

VIRTUAL LEARNING PLATFORMS: ASSISTING WORK INTEGRATED LEARNING

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ABSTRACT

Work integrated learning (WIL) assists with the assimilation of theory and practice, ultimately producing job ready graduates with the capacity to engage effectively within their chosen work environment. However, for the discipline of construction management (CM), WIL is often impeded by a range of challenges. First, construction sites are considered high risk environments where safety and liability may hinder work place opportunities. Second, large student cohorts combined with distance delivery where impediments of location and the need for an equitable educational experience arise. Furthermore, with regulatory courses, the potential for on-site identification of building code non-compliances (fire safety) further impacts opportunities. This paper presents Stage 2 of a pilot study: Stage 1 involved the preliminary use of a virtual learning platform to simulate an on-site practical experience for students learning construction management curriculum, specifically courses involving building regulation. To understand whether the platform is suitable as a teaching tool and to further enhance the environment and maximise its potential as a CM learning instrument it was also presented, in Stage 2, to a related discipline (health) student cohort who had completed work experience and had a knowledge of fire safety. The intent was to examine realism and replication of a real world environment. Initial qualitative results favour the environment for its realism, immersion and navigation capabilities. Furthermore, it was considered an effective tool for placing theory into context assisting work integration.

Keywords: virtual reality, construction management, work integrated learning.

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INTRODUCTION

The term work integrated learning (WIL) has been defined as the combination of *'...academic study and formal learning with student exposure to real-world practice settings to better prepare graduates for entry into the workforce.'* (Schuster and Glavas, 2017, p. 56). The advantages of work integrated learning (WIL) are well acknowledged (see for example, Brimble et al., 2012; Stoker, 2015) and has been considered an essential pedagogy within the undergraduate educational setting (Mazhar and Arain, 2015) and this is true for the Bachelor of Construction Management (Building) (Honours) degree at the University of Newcastle where students must complete a mandatory sixteen week placement as a core component of their studies.

Although WIL programmes may provide *'...an experiential learning experience in a professional environment...'* (Mazhar and Arain, 2015), there are a number of obstacles and barriers that impact upon WIL opportunities. In the realm of construction management, particularly courses associated with building codes and compliance, obstacles may be categorised into three primary areas:

- Industrial risk: in this context risk refers to a concept associated with legal liability from work, health and safety concerns through to issues over confidentiality of material (see for example, Cooper, Orrell and Bowden, 2010; Safe Work Australia, 2015) all of which hinder opportunities for on-site experience.
- Cohort characteristics: large cohort size (>200) combined with mixed mode methods of delivery (on-campus and distance) and the requirement for equity amongst cohorts, renders practical experience opportunities unfeasible.
- Code violations: on-site inspections involving assessment against building codes - even at a student level - may result in the identification of non-compliances requiring notification and remediation by the building owner; thus, availability of buildings for student inspection purposes is often limited.

Virtual learning environments are becoming increasingly popular within the educational setting as a mechanism by which to provide a simulated real world experience for students: overcoming many of the obstacles/barriers facing traditional on-site experiences such as those describe above.

This paper presents the outcome of stage 2 of a pilot study. In stage 1, the environment was presented to a CM cohort who having completed a

building regulations course conducted a virtual site inspection focusing on fire safety. The intent of stage 2 of the study was to explore the CM student outcomes against those of an associated cohort who had industrial experience and knowledge of fire safety to see how the tool could be further improved to maximise the construction management student learning experience.

VIRTUAL ENVIRONMENTS

Zhang & Kaufman (2013) define a virtual environment as '*...a 3-D computer-generated simulated representation of real-world physical environments*' (p.124). Therefore, they are a method of replicating a real world environment that can then be utilised by a student to explore and learn (Lee and Wong, 2014) within a safe situation.

In the context of an educational setting, virtual environments provide a more versatile classroom compared with traditional teaching methods (Jou and Wang, 2013) and in this manner they add a new dimension to the learning experience as they have the potential to transform the way in which material is delivered: presenting opportunities to enhance student engagement (Maltby and Mackie, 2009; Taylor and Disinger, 1997).

Unique to this method of learning is that virtual environments create a platform for learning in which there is a belief that the simulated environment is equivalent to the real given they '*...believe they are both physically and perceptually inside the computer-generated image*' (Taylor and Disinger, 1997, p. 39). For construction management students, particularly those focused on building regulations, realism of the environment may encourage immersion: an ability to fully engage with the environment. In this sense, the virtual environment would emulate a real world environment to capture knowledge associated with conducting a regulatory site inspection for compliance.

CONSTRUCTION MANAGEMENT DISCIPLINE CONTEXT

At the University of Newcastle, the Bachelor of Construction Management (Building) (Honours) degree (BCM) provides students with the opportunity to enter the certification profession: professionals responsible for the enforcement of the National Construction Code which contains the countries regulatory technical building provisions. Thus, from an educational perspective, a comprehensive working knowledge of the NCC is mandatory. ARBE1304 Building Codes and Compliance is one such course that has a primary focus upon the NCC and fire safety requirements; however, the ability for students to implement their theoretical knowledge in a practical sense – conducting on-site compliance inspections – is limited by the obstacles identified earlier in this paper.

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THE VIRTUAL ENVIRONMENT

The virtual environment was created by Smith and Trenhome (2009) using the source engine www.valvesoftware.com. The design involved creation of an environment where evacuations related to fire emergencies could be practiced. The environment was based on a three storey building and included materials and graphics to create realism.

In stage 1, the environment was modified for the construction management cohort to create an environment that enabled regulatory building inspections to be undertaken (refer Figure 1). Changes to the environment focused upon fire safety including removal of exit door signage.

In stage 2, the original environment was presented to participants so that they could navigate around the environment and provide feedback on areas such as realism to the working environments of which they had operational knowledge and experience (refer Figure 2).



Figure 1 Modified environment presented to construction management cohort



Figure 2 Environment presented to associated discipline cohort

METHODOLOGY: STAGE 1

The initial stage of the pilot study involved CM students who had completed the course ARBE1304. Participants were presented with architectural plans and extracts from the NCC along with a series of compliance related questions with a fire safety focus. The CM students were informed that their role was that of a building surveyor where they were to undertake a series of tasks associated with a compliance assessment. Participants were provided with a five minute introduction to gaming through the use of the Unreal Engine (www.epicgames.com) to introduce them to navigation in a virtual environment. Participants were then given twenty minutes to complete the tasks. At completion of the allotted time, participants were individually interviewed to obtain their experiences with the virtual environment and its capacity for use as a teaching tool.

METHODOLOGY: STAGE 2

While the CM student experience with the teaching tool provided valuable information, there was a need to further explore the value of the virtual environment. This need was mandated to ensure that as a learning platform, the tool is representative of the real professional working environment, particularly in relation to areas such as realism and navigation.

In this respect having an associated cohort who had an understanding of real world experience and fire safety, was seen as a beneficial to providing further insight into the virtual environment and its realism.

An associated cohort was recruited and given their role as that of building occupiers who had a familiarity with fire safety. Therefore, the second phase of the pilot study involved second and third year students from the Bachelor of Nursing and Midwifery degree. The participants had all completed intensive WIL as required by their undergraduate programme. Part of this work experience included orientation to fire safety and in particular to emergency evacuation drills involving patients and staff.

Written informed consent was obtained from participants prior to participation. Participants were provided with an office where they were seated at a desk with a desktop computer: Dell Precision T1600 with Dell UltraSharp 24-inch monitor. Their role as a building occupier and more importantly as a health care provider, required navigation through the building and upon hearing the emergency alarm to evacuate as fast as possible. Each participant completed the task three times to replicate the different evacuation scenarios: one exit blocked by fire, multiple exits

blocked, all exits blocked. A timeframe of fifteen minutes was allocated for the completion of the three tasks.

At the end of the session, focus groups were held to enable the participants to provide their feedback and experiences with the virtual environment. Table 1 provides an example of the types of questions that were presented to each focus group.

Table 1 Example questions from Stage 2

Question theme
<ul style="list-style-type: none">• How did you find the navigation of the virtual learning tool?
<ul style="list-style-type: none">• Did you find the visualisation of the models as realistic?
<ul style="list-style-type: none">• Tell me about your experience of the VR exercise.
<ul style="list-style-type: none">• Did you become engaged in the exercise (e.g. forget it was an exercise)? Did this concern you, if so how?
<ul style="list-style-type: none">• What were the good points in the VR exercise.
<ul style="list-style-type: none">• What do you think we should change or added? Why? How do you suggest we do this?

RESULTS

In Stage 1 all participants performed the set tasks within the allocated timeframe. The feedback was positive and areas such as navigation, realism, curriculum alignment and professional application were highlighted by all participants. Participants identified potential environmental modifications during this stage of the pilot study such as the use of colour coding doors (nominating those that could open and provide egress). Although considered important by students, in terms of WIL it would not necessarily emulate the real world environment as colour coding of doors is not representative of standard building construction.

Stage 2 involved a total of eight students all of whom achieved the inclusion criteria: year 2 or 3 of nursing degree and completion of WIL. Six of the eight participants completed the set tasks within the allocated time frame. Two participants were unable to complete the evacuation drills related to their inexperience with navigation within a virtual environment. Although these two participants were unable to complete the tasks, they were provided with the same time frame in which to explore and navigate throughout the virtual environment and experience the learning platform. A total of three focus groups were held and as per the first stage, feedback was positive and the tool was identified as one which could assist professional learning. All focus groups highlighted the realism, immersion and navigation aspects of the tool. In addition, the virtual environment was seen to enhance awareness of fire safety. Importantly, there were a number of potential areas of modification that were identified and considered essential to creating a more realistic and immersive environment for construction management students: sound interference, avatars and fixtures.

DISCUSSION

Across both cohorts, it is evident that a virtual environment can be a positive way in which to enhance the learning experience of students. Important areas raised by participants related to the realism of the virtual environment and subsequently immersion capabilities, and the potential for application to both the construction and health care professions.

The realism of the environment was considered extremely positive by both cohorts, in particular the walking and viewing capabilities and building operations such as door movement. The realism of the environment was considered to significantly promote immersion when undertaking the set tasks. Numerous participants across both cohorts made comment as to how the realistic nature of the environment made them feel they were in a real world environment conducting an inspection. Professional application brought forth considerable discussion from both cohorts. The virtual environment was considered a valuable tool to assist integrate theory with practice which aligns with the writings of Lee and Wong (2014) as they explain how such environments provide a mechanism by which to explore and subsequently learn Construction management students, traditionally completed assessments using 2 dimensional drawings and participants commented on the ability of the environment to move beyond such paperwork activities: a tool that enabled replication of professional on-site activities. Similarly, with the nursing cohort the environment provided an opportunity to explore and understand real world practice within a safe environment. Both cohorts agreed that the environment was considered one that would assist students to prepare for professional practice.

In terms of modifications, the stage 2 cohort raised a number of potential variations that would create a more realistic environment albeit one that may increase the difficulty associated with an assessment task. First, sound interference was raised, a real working building is not void of sound and inspections are undertaken within noisy environments that may impact upon concentration. Secondly, avatars were considered essential. Although regulatory inspections may be undertaken in a vacant building, for example a new build, the reality is that many regulatory building inspections have occupants present and this is particularly true of those involving ongoing fire safety assessments. Therefore, consideration of multiple scenarios would provide construction management students with an opportunity to experience a range of different building environment. This could be further extended to different styles of buildings giving consideration to multiple fire safety scenarios. Finally, additional fixtures were also identified as items that could help create realism. Although some fixtures were included, large equipment would portray a more 'lived in' environment.

The modifications identified by the nursing cohort are important to the future development of the virtual environment. It is also noted that consideration will also need to be given to students who have limited or nil gaming experience. This could be achieved by providing additional buildings in which they can learn gaming navigation skills and prepare for educational training.

Ultimately, virtual reality has the potential to maximise student learning through creation of the opportunity for CM students to undertake realistic regulatory on-site inspections in this flexible learning environment as described by Jou and Wang (2013). Thus, preparing them for industry with the knowledge and experience of the regulatory environment and the role of the certifier and overcoming obstacles set out earlier in this paper.

CONCLUSION

This paper reports on the second stage of a pilot study. The first stage had a focus upon construction management students and their learning around regulatory building codes. In stage 1 a construction management student cohort navigated the virtual environment and conducted a regulatory building inspection to highlight non-compliances. Participants were interviewed to obtain their experiences. In stage 2 a nursing student cohort were required to undertake multiple evacuation drills within the same virtual environment and then participate in focus groups. The intent being to understand from 'building occupants' - who had industry experience, a knowledge of fire safety preparedness and hence what creates a realistic virtual environment.

Feedback from CM participants favoured the environment and it was thought that the environment encouraged deeper learning and bridged the gap between theory and context. The associated discipline again favoured the environment and identified numerous modifications that could enhance the learning experience by creating a more 'noisy' working environment – one which simulated an actual occupied and working building.

Due to the inherent difficulties associated with on-site regulatory inspection: industrial risk, cohort characteristics and the identification of code violations, the use of virtual environments as a teaching tool holds promise for work integrated learning programmes. The next stage of this study involves larger cohorts of students to obtain a further understanding of the impact of virtual environments and their ability to assist construction management students.

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