

the EP always available, any time students or teacher thought it was time to inquire. In this regard, EP emulate nature: always available for inquiry. However, they offer some distinct advantages over wild nature, in terms of the accessibility (i.e., situated within the classroom), and the control over disciplinary engagement (discrete habitats, food webs, etc.).

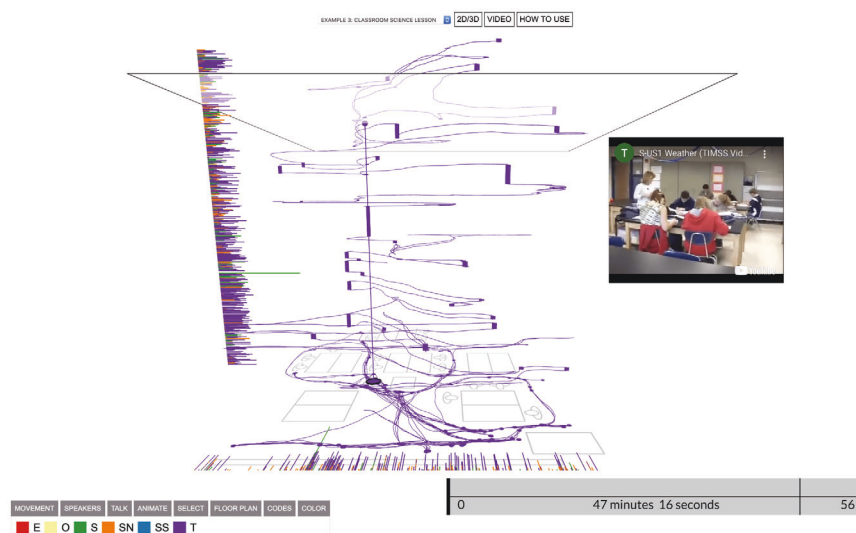
Studying Equity Oriented & Distributed Classroom Contexts through an Interaction Geography Lens

Ben Rydal Shapiro & Sierra Gilliam

The projects in this symposium share many different and innovative approaches to pedagogical and learner-centered design in relation to the physical environment, while also asking new questions, for example, concerning the ethical collection and use of data in classroom contexts. In this presentation, we first share our efforts to expand a methodological approach called interaction geography in collaboration with teachers and teacher educators to study different equity-oriented classroom contexts (Shapiro & Garner, 2021). Subsequently, we discuss how findings from this work might contribute to and be informed by projects described in this symposium and more broadly, the notion of distributed intelligence.

Figure 1.

Screenshot from the IGS showing a teacher's movement (purple path where thicker parts of the path indicate the teacher is stopped) and all classroom conversation (colored rectangles where color indicates speaker) over a floor plan and a timeline that extends upwards during a classroom science lesson. This visualization provides one way to see how movement and conversation unfold over space and time. Video can be dynamically selected by interacting with this type of visualization.



We begin by providing a brief background of interaction geography, highlighting how it draws from a growing body of work that foregrounds the role of movement in learning and teaching contexts (DeLiema, Enyedy, & Danish, 2019; Marin et al., 2021). Notably, we demonstrate two open-source tools, Mondrian Transcription and the Interaction Geography Slicer (IGS), to transcribe and dynamically visualize movement and interaction in relation to the physical environment (e.g., see: <https://benrydal.github.io/igs/>). Subsequently, we describe how we are working with teachers and teacher educators to study and support teaching practice and discourse by creating interactive visualizations through these tools such as in Figure 1 depicted above.

We share findings from this work focusing on the strengths and weaknesses of interaction geography to study phenomena such as pedagogical judgment, multi-party activity, technology use, and equitable participation patterns across classrooms as well as relevant perspectives on the ethical collection and use of classroom video data. Likewise, we use these findings to consider how interaction geography can support and be informed by the many different projects in this symposium and the broader notion of distributed intelligence.

Space Invaders: Multiple Entry Points on a Night Sky Simulation for Supporting Small Group Collaboration in Classrooms

Robb Lindgren, Nathan Kimball, James Planey, Emma Mercier & Jina Kang

Fundamental to understanding and explaining critical phenomena in astronomy is the ability to reason spatially and to integrate multiple visual perspectives (Plummer, 2014). While most astronomy instruction focuses on getting individual students to reconcile different sources of spatial data to construct canonical mental models of astronomical systems, we know from previous collaborative learning research that some of the work of integrating spatial information can occur through group activities where roles and perspectives are distributed (e.g., Colella, 2013; Hod, 2017). Astronomy education typically emphasizes observations of the night sky or the use of single-user night sky simulations, but some of the more challenging tasks, such as navigation based on star data, is benefitted by sharing and communicating across viewpoints.

Augmented reality (AR) technologies have been promoted in recent years for their ability to merge and enhance visual viewpoints in ways that are potentially productive in educational contexts (Akçayır, M., & Akçayır, 2017; Radu, 2014). AR technologies have the ability to expand and transform the physical space of a learning environment, but these transformations are usually bound to the visual perspectives of individuals with expensive headsets, and as such, the utility of AR in collaborative learning contexts has been limited. In this presentation we will describe a project in which AR is only part of a distributed technology ecosystem that supports multiple viewpoints and multiple modes of interaction with a persistent night sky simulation.

The Connections of Earth and Sky with Augmented Reality (CEASAR) platform was designed to add the component of space (literally) to small group problem-solving tasks. Students can access and annotate the same night sky simulation from a tablet, a laptop, or an AR headset such as the HoloLens 2. The diversity of access points means that certain kinds of information are privileged by different devices; the AR viewpoint, for example, affords the use of natural gestures to point and trace the trajectory of stars, whereas the tablet affords quick switching between modes such as between a view from Earth's surface to a view from outside the celestial sphere. These differences mean that students benefit from communicating with each other across viewpoints and synthesizing information to complete tasks such as calculating the latitude and longitude of an unknown position on Earth given a view of the sky at a certain point in time.

Figure 2

Gesture-based interactions in the augmented reality mode of the CEASAR platform.



In this symposium we will present learner data from several implementations of the CEASAR platform in classrooms, and we will give attendees the opportunity to engage with the technology in a live demonstration.

How big was a triceratops, really? Using Augmented Reality to Support Collaborative Reasoning about Scale

Jessica Roberts & Kyle Leinart

Immersive digital environments have tremendous potential to facilitate experiential learning tasks which would be otherwise impossible or impractical in a classroom setting (Lai et al., 2020; Pirker et al., 2020). Yet despite growing enthusiasm in educational design communities for these augmented and virtual reality (hereafter collectively, “XR”) technologies, many open questions remain for how, whether, and why these technologies support learning in the K-12 setting (Cook & Thompson, 2021), particularly for collaborative learning experiences (Pirker et al., 2020). Our ongoing work on FossilVR (Figure 3, A), an immersive 3D environment in which students engage in the inference-heavy scientific processes of excavating, identifying, and rearticulating fossil skeletons in a virtual world, is exploring the affordances of XR for supporting 3rd-5th grade students in developing language and science competencies.

The prototype of our platform, built in Unity with the visual scripting language Playmaker, allowed single users to uncover fossils placed around the virtual world and record observations and inferences about