Virtual Learning Environments (VLEs) and Social Presence

Barrett Lo

California Polytechnic State University, San Luis Obispo

GRC 400: Special Problems for Advanced Undergraduates

Dr. Hocheol Yang

June 11, 2021

References

Holstein, K., McLaren, B.M., Aleven, V. (2018). Student learning benefits of a mixed-reality teacher awareness tool in AI-enhanced classrooms. *Artificial Intelligence in Education, AIED 2018*, 154–168. https://doi.org/10.1007/978-3-319-93843-1_12

Holstein, McLaren, and Aleven, all from Carnegie Mellon University, seek to prove that live teachers and artificial intelligence-based intelligent learning systems (ITSs) together currently provide the most significant benefits to student learning outcomes. While these AI-enabled ITSs allow students to work at their own pace and receive hints from the software, teachers are vital to student success; they complement the software by providing emotional support and highly individualized problem solving assistance. The researchers co-designed a Microsoft HoloLens mixed reality application with middle-school teachers for the teachers to monitor individual students in a classroom progressing through a mathematics ITS. As a 3-condition experiment, the use of mixed reality monitoring with live student analytics was compared against one control of no analytics (headset with monitoring) and one of neither analytics nor monitoring (no headset). The results after one week showed much stronger student learning with the teacher's use of live mixed reality monitoring and analytics compared to both the "no analytics" and "no mixed reality" conditions. Additionally, with analytics, teachers gave more individualized time to students who actually needed the assistance and the learning gap within the class narrowed to within 1.5 standard deviations (as opposed to ~5 or ~6 standard deviations resulting from the other conditions).

Wu, W., Sandoval, A., Gunji, V., Ayer, S.K., London, J., Perry, L., Patil, K., & Smith, K. (2020). Comparing traditional and mixed reality-facilitated apprenticeship learning in a wood-frame construction lab. *Journal of Construction Engineering and Management, Vol. 146*(12). https://doi.org/10.1061/(ASCE)CO.1943-7862.0001945

Mixed reality (MR) technology is expected to bring great productivity and learning benefits to classrooms and industrial applications alike. Though a potentially revolutionary on-the-job tool, MR is often experimented with passive visualization applications. In this study, Wu et al. evaluate the effectiveness of MR when applied to an outdoor construction project—not in a controlled, indoor environment. Through several

first- and second-year construction management student groups split evenly between control and experiment groups, the researchers test productivity, learning outcomes, and limiting factors of MR compared to the use of traditional, ink-on-paper, 2-dimensional drafting documents.

Against many MR enthusiasts' hopes, this study showed a slightly lower productivity and learning advances in the student groups that used MR than those that were using 2D diagrams printed on paper. Several factors may have contributed to these unfavorable outcomes: students not adequately familiar with the MR tools made available, MR headsets too heavy and cumbersome for the physical activity of construction, headsets needing to be removed to charge or because of discomfort, sunlight glare and construction dust inhibiting the narrow field of view with headset, and hand motions not registered while wearing PPE (work gloves) among many other reasons. In the current state of MR hardware and software, this technology is not ideal for the construction worker; however, managers may still be able to utilize MR for quality checking against digital 3D mockups and deeper analyses. As MR technology becomes more compact and integrated, and people are properly trained in it's use, the large demand in trade work will be fulfilled.

Tang, Y.M., Au, K.M., Lau, H.C.W., Ho, G.T.S., & Wu, C.H. (2020). Evaluating the effectiveness of learning design with mixed reality (MR) in higher education. *Virtual Reality, Vol. 24*(4), 797–807. https://doi.org/10.1007/s10055-020-00427-9

Virtual reality and mixed reality has been positively tested in secondary schools for improved learning outcomes. In this study, Tang et al. (2020) test the learning benefits of mixed reality (MR) when applied to university-level design education. The researchers define MR as "a type of hybrid environment, where interactive virtual objects can be mapped to the physical environment, blending the real and the virtual," and have created a Microsoft HoloLens application that projects an interactive 3D model of an aircraft turbofan engine from a printed sheet of paper. To measure the benefits of MR design learning, improvements in model visualization, geometric analysis, and creativity were compared between the HoloLens-wearing experiment group and traditional 2D printed paper control group.

Unfortunately, the pre- and post-tests that were administered to both groups were not supplied in with the article; still, the reported results show a similar skill improvement between the experiment and control groups, with the HoloLens-wearing group significantly improving their visualization ability over their peers. This skill improvement is significant in that only 5–10 minutes of HoloLens training was conducted before the post-test—a sign that MR learning tools can provide benefits even if implemented at a low-complexity level.

Kyrlitsias, C., Michael-Grigoriou, D., Banakou, D., & Christofi, M. (2020). Social conformity in immersive virtual environments: The impact of agents' gaze behavior. *Frontiers in Psychology, Vol. 11*, 2254. https://doi.org/10.3389/fpsyg.2020.02254

The human decision making process is greatly influenced by other people's behaviors—this inclination towards the group norms in a given social environment is defined as conformity. Social presence, defined by the researchers as "the feeling of sensing another entity being present", can increase social influence and therefore, increase conformity level. In this experiment, Kyrlitsias et al. test the level of the subject's social conformity to non-human characters who either do or do not make eye contact in a virtual reality (VR) environment. Modeling the experiment off of Solomon E. Asch's 1951, 1955, and 1956 studies on conformity, the researchers placed one test subject in an immersive virtual reality (IVR) application with four virtual agents and conducted simple line-length comparison tests. The virtual agents in the control case did not make eye contact with the participant, whereas those in the experiment case did while the participant gave their answers. Conformity to the group was measured by the rate of participant agreement with the virtual agents when the latter gave incorrect answers. In a post-test questionnaire, participants rated their experience through a variety of questions evaluated on a 1–7 Likert scale. The results of the experiments showed that social conformity persists even in IVR, and even when the others present are virtual agents. While eye contact from the virtual agents to the participant did increase social presence, it did not improve their realism, nor did it induce higher conformity. Participants in the eye contact scenarios were less confident in their answers, but this did not significantly affect their final responses.

Schultze, U. & Brooks, J.M. (2019). An interactional view of social presence: Making the virtual other “real”. *Information Systems Journal, Vol. 29*(3), 707–737. https://doi.org/10.1111/isj.12230

Deviating from the other articles in this bibliography, Schultze & Brooks (2019) analyzes social presence in a two-dimensional virtual environment rather than in immersive reality. Schultze & Brooks define “social presence” by referencing several different researchers throughout the decades, never landing on a concise definition but presenting contextual facets of the concept such as psychological presence, ability to establish a personal connection, and the feeling of being in a communication exchange. Additionally, they draw a distinction between copresence and social presence—the former being the awareness that an “other” is available for interaction and the latter is a subjective perception that the “other” is psychoemotionally present.

The authors of this article use Erving Goffman’s theories on social interaction to develop an interactional view of social presence. In order to do this, they reference text logs of a player of Second Life, a realism simulation video game in which players can portray themselves as someone incongruent to their real world self. Contrasting two in-game interactions that took place between 2008—2010, Schultze & Brooks argue that social presence is determined by how the “other” accomplishes the actions necessary to sustain the joint activity. A lack of social presence—and thus a lack of focused attention (i.e., engagement)—is exemplified through a text-based conversation where one person does not seem to be acknowledging the others’ responses nor maintaining the conversation topic to the virtual in-game world. On the other hand, high levels of social presence are caused by shared engagement and congruency with the joint activity topic from both communicating parties.

While this research by Schultze & Brooks does highlight the interactional aspect of social presence, the conclusions may not be conclusive due to their small sample size, limited data, and unequal comparison of events. For one, only two events in one game were analyzed. Secondly, abductive reasoning was used for analyzing these events through the text logs after the times of occurrence. No supporting interview nor vocalized commentary from the player-subject(s) was collected. Finally, the low social presence

event was an interaction between the player-subject and a complete stranger, whereas the high social presence event was an interaction between the player-subject, the player-subject's real-life husband, and their long-time in-game friend; the existence of a pre-established relationship could have altered the player-subject's (text) behavior and decreased the quality of abductive reasoning.

Morina, N., Brinkman, W.-P., Hartanto, D., & Emmelkamp, P.M.G. (2014). Sense of presence and anxiety during virtual social interactions between a human and virtual humans. *PeerJ, 2*, e337. http://doi.org/10.7717/peerj.337

VRET is a technologically-driven therapy technique that immerses patients in a controlled environment containing their fear or anxiety trigger. Morina et al. define sense of presence in VR as "the extent to which virtual reality worlds feel realistic to participants"; while there is no universal correlation between higher sense of presence and better treatment outcomes, higher sense of presence has been argued to produce better activation of the patient's anxiety. Additionally, if VRET is as acceptably effective with less expensive VR hardware, VRET as a treatment option would be more widely available. Therefore, Morina et al. seek to prove that a sense of presence and anxiety can be triggered in virtual reality exposure therapy (VRET), and that stereoscopic VR head-mounted displays (HMD) induce more presence and anxiety than a less expensive one-screen projection-based display (1PBD).

With a data set consisting of 38 university students split into either the HMD group or 1PBD group, Morina et al. survey the participants at three different points in the study. Before VRET exposure, participants' social anxiety levels were scored; during exposure, anxiety levels were surveyed; and after the exposure, participants' sense of presence was scored. The results of the trials agreed with the hypothesis that virtual social reactions with the HMD would create a stronger sense of presence than with the 1PBD; however, both devices elicited nearly the same levels of anxiety. A caveat to these findings is that none of the participants in this study were clinical patients or diagnosed with social anxiety disorder. But if further research supports this conclusion, VRET and potentially other VR mental healthcare programs can be more widely adopted without loss of efficacy thanks to the more accessible price point of 1PBDs over HMDs.