

Exploring Learner Behavioral Patterns in Virtual-Reality-Based Role-playing for Teaching Training

Zhaihuan Dai, Fengfeng Ke, and Chih-Pu Dai
zd12@my.fsu.edu, fke@fsu.edu, cd18m@my.fsu.edu
Florida State University

Abstract: This mixed-method exploratory study aims to investigate learners' behavioral patterns when participating in the role-playing activities for teaching training in a virtual-reality simulation. Data were collected by screen-recoding 20 beginning graduate teaching assistants' (GTAs) behaviors in the virtual world. The learner behaviors were coded and analyzed using sequential pattern mining. Preliminary results showed that observatory learning behaviors and the related subsequences occurred most frequently. Active participatory role-playing behaviors and their associated subsequences demonstrated a lower frequency.

Introduction

Internet-based 3D virtual reality (VR) is a promising platform for teaching, learning, and training. The immersive and interactive features of VR afford a natural fit for role-playing. Role-playing has been commonly used in VR-based educational studies and implemented as part of the teacher education curriculum in some universities (Cheong, 2010; Dalgarno, Gregory, Knox, & Reiners, 2016). Having teachers deliver lessons to their peers who play the role of students is beneficial because it not only focuses on practicing lesson delivery, but also emphasizes and simulates teacher-student interactions which will expose the student teachers to situational decision making (Dalgarno et al. 2016; Hughes & Traill, 1975).

Yet, empirical based discussion on role-playing design in VR is still scarce. Current research on role-playing design mostly relies on self-reported surveys or interviews, rather than analyzing the actual learner behaviors during role playing. One way to examining role-play based learning is through sequential data mining. Human behaviors happen in certain orders rather than as isolated events. Sequential data mining defines an order of events as a *sequence*, each event in this order as an *item*, and a *subsequence* as some events extracted out of a sequence (Zhou, Xu, Nesbit, & Winne, 2010). Sequential pattern mining explores frequent subsequences in a database that could be built up through continuous observations (Kang, Liu, & Qu, 2016). In educational studies, the extraction of sequential patterns can generate valuable and comprehensive information that serves multiple purposes, such as to examine learner activities and to customize instructional design (Zhou et al., 2010). Understanding learner behaviors allows researchers to find out the circumstances in which a behavior happened and changed, to make predictions, and thus inform the design of effective role-playing in VR. Therefore, this study aims to use a sequential data mining approach to examine: What are the salient patterns of learner behaviors when learning and practicing teaching through role-playing activities in a VR-based environment?

Method

Using OpenSimulator, we constructed a variety of simulated university teaching contexts or scenarios, where role-playing is integrated for teaching practice. In each scenario, GTAs will obtain a role card which presents activity instructions and describes an instructional or student role. During training, a facilitator will guide the activities based on established protocols.

Twenty beginning GTAs (seven females and 13 males) in the Chemistry department participated the study. The GTAs were randomly assigned into two role-playing groups and each group was led by a trained facilitator. The whole VR-based teaching training lasted about three hours, during which we conducted on-site observation and screen recorded participants' behaviors in VR. Out of the 20 recordings, two video files were corrupted, and 18 were used in data analysis. The average video length was two hours and 43 minutes.

We first conducted a thematic analysis of 20% of the recordings. This analysis yielded 14 major behavior codes that composed a systematic coding scheme. After a calibration process and coding training, three coders independently coded the recordings using BORIS (Friard & Gamba, 2016), an open-source event logging software for video and audio coding. The inter-rater reliability (ICC) was .95. We then extracted the behavioral sequences from all recordings and conducted preliminary sequential pattern mining. Here we defined the order of all behaviors in one recording as one sequence, regardless of the behavior's duration. Therefore, the data set contains 18 sequences.

Results

The systematic coding resulted in a total of 2,156 behavior codes. Among the 14 major behaviors, observing peer's role-playing (*Obsv*) was the most frequent (n=429) and providing peer support being the least frequent (n=19). The most frequent behaviors include reading written information (*WrtnInfo*) (n=383), attending to facilitator's instruction (*FacilInstr*) (n=344), behaviors irrelevant to teaching practice tasks (*OtherBehav*) (n=294), and obtaining notecards (*ObtNcard*) (n=214). Behaviors directly reflecting role-playing occurred 121 times, including 26 times of agent prompted and 95 times of object prompted role-playing (*ObjPrmRP*). Moreover, the role-playing behaviors were coded 53 times for instructional roles and 68 times for student roles.

Preliminary sequential pattern mining extracted 1,854 subsequences, including 277 unique subsequences that repeated 2 to 89 times. The most frequent subsequences were *Obsv + FacilInstr* (n=89), *FacilInstr + Obsv* (n=77), *ObtNcards + WrtnInfo* (n=74), *OtherBehav + Obsv* (n=57), and *WrtnInfo + Obsv* (n=56). The most frequent subsequences involving role-playing were *Obsv + ObjPrmRP* (n=20), *ObjPrmRP + Obsv* (n=20), and *ObjPrmRP + TeachPractice* (n=9).

Conclusion and implications

Some salient patterns emerged from our preliminary sequential pattern mining. First, the GTAs demonstrated frequent behavioral transitions between observing peers' role-playing and attending to the facilitator's instruction or reading written information, which was the three most frequently observed behaviors. Second, the GTAs were active in obtaining notecards (mostly role cards) and reading the written content, then transitioned to observatory behaviors. Third, the most frequent subsequences directly associated with role-playing behaviors revealed a pattern that the GTAs often shifted between observing others' role-playing and actively playing their own roles as described in the role card (i.e., object prompted).

These salient sequential patterns revealed that participants intended to or were interested in role-playing and were engaged in the situated learning experience. The majority of participants played the role of an undergraduate student, who normally would only actively perform certain behaviors at certain points of time (e.g., asking questions). Therefore, the frequent act of observing peers' role-playing could be because the participants had mentally accepted the role but were hesitant or trying to find a good timing to act, based on the sequential patterns of behaviors related to role-playing. On the other hand, a conspicuous discrepancy can be observed between the frequency of observatory learning behaviors and the associated subsequences, and between the frequency of role-playing behaviors and the related subsequences. This suggests that the participants were prone to observatory learning and demonstrated a low level of active participatory role-playing, with the exception when they were assigned an instructional role and had to take the initiative.

The above findings were based on a preliminary data analysis. Overall, this study will illuminate the field of VR-based learning by advancing the understanding of learner behavioral patterns during VR-based role-playing. Mining the sequential patterns of learner behaviors helps discover useful and unexpected patterns to solidify the design and offer empirical guidance for designing effective role-playing for learning in VR.

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