A ROLE FOR EMERGING INTERACTIVE TECHNOLOGIES IN WORK-INTEGRATED LEARNING

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ABSTRACT

There is growing recognition that in order to transition students effectively into a professional practice setting, practical work experience during the term of their study is critical. A recent study highlights how essential the preparation of students prior to their workplace experience can be in the quality and scope of the learning outcomes they achieve during work experience placements. Emerging interactive technologies, such as high-end video game technologies, have the capacity to embed students in extremely realistic work situations. The opportunity exists for students and teachers to utilise this virtual work experience situation to practice and develop the specific skills required to ensure that the learning outcomes from a work experience placement are managed effectively. In this paper, the essential learning outcomes generally associated with a work experience placement and the key skills those learning outcomes demand from the student are reviewed. The capabilities of emergent high-end video game technologies relevant to the teaching and learning of such skills are illustrated and discussed. The technology capabilities are demonstrated using a new concept of The Situation Engine, a prototype system specifically configured to generate building industry site situations.

Keywords: work-integrated learning, serious video games, professional practice, the situation engine

INTRODUCTION

Like it or hate it, the term 'work-ready' has become a kind of catchcry for government, industry and the broader community when it comes to higher education. This has oriented more and more higher education programs of study towards a particular occupational outcome. It has pushed those programs of study with an existing occupational outcome (such as construction management) to focus more and more on employability.

Employability skills in the context of higher education tend to render down to the same key factors (Nettleton et al, 2008): communication, teamwork, problem-solving, ethics, self-management, initiative, life-long learning, etc. (see for example DEST, 2002). In a recent review of graduate employability (Precision Consultancy, 2007), the broad notion of Work-Integrated Learning (WIL) was identified as the most important mechanism available for the development of employment skills. This broad notion of WIL refers to any practice-based experience integrated into the higher education program of study. Practice-based experience might include such activities as a practicum, industry placement, case study, role play and/or site visit. Of course, the effective integration of practice-based experience into the formal study program still presents a major problem for curriculum design and resourcing (Billett and Henderson, 2011). The fact remains that it is in the workplace itself where the teaching and learning opportunity for employment skills is at its richest and contextualised best (McLennan and Keating, 2008).

Providing effective WIL particular to the workplace is already problematic. As the agenda for higher education continues to focus on a broadening of student access and participation in a climate of structural and organisation change (Bradley et al, 2008), the problems of providing effective WIL particular to the workplace can only be exacerbated. Such problems go beyond the mere provision of workplace experience, to how students actually learn from the experiences and how that learning then is integrated effectively with their formal studies. "Indeed, it is unlikely that smooth transitions and effective practice will be realised without students making such links, because being able to make associations between experiences in the two settings [workplace and formal studies] will likely provide important contributions to learning the knowledge required for effective practice." (Billett, 2011: 9).

According to Precision Consultancy (2007), WIL programs provide a range of potential benefits and outcomes. There can be academic benefits in terms of increased motivation to learn and succeed; personal benefits in terms of improved communication, teamwork and initiative; work skills benefits in terms of ethics and technical competence. To realise those potential benefits a series of reports have identified three broad categories of requirements (Billett, 2011):

(i) Preparation

Ensuring worthwhile workplace experiences requires a shared understanding of the purpose of the experience and how the different roles of various stakeholders impact on the quality of the experience (Patrick et al, 2008). Participants need quite specific skills if they are to make the most of their workplace experience. For example, the capacity to reflect on practice is a prerequisite to learning from experience. Reflective practice has become synonymous with an abundant array of techniques, including the keeping of diaries and journals, learning contracts, role play, critical thinking, visualisation, etc. (Atherton, 2005). Almost all of these approaches focus on the recording and subsequent review of accounts (in one form or another) of episodes in the (past) learning experience. This, of itself, is not a trivial undertaking. It begins with a consideration of how the experiences are to be noticed in the first place. Without first registering an experience as significant, subsequent reflections are going to be fruitless (Mason, 2002). Registering an experience is specifically addressed conceptually in terms of sensitisation, awareness and noticing (Marton and Booth, 1997). The strategies that enable sensitisation, awareness and noticing (learning how to experience) are explicit and can be learned. Learning how to experience is essential preparation for WIL in the workplace.

(ii) Integration

Experiential learning offers a particular orientation to teaching and learning that privileges individual agency and direct engagement in the socio-cultural practices that constitute a particular domain of professional practice. The socio-cultural practices are the shared routines, sensibilities, vocabulary, styles, artefacts, procedures, etc. that constitute a particular field of practice (Wenger, 1998: 73-84): what Schön (1983: 138) refers to as the language, media and repertoire of a particular professional community. To be effective, engagement in a field of practice must be legitimate. To be legitimate, the WIL experience must offer a framework for participation that is both authentic and culturally attenuated to the requirements of learning (Lave and Wenger, 1991). That means participants literally enact

their learning by 'doing' professional practice as a member of a community of practitioners – being a practitioner (trainee).

(iii) Control

The scope, usefulness and quality of a workplace experience can be varied and unpredictable. We have different students in different organisation doing different things on different projects at different points in time. Without effective control of the experience targeting specific teaching and learning outcomes is bound to be problematic. Explicit training programs, industry compacts and the like can certainly serve to improve the situation. However, the vagaries of workplace practice (and by association workplace experience) are unavoidable.

In response to the broader challenges of WIL particular to the workplace, as Precision Consultancy (2007: 30) points out, "there has been a move in some universities to establish simulated environments which mirror work settings and work situations." What role might emerging interactive technologies play in the provision of workplace simulations? How can a simulated workplace setting or situation be used to develop the skills students need?. This paper will map the key issues facing WIL against the key functionality of a new conceptualisation of an interactive digital technology we term The Situation Engine.

EMERGING INTERACTIVE TECHNOLOGIES

The most sophisticated interactive virtual reality simulation environments with practical application to teaching and learning are to be found in video games. Video games use high performance graphics engines to render moving photo-realistic scenes in real-time and 3D along with the potential for associated surround-sound audio and tactile feedback to a user who controls the action with a variety of input devices.

Figure 1. Real-time Scene Rendering in The Situation Engine

The fastest high-end renderer in the world is the Crytek CryENGINE® (see http://www.crytek.com/cryengine/). This platform has been used to develop a prototype simulation environment intended to support the learning and teaching of domestic building design and construction. It is one example of what we have termed a Situation Engine (Newton, 2012). A Situation Engine is: "An application that provides for specific and managed practical building and construction experience to be made available to students through advanced digital technologies." Figure 1 illustrates the visual quality achievable in this Situation Engine across standard PC, Xbox 360™ and Playstation®3 platforms.

Figure 2: Intelligent agents operating in The Situation Engine

The Situation Engine 'action' is variously controlled through input devices and the particular rules and properties 'coded' into the prototype during its development. Such coded rules and properties can be extremely sophisticated. Physical properties such as mass, velocity, conductivity, reflectivity, etc. are used to drive simulated real-world mechanical behaviours in exceptional detail. Objects in the Situation Engine can variously be opened, pushed, bent, lifted, broken and/or be used to trigger a myriad of other actions. Artificial intelligence and social dynamics are also now available to simulate agency and group behaviour in the different game 'actors' being incorporated into the prototype. Figure 2 illustrates one of those game actors responding to the partial collapse of a timber frame. Note the high quality facial features and capacity of the character to recognise, adjust to, and ultimately step over the fallen timber member (and any other dynamic obstacles that may or may not be presented).

What is timely about the potential development of video games for learning and teaching, is the recent development in video game technology that has resulted in the 'game engines' themselves (the kernel of coding used to drive a collection of actual game implementations) being made available on an open-source basis. Even the most powerful game engines are now relatively cheap to acquire for teaching and learning purposes, are intentionally configured to allow third party modifications to be created and embedded seamlessly into the game engine,

and are increasingly supported online by a significant and committed community of users and developers (referred to as 'modders').

Prototype 'serious video games' (a serious video game is one designed for a primary purpose other than pure entertainment, such as for learning and teaching) have now been developed as modifications to game engines across a range of game genres. For example, 'vehicle simulation engines' have been used to train and test vehicle operators from fighter pilots to crane drivers (Rouvinen et al., 2005); 'strategy game engines' are variously used for teamwork and project management training; 'business simulation games' model economic and manufacturing environments. The Situation Engine has focussed on a specific genre of video game known as a 'first person shooter' (FPS) game. FPS games are characterised by the use of an avatar which allows the user to see and be seen as a person would conventionally occupy a space (ie. bound to one's own body).

What is particularly useful about the emerging interactive technologies employed by The Situation Engine is that the intelligent agent illustrated in Figure 2 might just as readily be the character/avatar of another student, tutor or practitioner. The online multiuser option in CryENGINE® provides for each character in The Situation Engine to be controlled by a different user. All such users participate in the same situation at the same time. Rather than interacting with artificial intelligence, users of The Situation Engine are able to engage in a markedly more authentic socio-cultural context of workplace practices.

THE SITUATION ENGINE

The Situation Engine is a new concept in WIL. It takes the potential of 'simulated environments which mirror work settings and work situations' to a fundamentally different level. The aim of the current prototype is to examine how students might practice and demonstrate competence in core discipline-specific skills (such as construction technology), particularly where such skills are best exercised in a difficult practice setting (such as a construction site) (see Newton and Lowe, 2011). That remains a key aim of the project. However, as the project has evolved and the concept of The Situation Engine has developed, there is now a broader potential beyond the practice and demonstration of specific technical skills and competences. The potential of The Situation Engine as a complement to WIL creates a real opportunity, finally, to satisfy the three broad categories of requirements placed on WIL. The abiding problems of incorporating effective WIL experiences into formal programs of study may not be as intractable as they once appeared.

(i) Preparation

According to Billett (2011), one of the key findings identified through a range of significant projects specific to WIL was that incremental experience and progression is preferred. That is, that the best preparation for WIL involves a series of experiences, each building upon the previous. The conceptual structure for The Situation Engine is illustrated in Figure 3. A series of alternative situation settings can be configured that take the user through steadily more immersive and demanding situations. At one level, this might involve practicing and demonstrating the individual technical skills and competences associated with an introductory domestic construction technology subject. See for example, Newton and Lowe (2011). At another level, students might be required to reflect on such rudimentary workplace experiences.

Effective guidance in sensitisation, awareness and noticing can be practiced, evaluated and developed before students are deployed on actual workplace WIL. Sessions in The Situation Engine can be recorded and replayed to highlight and discuss particular learning issues. Learning how to experience is essential preparation for WIL in the workplace.

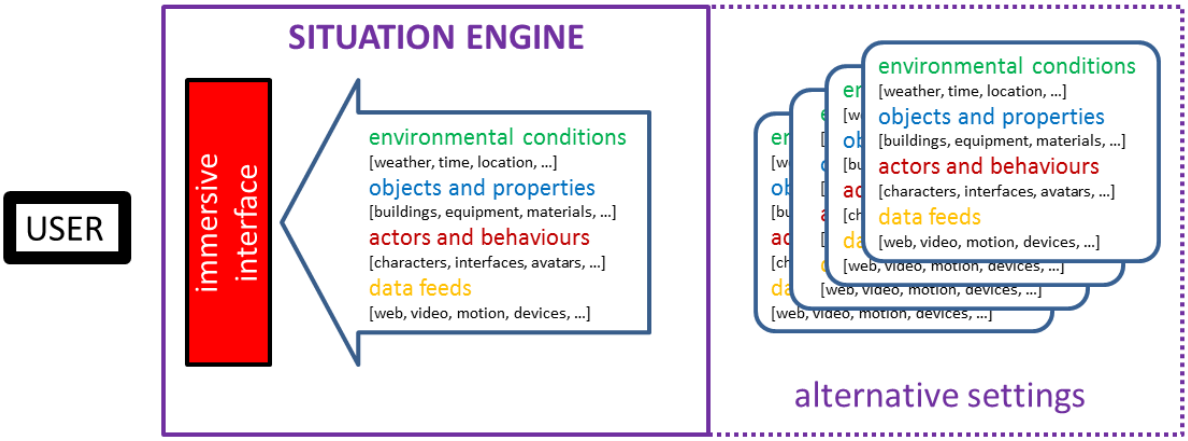

Figure 3: Conceptual structure for The Situation Engine

(ii) Integration

Any framework that promotes and improves our understanding of the sociocultural context of and for professional practice will contribute to the broader consideration of learning as a situated activity (Wenger, 1998). Of course situated cognition is not without its critics (Vosniadou, 2007). We concede that an exclusively sociocultural approach would undoubtedly ignore key cognitive aspects of learning and teaching. Knowledge-based learning is a necessary precursor to skill-based learning. However, whilst we might never reach a definitive expression of learning in sociocultural terms alone, it seems equally inconceivable that WIL is something that can ignore human dispositions and social constructs (Hager and Holland, 2006).

The multiuser functionality of The Situation Engine is highlighted specifically because it provides for real people (not just artificial representations of people/intelligence) to engage in a workplace situation collectively. Certainly experiential learning privileges individual agency, but the purpose of the agency is to engage in relevant socio-cultural practices. What better way to represent those practices than by providing a communal experience, involving an actual community of practitioners engaging directly in a shared workplace situation?

(iii) Control

The scope, usefulness and quality of a workplace experience can be varied and unpredictable. Variability and uncertainty are key characteristics of the building and construction industry. Seeking or exercising total control of a situation might well be counter-productive as a precursor to actual workplace WIL. Control in this sense is not intended to be absolute. However, there are many important aspects of a workplace experience that would very usefully be controllable. For example: certain environmental conditions (weather, time, location, etc.); certain aspects of construction (building types, equipment, materials, etc);

certain agents (their character, behaviour, expertise, etc.); and certain information (communication, devices, data feeds, etc.). Notwithstanding the inescapable vagaries of actual workplace practice, the ability to configure and reconfigure a particular situation framework to suit particular teaching and learning needs would be invaluable.

The concept of The Situation Engine is to provide just such a configurable experience. The purpose is not merely to provide access to particular combinations of knowledge – such an approach would associate specific learning outcomes to particular situation settings. Rather, it is to promote the learner as an active constructor of their knowledge in each situation setting – where learners themselves create knowledge through a subjective construction across different situations and experiences. The Situation Engine might afford particular learning outcomes, but the user might never construe their actual experiences to those particular learning outcomes. It is more likely that the simpler levels of knowledge (the facts and concepts) and deeper forms of understanding (the associations and connections) will act in concert (Billett, 2009). The goal-directed activities, performance monitoring, self-management, etc. all help the learner to generate understandings that reach beyond the intentional components of each situation. The learner might choose to reconcile, reject or ignore their learning experiences, which in any event may themselves be partial, incomplete or misconstrued.

CONCLUSIONS

There is growing recognition that in order to transition students effectively into a professional practice setting, practical work experience **(WIL)** during the term of their study is critical. Emerging interactive technologies, such as high-end video game technologies, have the capacity to embed students in extremely realistic work situations. The opportunity exists for students and teachers to utilise this virtual work experience situation to practice and develop the specific skills required to ensure that the learning outcomes from a work experience placement are managed effectively**.**

The technology capabilities are demonstrated using a new concept of The Situation Engine, a prototype system specifically configured to generate building industry site situations. The key strengths of The Situation Engine are visual realism and multiuser participation. These strengths are considered specific to the critical requirements of WIL: preparation, integration and control. A conception and prototype implementation of The Situation Engine is introduced and discussed in the context of WIL. Implementation and evaluation of this prototype is continuing. It was first evaluated by first year undergraduate construction management students as part of their initial introduction to domestic construction technology in 2011. Subsequent prototype developments are currently being evaluated in the same context. The intention is to evaluate the latest prototype in several other institutional contexts during 2012.

There is no suggestion here that The Situation Engine might replace actual workplace WIL experiences. Rather, it is presented as a complement. In particular it offers an antidote to the seemingly intractable problems of WIL – problems that require effective preparation, integration and control of the learning situation.

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