Chapter 14

The SUPL Approach: A Conceptual Framework for the Design of 3D E-Simulations Based on Gaming Technology within a Problem-Based Learning Pedagogy

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ABSTRACT
This chapter presents a conceptual framework for the design of e-simulations with a focus on developing knowledge and skills that can be transferred to real world scenarios. The Simulation, User, and Problem-based Learning (SUPL) approach has been developed to inform the design of e-simulations within a problem-based learning pedagogy. This approach is focussed towards the development of e-simulations using three-dimensional (3D) gaming technologies for low cost computer hardware to support face-to-face instruction. A case study has been undertaken using the SUPL approach to design an occupational health and safety training platform, designated the Fires in Underground Mines Evacuation Simulator (FUMES), to support traditional training for underground mining in order to evaluate the effectiveness of the SUPL approach as a design framework. This chapter offers guidance for the design of future e-simulations using the SUPL approach as well as report on current research and evaluation on the impact of FUMES within a blended learning environment.

INTRODUCTION
E-simulations can be utilised to provide three-dimensional (3D) representations of real, recreated, abstract, or imaginary environments that may otherwise be of impractical size, infeasible distance, prohibitive cost, or too significant a hazard to experience in person (Baylis, 2000). As such, e-simulations can provide a safe and effective means for developing knowledge and skills
The SUPL approach (Garrett & McMahon, 2009), as depicted in Figure 1, was developed to guide the design of 3D e-simulations within a problem-based learning pedagogy. The SUPL approach provides a number of key benefits to the design and development of 3D e-simulations for training and educational purposes. This approach identifies a series of design factors which serve as a solid foundation on which to base design. Iterations during the design process are supported due to the modularised and flexible nature of the SUPL approach whilst also anchoring each design factor relative to the user, problem-solving task, or 3D e-simulation components of the framework.

The SUPL approach also identifies the contextually relevant areas in which fidelity must be concentrated within the e-simulation. This serves to focus the development process whilst also reducing the time and costs associated with the fabrication of the simulation environment. Such an approach is thus well suited to agile development and rapid prototyping as aspects of the simulation environment which are not relevant to the specified learning objectives can be quickly implemented.

The SUPL approach was derived from a review of the literature that explored the interplay between problem-based learning, the affordances and limitations of 3D e-simulations, and the characteristics of the user that are relevant to the problem-solving process.

**Problem-Based Learning**

Problem-based learning is an experiential learning approach, which is situated in problem-solving experience (Hmelo-Silver, 2004). Two core tenets drive problem-based learning: that learning through problem-solving is more effective in
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