

Online Learning's Future in the Workplace with Augmented Reality

Katherine Ira

University of Maryland, Baltimore County, USA

Zane Berge

University of Maryland, Baltimore County, USA

INTRODUCTION

Augmented reality is a technology system that enhances one's perceptions and experiences by overlaying digitized images onto real world environments. By looking through the display lenses of special eyewear, the seamless, information-rich, composite view that can be seen enhances understanding of the real world. As the technology that enables augmented reality evolves, auditory and haptic information overlays will be added, making the user's experience far more vivid. Augmented reality has enormous potential for workplace e-learning and productivity improvement. Prototypes are currently in research and development for military, K-12, and university application. It is anticipated that advances in technology will make augmented reality a common learning tool within the next decade (Azuma, Baillo, Reinhold, Feiner, Julier, & MacIntyre, 2001).

Today's augmented reality system meets the broad definition of e-learning: learning that uses a network for delivery, interaction, and facilitation (Keengwe, 2005). Augmented reality is delivered to the learner via a local area network (LAN), wide area network (WAN), or the Internet. Wireless access has enabled flexible mobility and location independent e-learning, extending opportunities for outdoor and field-based workplace learning far from the classroom computer monitor (Doswell, Blake, & Butcher-Green, 2006). Research is currently underway to tap the potential of augmented e-learning using a networked online learning management system (LMS) (Yu, 2006). It may one day be possible to log in to an online learning management system to access augmented reality e-learning at a work site anywhere in the world whenever the need arises. Though still in development, augmented reality e-learning has the potential to provide immersive, situated learning in the workplace. This article will focus on how augmented

reality works, current research and prototypes, and future potential applications of augmented reality in e-learning.

SCENARIO 1: THE POTENTIAL OF AUGMENTED REALITY IN WORKPLACE LEARNING

Imagine a 30-person Army platoon patrolling an enemy city, wearing camouflage and goggle-like, see-through head mounted displays as seen in Figure 1. As the soldiers approach the center of the city, a warning is broadcast through their headphones from the command center 20 miles away; insurgents have been spotted approaching the American Embassy a half mile to the south. Moving cautiously, the platoon changes course and heads toward the target. Several minutes later, another broadcast warns that the insurgents have entered the embassy. As the soldiers approach, they take a moment to view the building through the eyepieces of their head mounted displays. They can see not only the outside of the building but also the outline of each interior room, doorway, hall, and staircase (Bradt, 1997). It is as if the eyepieces have given them X-ray vision, enabling them to see through the building (Azuma, 2004). Another warning is heard through their headphones, spoken in a much quieter voice: activity has been spotted on the third floor, northwest corner of the embassy. The soldiers scan the outline of the building's interior layout and plan their entrance strategy. Identifying a path through interior doors, stairs, and hallways that will provide the best cover while allowing quick access to the target, they deploy. Twelve soldiers enter the building; the rest take up positions around the perimeter and wait as those inside move toward the enemy. Gunfire is heard coming from the

Figure 1. U.S. Navy wireless head mounted display (HMD) From "Eye on the Fleet Photo Gallery," by the U.S. Navy, 2006, <http://www.news.navy.mil/>. (U.S. Navy photo by John F. Williams (Released))



northwest corner of an upper floor. After several long moments of silence, the sound of heavy footsteps and loud voices is heard coming down the stairs toward the outside doorway. It is time to debrief. Was their strategy successful? Could they have planned a more effective strategy? The soldiers are focused on learning from their mistakes in preparation for their imminent deployment to the war zone.

Augmented Reality

The technology of augmented reality (AR) made it possible for the platoon to "see through" the building. Augmented reality enables users to view the real world enhanced by the addition of computer-generated, or virtual, images. Each virtual image is aligned with its related real world object so that the real and virtual images appear to coexist. A view of augmented reality as seen through a head mounted display is shown in Figure 2. The virtual electrical wires seen on the wall match the exact placement of the actual wires inside the wall (Azuma, 1997). The addition of virtual images enhances the viewer's perception and augments their experiences in the real world environment (Azuma, 2004).

Many image formats are used in augmented reality: graphics, diagrams, drawings, text, short movies, and avatars, or virtual people (Shelton, 2002). Displayed images can be 2- or 3-dimensional (Regenbrecht, Barattoff, & Wilke, 2005), depending on the environmental context. Figure 2 shows a head mounted display view of

2-dimensional wiring behind a wall. Figure 3 shows a head mounted display view of a 3-dimensional character and church created to bring art history to life.

Augmented reality immerses participants in workplace contexts that closely match the actual contexts of their jobs. This contextual approach to learning is consistent with principles of adult learning theory: adults need to know why they need to learn something; adults prefer the learning context to be practical and applicable; and adults are motivated to learn when it will help them better cope with actual job and life tasks (Knowles, Holton, & Swanson, 1998). Contextual learning facilitates the development and retention of skills and knowledge and active engagement in problem solving (Brill, 2001). Some experts theorize that the contexts of work and job-related learning are intertwined with workplace knowledge. According to Eraut (1994):

Professional knowledge cannot be characterized in a manner that is independent of how it is learned and how it is used. It is through looking at the contexts of its acquisition and its use that its essential nature is revealed. (p. 19)

Enabling Technologies

Augmented reality images are dynamic, changing in response to user movement. As the user moves while viewing images through a head mounted display, the images alter to accommodate the person's perspec-

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