

Introduction to Virtual Reality in Education

Chris Dede

Chris_Dede@Harvard.edu

Graduate School of Education, Harvard University, Cambridge, Massachusetts, USA

Abstract

As an emerging technology for learning, virtual reality (VR) dates back four decades, to early work by Ivan Sutherland in the late 1960s. At long last, interactive media are emerging that offer the promise of VR in everyday settings. Quasi-VR already is commonplace in 2-1/2-D virtual environments like Second Life and in massively multiplayer online role-playing games (e.g., World of Warcraft). Realizing the potential of VR for education, however, is much more complex than simply making its interface practical and affordable. Learning applications are not like fire, a wonderful technology that provides a benefit from merely standing in its vicinity. In education, technologies achieve their power indirectly, as catalysts for deeper content, more engaging activities, more active forms of learning and instruction, and richer types of assessment.

The power of immersion in learning and engagement

Immersion is the subjective impression that one is participating in a comprehensive, realistic experience (Heeter, 1992). Uniquely among all technologies, high end virtual reality (such as head-mounted displays and CAVEs) provides full sensory immersion in a simulated experience. This immersion psychologically involves the willing suspension of disbelief. As an example, when watching a Harry Potter movie on an IMAX screen, the plot and characters coupled with visual and auditory input produce a sense of psychological immersion: the audience does not focus on the sensations of sitting in a theatre seat but instead on being present in a wizarding “world,” observing a fascinating series of events. The example is weak, however, because the experience is passive, as opposed to the stronger immersion induced when participants shape an experience rather than just observe it.

The design of immersive, simulated learning experiences depends on actional, symbolic, and sensory factors (Dede, 2005). Inducing actional immersion involves empowering the participant in an experience to initiate actions that have novel, intriguing consequences. For example, when a baby is learning to walk, the degree of con-

centration this activity creates in the child is extraordinary. Discovering new capabilities to shape one's environment is highly motivating and sharply focuses attention.

Inducing a participant's symbolic immersion involves triggering powerful semantic associations via the content of an experience. As an illustration, reading a horror novel at midnight in a strange house builds a mounting sense of terror, even though one's physical context is unchanging and rationally safe. Invoking intellectual, emotional, and normative archetypes deepens the experience by imposing a complex overlay of associative mental models.

Beyond actional and symbolic immersion, advances in interface technology are steadily evolving towards virtual realities that induce sensory and physical immersion. For example, one design strategy to induce psychological immersion in virtual environments is using egocentric rather than exocentric frames of reference. As Salzman, Dede, and Loftin (1999) describe:

"The exocentric frame of reference (FOR) provides a view of an object, space, or phenomena from the outside, while the egocentric FOR provides a view of the object, space, or phenomena from within. Imagine a dollhouse. As a human, you can peer at the house from a number of angles, you can reach into it to feel the rugs and furniture with your fingers, and you may even be able to stick your head inside; but you can only imagine what it would be like to be a doll living inside that house. You experience the dollhouse from the exocentric FOR. If you were the doll inside the house, you would experience the house and its furnishings from within—walking on the rugs, sitting in the chairs, and sleeping in the bed; but you would only be able to imagine what it would be like to be the human on the outside looking in. You would experience the dollhouse from the egocentric FOR. Each FOR would give you different kinds of information about the dollhouse and it might shape what you come to know about that structure".

The research on virtual reality we conducted on frames of reference found that the exocentric and the egocentric FORs have different strengths for learning. Our studies established that learning ideally involves a "bicentric" perspective alternating between egocentric and exocentric FORs.

We also researched how each of these three perspectives—the egocentric, the exocentric, and the bicentric—influenced participants' motivation and learning styles. One major advantage of egocentric perspectives is that they enable participants' actional immersion and motivation more strongly than exocentric FORs, which are better suited for dispassionate observer roles. Another advantage of the egocentric FOR is that this perspective enables "situated" learning, while exocentric perspectives foster insights gained from distancing oneself from the context (seeing the forest rather than the trees). Bicentric FORs combine the strengths of each perspective.

Contents of this issue

This brief overview of affordances for learning that VR provides illustrates the psychological complexity of the immersive experience, which in turn creates both opportunities and challenges for instructional design. The authors of this issue's articles have wrestled with these and other issues in developing and studying educational VR. The research my colleagues and I conducted in the 1990s on VR in science education documents that full sensory immersion is not necessary for many kinds of learning, but is invaluable under the right circumstances, such as when three-dimensionality, perceptualization, and frames of reference are useful for understanding. Beyond this, the insights about instructional design that VR provides transfer into many other media, such as multi-user virtual environments, Internet games, and augmented realities that combine physical and virtual settings. I congratulate the editors and authors for developing this intriguing set of perspectives on a very powerful form of experience.

References

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