addition, iSAT's Strand 3 External Advisory Board members Karlyn Adams-Wiggins and Marcelo Worsley joined to provide their expertise and perspectives.

In person over two days, the workshop participants explored ways in which AI can support equitable interactions during collaboration. Breaking up into three groups, the goal was for each group to identify what equitable interaction looks like during collaboration using video consisting of storyline units. Group members were also tasked with identifying what hopes and dreams they might have around how AI can support equitable interactions during collaboration, and what steps we can take to get there, in both the immediate future and long term. The groups then summarized their findings and presented them to one another. The results were also presented at two institute whole-team meetings held in January and February.

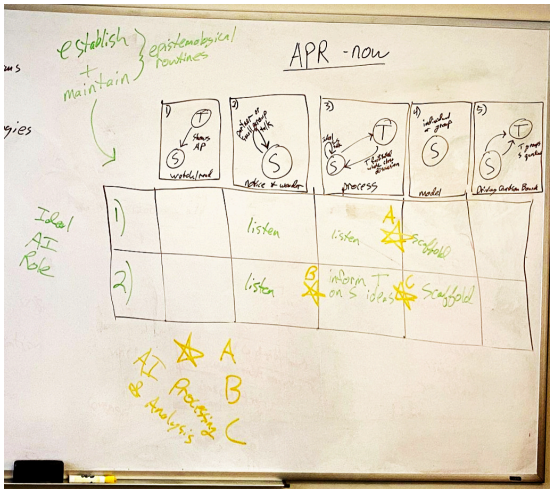
Group 1 began by hashing out what exactly the goals of collaboration are. They concluded that the valued outcome of collaboration is that each student feels they are a valued part of a learning community. If the students get a sense that their thoughts and ideas—even the wild ones—have value toward figuring stuff out together and moving the collective thinking forward, then collaboration is happening effectively. When divergent thinking and minority ideas are shut down, the student who shared those ideas will also shut down and tend to not speak again. The group discussed how an AI Partner could potentially act as a "hype person" that takes interesting ideas which may otherwise be dismissed and instead elevates those ideas by pointing them out to the teacher. In another scenario, the AI Partner could intervene in real-time during the conversation, honoring divergent thinking. They identified different ways the AI Partner could support multimodal interpretation of student thinking and provide translations between different modalities and concluded that research happening right now within iSAT will contribute to more sophisticated future analyses and interactions.

Group 2 started out with an activity focusing on the group's dreams for an AI Partner. They discussed the question: how does the ideal learning space respond to equitable moments or diverse types of sensemaking such that youth can feel uplifted and welcomed? They concluded that their dream scenario envisions an AI Partner that

iSAT researchers discuss Group 3's ideas during the Equitable AI Talk workshop.

will provide an onramp for students' critical perspectives and provide buoyancy to student ideas that are suggested by those from non-dominant groups and / or are divergent. Next, the group discussed AI functionality in the context of Anchoring Phenomenon Routine – the process used to kick off a unit of study and drive student motivation throughout the unit. During this exercise, the group identified the AI functionality to be (a) AI listens during small group work, (b) AI listens to whole-class discussion, (c) AI informs the teacher of student ideas that relate to goals, and (d) AI provides scaffolds to an individual or groups as they model the phenomenon that relate to the goals. Group 2 then took it one step further and explored AI backend processing and analytics—how can the AI Partner take data from classrooms and use it to make decisions during the functions mentioned above? They identified possible ways to do this including Automatic Speech Recognition, categorizing student ideas, equity evaluation, and divergent / non-dominant evaluation. In order to achieve this type of AI Partner, the group came up with specific goals over the next three years including presently incorporating features for filtering ideas based on similarities (convergence) and differences (divergence) based on different analysis by the AI, and in the long-term focusing on things such as improving Automatic Speech Recognition, identifying multimodal indicators of potential marginalization of diverse ideas, and proactively mitigating such moments, deepening professional learning and routines for teachers to productively leverage divergent and convergent idea summaries into classroom discourse, and developing a Definitions Matching Tool.

Group 3 jumped in by identifying a problem and a goal for solving it. The problem was how do we notice and intervene when some members of a group are experiencing learning as inequitable, but others experienced it equitably? The end goal being that students who experience the collaboration equitably still do after the intervention, while uplifting the experiences of those who experience it as inequitable. Imagining how an AI Partner could help achieve this, the group members explored tools in which the AI Partner can recognize when participants are feeling like learning is inequitable and then suggest strategies to help youth recognize the potential sources of inequity and provide strategies for dealing with micro-exclusions (at the individual student, teacher, and group level) as well as



Group 2 maps out their idea on how the AI Partner could function in the context of an Anchoring Phenomenon Routine.

for re-grouping. Steps that can be taken to help accomplish this include starting to work on coding for examples of inequities (to help the AI Partner recognize when it's happening), improve current tools and begin automated processes for regrouping students and identifying moments of inequities within groups, and professional development for teachers.

Overall, this workshop brought equity front and center and allowed iSAT to think deeply about what the equitable outcomes are that we value and what equitable interactions look like within collaboration. Across the institute and in each of our fields, we can identify what theories help us understand these equitable and inequitable interactions and what context those theories shine a light on. Focusing on equity will continue to be at the forefront of our AI Partner development!

A Special iSAT Shout Out

Congratulations, Julie Harrison!

In January, Julie Harrison—one of the Framework & Measures researchers—successfully passed her preliminary exams for her doctorate! Julie's work reviewed existing frameworks developed to measure collaborative problem solving (CPS) associated skills and processes in isolated behaviors, in light of the interactive nature of CPS and timescales longer than singular behaviors (i.e., CPS phases). The review theorized the nature of dynamic mental representations of first-person actors in CPS situations by applying concepts from the event cognition and situation awareness literatures. The review concluded with a proposal of a CPS system model that considers how the global CPS interaction across actors and the local experience of individual CPS actors combine dynamically to form the CPS system.

Listen, Understand, and Connect

Strand 1

Strand 1 is guided by the foundational question: What AI advances are needed to understand and facilitate collaborative learning conversations? The three research themes identified in Year 3 to help Strand 1 reach this goal are: Speech Processing & Diarization, Content Analysis & Dialog Management, and Situated Grounding.

Hearing Child Speech and Interruptions

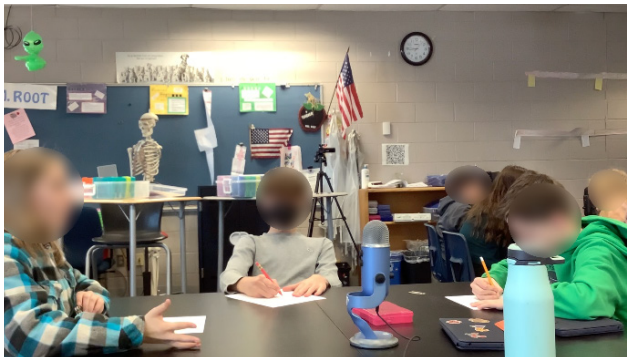
Thanks to the Speech Processing & Diarization theme team, our AI Partner will have hearing that is fine-tuned to classroom environments! The team is working on the training of automatic speech recognition (ASR) models for classroom speech. To this end, researchers are using the SpeechBrain machine learning and speech processing toolkit to train automatic speech recognizers (ASRs) specifically for child speech in classroom environments. Models are being trained for both close-talking and tabletop microphones. The team also explored to what extent Whisper ASR (from OpenAI) can help us to achieve better speech transcription accuracy on iSAT Sensor Immersion classroom videos. Regarding speaker diarization, the team is performing experiments to understand what factors influence the accuracy of person re-identification, as well as new strategies for improving person re-id accuracy on classroom data. Finally, team members also collaborated on automatic interruption detection in school classrooms, a tool meant to give students and teachers automated feedback about which students are being interrupted.

Training an Interactive Agent

As our AI Partner hears what's happening in a classroom, it will need to know how to understand and engage with student and teacher speech to facilitate classroom activity. To help our Partner do this, the Content Analysis & Dialog Management theme team has progressed its Abstract Meaning Representation (AMR) parser development through an ongoing AMR annotation effort and parsing experiments. They're working toward incorporating more datasets to train the parser on classroom collaboration and conversational interactions and have also tested the differences in performance occasioned by automatic speech recognition instead of human transcription.

The team wants to use the parser output to create a knowledge graph for the Sensor Immersion curriculum unit to evaluate the content of student utterances. A key application of this approach is iSAT's Jigsaw Interactive Agent, Jia, focused on lesson four of the curriculum unit, in which students' collaborate on filling out a jigsaw worksheet. The team envisions Jia playing dual roles: (1) Answer Assistant: an individual-level partner to help students complete their worksheets; and (2) Jigsaw AI: a group-level partner to observe the overall jigsaw classroom conversation by jointly interacting with the Answer Assistant and students.

Lab studies utilizing a Wizard of Oz approach for Jia have already begun. To interact appropriately with the students, Jia will need to follow the main points of the unfolding dialogues. To this end, the team is interested in pursuing Dynamic Dependency Acts, a modification of the ISO Dialogue Bank annotation scheme. The annotation guidelines have been finalized and an efficient tool has been implemented so that annotation can begin.



Middle school students collaborate on the jigsaw worksheet during lesson four of the Sensor Immersion unit.

Finding Common Ground

The AI Partner will also need to understand the common ground teachers and students establish when interacting with one another, such as their behavioral and verbal cues, as well as prior goals, expectations, and beliefs they bring into the classroom. To accomplish this, the Situated Grounding theme team has spread their work across three related projects.

Creating a taxonomy for different kinds of situated grounding. The team identified the initial type distinctions for grounding strategies as *situated discourse grounding* and *situated object grounding*. Speech data is annotated with AMR and dialogue moves, while gestures are annotated with gesture abstract meaning representation (GAMR). The team has performed an initial annotation of the lab-collected Fibonacci Weights Task data and performed a first assessment of the coverage over the weights task data. The outcome will result in novel formal taxonomy of grounding strategies.

Creating an annotated dataset for the weights task interactions. The team is using the weights task data to develop feature extraction and annotation pipelines for GAMR and CPS indicators. An initial automatic feature extraction pipeline has been assembled using existing technology for low-level multimodal features, speech recognition, and object and pose detection. These extracted features will be aligned with GAMR annotations that indicate actors, items, and grounded semantics in the video data. The recordings are being annotated with CPS indicators. The outcome will result in novel annotated datasets of lab- and classroom-based interactions that can be used for rapid model training and evaluation.

Training models to detect CPS facets from multimodal data. As the extraction pipeline and annotation methodology are streamlined, the team will begin training preliminary models to detect CPS facets from multimodal data. Their goal is to develop workflows and architectures that can be adapted to new iSAT-relevant tasks and domains as rapidly as possible. They have performed an initial model training with the weights task data, and updated the weights task model and performed an evaluation over it.

Influencers, NICE Collaboration, and Jamming

Strand 2

Strand 2 is guided by the foundational question: What advances in theories, interaction-paradigms, and frameworks are needed to orchestrate effective student and teacher interactions with AI partners? The three research themes identified in Year 3 to help Strand 2 reach this goal are: Framework & Measures, Collaborative Learning (non-verbal and verbal communication; peer scaffolding), and UX Design & Multimodal Modeling.

Can Teams Have Influencers?

Influencers shape trends in fashion, food, lifestyles, viral video, and more. But can small collaborative groups also have influencers? If so, how can we tell? This quarter, the Framework & Measures theme team worked to answer these questions by measuring influence in team interactions, which they conceptualized as a component of equitable interaction. They operationally defined influence as the degree to which an individual team member's verbal and/or nonverbal behavior correlates with changing the team's state (e.g., making a team decision). The team analyzed the verbal influence measure of a laboratory task involving a "controller" team member and two other participants. The "controller" had direct access to the Minecraft control interface used in the task, while the other participants needed to verbally communicate with the "controller" to direct the task. By measuring each team member's communication and collaborative problem-solving (CPS) states, the team found the "controller" showed significantly greater influence compared to the other two participants. In addition to the validation results, that paper provides a vision for how this metric can be used to help promote equitable interaction in a student-AI teaming classroom.

Coding NICE Collaboration

Teams can accomplish a lot without uttering a single word. To help our AI Partner understand how teams do this, the Collaboration Processes & Orchestration theme team works to identify various aspects of non-verbal behaviors including eye gaze, gestures and body language, and emotion that can be applied to video data of students collaborating on the Sensor Immersion unit. This quarter, the team developed a coding scheme for nonverbal interactions during small group work. This coding scheme, called the NICE (Nonverbal Interactions in Collaborative-Learning Environments) framework focuses on what meaning could be ascribed to nonverbal actions, grounded in literature. The team used videos of middle school students working on biology or physics units to build and refine the NICE coding scheme, then applied the scheme to iSAT's Sensor Immersion and iSAT Lab data.

The nonverbal coding scheme has been demonstrated to be complementary to, but independent of, an adapted verbal coding scheme, providing a more comprehensive understanding of how small groups collaborate. In each case the team found that examining the non-verbal interactions helped them understand collaboration better. This helped highlight the nonverbal interactions of each group member in computer-supported collaborative learning classrooms and informed how the group members' nonverbal participation contributes to the group's collaboration.

Jamming on Collaboration

Our AI Partner will need to understand what collaboration looks and sounds like. Enter iSAT's UX Design & Multimodal Modeling theme team, which uses multimodal measurements of teams collaborating to measure and model group collaboration processes. To streamline analyses and obtain diverse perspectives on that multimodal data collected in the iSAT laboratory studies, iSAT researchers helped organize the iSAT-CHART Data Jam at Arizona State University (ASU) in late February. Fourteen iSAT researchers joined seven ASU researchers, each group including faculty, postdocs, and graduate students, to analyze the gaze, verbal communication, non-verbal communication in the datasets. Workshop participants analyzed the data prior to arriving, shared their initial results in a poster session, formed teams organized around five central CPS processes/constructs (influence, linguistic factors, non-verbal interaction, teamness, and dynamics of CPS), and jammed with their teams. By the end of the jam, each team produced plans for completing their jam-inspired analyses and reporting the findings.

Attendees share ideas and insights on the collaboration data during the iSAT 2023 Data Jam.

Data Jam attendees pose for a picture after a productive workshop.

Engaging All Learners

Strand 3

Strand 3 is guided by 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? The three research themes identified in Year 3 to help Strand 3 reach this goal are: Learning Futures Workshop, Games Unit, and Sensor Immersion Unit.

Learning Futures Workshop

This team is currently in the middle of carrying out its 3rd Spring Learning Futures Workshop (LFW). This year, it's being implemented as an in-person 9-week workshop held from February 2 to March 30 of 2023. Participants include 15 diverse youth—two of whom have participated in all three LFWs—and three teachers from an East Bay High School in Oakland, California. The main goal of this year's workshop is to learn more about how young people and teachers conceptualize ideal relations between care, authority, and independence inside the classroom and how AI might improve or compromise these ideal relations. The valuable feedback from these workshops are used to shape the characteristics of our AI Partner. The LFW group has also been hard at work disseminating the previous results from LFWs 1 and 2.

Games Unit

At the start of this semester, the Games Unit curriculum - a sequence of nine lessons designed to focus on teaching AI through investigating causes of racism in gaming and what to do about it - was implemented in one new classroom, bringing the total to four classrooms this school year. The Games Unit team is working on developing research programs across two themes. One theme focuses on teacher adaptation of the curriculum and how they negotiate tensions of designing for justice, young people's everyday practices, and academic domains - all simultaneously. The other theme is directed at young people's practices of social dreaming in the context of small groups during the implementation of the Games Unit. To support these programs, the team has been logging and interpreting video interactions gathered from two of the major enactments of the curriculum so far. They are exploring how students' everyday experiences with games are surfacing in their discussions, as well as how and when teachers are building with them in their enactment of the units.

Sensor Immersion

After a successful roll out in the fall with 14 teachers (in 37 classrooms), the Sensor Immersion team has continued to support the implementation of the Sensor Immersion storyline unit in both the St. Vrain Valley Schools District and Denver Public Schools with 5 new teachers this semester. In addition to working with these teachers providing professional learning, they are also working with SVVSD teachers to co-design another AI unit as a follow up to Sensor Immersion that builds on the programming skills and sensor knowledge to study self-driving cars. The unit is aligned to AI4K12 learning standards and is built around guidelines for collaborative learning and AI Partner deployment.

High-school-age youth participants work on a collaborative building project during the second Learning Futures Workshop.

Middle school students work on their worksheets for the Sensor Immersion curriculum unit.

Cross-strand Collaboration

Two members of the Strand 3 team recently supported the Institute-wide efforts to build a reliable coding scheme for collaborative interactions using the dimensions of the OpenSciEd community agreements that the Community Builder (CoBi) will monitor. They watched 36 segments of video - that institute-wide scholars had viewed of Sensor Immersion - and came up with a coding scheme that integrated verbal and non-verbal cues related to the community agreements. They also initiated a small group to develop assessments of learning for CoBi. The team is exploring existing measures for collaboration and classroom culture, as well as how we can use data collected directly from small groups that reveal the degree to which students' small group interactions are respectful, equitable, moving thinking forward, and revealing a commitment to our learning community.

Converging Research, Design, & Strategy

Institute-wide

The Institute-Wide team provides resources (data, annotations, technology) to guide iSAT's core research. The three themes are: Classroom Data Collection and Coordinated Analysis, Technical Architecture, and AI Partner Design, Implementation, and Testing. It has been a productive quarter!

Classroom Data Collection and Coordinated Analysis

Our team responsible for classroom data collection has been busy in the classrooms doing what they do best—collecting data! Over the course of the 2022-23 school year, they have collected Sensor Immersion curriculum data from 37 classes (14 teachers' classrooms and are adding five more teachers this semester) across the St. Vrain Valley Schools District and Denver Public Schools (DPS), and started collecting data on our Games Unit from two DPS classrooms. The methods by which they collect include: videos of the classroom using a wide lens camera (Zoom/Go-Pro on a tripod), videos of the teacher with a close lens camera (camcorder and lapel microphones), videos of students working in pairs/groups (iPads on stands with Yeti microphones), and student artifacts, perceptions, and demographics. In addition, the team also

Middle school students using the iSAT Researcher Recorder.

began testing the iSAT Researcher Recorder in classrooms and is planning on testing a student-facing version this spring. Lastly, the analysis team tested different approaches to mic'ing up students in active classrooms for comparison to current ASR results on Yeti Blue audio data.

The second part of this theme is coordinating the analysis of all this data! The analysis team has completed annotating the student group speech from the previous year with Collaborative Problem Solving (CPS), Academically Productive Talk (APT), Team Communication (TC) and Community Agreement (CA) coding schemes. Another accomplishment included consolidated analyses of classroom data from across the Institute, including Google Automatic Speech Recognition (ASR), Whisper ASR, human transcriptions, diarization, Topic/Task, CPS, APT, TC, and CA.

Technical Architecture

The role of this team is to develop core infrastructure and components for the AI Partner, support integration of AI models and services into the AI Partner, support secure data storage and access to data collections from the classroom and lab, and configure and operate cloud infrastructure and support iSAT computing services needs.

Over the last few months the architecture team has made great efforts to do the following: (1) improve data pipeline architecture to enable the addition of new analyzers and models; (2) refactor the data pipeline to run as a service for performing near real-time analysis of audio captured by the iSAT Recorder; (3) implement a production-level pipeline deployment in the cloud that allows the team to analyze multiple audio streams of student group interactions and make the learning analytics available for display through the AI Partner in near real time; (4) create a cloud infrastructure that enables the team to flexibly expand capacity; and (5) add a new computational model for analyzing interactions along three dimensions: committed to community, moving our thinking forward, and respect for others. The architecture team also implemented an automated development workflow for the AI Partner web application that allows the team to rapidly incorporate, test, and deploy new features to the web.

AI Partner Design, Implementation & Testing

Exciting things have been happening with our AI Partner Design, Implementation and Testing team! Over the past quarter, they have created and refined two visual designs for our Community Builder (CoBi) AI Partner. One design utilizes a radar chart that aggregates student expressions of community agreements over time. The other design is more abstract; it takes aesthetic liberties and visualizes student expressions of community agreements as a growing tree that contains color-coded flowers.

In addition, the team has developed front-facing interfaces for CoBi with student and teacher views that incorporate the visual designs and conducted interviews with teachers to get their feedback about the designs and how they could be used in class.

Teachers noted that both designs would provide a centerpiece for important conversations as a class. The visuals would allow students to see the trend of how the class is engaging with the agreements, share examples of how they saw the agreements being carried out by classmates, and provide explicit examples of how to "fill the radar" or "make the tree grow." While opinions were split between which design would be easier to use, teachers stated that the tree visual may be more intriguing to students. User tests of the radar version with students in the iSAT lab and classrooms are scheduled for March!

Member Spotlight

Learn more about our members!

Meet Thomas Breideband, an iSAT Institute-wide Research Associate and project manager for our Community Builder (CoBi) AI Partner design. Thomas holds PhDs in English Cultural Studies with a research focus on Rhetoric and Digital Media.

Q: What does your research focus on?

A: My work at iSAT currently revolves around designing and testing the user experience for our AI Partner. To that end, I have been developing user interfaces and displays as well as creating study protocols for our upcoming user testing sessions of our AI Partner with students in the classroom. I am also in the process of putting together material for an internal iSAT study with the goal of improving cross-strand and cross-institute collaborations.

Q: What is the coolest thing about your research?

A: As an institute-wide researcher at iSAT, I find it very exciting and inspiring to be able to collaborate with researchers from so many different fields and backgrounds. I also enjoy the opportunity to tap into my creative side and think about novel ways to visually represent aggregated group dynamics.

Q: What has been a turning point or defining moment in your career?

A: A major turning point in my career happened when I joined Gloria Mark's Media Lab at the Department of Informatics at the University of California Irvine (UCI) in early 2020. This is where I really found my way into the field of team science research after many years of looking at issues and questions surrounding technology use exclusively from an Arts & Humanities perspective.

Q: What do you like to do outside of work?

A: I have a big love for music! I play several different instruments myself and I like going to concerts or listening to albums on a good pair of headphones. I am also new to Colorado and am looking forward to exploring nearby hiking trails.

Meet Kenneth Lai, a Strand 1 student researcher. His advisor is Dr. James Pustejovsky, and his research focus is on Natural Language Processing.

Q: What are you working on?

A: My research focuses on multimodal semantics and meaning representations. One project I am working on in particular is developing, and creating a corpus of, Gesture AMR. The goal is to represent the meanings of gestures in terms of AMR (Abstract Meaning Representation). Additionally, we are in the process of linking together the gesture and speech representations, so that we can keep track of entities and events across modes of communication. In the future, we will try to extend this framework to other forms of nonverbal communication, and to action in general.

Q: How does your research contribute to iSAT?

A: In order for the AI Partner to be able to facilitate learning, it must first have a model of the state of the classroom and of the students within it; this requires an understanding of multimodal interactions. For example, gesture, gaze, and facial expression are all crucial for understanding when students are frustrated, bored, or engaged.

Q: What is a fun fact about you?

A: I have made it my mission to teach people about ELMo and BERT using...Elmo and Bert.

New Quarter, New Faces!

Growing our team and our impact.

We're excited to welcome four new members to our team!

Chelsea Chandler is a postdoctoral researcher at the University of Colorado Boulder who specializes in developing and validating natural language processing and speech-based tools. Her past research was focused on the detection of psychiatric and neurocognitive disorders, however she is excited to apply these skills within the domain of education. Chelsea is especially interested in the creation of ethical and transparent AI methods that harness explainability and computational safeguards, as well as incorporating aspects of participatory design for the creation of human-in-the-loop enabled interfaces for informed decision making.

Tori Hardy is a professional research assistant for iSAT's Strand 2. As a former educator, her focus has been on equitable teaching practices for bi/multilingual learners. Her passion is research and utilizing its findings to better the field of education and advocate for changes that move towards equity. Tori holds a Bachelor's degree in Psychology, a Master's in Educational Equity, and Cultural diversity, and a certification in K-6 education from the University of Colorado Boulder. Additionally, she holds a Master's of Educational Leadership and her principal's licensure from Regis University.

A software engineer at iSAT, Pawan Ranjith Muthaiah Subramanian's work is on full-stack development and focuses on enhancing the UI/UX of iSAT's suite of applications. He is a graduate student pursuing a research-based master's degree in Computer Science at the University of Colorado Boulder. His broad research interest lies in Deep Learning and Computer Vision.

Sarah Leonhart is a graduate student in the Learning Sciences and Human Development program at CU Boulder. Sarah's research interests include equitable K-12 science education and school hegemony. As a part of the iSAT team, she observes middle and high school classrooms to collect data regarding student's collaborative problem solving.

Welcome Chelsea, Tori, Pawan and Sarah!

Chelsea Chandler
Postdoctoral Researcher

Tori Hardy
Strand 2 Research Assistant

Pawan Ranjith Muthaiah Subramanian
Software Engineer

Sarah Leonhart
Student Researcher

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iSAT Publications and Outreach

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Published & Submitted Papers

Reitman, J., Clevenger, C., Beck-White, Q., Howard, A., Rose, S., Elick, J., Harris, J., Foltz, P., D'Mello, S.K. (Submitted). A multi-theoretic analysis of collaborative discourse: a step towards AI-facilitated student collaborations. *Proceedings of the 24th International Conference on Artificial Intelligence in Education (AIED 2023)*, Tokyo, Japan.

Bradford, M., Khebour, I., Blanchard, N., Krishnaswamy, N. (Submitted). Automatic detection of collaborative states in small groups using multimodal features. *Proceedings of the 24th International Conference on Artificial Intelligence in Education (AIED 2023),* Tokyo, Japan.

Jung, C., Fuchs, Z., Krishnaswamy, N., Blanchard, N. (Submitted). Tactile collaboration: 6D pose for collaborative group work with physical objects. *Proceedings of the 24th International Conference on Artificial Intelligence in Education (AIED 2023)*, Tokyo, Japan.

Dey, I., Bradford, M., Puntambekar, S., Krishnaswamy, N., Pustejovsky, J. Analyzing nonverbal interactions through two complementary frameworks during collaborative learning. *Proceedings of the 24th International Conference on Artificial Intelligence in Education (AIED 2023)*, Tokyo, Japan.

Chang, M. A., Philip, T. M., Cortez, A., McKoy, A., Sumner, T., & Penuel, W. R. (2022). Engaging youth in envisioning artificial intelligence in classrooms: Lessons learned. *Rapid Community Report Series. Digital Promise and the International Society of the Learning Sciences*.

Dudy, S., He, X., Southwell, R., Whitehill, J.R. (Submitted). Interruption detection tool: towards understanding classroom social dynamics. *Proceedings of the 24th International Conference on Artificial Intelligence in Education (AIED 2023)*, Tokyo, Japan.

Cao, J., Ganesh, A., Cai, J., Southwell, R., Perkoff, M., Regan, M., Kann, K., Palmer, M., D'Mello, S.K. (Submitted). A comparative analysis of automatic speech recognition errors in small group classroom discourse. *Proceedings of the 31st ACM Conference on User Modeling Adaptation and Personalization (ACM UMAP 2023)*, Limassol, Cyprus.

Dai, Z., McReynolds, A., Whitehill, J. (Submitted). In search of negative moments: multi-modal analysis of teacher negativity in classroom observation videos. *Proceedings of the 16th International Conference on Educational Data Mining (EDM 2023)*, Bangalore, India.

Dey, I., Puntambekar, S., Examining nonverbal interactions to better understand collaborative learning. *Proceedings of the International Society of the Learning Sciences (ISLS 2023)*, Montréal, Canada.

D'Mello, S.K., Duran, N., Michaels, A., Stewart, A. (Submitted). Improving collaborative problem solving skills via automated feedback and scaffolding: a quasi-experimental study with CSPCoach. *Proceedings of the 26th ACM Conference on Computer-Supported Cooperative Work and Social Computing (CSCW 2023)*, Minneapolis, MN.

Ganesh, A., Cao, J., Perkoff, M., Southwell, S., Palmer, M., Kann, K. (Submitted). Mind the gap: between the application track and the real world. *Proceedings of the 61st Annual Meeting of the Association for Computational Linguistics (ACL 2023)*, Toronto, Canada.

Ko, M.-L.M, Cortez, A., & Penuel, W. R. (Submitted) Curriculum as Seed: Designing and Supporting the Use of Open Education Resources to Promote Teacher Agency and Innovation. *Proceedings of the International Society of the Learning Sciences (ISLS 2023)*, Montréal, Canada.

Mawasi, A., Penuel, W. R. Cortez, A., & *McCoy, A. (in revision). "They were learning from us as we were learning from them": Perceived experiences in co-design process. *Mind, Culture, Activity.*

Cai, J., King, B., Perkoff, M., Dudy, S., Cao, J., Grace, M., Wojarnik, N., Ganesh, A., Martin, J., Palmer, M., Walker, M., Flanigan, J. Dependency dialogue acts—annotation scheme and case study. *Workshop as part of The 13th International Workshop on Spoken Dialogue Systems Technology (IWSDS 2023)*, Los Angeles, California.

Cao, J., Dickler, R., Grace, M., Bush, J., Roncone, A., Hirshfield, L., Walker, M., Palmer, M. (Accepted). Designing an AI Partner for Jigsaw Classrooms. Workshop on Language-Based AI Agent Interaction with Children as part of *AIAIC 2023,* Los Angeles, California.

Chang, M.A., Breideband, T., Philip, T., Mckoy, A., Cortez, A., Wong, R., D'mello, S. (submitted). From Policing to Community Building: Expansive Dreaming with Youth to Design Equitable Interactions in Inequitable Institutions. *Designing Interactive Systems (2023)*, Pittsburgh, PA.

Workshops, Demos, & Conference Abstracts

Weatherley, J., Dickler, R., Foltz, P. W., Srinivas, A. B., Pugh, S., Krishnaswamy, N., Whitehill, J., Bodzianowski, M., Perkoff, M., Wouthwell, R., Bush, J., Chang, M., Hirschfield, L., Showers, D., Ganesh, A., Li, Z., Danilyuk, El., He, X., Khebour, I., K., Dey, I., & D'Mello, S., (2023). The iSAT Collaboration Analytics Pipeline. Workshop on Collaboration Analytics organized as part of the *13th International Learning Analytics and Knowledge Conference (LAK 2023)*, Arlington, Texas.

Foltz, P. W., Reitman, J., D'Mello, S. K., Putambekar, S., Gorman, J. (2023). Interactive Workshop: Collaboration Analytics. Workshop on Collaboration Analytics organized as part of the *13th International Learning Analytics and Knowledge Conference (LAK 2023)*, Arlington, Texas.

Dickler. R., Spencer, C., Doherty, E., Harrison, J., Ganesh, A., Tan, B., Elick, J., Kann, K., Palmer, M., Foltz, P., D'Mello, S.K., Hirshfield, L. (Accepted). A multimodal approach to collaborative analytics. Workshop on Collaboration Analytics organized as part of the *13th International Learning Analytics and Knowledge Conference (LAK 2023)*, Arlington, Texas.

Dey, I., Puntambekar, S., Li, R., Gengler, D., Dickler, R., Hirshfield, L., Clevenger, C., Rose, S., Bradford, M., Krishnaswamy, N., The NICE framework: analyzing students' nonverbal interactions during collaborative learning. Workshop on Collaboration Analytics organized as part of the *13th International Learning Analytics and Knowledge Conference (LAK 2023)*, Arlington, Texas.

Bush, J., Dey, I., Hoang, N. (Accepted). Reflective, iterative and interdisciplinary design of a situated coding scheme for classroom collaborative work. Workshop on Collaboration Analytics organized as part of the *13th International Learning Analytics and Knowledge Conference (LAK 2023)*, Arlington, Texas.

Dey, I. Li, R., Puntambekar, S., What do non-verbal indicators tell us about collaboration in small groups? *American Educational Research Association (AERA) 2023 Annual Meeting*, Chicago, Illinois.