Exploring the potential of IVR technology to promote collaborative learning in science experiences

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Abstract: This poster explores how different types of virtual reality technology (VR) allow for various degrees of collaborative enactment within virtual environments. This two-staged study analyzed the engagement and reflections of 27 students with three forms of VR hardware. Findings from direct observations and students' perceptions suggest that the capabilities of high-end immersive virtual reality (IVR) can allow for more meaningful and natural forms of embodied interactions, locomotion, and verbal communication.

Keywords: Computer supported collaborative learning (CSCL), Virtual reality assisted education (VRAE), enactment in VR, embodiment in IVR, sensorimotor contingencies for virtual collaboration.

Introduction

For years, studies have explored the potential of non-immersive virtual reality (NiVR) for training, skills development, and formal education (Jensen & Konradsen, 2018; Wang, Wu, Wang, Chi, & Wang, 2018). As a platform, NiVR has reached a stable state of maturation; however, immersive virtual reality (IVR) is still in an early evolutionary state. With the advent of the first modern commercial headsets since 2014, companies like Google, HTC, Sony, and Oculus have contributed to creating a saturated and fragmented market by commercializing headsets with very distinct features that can afford users rather different experiences, all under the umbrella term of virtual reality (VR). This has become problematic not only for its rate of adoption, but also for its implementation in educational settings, and for educational research. Although there is little evidence supporting the notion that these new and varied versions of the technology can enhance instruction in any significant way compared to NiVR, the push from these companies has led to initiatives seeking to bring IVR into classrooms, i.e. Google Expeditions, Immersive VR Education, zSpace, and Avantis Education's ClassVR, Furthermore, these ventures follow the assumption that IVR headsets can inherently support learning due to their perceived qualities and fail to acknowledge that the findings from the empirical studies on the educational uses of NiVR do not necessarily carry over to IVR. Some researchers have tried to address this gap in the literature; however, there still is little consensus on the usefulness of IVR for educational purposes. Whilst some studies have shown positive results (Dede, Salzman, & Bowen Loftin, 1996; Ketelhut, Nelson, Clarke, & Dede, 2010; Webster, 2016), others present a less favorable vision on the educational advantage of IVR (Makransky, Terkildsen, & Mayer, 2017; Moro, Štromberga, & Stirling, 2017; Parong & Mayer, 2018).

Methodology and analysis

This piece of research comprises a pilot study carried out in preparation for a larger project exploring how high-end IVR technology (1) affords sensorimotor experiences that could support learning through embodied interactions. During data collection, it became evident that the qualities that make high-end IVR technology more advanced allowed for deeper interactions and showed the potential to support collaborative activities.

This pilot study took place in a secondary school in London with a sample of 21 girls aged 11-13 and a separate sample of 6 adult participants at university level, its aim was to test different data collection instruments and to define the sensorimotor differences between low and high-end IVR, and NiVR. Due to limitations of time and number of headsets available, only a few students were able to use the VR technology directly. Those who were selected for participation were randomly allocated into three groups where they performed science related activities using a type of VR hardware and a piece of commercial software specifically designed for each platform: those in the control group used desktop-based VR technology, group 1 used Samsung's Gear VR headset, and group 2 and the adult sample used an HTC Vive headset. Data was collected through video recordings, an observation log, notes from interviews and discussions, and short pre and post-tests. Participants were briefed on the study asked to opt in through consent forms, additionally, parental consent was sought for underage students.

Thematic analysis was carried out on the notes made from unstructured interviews and on the embodied interactions observed on the video recordings. Coding was done in two stages (first deductively and then inductively).

Discussion and findings

The experimental design of this pilot study brought about a few lessons going forward. Firstly, although some NiVR platforms are capable of embedded collaborative work, the version of the software used here relied on external collaborative activities. Students were able to perform the tasks in pairs and take turns and negotiate the steps to follow. Based on the notes and video recordings, it was observed that students not only became more engaged with the activities whilst working in pairs, but they were also more willing to explore the virtual spaces as they had to navigate them by taking into consideration the requests of their partner. In contrast, those who performed the activities on their own followed a more linear path which aligned to the directives in the environments. Although this outcome in the control group is worth exploring further, the conditions of the study groups led to more unexpected collaborative uses of the technology given the isolating nature of wearing a headset. On the one hand, the stereoscopic 3D view and first-person perspective of the technology used in both cases added to a more immersive experience, but on the other, the hardware used in the first group limited students to a fixed position which hindered exploration. Additionally, the pointer-like controller in this group did not allow for more natural and direct manipulation of objects and for the exploration of the space as was possible with the technology used in the second study group. Regardless of the constrains, students who were not using the technology at the time still engaged with their peers through voice commands after visualizing the virtual environment on a screen. Furthermore, the fact that the second group involved being able to manipulate objects and physically walk, allowed non-participants to spatially navigate the virtual space with the help of the screen and physically help their peers move and walk as they would a visually impaired person, although participants were perfectly capable of performing the activities themselves. This demonstrated not only the impact that collaboration can have in virtual spaces as pupils could discuss solutions and negotiate a common understanding of concepts, but more importantly, it showed the need for collaboration that students have for deeper engagement with the environment.

Ultimately, what this pilot study has done is raise a number of questions in relation to the use of VR as an instructional tool such as in what ways and to what depth are embodied interactions and locomotion involved in supporting learning through this medium, which learning domains have the potential to be more effectively supported by VR technology, and how can VR instruction shape distance learning and collaboration.

Endnotes

(1) High-end IVR refers to tethered headsets that require a powerful computer to operate. In contrast, low-end IVR describes untethered headsets with low computing power either embedded in the casing or based on a mobile phone.

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