

Advocating Facilitators' Interdisciplinary Learning With Computer Science Teaching Assistants in a Virtual Reality Environment

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Abstract: As part of an ethnographic study of the dynamic relationships between the facilitators and Computer Science Graduate Teaching Assistants (GTAs) in a Virtual Reality (VR) simulation-based teaching training environment, we examined three facilitators' shared learning experiences in VR. Two nascent emerging patterns were the facilitators' understanding of VR facilitation and VR-assisted interdisciplinary negotiation of meaning. We concluded that interdisciplinary dialogue is important for fostering facilitators' learning in VR. Implications and future research are discussed.

Introduction and literature review

Using Virtual Reality (VR) to support learning has been widely studied (e.g., Dede, 2009; Ke et al., 2015). Immersive and transformational presence are key advantages of VR learning environments, but there are associated challenges as well. Learners in VR environments require support and appropriate facilitation to make deep learning possible. Some previous studies have explored the phenomenon of external facilitation for VR (e.g., Ke et al., 2015). However, there is very limited research focused on the interactions and ecology of facilitators and learners in a VR environment for college teaching assistants in STEM subjects, in this case, Computer Science (CS). From a situated cognition perspective, learning occurs in real-life contexts; cultivating learning in naturally embedded contexts is thus crucial for knowledge acquisition and transfer (Choi & Hannafin, 1995; Lave & Wenger, 1991; Nash & Shaffer, 2013). Furthermore, Choi and Hannafin (1995) suggested that in situated learning environments, facilitation encourages learners to internalize knowledge and self-monitor performance. Likewise, a Vygotskian framework indicates that learning and development depend on the co-construction of knowledge with others (Vygotsky, 1978).

Grounded in the aforementioned theories, learning in a situated VR environment requires guidance and facilitation. Specifically, this can be achieved via coaching, guiding, and advising from a facilitator: a facilitator can "direct the learners' attention, point out overlooked steps, provide hints and feedback, and challenge learners with additional problem-solving tasks (Choi & Hannafin, 1995, p. 62). Although VR environments simulate real-life contexts, the unique virtual space distinguishes it from traditional face-to-face (F2F) environments (Ke et al., 2015). Researchers have thus been arguing that more research on facilitators in VR environments is needed (Ke et al., 2015). The purpose of this study is to address this by exploring the shared experiences of facilitators of a CS Graduate Teaching Assistant (GTA) training module in a VR learning environment. Specifically, the following research question is addressed: What did the facilitators learn in a VR teaching training program with CS GTAs?

Methods

By situating our study in ethnography, we sought to discover the mutual and learned experiences, beliefs, and patterns of the facilitators for CS GTAs in a mix of physical and VR naturalistic setting (Creswell & Poth, 2017). In this study, three facilitators (Education majors), as an ethnographic cultural group, engaged in 42 one-on-one individual sessions with 21 CS GTAs for a total of 84 hours. VR teaching training was part of the GTA professional development at the department level. Trustworthiness and rigor were established by triangulation and member-checking (Lincoln & Guba, 1985). We triangulate our results through multiple data sources, between the three informants (facilitators) and with the literature. The data sources were screen recordings, periodic semi-structured interviews, and participatory observations. The participatory observations performed by the facilitators during the teaching training sessions were later transformed into descriptive reflexive research journals. For the VR environment, we used OpenSimulator. Ten teaching scenarios were designed to train the CS GTAs (i.e., three "teaching adaptively," three "teach for better explanation," three "problem-solving," and one "office hour" scenarios). In each scenario, the GTAs worked with a facilitator, and a group of simulated students programmed with an algorithm to prompt the GTAs with teaching challenges. The facilitators could also puppeteer the simulated students via text input to prompt the GTAs manually. As part of our ongoing analysis, we present our nascent themes in the following sections: (1) facilitators' understanding of VR simulation-based facilitation, and (2) VR-assisted interdisciplinary negotiation of meaning.

Results

Facilitators' understanding of VR simulation-based facilitation

Emerging from the data, we found that facilitators developed a better understanding of facilitating VR simulation-based teaching training by iteratively testing the affordances and constraints of the VR environment. First, the facilitators face the challenge of engaging the GTAs to interact with the virtual world. For example, the facilitators observed that sometimes GTAs were not engaging in maneuvering their virtual avatars, but simply lecturing. The facilitators also indicated that *"it is hard to balance between giving guidance and giving independence."* Second, in the situated learning design implementation, the facilitators also strengthened their understanding about the integration between domain-generic scaffolding and content-related prompts. The facilitators suggested that a facilitator-friendly VR learning environment should enable the contextualization of the scaffolding in the semantic content or language authentic to the GTAs' discipline, while not overloading the facilitators. Third, facilitators reported that they helped to foster GTAs' active teaching practice by cuing them to attend to students' learning needs and reactions, which they were prone to neglect in their instruction before.

VR-assisted interdisciplinary negotiation of meaning

Interdisciplinary negotiation of meaning in this study involved subject-specific content and problem-solving processes. First, the facilitators tried to prompt the GTAs to teach the subject-specific content to the simulated students. By negotiating the teaching strategies with the facilitators, the content was eventually explained clearly. Second, CS GTAs and Education facilitators had both contributed to the interdisciplinary dialogue in problem-solving scenarios. To elaborate, the CS GTAs often mentioned "step-by-step" as a strategy for problem-solving. However, oftentimes, the "step-by-step" strategy alone is not effective for teaching problem-solving in the VR environment. That is, the problem-solving process was still ambiguous during the teaching training. Thus, the facilitators guided the GTAs to *"dissect the problem and analyze the problem components such as figuring out restrictions and givens,"* which the GTAs were not cognizant of previously.

Conclusion and implications

In this ethnographic study, we explored the dynamic relationships between the facilitators and the CS GTAs in a VR learning environment. We conclude with two implications. First, dynamic development of the facilitators' understanding toward the VR environment revealed that the facilitators were actively experiencing a knowledge construction trajectory for the VR environment (Choi & Hannafin, 1995; Nash & Shaffer, 2013). Second, the negotiation of meaning path prepared both the GTAs and facilitators for particular ways of thinking for subject matter and problem-solving (Nash & Shaffer, 2013). Our results illuminate the importance of interdisciplinary dialogue to foster learning in VR environments for both facilitators (Education) and GTAs (Computer Science). Future research should continue to delineate the role of facilitators in VR as artificial intelligence advances.

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