Creating Smart Learning Environments with Virtual Worlds

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Abstract. A virtual world is an immersive 3D online environment whose residents are represented by avatars that move through the spaces and interact with other users and objects synchronously or asynchronously. The literature reveals that virtual worlds have significant potential to foster constructivist learning and create smart learning environments that are effective, efficient, scalable, engaging, flexible, adaptive, and personalized. This paper presents seven ways to use virtual worlds to create smart learning environments: (1) visualization of inaccessible and invisible content, (2) role-playing and identity exploration, (3) situated learning, (4) safe and adaptive environments for skill practice, (5) spatial simulation and virtual field trips, (6) social interactions and collaboration, and (7) virtual performance assessments.

Keywords: smart learning environments · virtual worlds · personalized learning

1   Smart Learning Environments (SLE)

The concepts of smart classroom and smart learning environment emerged in an effort to make learning environments more effective, efficient, and engaging. As an emerging field, smart learning environments (SLE) have been defined differently by different researchers. For example, Koper defined SLE as "physical environments that are enriched with digital, context-aware and adaptive devices, to promote better and faster learning" [1]. Hwang defined SLE as the "technology-supported learning environments that make adaptations and provide appropriate support (e.g., guidance, feedback, hints or tools) in the right places and at the right time based on individual learners' needs, which might be determined via analyzing their learning behaviors, performance and the online and real-world contexts in which they are situated" [2]. An increasing number of research studies have examined smart classroom and smart learning environments. However, most studies have focused on technology aspects (e.g., use of mobile devices), and the pedagogical aspect has not received sufficient attention [3].

2   Virtual Worlds

A virtual world is an immersive 3D online environment whose residents are represented by avatars that move through the spaces (e.g., walk, run, fly, teleport) and interact with other users and objects synchronously or asynchronously [4, 5, 6]. Providing a sense of being there, virtual worlds provide new learning experiences. Many universities and researchers have been exploring various educational benefits of virtual worlds. Examples of virtual worlds designed for learning include *River City*, *EcoMUVE*, *Quest Atlantis*, *SimSchool*, and *Whyville*. The literature reveals that virtual worlds have significant potential to foster constructivist learning [5] and create smart learning environments that are effective, efficient, scalable, engaging, flexible, adaptive, and personalized.

3   Using Virtual Worlds to Create Smart Learning Environments

3.1   Visualization of Inaccessible and Invisible Content

Virtual worlds can make learning more effective and engaging by allowing students to observe things that they cannot see in classroom or other traditional learning environments. In virtual worlds, it is possible to show students the phenomena that cannot be observed in real time (e.g., climate change, erosion) or are invisible to the naked eye (e.g., the movement of molecules). It is also possible to create inaccessible content that is historically lost, imaginary, futuristic, or too expensive to reproduce in real life [6]. The visualization of inaccessible or invisible content offers new learning opportunities and fosters deep understanding.

3.2   Role-Playing and Identity Exploration

Role-playing is one of the most powerful engagement strategies. In virtual worlds, students experience new worlds and new identities by taking on roles otherwise inaccessible to them. They become heroes, scientists, doctors, and other experts and do important and meaningful things (e.g., solving a problem, saving others). The identity exploration through the virtual embodiment in the form of an avatar enables students to experience different situations, lives, and perspectives [6, 7]. Thus, virtual worlds have the potential to help students understand diverse perspectives and develop empathy.

3.3   Situated Learning

Virtual worlds can provide alternative environments for situated learning [8, 9] because a variety of real-world contexts can be created in the virtual space. Virtual worlds can make situated learning more effective by allowing students to learn at their own pace and by providing personalized and timely feedback. In addition, virtual worlds can expose students to a wide range of scenarios, enable students to explore alternative perspectives, help them develop greater cognitive flexibility, and improve transfer of knowledge and skills to real situations [10, 11].

3.4   Safe and Adaptive Environments for Skill Practice

It is often impossible or very expensive to provide students with sufficient practice opportunities in real life. Virtual worlds can provide a safe environment for students to practice a variety of skills, including taking off and landing a plane or administering medications to patients. In virtual worlds, students can practice with repetitive tasks at a time and pace convenient to them without real-world consequences. In medical simulations, for example, students can practice clinical decision making repetitively at no cost and without fear of harming patients [12]. They can take risks, try alternative strategies, and learn from mistakes.

3.5   Spatial Simulation and Virtual Field Trips

A variety of real-life places, including historical sites and museums, have been recreated in virtual worlds. Spatial simulation is one of the fundamental features of virtual worlds [13], and it can be used to create virtual field trips that are interactive and engaging. Many students do not have the opportunity to travel the world, and schools often do not have enough resources to provide many field trip opportunities. Virtual field trips remove many of the barriers (e.g., lack of funding, logistical challenges, physical limitations) and can take students to many different places and provide rich learning experiences.

3.6   Social Interactions and Collaboration

Many virtual worlds provide opportunities for social interactions and collaboration between individuals and communities, as well as interactions with objects and characters in the virtual space [6, 7]. Avatars can communicate nonverbally using gestures and postures, as well as verbally through the use of text-based chat, voice chat, and other communication tools. If designed and used effectively, virtual worlds can provide rich environments for collaborative learning.

3.7   Virtual Performance Assessments

In virtual worlds, students leave "information trails" [14] as they move through the virtual space and interact with objects and other characters or peers. Therefore, virtual worlds provide new vehicles for rich observations of student learning and performance and sophisticated analysis of complex performance that is impossible to assess in paper-based or other traditional assessment formats [15]. In addition, virtual performance assessments can be cost-effective because everything will be inside the virtual environment. It is unnecessary to purchase expensive equipment or materials needed for performance assessments in real life.

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