



# Immersive Simulations for Skill Learning: an Interactive Workshop

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**Abstract.** This workshop highlights leading-edge design-based research on immersive simulations for learning. The capability of VR, MUVE, and MR interfaces to foster psychological immersion enables technology-intensive educational experiences that draw on a powerful pedagogy: “Situating” learning takes place in the same or a similar context to that in which it is later applied, and the setting itself fosters tacit skills through experience and modeling. Three exemplary illustrations of immersive simulations are described. First, immersive training systems have shown promise for using virtual simulations to enhance negotiation skills development, including conversational skills and knowledge as well as self-efficacy. Second, game-based learning environments can provide immersive simulated experiences in which learners engage in situated challenges, motivating players learn and practice tasks within the game world. Third, mixed reality simulation (MRS), operated by a human simulation specialist who puppets avatars in virtual environments, offer new opportunities for educators to learn and practice teaching techniques in a consequence-free classroom.

**Keywords:** Simulations, Immersion, Situated Learning.

## 1 Purpose of and Background for the Workshop

The goal of this workshop is to highlight leading-edge design-based research on immersive simulations for learning. Participants will learn about exemplary projects and engage in breakout group discussions based on various dimensions of this topic (e.g., design and development, implementation and evaluation, integration of Gen AI).

### 1.1 Situated Learning and Transfer in Immersive Simulations for Skill Learning

The capability of VR, MUVE, and MR interfaces to foster psychological immersion enables technology-intensive educational experiences that draw on a powerful pedagogy: “Situating” learning takes place in the same or a similar context to that in which it is later applied, and the setting itself fosters tacit skills through experience and modeling [1]. For example, in a medical internship, both the configuration and the coordinated team activities in a hospital surgical operating room provide embedded knowledge.

Situated learning requires authentic contexts, activities, and assessment coupled with guidance from expert modeling, mentoring, and “legitimate peripheral participation” [2]. As an example of legitimate peripheral participation, graduate students work within the laboratories of expert researchers, who model the practice of scholarship. These students interact with experts in research as well as with other members of the research team who understand the complex processes of scholarship to varying degrees. While in these laboratories, students gradually move from novice researchers to more advanced roles, with the skills and expectations for them evolving.

Situated learning is important in part because of the crucial issue of transfer, the application of knowledge learned in one situation to another situation. Transfer is demonstrated if instruction on a learning task leads to improved performance on a transfer task, typically a skilled performance in a real-world setting. For example, statistical reasoning learned in a classroom can potentially aid with purchasing insurance. A major criticism of instruction today is the low rate of transfer generated by conventional instruction. Even students who excel in schooling or training settings often are unable to apply what they have learned to similar real-world contexts.

Situated learning addresses this challenge by making the setting in which learning takes place similar to the real-world context for performance in work or personal life. Learning in well-designed digital contexts can lead to the replication in the real world of behaviors successful in simulated environments [3, 4].

Moreover, the evolution of an individual's or group's identity is an important type of learning for which simulated experiences situated in immersive interfaces are well suited [5]. Reflecting on and refining an individual identity is often a significant issue for students of all ages, and learning to evolve group and organizational identity is a crucial skill in enabling innovation and in adapting to shifting contexts. Identity "play" through trying on various representations of the self and the group in virtual environments provides a means for different sides of a person to find common ground and the opportunity for synthesis and evolution [6].

All these capabilities suggest that, to maximize the power of immersive learning it's important not to present isolated moments in which VR, MUEs, and AR are used to provide short-term engagement or fragmentary insight. Instead, extended experiences that immerse students in rich contexts with strong narratives, authentic practices, and links to real world outcomes are what truly unleash the transformational power of immersion.

In particular, immersive virtual learning environments can enhance learning of science concepts by situating students' investigations in realistic, yet scaffolded contexts [7]. Situated experimental tools let students interpret results contextually and integrate their findings with other sources of evidence—including observations and data collected in the virtual world—to build and test hypotheses. As illustrated in the educational applications discussed next, the natural language processing enabled by Generative AI enables both richer immersive experiences that evoke sophisticated skills and more powerful analytics for developing rich feedback to learners and teachers.

## **2 Workshop Presentations as Exemplary Illustrations of Immersive Simulation**

### **2.1 Example: Chatbots for Negotiation Training**

Negotiation is an interaction between two or more parties in which the overall objective is to achieve a more optimal overall outcome than what the parties can accomplish individually. An example of a productive negotiation could be a small business owner securing a lower price point with a supplier in exchange for increasing the volume of the order. Being able to negotiate with agility under a variety of circumstances is a crucial strategic skill for success in personal and professional endeavors. Negotiation instruction typically relies on lectures followed by case studies, role plays, and simplified simulations [8]. The simulations, occurring in the controlled environment of a classroom devoid of the contextual complexities experienced in reality, often leaves learners feeling that what they learned in class cannot be put into practice [9], and, in turn, they fail to transfer learnings to the performance context [10].

Immersive training systems have shown promise for using virtual simulations to enhance negotiation skills development, including conversational skills and knowledge [11, 12], and self-efficacy [13]. They have also been explored as environments that can evoke culturally-based biases similar to those in real-world negotiation interactions [14]. With generative AI, these simulations can flow more authentically, allowing learners to test strategies that weren't considered by the original designers. Moreover, learners can now receive automated feedback from the LLM based on a set of predetermined assessment criteria. Initial negotiation chatbot pilots suggest that they could offer an additional opportunity for simulating real-world practice and feedback in an educational setting [15].

### **2.2 Example: Role-play in Immersive Narratives for Science Learning and Identity**

Game-based learning environments can provide immersive simulated experiences in which learners engage in situated challenges, motivating players learn and practice tasks within the game world. Often labeled as "serious games," they present authentic scenarios that simulate real-world environments and challenges. Science learning games can give students the opportunity to take on the simulated identity of a scientist, doing meaningful science practices within realistic contexts, and receiving immediate feedback and scaffolding to aid skill development [16, 17].

*Wake: Tales from the Aqualab* is an example of an extended game experience that exemplifies the power of immersive learning, offering a strong narrative and identity "play" to middle school students as they take on simulated challenges based on life sciences content in realistic environments across various ecosystems. Players adopt the role of a young scientist named Olivia, and engage in authentic science practices including exploring sites, identifying species, conducting experiments, and building models. Each challenge culminates in players presenting evidence-backed claims, facilitating a deeper understanding of scientific inquiry.

Immersive simulation games can enrich the learning experience by through strong narratives that integrate diverse characters with individual drives and stories [18]. In *Wake*, players navigate a storyline that explores Olivia's growth as an ecologist, and through role-playing and interaction with other characters, players gain insight into the diversity and motivations of people in science, encouraging them to embrace their simulated identity as scientists. This immersive role-play can enhance scientific self-efficacy, interest, and identity, and help students see themselves as part of a community, actively engaging in problem-solving and scientific discourse [19, 20].

### 2.3 Example: Mixed Reality Simulation for Teacher Capacity Building

Another type of skill-centered experience in an immersive virtual environment is mixed reality simulation (MRS). As an illustration, operated by a human simulation specialist who puppets avatars in virtual environments, MRS offers new opportunities for educators to learn and practice teaching techniques in a consequence-free classroom [21]. Based on Lindeman's (1926) seminal research [22], simulation design can leverage qualities of deliberate practice [23], including opportunities to adjust teaching strategies with an explicit goal of responding to student differences, receiving immediate feedback from avatar students and a coach, and repeating practice. MRS also holds opportunities for self-evaluation, self-direction, and applications to the adult's current context [24]. Applying all these precepts, MRS has the potential to provide effective PD qualities and teacher capacity building. Further, teaching in a virtual classroom addresses a common critiques that educator PD is detached from the realities of day-to-day classroom experiences [25].

### 2.4 Connecting the Case Studies

Across the three case studies, different types of XT are used for immersion: through an avatar in a virtual environment, via chat-gpt, and using digital puppeteering. Presenters will contrast the strengths and limits of utilizing each of these media. The case studies also compare learning across a spectrum of skills: teacher capacity building in equitable discussions, STEM identity and knowledge, negotiation skills. These contrasts will inform the breakout group discussions on emerging opportunities and challenges for immersive authentic simulations.

## 3 Format of the Workshop

Workshop Chair Chris Dede will provide a two-minute overview of the purpose and plan of the workshop. Then Ashley Etemadi will present a 10-minute overview of her work in simulations for negotiation training, followed by a 10-minute presentation by Shari Metcalf about her work in simulations and a 10 minute presentation by Chris Dede about his work in mixed reality simulations for teacher capacity building. Next will come 15 minutes for questions and discussion by the group of the whole. The following 25 minutes will be spent in breakout groups, each moderated by workshop leader. The final 15 minutes will feature reports from the breakout groups and a discussion of potential next steps. The total time is 90 minutes. The workshop is discussion only and does not include live demonstrations or interactive experiences. By the end of the workshop, participants will be able to identify characteristics of leading-edge design-based research involving situated learning and to articulate opportunities and challenges in using XR to create immersive authentic simulations across a range of skills (cognitive, durable, socioemotional). No technologies or software will be required for participation.

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