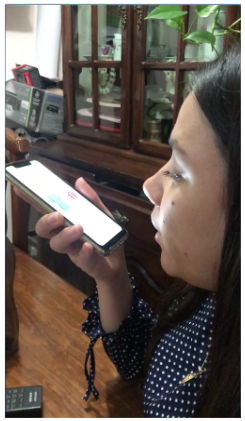
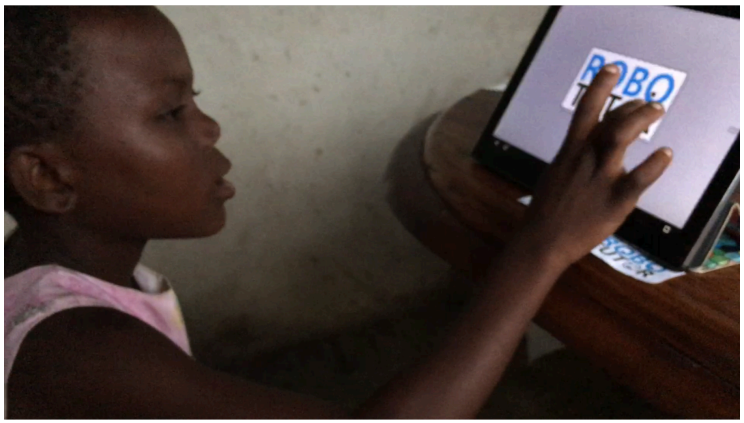
How AI Can Support Learners Under COVID-19 and Beyond

James Lester, Jack Mostow, Carolyn Rosé, & Lewis Johnson

www.alelo.com/AIED





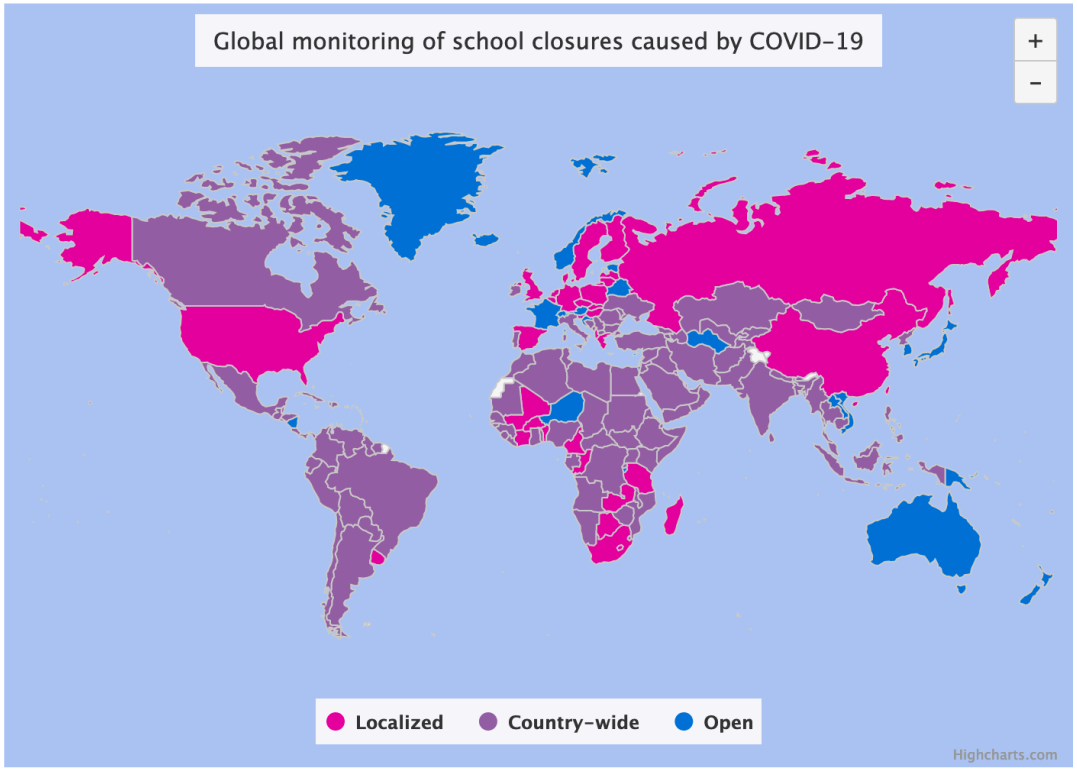
James Lester, NC State Univ.

Jack Mostow, Carnegie Mellon Univ.

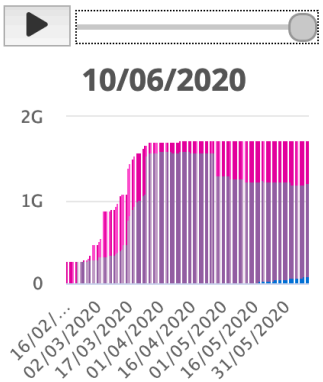
Carolyn Rosé, Carnegie Mellon Univ.

Lewis Johnson, Alelo

The Current Situation

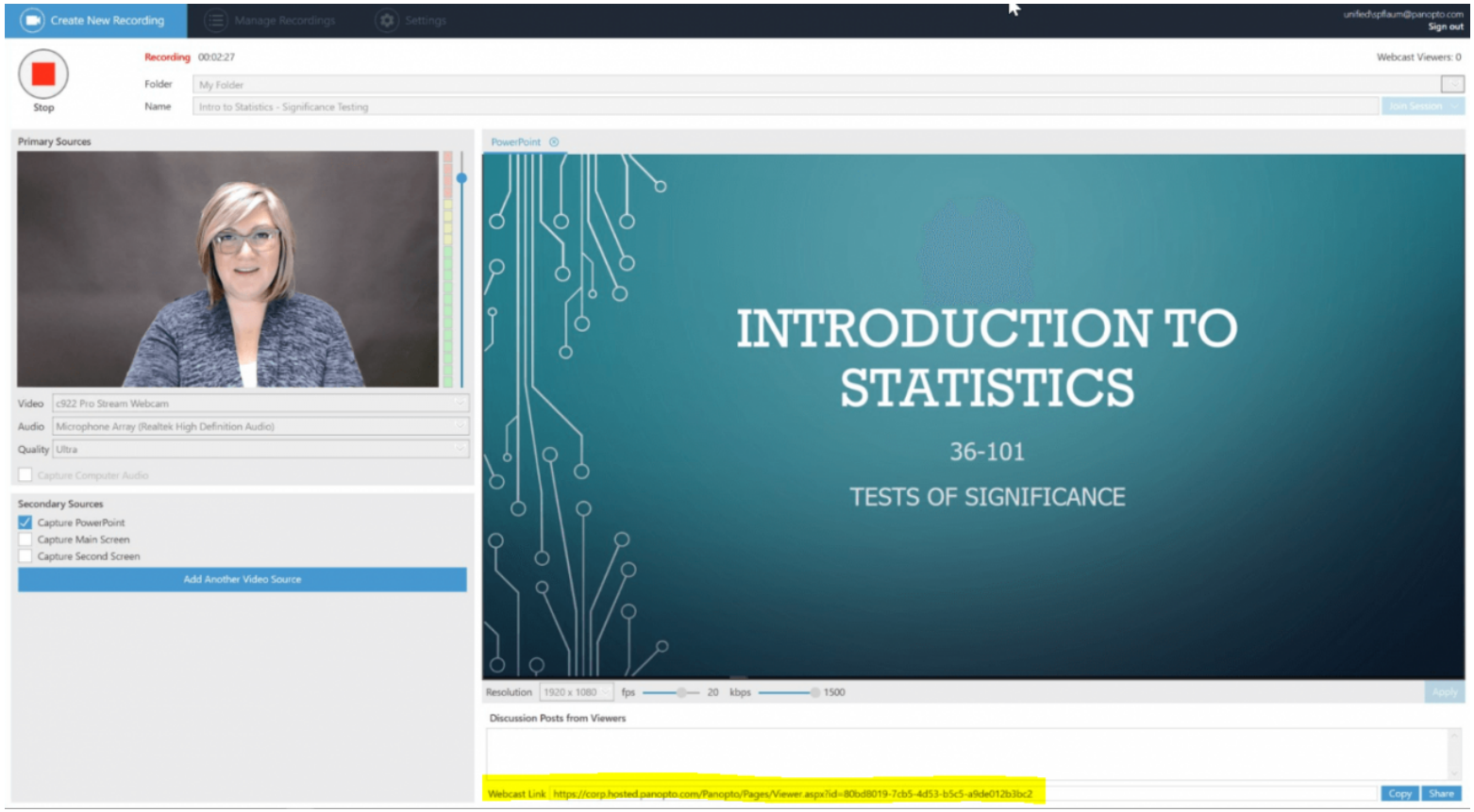


Visualize evolution over time.

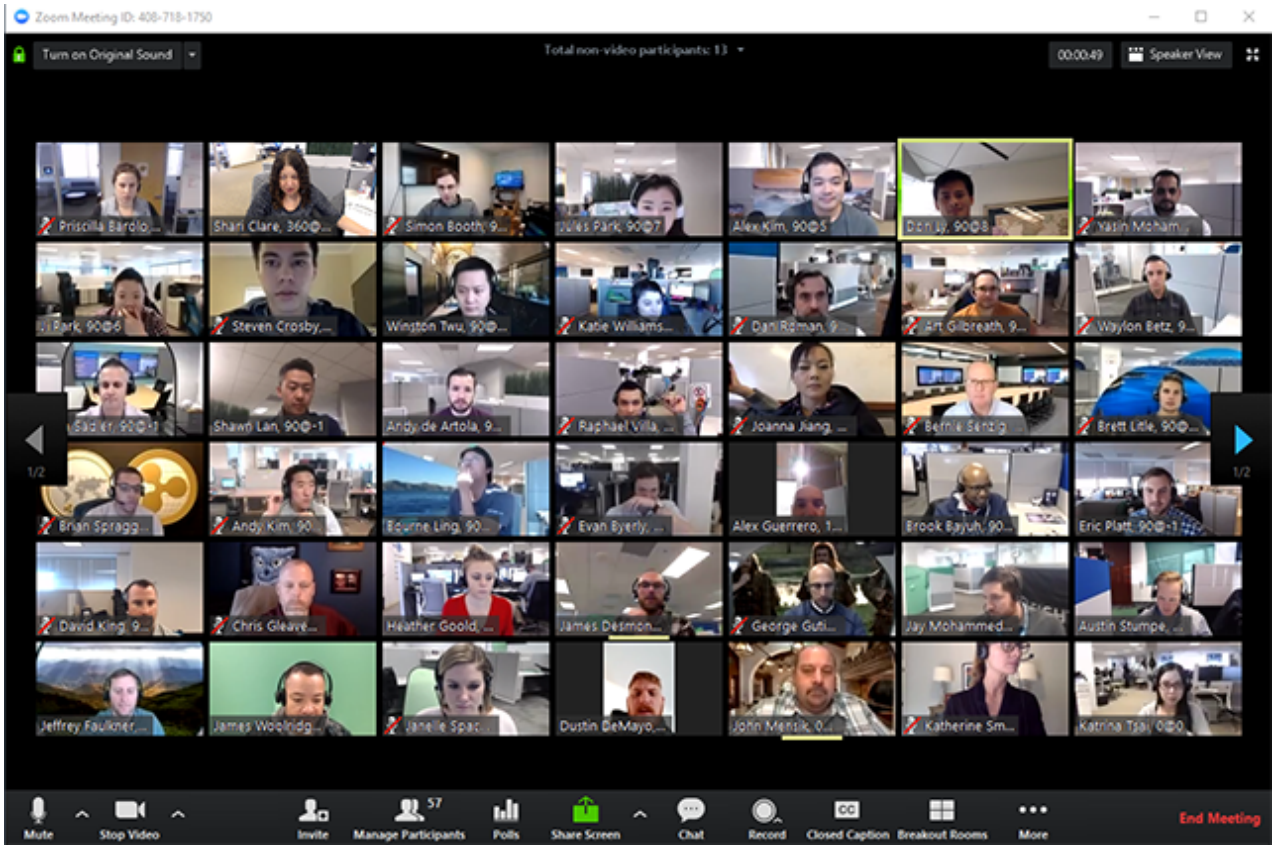


1,109,020,109 affected learners
63.3% of total enrolled learners
129 country-wide closures

Sudden Shift to Online Learning



Sudden Shift to Zoom School



INSIDE HIGHER ED

Published on *Inside Higher Ed* (https://www.insidehighered.com)

Home > Online learning is not the future of higher education (opinion)

alelo

Online learning is not the future of higher education (opinion)

Submitted by Peter C. Herman on June 10, 2020 - 3:00am

The major advantage of online learning is asynchronicity, or, "anytime, anywhere learning."

What this means in practice is that the student takes the class alone. There is no immediate interaction between the professor and the students, no immediate interaction among the students. "We basically have to teach ourselves. It's like paying tuition to watch YouTube videos."

Impact of COVID-19 on Learners

- Economic disparities are exposed and exacerbated
- Unequal access to learning resources
- Increased disparities in learning outcomes
- Feelings of loneliness and isolation
- Motivation suffers

How Can AI Help?

- Learning experiences that are engaging and motivating
- AI technologies can narrow skill and achievement gaps
- Technologies that are available to students wherever they are
- Foster connections between students and teachers
- Foster connections with other students
- Do this at the scale necessary to address the global need

Learning experiences that motivate and engage

James Lester (North Carolina State University)

NC STATE UNIVERSITY

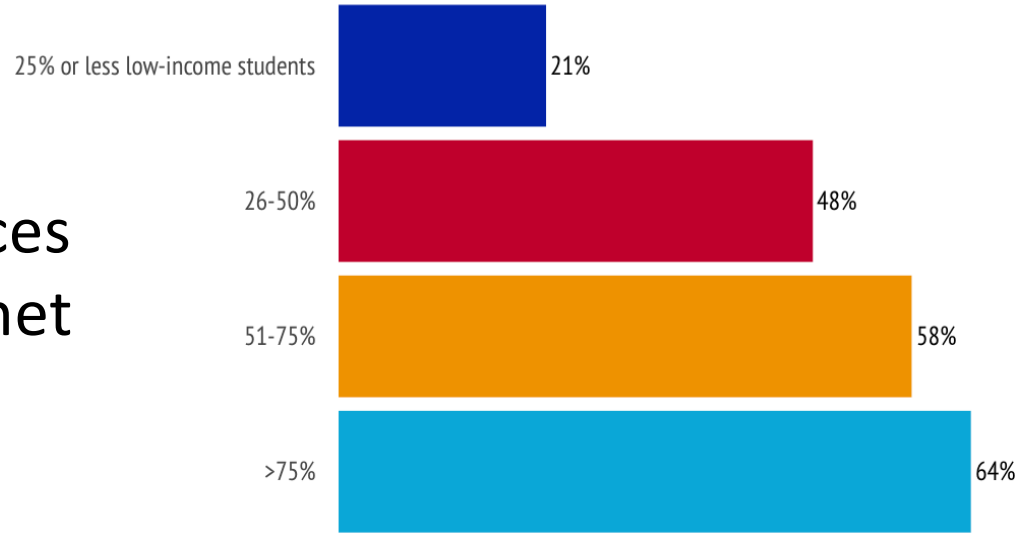
Education Realities of a COVID-19 World

- By fall 2020, the coronavirus pandemic will see unprecedented impact on academic achievement (NWEA, 2020)
  - Average US student will have lost 1/3 expected progress in reading
  - Average US student will have lost 1/2 expected progress in math
- Disparities in computing access
- Disparities in connectivity
- Disparities learning interactions with teachers

SES Effect: Wealthy districts 2x more likely to provide live teaching than low SES districts Center on Reinventing Public Education (2020)

Technology Disparities (March 2020)

Access to digital devices and high-speed internet

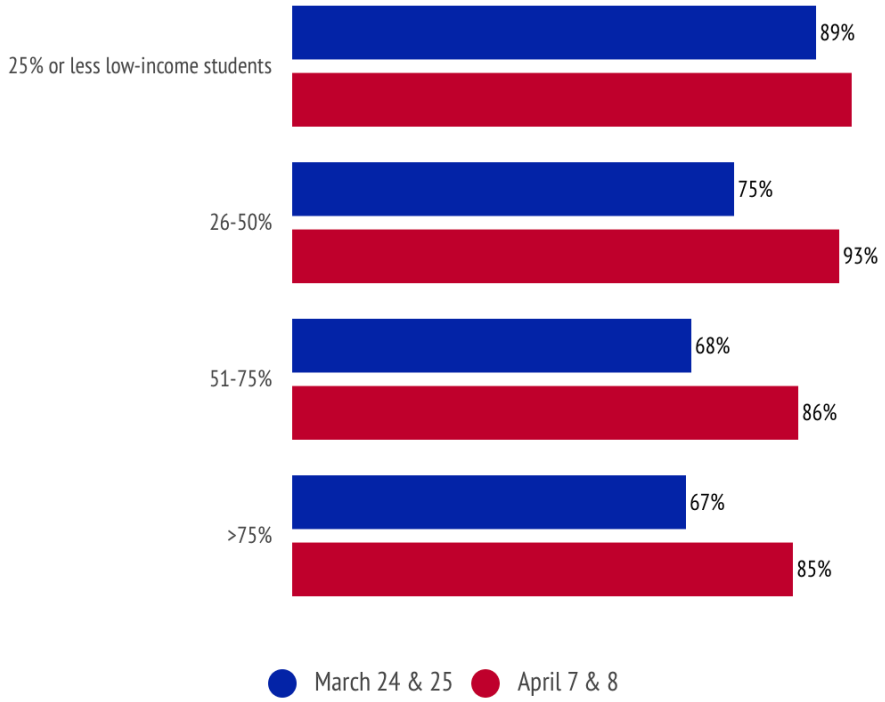


SOURCE: EdWeek Research Center

NC STATE UNIVERSITY

Teaching Disparities (March-April 2020)

Teachers engaging in online instruction

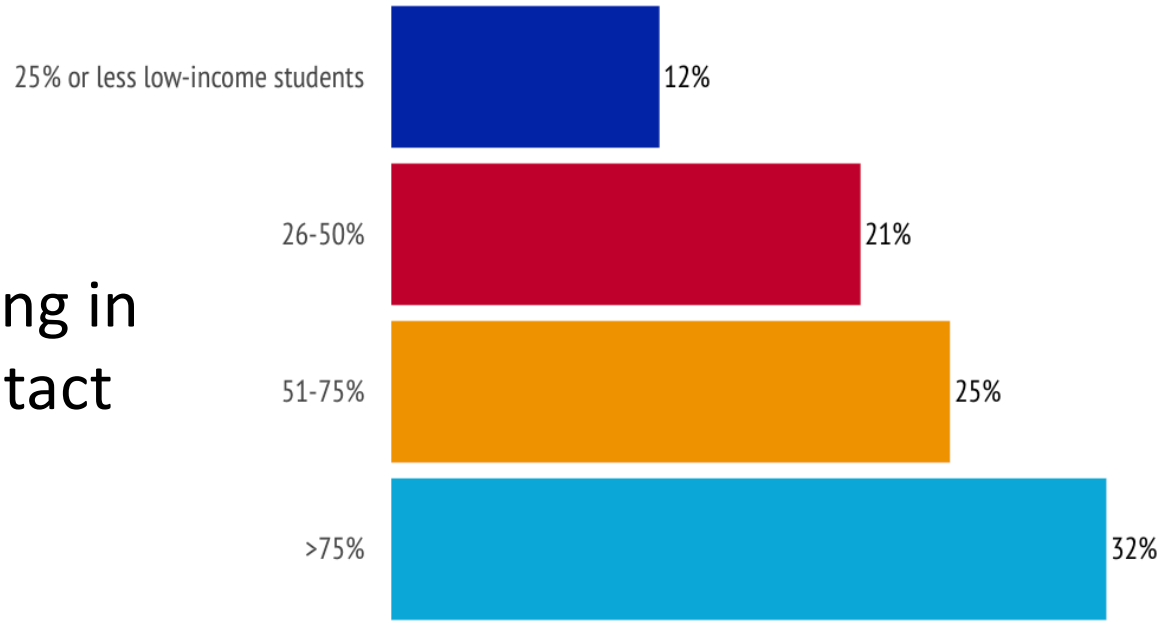


SOURCE: EdWeek Research Center

NC STATE UNIVERSITY

“Truancy” Impact (April 2020)

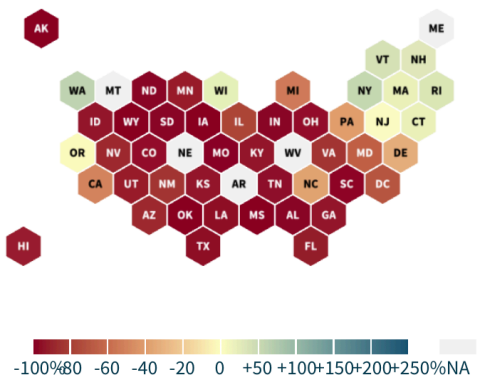
Students not logging in or making any contact



SOURCE: EdWeek Research Center

SES Example: Math “Progress” (Jan-June)

Percent Change in Student Math Progress ⓘ



Total

○ All

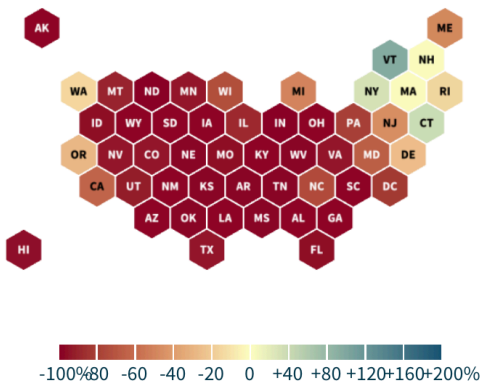
School ZIP Inc...

◉ High Income

○ Middle Inc...

○ Low Income

Percent Change in Student Math Progress ⓘ



Total

○ All

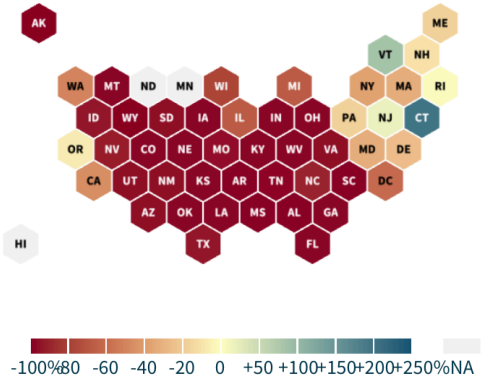
School ZIP Inc...

○ High Income

◉ Middle Income

○ Low Income

Percent Change in Student Math Progress ⓘ



Total

○ All

School ZIP Inc...

○ High Income

○ Middle Inc...

◉ Low Income

Chetty, Friedman, Hendren, Stepner, and the OI Team (2020)

NC STATE UNIVERSITY

Leveraging AI for Learner Engagement

Question: What's needed?

Answer: Engaged learning environments that adaptively motivate and can operate at scale.

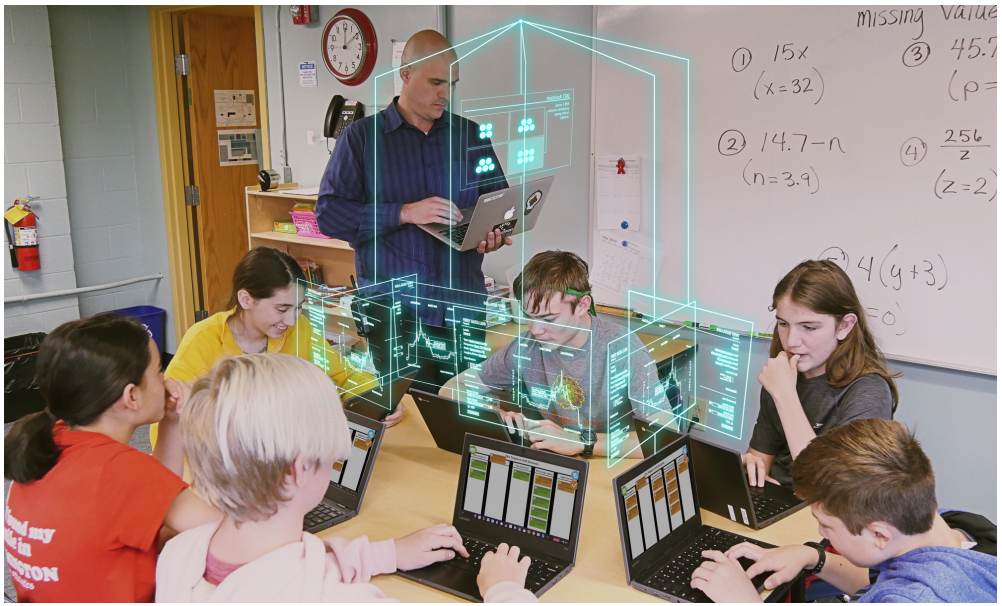
Question: Are there "AI in education" research foundations?

Answer: Yes. And there's very important work to do.

Learning Environments Designed for Engagement

NC STATE UNIVERSITY

Research Foundations:
Engaged Learning in the Classroom

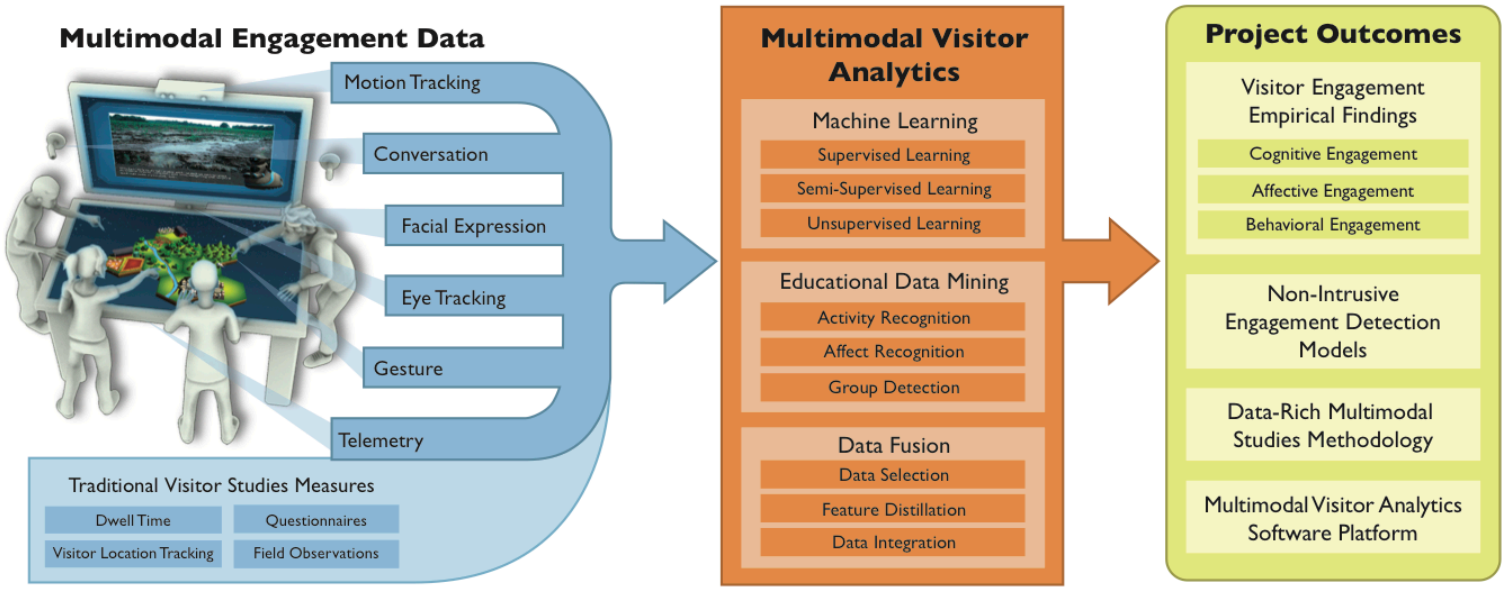


Learning analytics for classroom orchestration

INDIANA UNIVERSITY

NC STATE UNIVERSITY

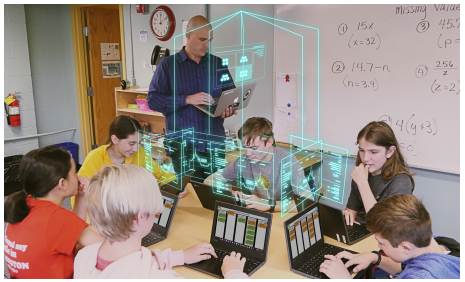
Research Foundations: Engaged Learning in Museums



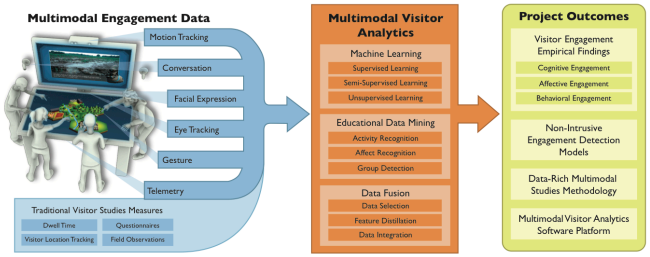
Learning analytics for museum engagement

NC STATE UNIVERSITY

Current Research: Engaged Learning at Home



AI-engaged learning in classrooms



AI-engaged learning in museums

Research Foundations

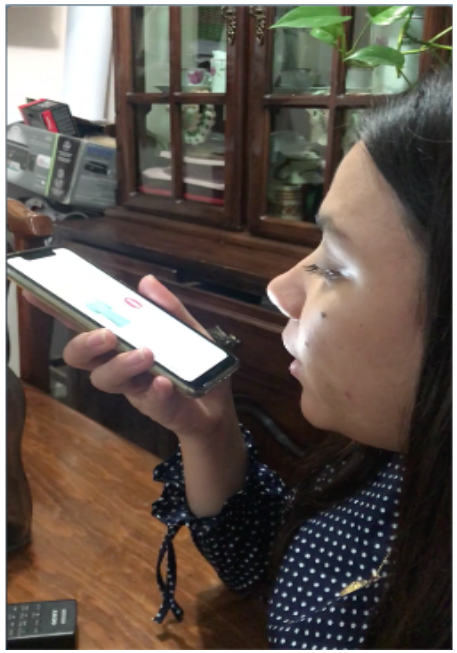
AI-engaged learning at home for *all* learners

Next Frontier

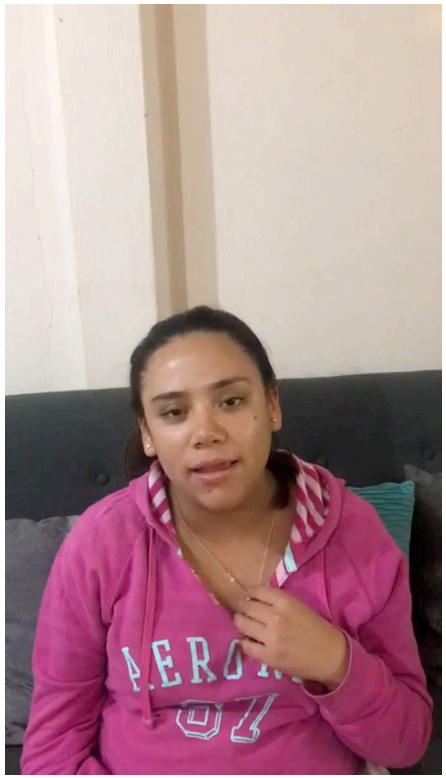
NC STATE UNIVERSITY

Alelo Enskill: An AI-driven learning architecture

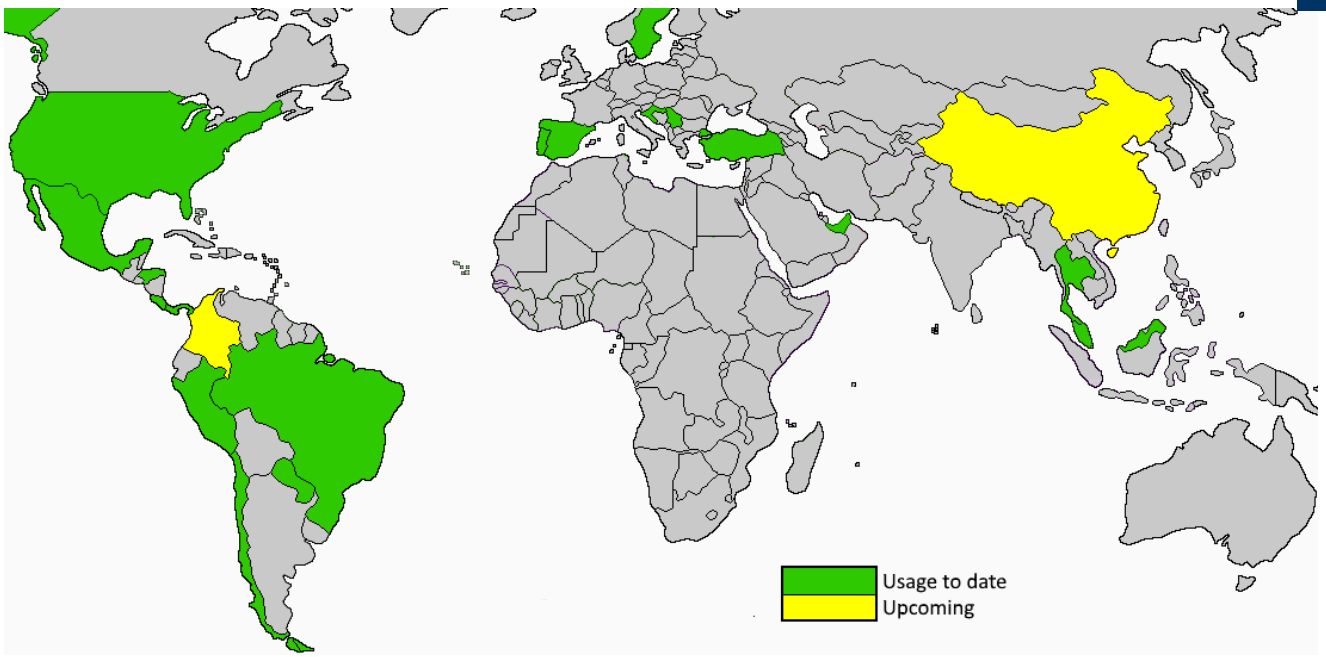
1. Communicative practice with AI avatars in safe environment
2. Personalized learning
3. Analytics for teachers, learners, administrators, and developers



WhatsApp Student Recordings



Enskill Around the World



Brazil • Chile • China • Colombia • Costa Rica • Croatia • Honduras • Malaysia • Mexico • Panama

Paraguay • Peru • Portugal • Serbia • Spain • Sweden • Thailand • Turkey • United States • United Arab Emirates

NOT

Technologies ^ available to students everywhere

Carnegie Mellon University

ROBO TUTOR

NOT

Technologies ^ available to students everywhere

- Reliable electricity
- High-bandwidth Internet access
- Fast WiFi
- Powerful computers
- Sophisticated sensors
- Expert support

… and some work-arounds in RoboTutor

- $1M Finalist in Global Learning XPRIZE

Carnegie Mellon University

ROBO TUTOR

Power

- Assumption
  - Reliable electricity
- Reality
  - Limited availability
  - Fluctuating level
- Workaround
  - Batteries
  - Solar-powered recharger

Carnegie Mellon University

ROBO TUTOR

Internet

- Assumption
  - Reliable, wide-coverage, high-bandwidth Internet access
- Reality
  - Limited, slow, or no Internet access
- Workaround
  - Non-web-based apps

Carnegie Mellon University

ROBO TUTOR

WiFi

- Assumption
  - Reliable, wide-coverage, high-bandwidth local WiFi
- Reality
  - Limited coverage
  - Limited bandwidth
  - Frequent outages
- Workaround
  - Run client-side without relying on local server

Carnegie Mellon University

ROBO TUTOR

Computers

- Assumption
  - Plentiful, powerful, personal
- Reality
  - Scarce, low-end, shared
- Workaround
  - Support shared use

Carnegie Mellon University

ROBO TUTOR

FaceLogin

- Share tablet
- Keep profile
- Kids enroll
- Easy login

- (Bagamoyo, May 2018)

Carnegie Mellon University

ROBO TUTOR

Sensors

- Assumptions
  - Reliable, many-modal, accurate
  - Controlled environment
- Reality
  - Unreliable, few, inaccurate
  - Noisy environment
- Workarounds
  - Apply selectively
  - Degrade gracefully
  - Provide fallback

Carnegie Mellon University

ROBO TUTOR

Fisi na kunguru walikuwa marafiki sana hapo awali ingawaje tabia zao zilikuwa tofauti sana kwa njia nyingine.

Kunguru aliweza kuruka lakini fisi hakuweza isipokuwa kutembea tu.

Support

- Assumption
  - Available, expert assistance (technical and educational) and assessment
- Reality
  - Scarce or absent
  - Inexpert, even illiterate
  - Teacher over-burdened, under-trained, absent, or non-existent
- Workaround
  - Self-explaining, spoken prompts, pointing
  - Video to show external context and demonstrate how to use
  - Automated assessment for placement and promotion

Carnegie Mellon University

ROBO TUTOR

CorelDRAW
HUMAN PHYSIOLOGY
ROBO
TUTOR

For more information, see

- RoboTutor.org:

Toward Learning at Scale in Developing Countries: Lessons from the Global Learning XPRIZE Field Study

Andrew A. McReynolds
U. of San Francisco
San Francisco, CA, U.S.

Sheba P. Naderzad
U. of Southern California
Los Angeles, CA, U.S.

Mononito Goswami
Delhi Technological U.
New Delhi, India

Jack Mostow
Carnegie Mellon U.
Pittsburgh, PA, U.S.

Fostering connections among students

Carnegie Mellon

Will there be collaboration in the Post-COVID19 classroom?

Grade 12 students at Port Moresby National High School (Credit: Malachi Wurr)

Safety concerns emphasize distancing

Distancing requirements may make collaboration challenging

Questions regarding maintaining social distance while encouraging collaborative engagement

Concern regarding social isolation in schools

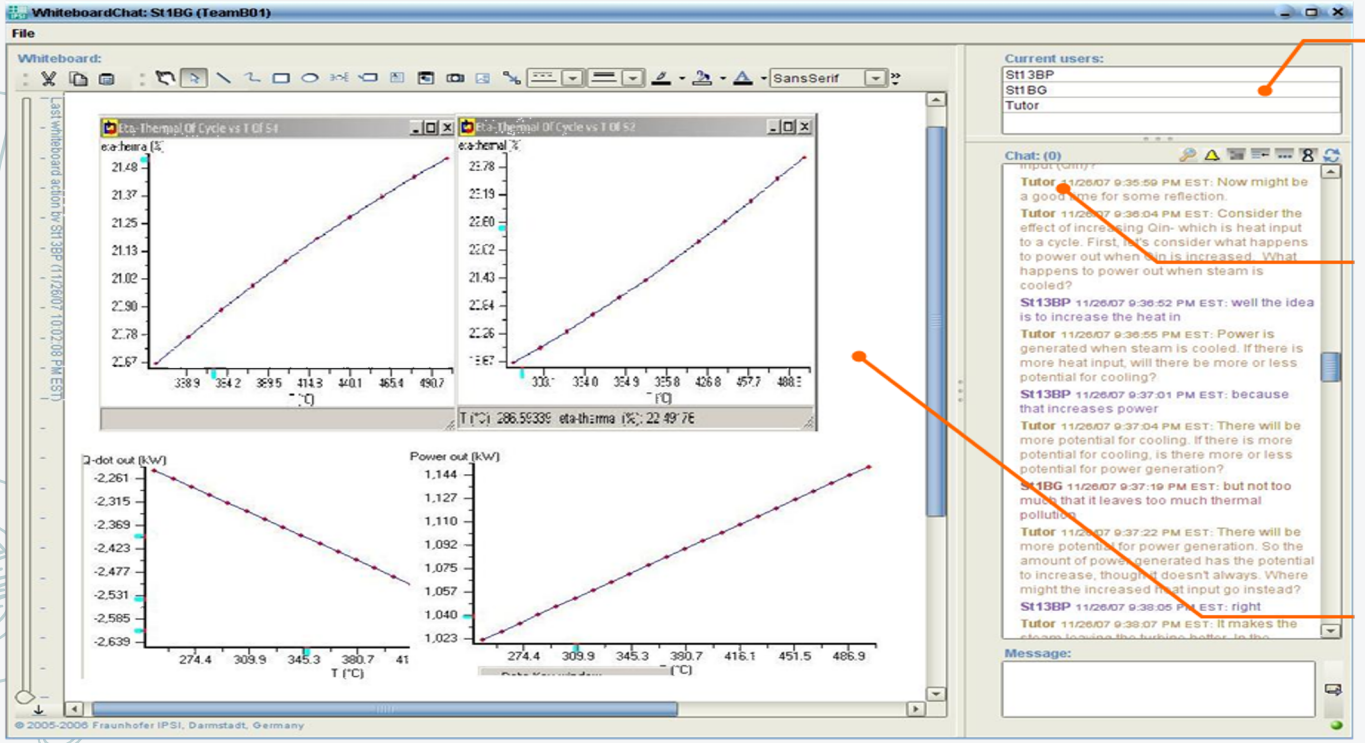
The Collaborative Alternative
Students as learning resources for each other

Students gain as much from a human partner as from a carefully crafted tutor agent (Kumar et al., 2007)

Students can benefit from working with another human student, even in the absence of scaffolding (Gweon et al., 2006)

Students elaborate more when talking with a human partner (Rosé & Torrey, 2004)

Building on 15 years researching
Dialogue agents as collaborative learning support



Students & Tutor working on designing a power plant

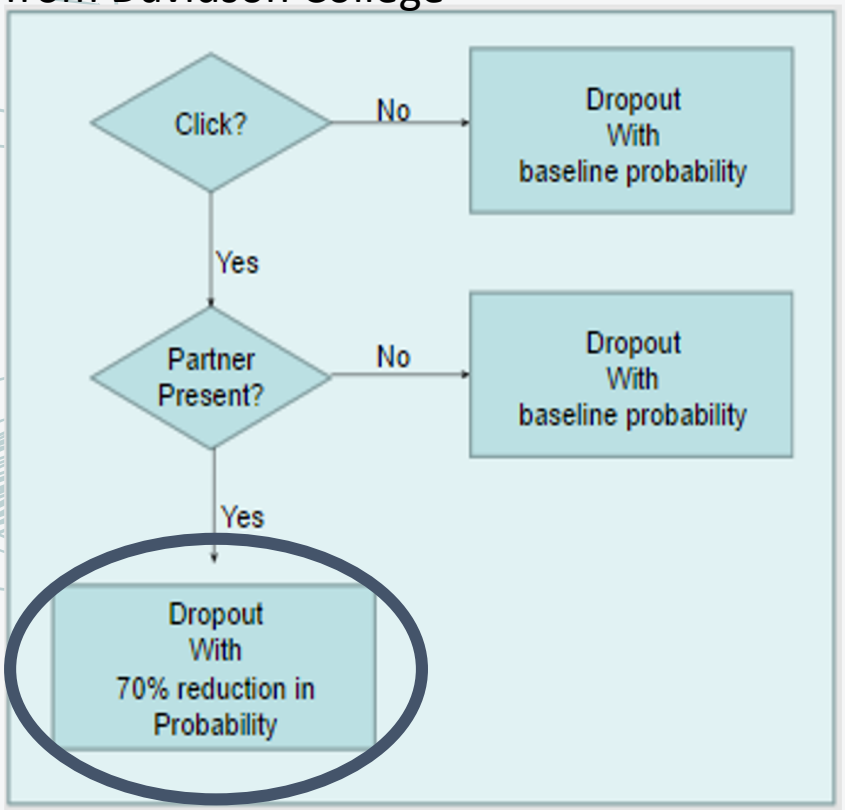
Tutor discusses thermodynamics concepts and makes arguments for design alternatives.

Students share results and ideas in a common workspace

Students learn 1.25 letter grades more when working with a partner + automated support than working alone (Kumar et al., 2007)

Student Persistence Benefits From collaborative interactions

Study in Medicinal Chemistry MOOC from Davidson College



Impact on Rate of Attrition in MOOCs

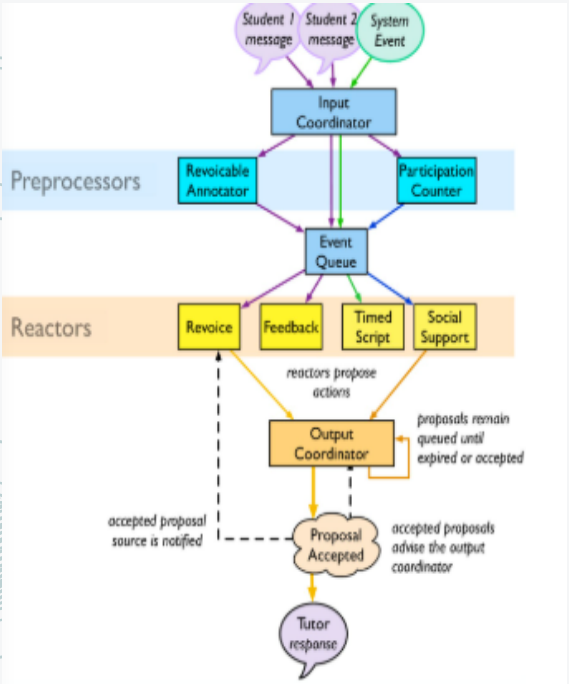
Engagement in collaborative reflection opportunities increase commitment, controlling for self-selection effects

Consistent across multiple MOOCs

Design Principles

Effective dialogue agent based support for collaborative learning

The Bazaar Architecture



Adamson, D., Dyke, G., Jang, H., & Rosé, C. P. (2014). Towards an agile approach to adapting dynamic collaboration support to student needs. *International Journal of Artificial Intelligence in Education*, *24*(1), 92-124.

Show personal interest (Kumar et al., 2007)

Offer students control (Chaudhuri et al., 2008; Chaudhuri et al., 2009)

Adopt Balesian social strategies (Kumar et al., 2010; Ai et al., 2010)

Avoid showing favoritism (Ai et al., 2010)

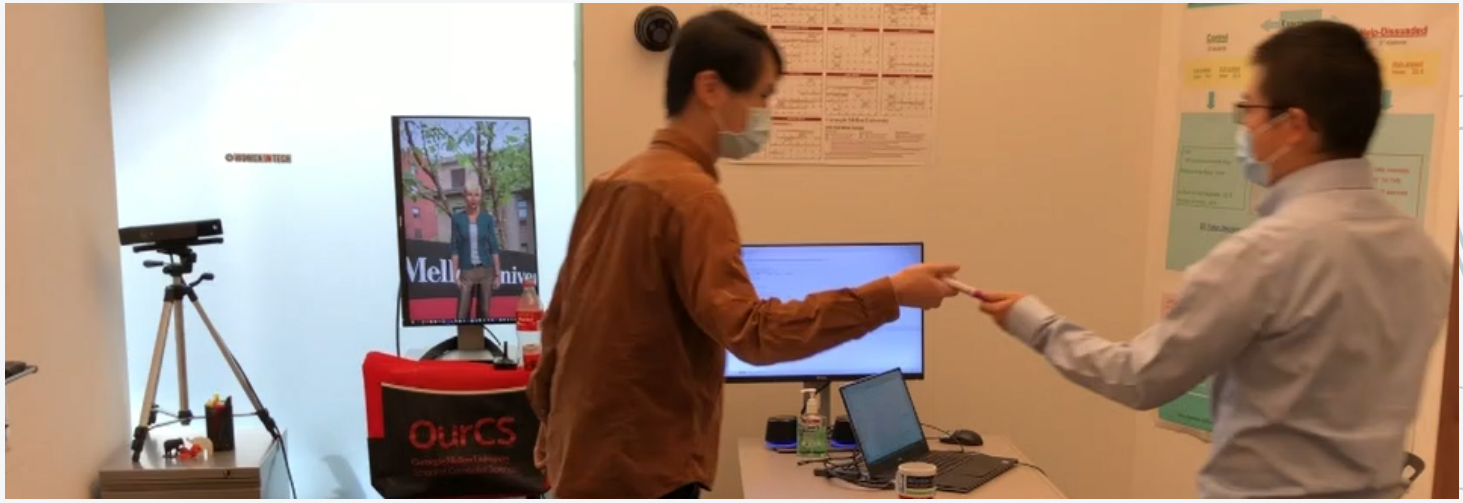
Display openness (Kumar et al., 2011)

Use targeted elicitation (Howley et al., 2012)

Accountable talk (Dyke et al., 2013; Adamson et al., 2014)

Support for regulation of social distancing while encouraging collaborative engagement

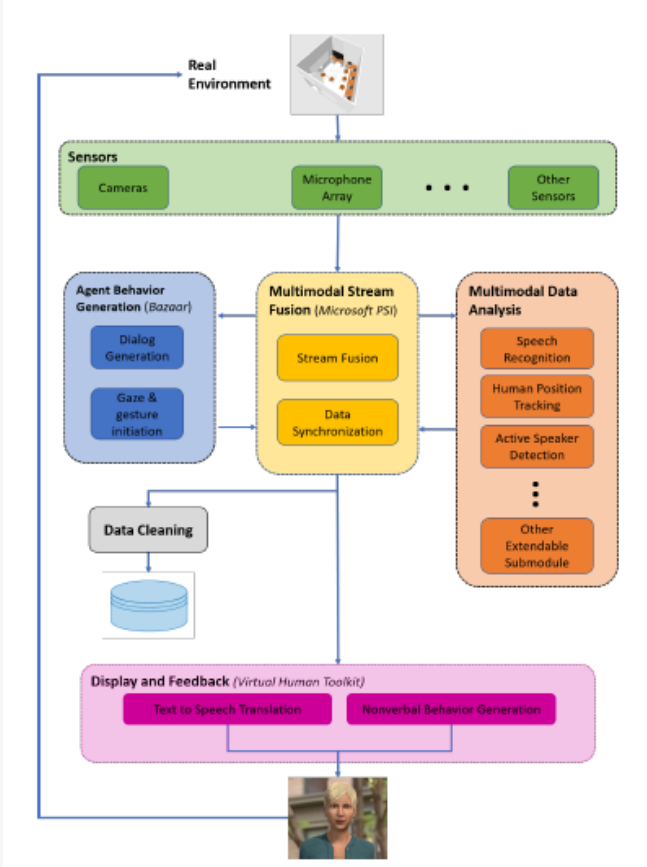
Find the video on **vimeo** in the **CMU LTI** space



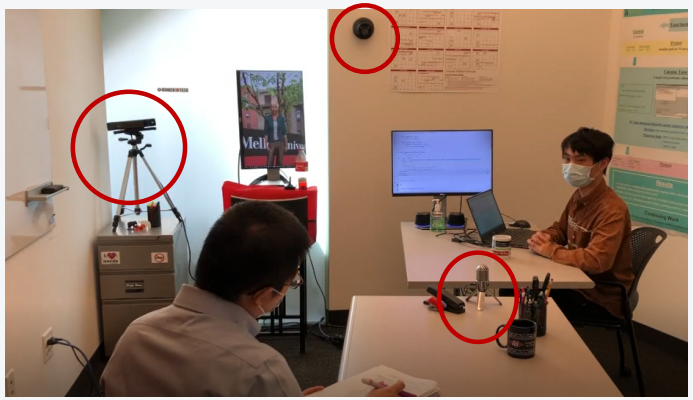
Video Demo: vimeo.com/430857816

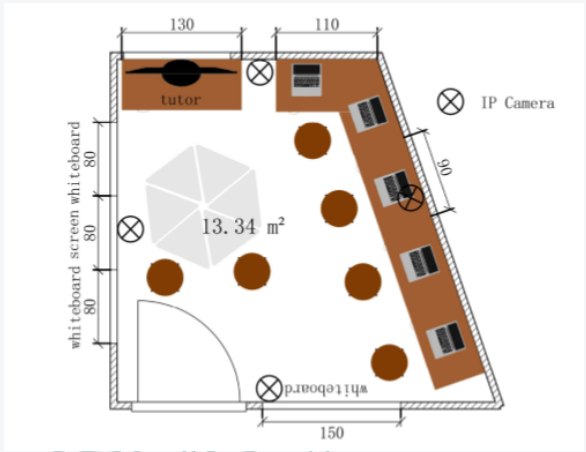
Building on and extending collaboration support through chat

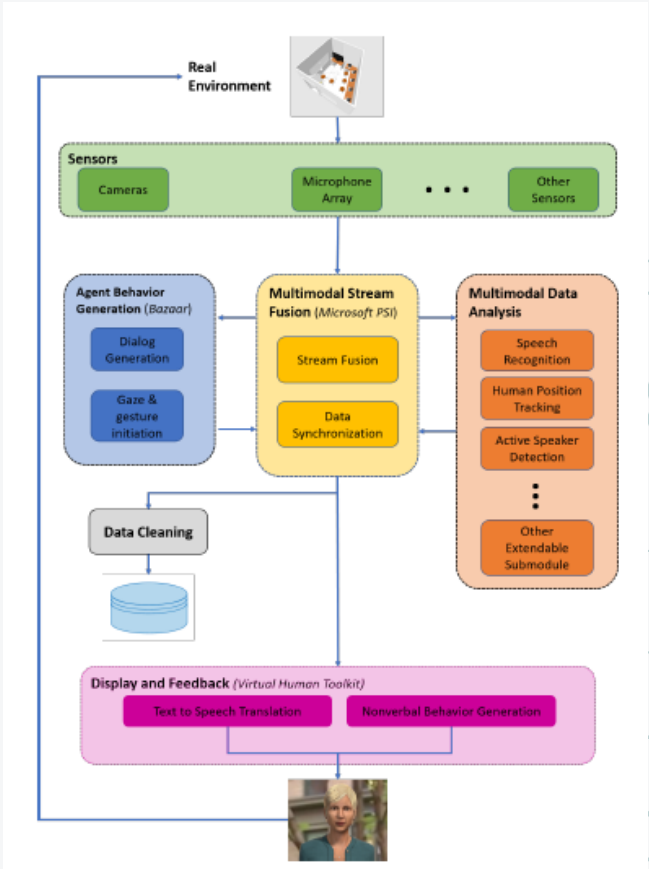
Wang, Y., Murray, R. C., Bao, H., Rosé, C. P. (2020). Agent-Based Dynamic Collaboration Support in a Smart Office Space, *Proceedings of the 21st SIGDIAL Meeting on Discourse and Dialogue*



Building on and extending collaboration support through chat

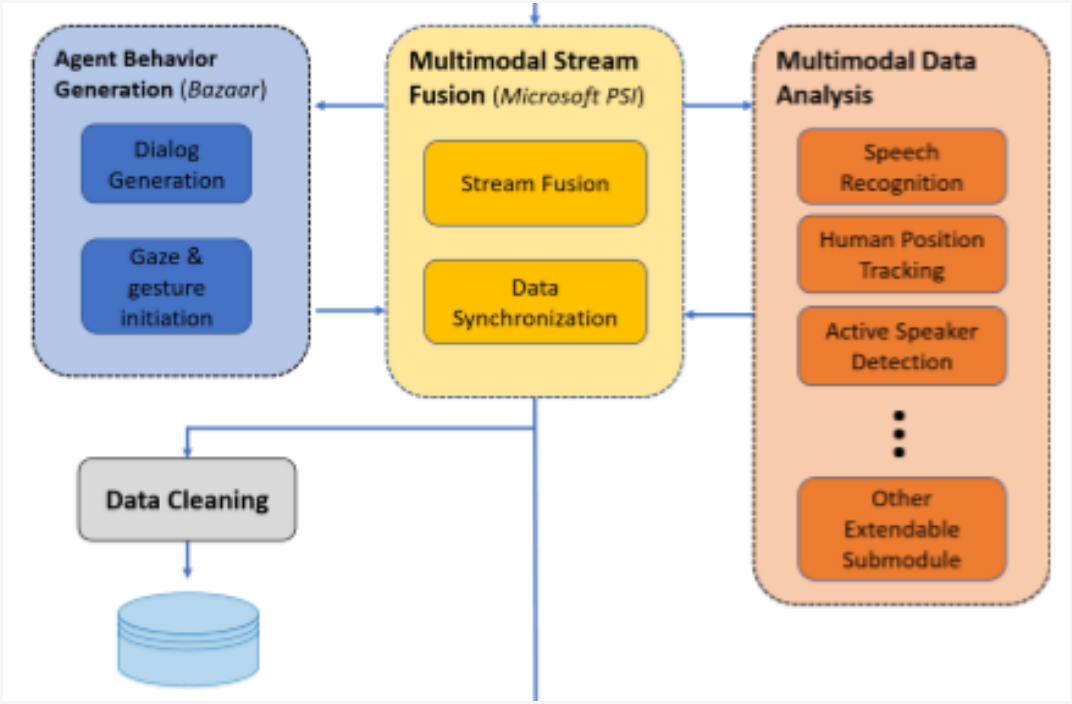






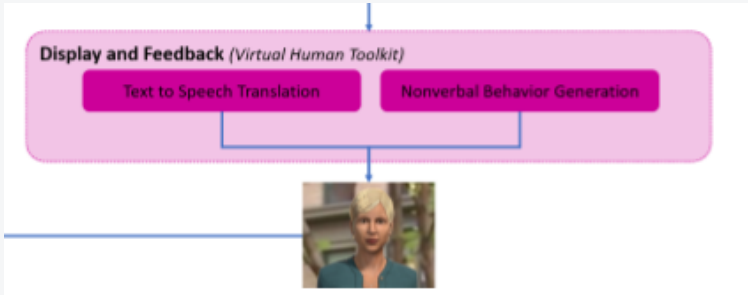
Building on and extending collaboration support through chat

Same **Bazaar architecture** used for collaboration in text based chat

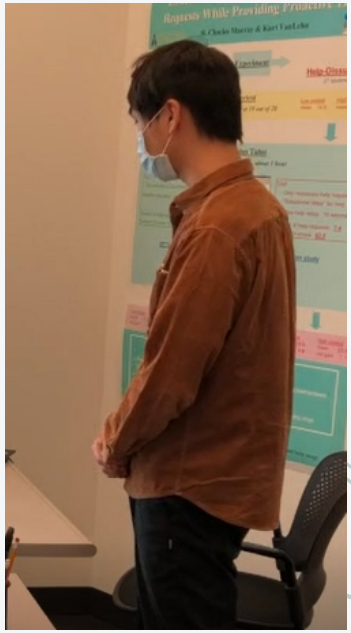


Active speaker detection to associate names with speakers, **Position tracking** for gesture generation and social distance detection, **Speech recognition** for input

Building on and extending collaboration support through chat

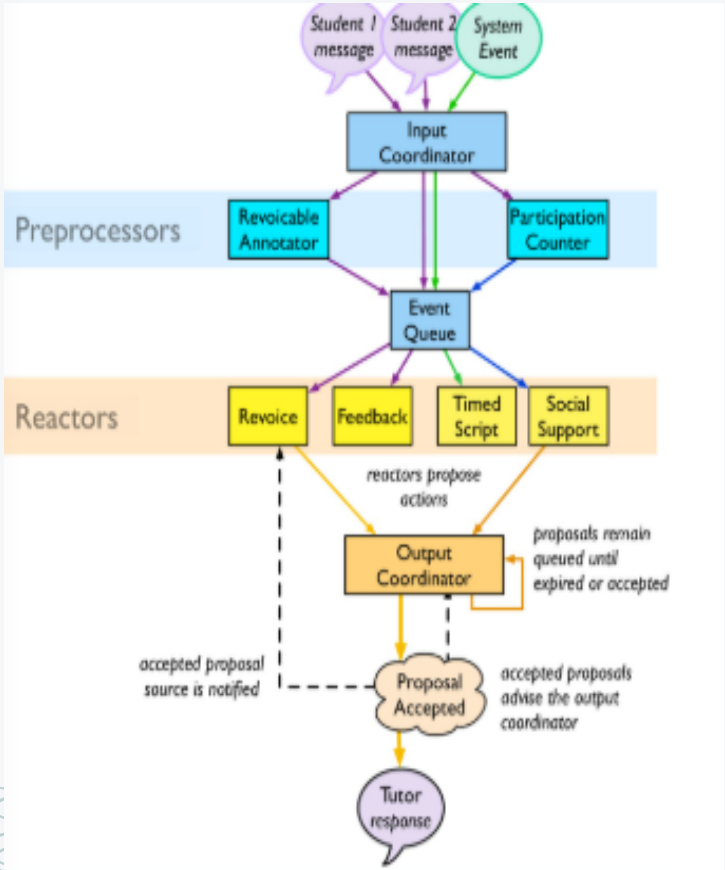


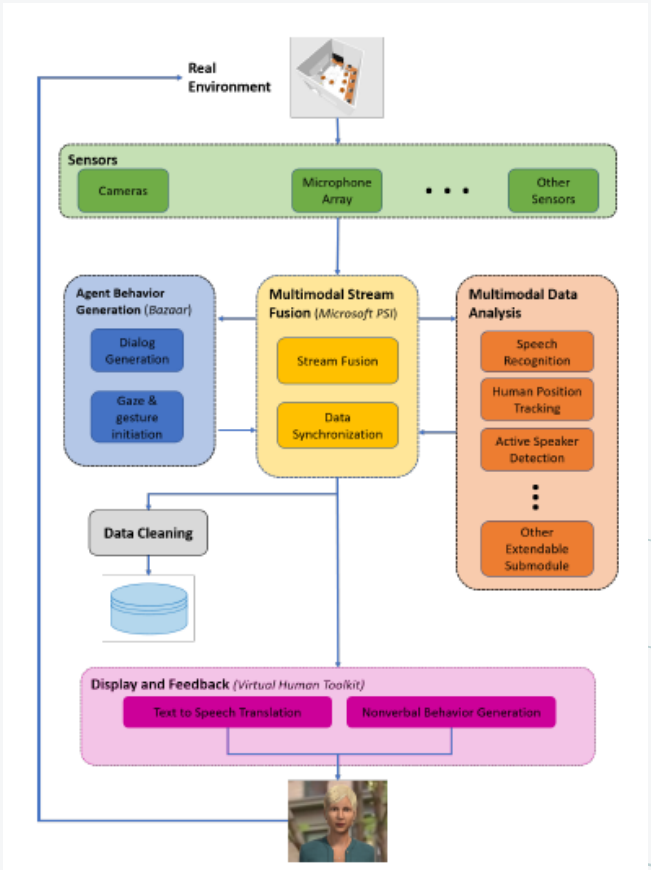
Eye gaze,
Gesture,
and Use of
personal
names



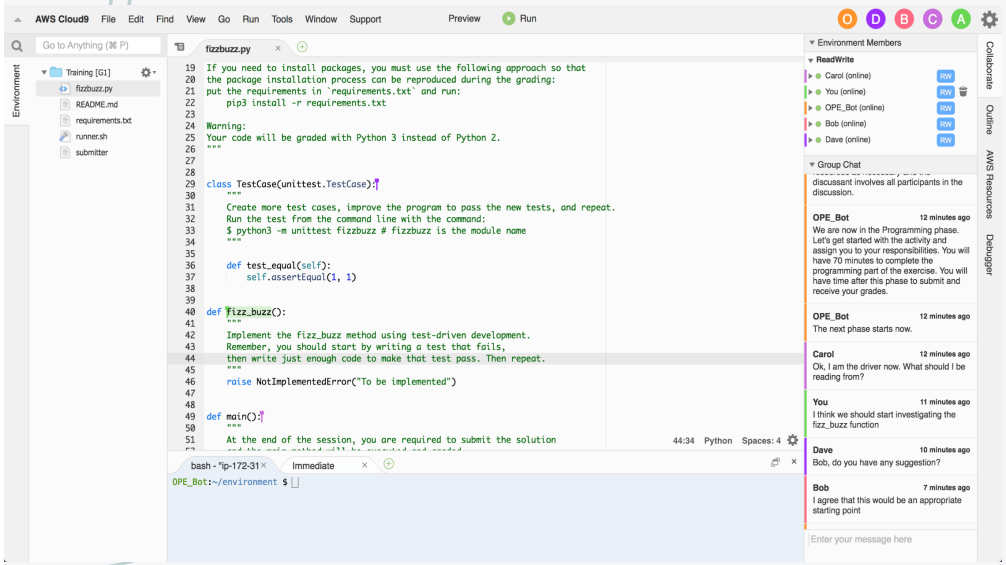
Building on and extending collaboration support through chat

Bazaar is available as part of **the Open Simon Toolkit**





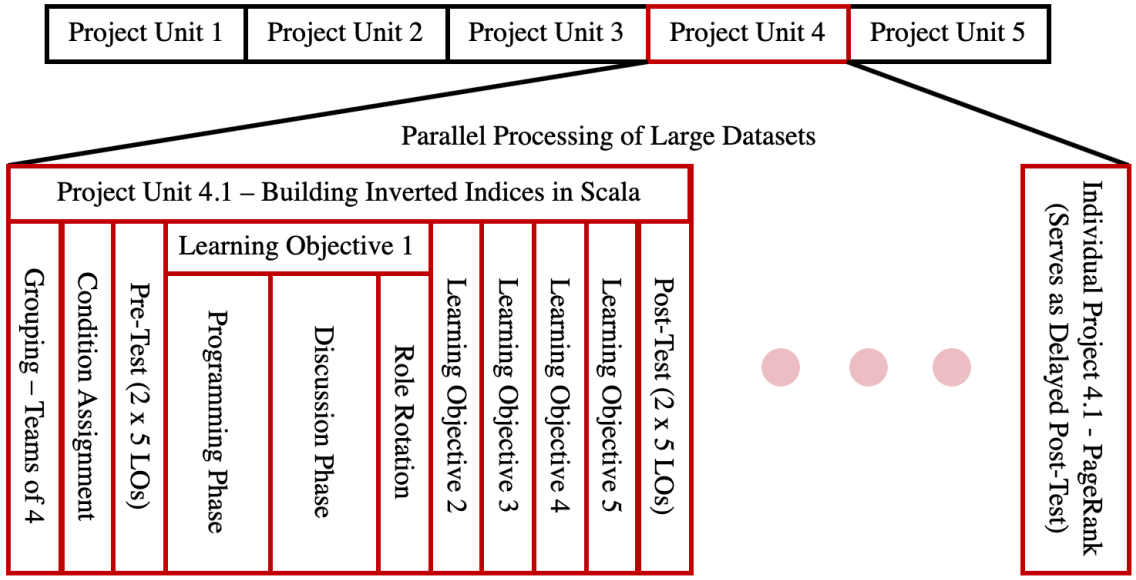
Online Collaborative Project Based Learning



- Groups of students collaborate through chat in cloud based IDE
- Conversational agent structures the activity, assigns roles, and supports idea exchange and elaboration
- Light feedback on submitted code offered automatically in real time

Design Guidelines for Practitioners for Online Collaborative Project Based Learning

80 minute collaborative activities integrated within course units as effective preparation for extended individual software development



Sankaranarayanan, S., Kandimalla, S., Cao, M., Maona, I., An, H., Bogart, C., Murray, R. C., Hilton, M., Sakr, M., Rosé, C. P. (in press). Designing for Learning During Online Collaborative Projects: Tools and Takeaways, *Information and Learning Sciences Journal*

lester@ncsu.edu

mostow@cs.cmu.edu

cprose@cs.cmu.edu

ljohnson@alelo.com

www.alelo.com/AIED

alelo