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Featured Article

Assessing Simulation, Virtual Reality, and Television Modalities in Clinical Training

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Abstract

Background: High-fidelity simulation (sim) centers can accommodate large groups of observers through virtual reality (VR) observation. This study compared three learning modalities: active participation, VR observation, and television (TV) observation.

Method: We used Immersive Tendencies and Presence questionnaires to measure subjective presence across modalities. Using a within-subjects A—B—A design, we measured 58 subjects three times during a three-part unfolding sim. An All-Sim track (sim → sim → sim) established baseline presence of sim participants. A—B—A tracks comprise VR tracks (VR → TV → VR), which were counterbalanced by TV tracks (TV → VR → TV).

Results: A two-way analysis of covariance revealed significant effect of track across scenarios. All-sim presence was greatest, followed by VR, with TV being least.

Conclusion: Findings suggest that VR observation mirrors active participation more closely than does TV observation. For further investigations, we proposed presence versus learning performance as well as VR observation for sim center collaborations.

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Clinical simulation (sim) is a fixture in modern health care education and continues to grow (Healthcare/Medical Simulation Market by End User, Product & Services—Global Forecast to 2021, 2016; Rosen, 2008). This growth is justified: In undergraduate nursing education, no significant differences in nursing knowledge, National Council Licensure Examination passing rates, and clinical competence were found when up to 50% of traditional clinical experience was replaced by high-fidelity sim (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014). In

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the workforce, sim had been shown to reduce staff orientation time and costs (Nehring & Lashley, 2009). However, high starting and maintenance costs combined with limited operational capacity may discourage adoption (Brown, 2008; Durham & Alden, 2011; Frick, Swoboda, Mansukhani, & Jeffries, 2014; Kaplan, Abraham, & Gary, 2012; Lapkin & Levett-Jones, 2011; Nehring & Lashley, 2009). Sim educators are therefore encouraged to explore different technologies to heighten student access and learning outcomes, reduce costs, and ultimately improve patient safety—including exploring various screen-based and virtual reality (VR) simulators (Gaba, 2004).

Key Points

- Simulation (sim) centers can accommodate larger student groups by using video cameras to televise sims.
- Observing sim in virtual reality (from a first-person perspective) is more similar to active participation than observing from a television.
- Virtual reality observation could help sim centers accommodate larger student groups, which include students from other campuses.

Evolving sim technologies offer varying degrees of immersion and interactivity; therefore, there has emerged a general need to compare experiences across different learning mediums. *Presence*, the experience of being there in a mediated environment, could measure such experiences (Lessiter, Freeman, Keogh, & Davidoff, 2001; Witmer & Singer, 1998). Presence determines the sense of immersion and involvement in the medium (e.g., the perception of being inside a video game that is mediated by a television [TV] monitor). The concept of presence has helped design experiences in mediated environments to measure and enhance the ability of these environments to provide comparable experiences to the real world—for therapy, entertainment, or training (Cummings & Bailenson, 2016; Nunez & Blake, 2001; Slater & Wilbur, 1997; Tamborini & Bowman, 2010). Researchers have experimented with different types of media technologies. The effects on subjective presence have been measured in video games, movies, navigation simulators, puzzle tasks, and others. In a meta-analysis of 83 research studies that ranged from 1995 to 2014, Cummings and Bailenson (2016) found that *user tracking* (nature and degree of users' movements in a virtual environment), *stereoscopy* (the use of binocular vision to give a perception of three-dimensional [3D] vision), and *field of view* had the most impact on subjective presence.

This study examined VR in nursing sim observation. VR was defined as a computer-mediated environment that induced user immersion (Society for Simulation in Healthcare, 2016). In the case of nursing sim, the mediated environment was the simulated hospital room. VR headsets and earphones immersed observers in a first-person perspective of the simulated clinical environment. Observers freely looked up, down, side to side, and behind. VR observation differed from TV observation, in which students observed through a synchronous TV monitor as others participated in a sim (Kaplan et al., 2012).

Based on the work of Cummings and Bailenson (2016), stereoscopy, user tracking, and panoramic field of view of VR should have enabled a greater sense of presence in the sim than did TV observation. Active participation should have yielded the greatest possible sense of presence. Accordingly, we tested a hypothesis that subjective presence in sim was highest while actively participating, followed by VR observation, and finally TV observation.

Methods

Design and Procedures

This study was conducted in a high-fidelity sim center at a West Coast university in the United States. After institutional review board approval was obtained, 58 nursing students were recruited from semester 2 of a six-semester baccalaureate program. The study lasted for six sessions, during a course of eight hours. Sessions 1 to 6 had groups of 10, 9, 9, 10, 10, and 10 subjects, respectively. Every session consisted of the same three-part unfolding sim (described later). At the start of each session, each newly arrived subject was given an Immersive Tendencies Questionnaire (ITQ; described later), demographics survey, screened for motion sickness, and assigned to a track. Those who screened positive for motion sickness were assigned to an All-Sim participation track and actively participated in sim throughout the three unfolding scenarios. Remaining subjects were randomized and evenly assigned to VR or TV observation tracks.

All-Sim subjects entered the laboratory and completed the sim in pairs (Figure 1). When a scenario ended, the pair exited the laboratory to complete a Presence Questionnaire (PQ described later), whereas the sim staff prepared the next scenario. The pair then received a scripted handoff from a sim instructor and re-entered the laboratory for the next part.

The VR and TV observation tracks followed a within-subjects A−B−A design (Figure 2). In A−B−A design, subjects were exposed to two conditions: condition A (control) established a baseline response; transitioned to condition B (experimental), the subjects may or may not have yielded a change in response; then a return to condition A, coupled with a response reversal back to baseline, confirmed a direct effect of condition (Barlow & Hersen, 1973). In Figure 2, VR track subjects observed the first scenario in VR, second scenario through TV, and third scenario in VR; the presence was measured at the end of each scenario.

The VR observation condition was created by hanging a VR camera manufactured by ALLie in the sim laboratory, a meter above the manikin's umbilicus (Figure 1). The VR