Embodiment and Social Interactions in a Class Virtual Reality

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Abstract: There is a growing enthusiasm to use VR to improve remote student learning experiences. However, incongruities between students' *virtual embodiment* – as avatars in the virtual environment – and *physical embodiment* – from their biological bodies – can significantly impact them. We observed a university class poster session held entirely in an immersive Mozilla Hubs environment. We found that incongruities in embodiment created both challenges and significant opportunities for students to collaborate and learn in a shared space.

Introduction and background

Virtual reality (VR) fills the gap between the physical and digital worlds by enabling interactions with objects in the virtual world (Liu et al., 2019). In recent years, lowered costs and improved system capabilities have encouraged applications that provide students with immersive experiences that permit them to interact with content in meaningful contexts (Abadia et al., 2018) and encourage active collaboration through shared experiences (Gao et al., 2019). Some research has shown that VR changes physical interactions within the environment, impacting cognition (Bailey et al., 2016) and student learning (Abadia et al., 2018). Additionally, embodiment in VR can provide a high level of social presence and cultivate a sense of community (Liu et al., 2019; Holt et al. 2020). However, little research explores how incongruities between *physical embodiment* – the sensations that come with having and controlling a physical body – and *virtual* embodiment – the sensations that come with controlling a body in VR – can affect learning in formal higher education settings.

We studied this gap in a virtual poster session in a postsecondary course. Through observations and student interviews, we investigated the following research questions: (RQ1) How do incongruities between physical and virtual embodiments impact social interactions in a classroom? (RQ2) How do these incongruities open opportunities that are otherwise missing from remote classroom environments?

Methods

This study centers on a VR poster session conducted in a 3D User Interfaces class taught by the second author in Fall 2020. The 75-minute session was held in Mozilla Hubs – a free, open source, virtual collaboration environment that can be accessed without installation or app store (see https://hubs.mozilla.com/docs) – as a part of the regular course syllabus. The course's 33 students were divided into three Hubs rooms. The lead researcher recorded observations of the 11 study participants (2 female graduate students, 4 male graduate students, and 5 male undergraduate students) and performed follow-up interviews with 8 of them.

During the poster session the first author participated as an avatar and took field notes focused on interactions in which congruities and incongruities in embodiment were observed to impact students' social interactions. A group interview was conducted after the session with seven students. One student was interviewed individually within a week using the same interview protocol. Interviews focused on in-person and remote classroom experiences and on their social interactions. Episodes of collective social interaction were sorted into two emergent themes at the intersection of embodiment, collaborative problem solving, and social interactions.

Findings

The first emergent theme was opportunities for collaborative learning in VR. A large part of students' shared experience was exploring their physical and virtual embodiment in the Hubs environment. This opened opportunities for playfulness, creativity, and genuine peer-to-peer interactions as students discovered novel aspects of the environment. For example, at one point a student asked a large group of peers whether each of them was physically sitting or standing. The students then realized that avatars were at different heights depending on their physical posture, prompting excited conversation and several bobbing avatars:

Student A:	*Oh! I didn't realize that's why I'm so high up.*
Student B:	*That's why I've been looking up to everyone this whole time.*
Student C:	*Yeah. You can even set it up to crouch.*
Student D:	*Haha. You can even dance a little.*

At other times, embodiment facilitated student communication and peer teaching episodes. For example, students used gestures to instruct others how to navigate the virtual space and control their avatars. These episodes were

prevalent during class and were referenced as positive experiences by multiple students during the interviews. Such peer mediation mimics the social learning supports that happen naturally in face-to-face classrooms but are often missing in remote spaces.

While virtual embodiment through avatars provided positive collaborations when replacing some aspects of co-located interactions at typical poster sessions, we found it could also have unexpected effects. For example, virtual walking is relatively inefficient and can cause motion sickness, so most students teleported through the space. However, they often accidentally teleported into other presentation listeners. Additionally, Hubs mimics sound in physical embodiment so people farther away sound fainter, but students, unfamiliar with this feature, felt they needed to get distractingly close to a presenter to hear. In combination, students perceived the "normal" behavior of walking by a poster presentation as more disruptive in the virtual space and avoided doing so.

Discussion

While the interactions described may seem trivial, they highlight two key strengths of VR. First, it provides the opportunity for students to interact naturally within a shared space. In the interviews, students reported that in classes held through video conferences they felt alone in what one student referred to as a "sea of information" with no unstructured interactions such as casual conversations. Students reported that VR allowed for interactions that decreased feelings of isolation, indicating these interactions built a sense of community. Second, the VR environment helped students participate in peer-to-peer learning, which made class more engaging and comfortable.

In remote collaboration settings, students felt that interactions were awkward when they could not have spontaneous interactions. While VR solves some challenges such as moving around a shared space, incongruities in embodiment can create unusual or frustrating social situations, such as with teleporting. Although such incongruities may make VR seem undesirable, it was exactly these challenges that presented opportunities for students to engage in open discourse and collaborative exploration. This in turn engaged students throughout the session and created a sense of community. VR technology increasingly grows more advanced, and as interactional elements are improved, opportunities to learn and explore novel environments together will expand.

Limitations

This is a small observational study to serve as a foundation for future empirical work. We interviewed a small number of students who were novice VR users, but interactions between non-novices may differ. Additionally, we explored an immersive VR experience, so students without headsets may not share the same effects of embodiment.

Conclusion and future work

VR can powerfully engage students in remote settings, allowing them to share digital artifacts, talk, and move in a shared space. However, incongruities between physical and virtual embodiment can alter social interactions between students, but also provide new opportunities for students to explore and learn from one another. Educators who want to use VR in their courses need to design their courses with embodiment in mind.

Future research should identify how to balance structure and spontaneity in remote education settings. For example, the integration of problem solving and platform exploration sessions in a course could provide a supportive class structure that helps students collaboratively explore navigation features while acclimating to how their peers act, move, and speak in VR. We remain optimistic that free, open-source technologies such as Hubs will continue improving accessibility to VR technology, paving the way to impactful remote student experiences.

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