Contextualizing the pedagogy of digital game-based learning (DGBL) within an experiential environment for construction designers

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In Singapore, the Workplace Safety and Health (WSH) Council seeks to bring together designers, contractors, and clients to enhance workplace safety and health. Since August 2016, the WSH (Design for Safety) Regulations require designers to consider safety of workers be incorporated as a part of their designs (MOM, 2016). However, past research had shown that designers generally are not inclined to address construction worker safety in their design decisions (Gambatese, Hinze and Haas, 1997), even though in a construction project, workplace safety performance are influenced by the designers’ decisions (Hinze and Wiegand, 1992).

To support these design professionals with further knowledge related to their daily work, for instance, identifying risks and hazards embedded within construction sites, the use of an immersive virtual environment can be helpful. An understanding of how adult learners advance in their learning is essential for designing and refining training programmes since social contexts and technologies are transforming expeditiously the way people learn, interact, and work. In engineering design, deep domain knowledge is required (Ullman, 2010) but we do not expect that engineers are fully aware of all task-related knowledge (Ehrlenspiel & Meerkamm, 2013).

Therefore, the aim of this short paper is to contextualize DGBL within the pedagogical theory of Experiential Learning and provide an understanding of their applications with construction design professionals, the adult learners. Knowles (1984) points out four characteristics of adult learners: First, adults need to know the reasons for learning. Second, adults need to learn experientially. Third, adults approach learning as problem solving. Finally, adults learn best when the topic is of immediate value. Adult learners are problem- or performance-centred since they prefer to learn something that is relevant to their concerns (Cranton, 1992).

As indicated in Knowles’ adult learning framework, adults need to learn experientially. But this surfaces a question: What are the ways to create real-life learning experiences during classroom sessions? A DGBL environment could address this potential question by assisting adult learners with conducting risks and hazards analysis in a simulated context similar to real life. Recently, numerous educational institutions are devoting significant resources to developing DGBL environments (Greenlight & Roadtovr, 2016; Blascovich & Bailenson, 2011). According to Bodekaer (2016), this paradigm shift within the educational fields is partly driven by technology companies such as Google, Apple, and Microsoft. The surge surrounding DGBL comes with the expectation that users’ motivation and learning will increase.

DGBL affords users the opportunity to observe and live experiences that may not be possible in physical environments. DGBL provides important personal experiences for users to navigate, browse, and control objects in an immersive environment (Burdea & Coiffet, 2003). For instance, similar to a face-to-face learning experience, a learner can interact with avatars in a virtual world to gather relevant information for risk assessment. However, the design of a DGBL environment requires pedagogical knowledge to underpin development of an experience-based digital tool.

Mikropoulos and Natsis (2011) highlight that few research studies propose a clear pedagogical model to inform the design of educational virtual environments. However, in studies where a theoretical model is used, the experiential learning model is identified as one of the approaches. Notably, experiential learning differs from a teacher-centered classroom (Huang, 2016) because it emphasizes acquisition of direct experiences, real-time feedback, and opportunities to apply and test learning contents through interactive learning processes. Kolb (1984) delineates four cyclical stages in the experiential learning model: (1) concrete experience, (2) reflective observation, (3) abstract conceptualisation, and (4) active experimentation. Briefly, concrete experience refers to learning from actual experiences. Reflective observation indicates observation and reflection of experiences from the previous stage. Abstract conceptualization refers to how previously learned ideas can apply in a real-world context. Finally, active experimentation points to the application of new concepts in different contexts.

To provide concrete learning experiences to students in Building Construction Materials and Methods classes, Chan, Quang, Pedro, and Lim (2016) developed a Virtual Reality (VR) based Interactive Building Anatomy Modelling (IBAM) system. It enables students experiential perceptions of a simulated construction environment through exploration, rotation, and zooming of construction elements. The IBAM system facilitates “learn by doing” to acquire construction knowledge. Through this immersive virtual experience, students acquire knowledge in an interactive method similar to real-life. These researchers suggest that such a simulation-based approach is particularly engaging for mature learners who are self-directed.

Finally, DGBL can be a part of safety-related experiential learning for learners to recognize potential hazards by exploring simulated construction sites. This active role-playing programme enables learners to collaborate, observe, and reflect on safety issues embedded in the virtual environment. Moreover, they could examine learned experiences through active participation in the simulated world from diverse perspectives (Quang, Pedro, & Park, 2014).

In conclusion, to prevent work-related risks, the role of design professionals is key in the effort to address and improve construction worker safety. DGBL, as a viable instructional tool is essential to implement construction safety training programmes.

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