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Virtual Reality and Situated Experiential Education: A conceptualisation and exploratory trial

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Abstract

Virtual reality is widely recognised as offering the potential for fully immersive environments. This paper describes a framework that guides the creation and analysis of immersive environments that are pedagogically structured to support situated and experiential education. The "situated experiential education environment" framework described in this paper is used to examine the impact that a virtual environment can have on the user experience of participants in a virtual space. The analysis of a virtual environment implemented to support learner exploration of issues of tourism development and the related impacts suggests that this type of experience is capable of providing participants with a holistic experience of real world environments that are otherwise too expensive, impractical or unethical for large groups of people to visit in person. The pedagogical value of such experiences is enabled through immersion in a reality-based environment, engagement with complex and ambiguous situations and information, and interaction with the space, other students and teachers. The results demonstrate that complex immersive learning environments are readily achievable but that high levels of interactivity remains a challenge.

Keywords: experiential education, situated cognition, digital immersion, virtual reality

Introduction

Educational Psychologists, including John Dewey and Kurt Lewin, have promoted the benefits of experiential forms of education since the early 1900s. These benefits have been found to include the enhancement of student's deeper subject knowledge (Chickering & Gamson, 1987), the increased engagement of students (Hanson & Moser, 2003; Schott & Sutherland, 2009), enhancement of student career decision making (Cantor, 1997), and the development of lifelong learners (Grabinger & Dunlap, 1995). Although predominantly used in primary and secondary education, experiential education has valuable applications in tertiary education. For instance, Kolb, Boyatzis and Mainemelis (2001) note in a review article that Experiential Learning Theory (Kolb, 1984) and the related Learning Style Inventory (Kolb, 1971) have been researched in disciplines as diverse as Accounting, Computer Science, Education, Law, Management, Medicine, Nursing and Psychology. This wide ranging application of experiential education is also reflected by the learning environments and tools commonly enlisted, which include residential fieldtrips & site visits, placements & internships, role play, and class-room based laboratory activities (Cantor, 1997; Healey & Jenkins, 2000; Wurdinger & Carlson, 2009). The pedagogy of experiential education then is well-established at tertiary level. The recent rapid advances in technology present ever more sophisticated prospects to foster experiential education. A notable innovation has been virtual reality (VR) enabled through headsets, which provides the user with a highly responsive and fully immersive experience of a constructed virtual environment that is both visual and auditory.

The overarching question guiding this paper is to what extent virtual environments implemented via VR headsets can provide opportunities for experiential education that is situated in a meaningful geographical and situational context. Adopting a user experience (UX) perspective (Hassenzahl & Tractinsky, 2006) this paper explores VR headsets as a tool for

virtually positioning learners in a situated experiential education environment (SEEE), which we conceptualise into a framework as part of the literature review. Subsequently the paper introduces a VR-headsets-for-experiential-education trial before mapping the user responses from the trial against the conceptualisation of SEEE developed earlier in the paper.

Experiential Education

Experiential education is best understood as a philosophy. It draws on the influential work of the educational philosophers Dewey, Lewin, and Piaget (Kolb, 1984) and embraces the notion that to understand the world, learners need to interact directly with it (Dewey, 2004). Although a variety of definitions for experiential education are available, the one formulated by Itin in his doctoral thesis (1997 in Itin, 1999) effectively synthesises key points proposed by a variety of authors:

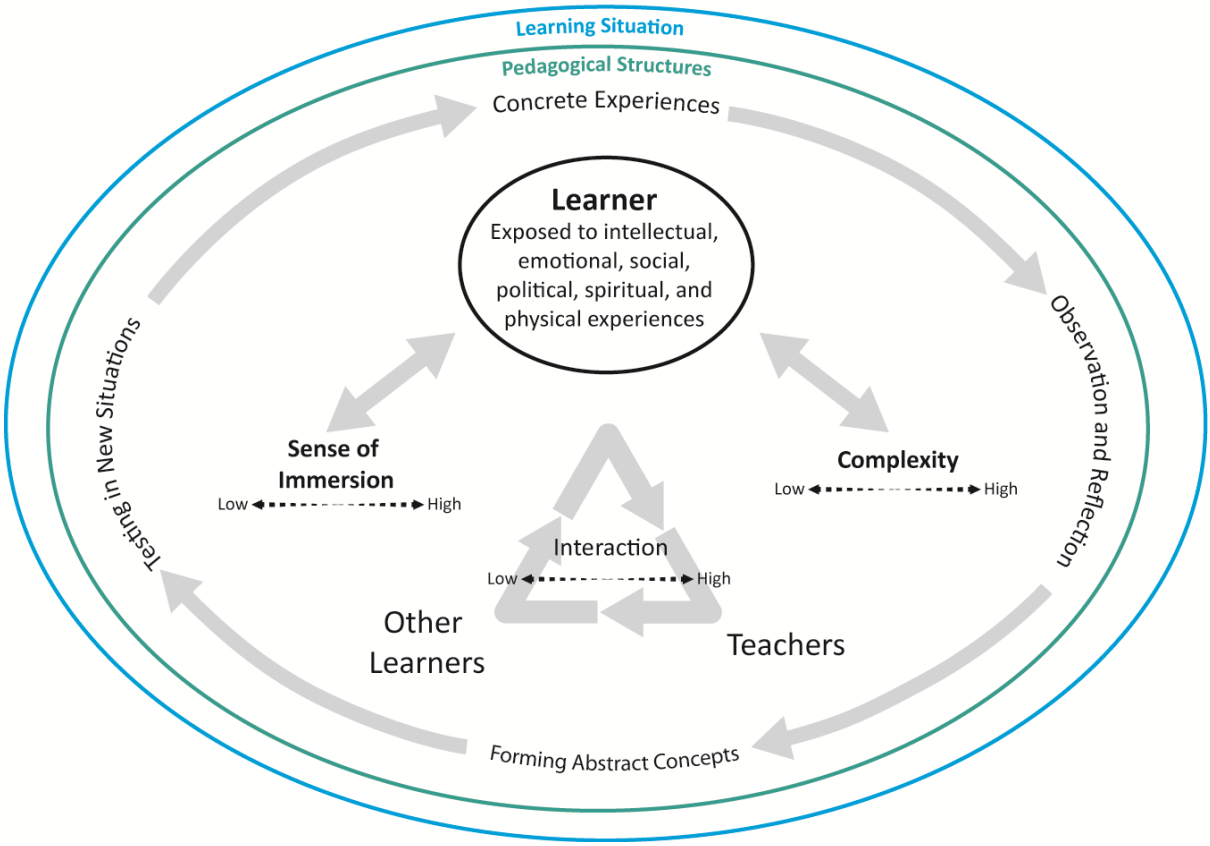
> *"experiential education is a holistic philosophy, where carefully chosen experiences supported by reflection, critical analysis, and synthesis, are structured to require the learner to take initiative, make decisions, and be accountable for the results, through actively posing questions, investigating, experimenting, being curious, solving problems, assuming responsibility, being creative, constructing meaning, and integrating previously developed knowledge"* (p.6)

He continues to explain that learners are engaged intellectually, emotionally, socially, politically, spiritually, and physically in an uncertain environment where the learner may experience success, failure, adventure, and risk taking. Prominent pedagogical theorisations and definitions of experiential learning, which is a core component of experiential education, include Dewey's three stage process of learning, Kolb's cyclical learning process, Joplin's

action-reflection cycle, Williamson's format for designing an experiential curriculum, and Kesselheim's learning process. Stehno (1986) examined these five theories and formulated the following features of experiential learning that emphasise its inherently circular nature: action creates an experience, which is followed by reflection on both the action and the experience, which in turn triggers abstractions from the reflection, and ultimately new application of the abstraction.

An important related pedagogy is situated learning (Lave, 1988) or situated cognition (Brown, Collins, & Duguid, 1989; Choi & Hannafin, 1995), which positions the learning process in the 'real world' to provide *meaningful* learning and promote the transfer of knowledge. Situated learning theory posits that much of what is learned is specific to the situation and place in which it is learned (Greeno, Moore, & Smith, 1993). Equally, Choi & Hannafin (1995) promote the importance of context in tertiary education. They observe that abstraction and decontextualized learning leads students to experience problems when applying the knowledge and skill acquired to other contexts; bluntly stated they note that "students may pass exams but be unable to apply the same knowledge in everyday circumstances" (p.53). Further, Quay (2003) concurs that the situated nature of the learning process is very important, indeed Choi & Hannafin (1995) emphasise the connections it creates between knowledge, skill, and experience, but Quay argues that situated learning is not sufficiently emphasised in dominant theories of experiential education; a sentiment we share.

Figure 1. Conceptualisation of Situated Experiential Education Environment (SEEE)



Adapted from Choi & Hannafin (1995), Itin (1997), Hall and Kidman (1996), and Moore (1993).

Drawing on the experiential education and situated cognition literature, as well as our own experience of this pedagogy, we conceptualise a situated experiential education environment (SEEE) as illustrated in Figure 1. The diagram positions the learner at the centre of the environment and highlights the rich variety of experiences that the learner may be exposed to, ranging from intellectual, to social and physical experiences (Itin, 1999). In terms of the environment three key features are identified as essential for a SEEE: sense of immersion, interaction with teachers and other learners, and the complexity of what is studied. However, it is important to recognise that that each of these features can be present at differing levels of intensity; this aspect will be elaborated on at the end of this paragraph.

First, a sense of immersion is central to a SEEE as the learner feels embedded in a specific situational and geographical context (Choi & Hannafin, 1995). This a cornerstone feature of situated cognition and situated learning theory as outlined earlier (Greeno, et al., 1993; Lave, 1988). In the virtual reality literature, the terms immersion and presence are closely related and consistent with the pedagogical conception. Murray (1997, pp 98-99) defines immersion as a state where the user (the learner in this context) is surrounded with another reality claiming their complete attention. The resulting experience generates a sense of presence, defined as "the subjective experience of being in one place or environment, even when one is physically situated in another" (Witmer & Singer, 1998, p. 225).

Second, interaction with teachers, and often other learners, is an important component of experiential education (Dewey, 2004), as direction, transaction and collaboration are core components of this theory (Itin, 1999). The importance of interaction between students with teachers, other students, and the information or content of learning activities has been recognised as a key feature of learning environments (Moore, 1993). The third feature is the complexity of what is studied and how this complexity is embodied in an environment or situation. Complexity in this model should be understood in pedagogical terms, rather than reflecting the technical or other affordances of an activity or assessment. Complex pedagogical tasks reflect a deliberate exposure of the student to experiences incorporating threshold concepts and 'troublesome knowledge' (Meyer & Land, 2003). The intention is to help the student develop their thinking in more sophisticated ways, as for example reflected by the SOLO taxonomy (Biggs & Collis, 1982). SEEE activities provide a means by which students can engage with concepts from multiple perspectives, receiving information in multiple modalities simultaneously, and seeing information in a rich and potentially confusing context. In both experiential and situated learning theories the need for students to unpack and reflect

on the interconnectedness of what they are observing is pivotal (Brown, et al., 1989; Kolb, Lublin, Spoth, & Baker, 1986). Understanding and unpacking complex problems grounded in the real world are very challenging tasks in themselves but rendered even more challenging when attempted from the classroom setting or readings. When also considering the roles of universities as thought-leaders (Dredge and Schott, 2013) and even critics of society, as for instance designated by the New Zealand Education Amendment Act (Harland et al., 2010) , then the pedagogical merit of SEEE is clearly illustrated.

Each of the three features can be present at varying levels of intensity, as guided generally by the course coordinator and aligned with the level of study and the identified learning objectives. For example, the level of interaction between the learner and the teacher/s will differ greatly in SEEE depending on the learning outcomes and whether independent learning is actively being fostered; higher and more frequent levels of interaction in the SEEE are generally more common in first year undergraduate courses than in Master's courses. Depending on the broader purpose of the learning task there can also be high levels of interaction with other learners, in the form of group-assessed group work projects, or low levels of interaction, if every learner is tasked to explore the SEEE and reflect on that experience on their own. Equally, the degree of complexity exemplified by the environment/situation under study will vary from low to medium to high depending on the factors being modelled and the level of ambiguity or conceptual conflict they represent; indeed, the level of complexity demonstrated by the environment/situation is a central pedagogical decision for course coordinators when selecting the SEEE and will necessarily reflect the level of the course and the capabilities of the students.

Although the level of immersion experienced by learners in SEEE is less variable than for the other two features, some nuanced differences are nevertheless present. While an example of a high level of immersion is the presence of the learner in the situation and geographical setting under study, a lower level of immersion occurs when learners observe the situation and geographical setting under study from a short distance without being present in it. Examples could include the study of the realities and complexities of the relationship between North Korea and South Korea from a South Korean observation post that overlooks the de-militarised zone into North Korea; and where only South Koreans are available to ask questions about the relationship. A particular challenge is ensuring that the level of immersion is balanced with the student's requirements to engage in reflective activities that critique their interactions and experiences and provide evidence of achieving the learning objectives.

The pedagogical structures of the SEEE operate within the learning situation and encompass the mechanisms driving the experiential learning loop (Figure 1). These structures need to be purposeful and focused on supporting a learner in developing important outcomes through their iteration of the experiential loop. The alignment of the interactive, immersive and complex features of the SEEE with explicit learning objectives reflects constructive alignment between the experience and the intended outcomes and learner goals (Biggs, 1996). Biggs describes this holistic view of the teacher, students, the learning situation, the activities and the outcomes as an "internally aligned system" (Biggs, 1996, p. 350). While in many cases a real (non-virtual) SEEE will deliver the greatest range of cognitive, affect and skill outcomes, there are several incentives to consider the use of virtual SEEEs. These include the opportunity to allow students to virtually experience challenging-to-access or dangerous environments (such as working laboratories, commercial premises, remote rainforests, derelict mines, or sites of conflict), places where the presence of students would be disruptive to others due to practical and ethical

concerns (such as a class of 100 students visiting a small village of 50 people), or indeed places that no longer exist due to natural disasters or armed conflict. Learning in virtual as opposed to real SEEE can also assist institutions with the management of constrained budgets (Stainfield, Fisher, Ford, & Solem, 2000), increasing concern about liability issues (Pearson & Beckham, 2005) and increasing work load pressures on staff (Dredge & Schott, 2013). Pedagogically, a virtual environment also has a range of desirable features including the deliberate creation of affordances linked to specific learning objectives, the ability to easily record and repeat experiences with or without variations intended to enable deeper learning, and the ability to provide feedback in context.

In comparison to the substantial body of literature on experiential education and situated cognition the topic of VR for education is still in a state of emergence. A significant proportion of published educational VR research relates to the use of VR in medical education (Freina & Ott, 2015) including basic information delivery as well as more sophisticated simulations aimed at training surgeons (Aïm, Lonjon, Hannouche, & Nizard, 2016; Bric, Lumbard, Frelich, & Gould, 2015) or exploring public health (Ma, Jain, & Anderson, 2014). VR technology requires virtual worlds as the platform in which learning takes place. Educational virtual worlds combine a range of features that realistically display dynamic real-world environments (representational fidelity) with interactive features designed to enable learning (learner interaction). In combination, these enable a range of learning modalities (de Freitas, 2008; Dalgarno & Lee, 2010). As noted earlier, a particular feature of virtual worlds is the creation of a sense of spatial immersion in the environment, leading the user to believe that they are present in a simulated environment, "spatial immersion occurs when a player feels the simulated world is perceptually convincing, it looks 'authentic' and 'real' and the player feels that he or she actually is 'there'" (Freina & Ott, 2015, p. 1). Without a doubt, there is still a

place for real world experiences in supporting embodied learning through sensorimotor experiences, but virtual spaces appear to be effective in supporting decision-making and interaction as well as experiential learning (Loke, 2015).

Virtual worlds in their modern sense consist of an illusion of a 3-D space, representations of people within that space (avatars), and tools for communication between users (Dickey, 2005). The first examples of virtual worlds were text game environments that enabled users to play in different environments. Referred to as MUDs (Multi-User Dungeons), MOOs (MUD Object Oriented), MMOGs (Massive Multiplayer Online Games) and MMORGs (Massive Multiplayer Online Roleplaying Games) these evolved rapidly into sophisticated environments that included spaces simply created for unstructured creative play and socialisation (MUVEs – Multi-user Virtual Environments). Technological progress meant that MUVEs were able to transition during the first decade of the millennium into a three-dimensional graphical space that directly represented an environment as moving images rather than text. The Second Life and related OpenSim MUVEs provided one of the first major internationally adopted virtual worlds supporting a diverse range of educational experiences (Penfold, 2009; Schott, 2012; Wang & Burton, 2013). More recently other game environments such as Unreal and Unity (Rogers, 2012) have provided development tools that can be used to create stand-alone virtual worlds enabling greater oversight and control by educators and institutions (Mathur, 2015; Potkonjak *et al.*, 2016).

The evolution of software to create virtual worlds has been accompanied by the evolution of tools used to experience and interact with such software. The screen, keyboard and mouse have given way to a variety of technologies aimed at more completely replacing the real world with a virtual representation, including the mapping of a user's hands into the environment

(Wozniak et al., 2016). Perfect immersion in a virtual world is however still very much science fiction. A particular challenge is that despite decades of research and development we still do not have tools able to render and display a completely immersive and believable virtual world without making significant numbers of users nauseous. Augmented reality tools such as the Google Glass (Torgovnick, 2013) and Microsoft HoloLens (Microsoft, 2015) are less prone to these issues and provide a limited degree of immersion but with significant limitations on the amount of information that can be provided.

Another practical approach is to use consumer three-dimensional products such as televisions to create immersive environments. Known as Cave Automatic Virtual Environments, or CAVEs (Kenyon, van Rosendale, Fulcomer, & Laidlaw, 2014), they consist of a large number of displays configured into a curved wall which when viewed with suitable polarised glasses generates a simulated three-dimensional image (Figure 2). Infrared gesture detection and the use of game controllers can render the environment interactive. CAVEs are however currently very expensive to install and maintain as well as limited in terms accommodating only about a dozen users at a time. While these spaces have the advantage of allowing multiple people to visually experience an environment together, similar experiences can be achieved at far less cost by having multiple users talking with each other while independently exploring a virtual environment.

Figure 2. Cave Automatic Virtual Environment (CAVE) at the University of the Sunshine Coast

Source: Authors (2016)

Over the last few years significant progress has been made in addressing the limitations and challenges of VR tools. Technologies such as the Oculus Rift and Vive headset have the ability to immerse people in a virtual world for a much more affordable cost than CAVEs. Importantly, the constant improvement in computing and graphics processing means that the necessary power is plausibly achievable using desktop computers in teaching laboratories or homes. While research on virtual world experiences has been increasing over the last few years there is a lack of theorisation of how students learn in these environments (Loke, 2015) as most empirical explorations have focused on practical issues (Wang & Burton, 2013). Despite the potential benefits, the pedagogical literature on the educational impact of recent advances with VR headsets remains weak. Additionally, there is a dominance of self-reported perceptions of effectiveness, without sufficient feedback from users of VR. Nevertheless, some of the more

in-depth studies have indicated that even earlier versions of VR can positively stimulate interaction (Roussou, 2004) and motivate students (Garris, Ahlers, & Driskell, 2002; Ott & Tavella, 2009). It is timely then to conduct research to explore VR headsets' effectiveness in virtually placing the learner in a situated experiential education environment. Adopting a user experience (UX) perspective (Hassenzahl & Tractinsky, 2006), which considers the experiential facet, the emotion and affect facet, and the holistic and aesthetic facet, the paper conducts a trial of VR-headsets for learning in a SEEE before mapping the participants' responses against the conceptualisation of SEEE presented in Figure 1.

Method

The research comprised two stages. The first stage consisted of a range of university stakeholders (academics, professional staff and students) 'visiting' a Unity software based virtual island in Fiji by using the OR headset. The second stage sought to explore through semi-structured interviews what each respondent identified as the strengths and weaknesses of the experience as a SEEE. A total of 11 people, six staff and five students, responded to the invitation to participate; none had previously used a VR headset. A diverse cultural background largely reflective of undergraduate classes at the authors' business school was represented by the student respondents, which included two students of New Zealand European/pakeha background, one international student from Asia, one New Zealand Maori student and one Pasifika student with Fijian background. Three were female and two males, which is again consistent with broader business school demographics. Staff respondents were evenly balanced in gender terms and included three cultural backgrounds: New Zealand European/pakeha (three staff), European (two staff) and New Zealand Maori (one staff). The roles held by staff covered the breadth of the university's educational system and included Associate Dean, academic

member of staff (with teaching and research responsibilities), and professional roles in IT and student educational support.

The questions were designed to provide the interviews with a guiding framework while at the same time giving respondents the freedom to modify the sequence of questions and to add additional points. The interviews started by asking about respondents' initial impressions of the experience, followed by questions about the strengths and the weaknesses of the virtual SEEE. Each interview lasted on average 20 minutes, was subsequently transcribed, and analysed in Nvivo using thematic analysis (Braun & Clarke, 2006). The analysis process enlisted a combination of inductive-deductive reasoning (Fereday & Muir-Cochrane, 2006) which saw themes from the literature combined with emergent themes from the interviews.

The Virtual Situated Experiential Education Environment and Learning Context

The SEEE created for this project was a virtual Pacific island, which was recreated based on a real Fijian island using the Unity software platform. Because a sense of authenticity of the learning experience are salient pedagogical features of experiential education (Carver, 1996) great attention was paid to the following aspects: the size of the island, distances between buildings and natural features, geographic features and topography, the diverse range of natural and human-made features, and importantly, the members of the village community who were represented through embedded videos. The embedded videos contained recordings of community members as well as external stakeholders, such as government officials, talking about the island, its relationship with tourism as the main income earner, other sources of income, and their aspirations for the future of the island. As the process of exploring the island, finding community members to 'talk' to, and interpreting the island's features and

community's perspectives is user-controlled the experiential learning process students undertake is both inherent and implicit; characteristics that are fundamental to SEEE.

The learning goals underlying the selection of the real Fijian island are to learn about life on this island and the academic concept of sustainable development; more specifically the learning goals are to develop a deeper understanding of the three pillars of sustainable development (environmental, socio-cultural and economic considerations) and their interwoven and complex nature in the context of a small island developing nation; salient features of situated cognition. The experience of a geographically distant island and its environmental and cultural setting then provide the context that constructively aligns the students' with these learning goals. As is common in small island developing states, tourism is an important feature of both the economic and social life, which is why sustainable development in the context of tourism was used as an example for the technology's application to higher education. Specifically, the student task embraces the learning practice of conducting 'fieldwork', which has a long standing history in disciplines such as Geography and Geology, amongst others. It requires groups of three to four students to work together on three sequential tasks: (a) learning about the unfamiliar environment, life style and views of its people and external stakeholders, (b) weaving theory from the course into what they have learned, and (c) arguing whether a sustainable development proposal should be developed and what form and shape it should take (for more detail about the learning design and student tasks see Schott (2017)). Although in-world collaboration is desirable and currently being implemented students have accessed the island in 'single player' mode and interacted with their group members in a variety of similarly effective ways to discuss what they observed and how it relates to theory. The communication and collaboration most commonly takes places directly by being in close (physical) proximity to their group members; however, social media such as Facebook Messenger and collaborative

platforms such as Google Docs are also used widely to collaborate after the students have completed fieldwork sessions.

Figure 3. Northern part of the village on the virtual island

Source: Authors (2018)

The virtual island environment is comparatively large taking users 2 minutes and 40 seconds just to walk from one end of the village (a pier) past the church and the community hall to the beach on the other side of the village (Figure 3). To develop the virtual island, a team of two, including one of the authors and a cultural research assistant, visited the real Fijian island on two occasions to collect all the necessary information and material for the development of the VR island; for more details about the development process see Schott (2015).

Findings

In order to provide an exploratory assessment of the effectiveness of the virtual island as an SEEE the key findings from the interviews were mapped in detail against two of the three key

features of SEEE: sense of immersion and the complexity of what is studied. Although equally important, the interaction feature of SEEE could not be substantially analysed as it was beyond the scope of this exploratory project due to the technical limitations of the current VR platform.

Sense of Immersion

A strong sense of immersion was reported by more than three quarters of respondents. Many commented on a strong sense of place, which is critical in SEEE, "it actually made me feel like, pretty much you were physically there, which was really cool", while other comments praised the strong sense of realism offered by this virtual SEEE, "beautiful like you actually felt you were standing on the rock". Of the three-quarters who mentioned a strong sense of place most framed it in the context of the virtual world offering a holistic immersive experience, "at the end when I ran out to the pier you could stand on the pier, with the sounds of waves crashing against it, looking back at this massive, expansive coastline and village …it was amazing". Additionally, just under half also discussed the realism of what they had experienced. Key aspects mentioned included animated content (relating to visual and auditory sensory domains), the appeal of colours (visual domain), as well as tactile sensory responses reported by respondents.

The animated content (waves, sea gulls, butterflies, fish, chicken and falling leaves) combined with associated sounds were emphasised as powerful stimuli in creating a sense of realism in this virtual SEEE, "the fact that you can look up in the sky and see the birds and you can actually see the fish…to me that was quite awesome" and another respondent emphasised "seabirds squawking…the sounds are pretty evocative". Colours were discussed by half the respondents who associated the familiar colours of the Pacific sea and sky with a sense of

familiarity and ease, “one of the things I love … the beautiful view of the sea” and another respondent added “I like walking along the beach because the ocean is bright blue”.

A third of respondents also made reference to the tactile domain in that they felt stimulated to try to touch objects because of the strong visual and auditory appeal. This multisensory stimulation had a profound effect on several respondents who commented not only on the desire to touch but also on muscular and skin responses “as soon as you started walking it almost felt like phantom legs moving, I could feel my muscles are almost moving…I think it’s incredibly realistic… there was a weird tingly sensation in my knees and my legs as I was walking through the grass, because it felt like there should be something there”.

The term ‘real’ was commonly used by respondents, but it became evident during the analysis that respondents construed ‘real’ with reference to two different conceptualisations. One conceptualises real in the context of the Fijian island and community on which the virtual island is based (authentic), “I think that you are literally putting yourself in Fiji, to me that is an incredible strength”. While the other refers to respondents feeling meaningfully immersed in a place that is understood to be artificial, “it’s like playing a game. It’s like being there in real life...(but) it’s more like playing a game”. Both conceptualisations have value in the context of immersion and immersive learning, however to foster SEEE, the former is the version of ‘real’ that virtual SEEE need to be able to deliver.

Complexity of what is studied

A number of respondents emphasised the holistic and integrated nature of what they experienced on the virtual island. As is common in interviews based on a hybrid of inductive and deductive reasoning the word ‘complex’ was never used by respondents, but instead they

described the experience itself. For example one respondent commented on the many integrated aspects of the island that are all significant in understanding the case and topic under study "you are getting the visuals which give a broader sense of the culture of the island, physical space, the benefits and constraints of that space". Others framed the complex challenges they observed on the Fijian island in the context of a sense of 'being there'. Being there referred to the remoteness of the island relative to the economic heart of Fiji on the island of Viti Levu, the cultural protocols of the village, the lack of running water and electricity, the vulnerability to storm surges, etc. One respondent simply put it as "you can actually see what it's like being on the island". As a holistic understanding of an island, its community and its socio-economic context is an important feature of SEEE it is encouraging that the associated learning process and benefits were specifically highlighted by a respondent "I think its strength is giving students a whole range of information, more than they would get from a case study. And then allowing them to make the most of that information".

A different perspective on the notion of complexity in learning was offered by a respondent with a strong interest in culture. She talked about the opportunities provided by the virtual SEEE in comparison to navigating the complexities of visiting a real SEEE without the ability to speak the language and being unfamiliar with the culture protocols, "it was so rich because you had someone translating and you had [the video] in that indigenous voice [videos were commonly recorded in Fijian and supported by a sub-text translation]…If I am in any island and I wanted to experience something cultural I would have to find myself a translator for the start, how would I get into this island? what is the cultural way of doing that?". Although meaningful access to the community, their culture and everyday life was an important consideration in the development of the virtual island the authors did not expect this aspect to be recognised as soundly as it was by this respondent. It would indeed be difficult to be invited

into the portrayed community and to overcome the language barrier as a non-speaker of Fijian; the project team spent several months planning the logistics and consulting the community elders about the cultural protocol and mutual expectations for the research visit. The project team included a staff member who speaks not only Fijian but also the local language and has a deep understanding of the cultural protocols of Fiji's Western islands (see Schott (2015)).

The benefit of visiting a virtual SEEE, instead of a real SEEE, to avoid contributing to the very complexities being studied was also raised by a respondent. Both the environmental and cultural impacts are minimal when 100 people visit a virtual SEEE compared to the same number of people conducting a one week visit to a real SEEE in or around a small village; the only impacts created by the virtual SEEE occur when the project developers visit the real environment to collect all the necessary material and information for the development of the real world. As such the respondent raised a significant point about the complex issues that arise from visiting small communities in remote locations where the economic impacts, that are commonly positive, are accompanied by significant socio-cultural and environmental impacts, which are commonly negative. Complexity then is clearly recognised by respondents as an important feature of the virtual SEEE.

Discussion

Universities across the world are welcoming an increasingly diverse student community into their faculties and departments, and as Altbach, Reisberg, and Rumbley (2009) posit, "an increasingly diverse student body also creates pressure to put in place new systems for academic support and innovative approaches to pedagogy" (p.x). Innovative approaches should include tools that serve traditionally-focused learners as well as those who have a more kinaesthetic (active), visual, inductive, sensing and global learning preference (Felder, 1993).

VR-based opportunities for situated experiential education should be considered in this context as they combine established educational philosophies from the 20th century with 21st century technological innovation. The interviews exhibited strong support for the provision of diverse learning opportunities to match students' diverse learning preferences. Respondents commented that VR provides effective opportunities in this context; by making situated experiential education environments available to learners in an era of less real fieldtrips and site visits for students.

Aligning the trial and subsequent interviews with the literature-based conceptualisation of a Situated Experiential Education Environment, as outlined in Figure 1, the findings will now be discussed with reference to the two key features of SEEE that are the focus of this paper, sense of immersion and complexity of material studied.

Overall a strong sense of immersion was reported by respondents. This was in part attributed to the headset's responsiveness to the user's instinctive head movement as well as a strong visual appeal and depth perception of the large virtual SEEE visited. Aspects that were particularly emphasised in this context were the bi-sensory appeal of detailed high resolution visuals and situated animated content, coupled with realistic and appropriate sound throughout the island. This was reported to invoke both a strong feeling of immersion and fidelity in the respondents. When mapping the findings on to the intensity scale in Figure 1 it can be concluded that the sense of immersion experienced by the respondents can be summarised to be around the elevated mid-level of the scale as certain sensory stimuli are strong while others are absent.

When refining the virtual SEEEs further, additional senses should be catered to in order to

increase both the user's sense of immersion and to enhance the complexity of the material and situation under study. For example, the tactile domain in VR, which is gaining increasing research attention in neuroscience (de Jong, Keizer, Engel, & Dijkerman, 2017) could be incorporated through the use of a small selection of meaningful real items that are connected to appropriate places in the virtual world and can be picked up by learners; in the case of Fiji these items could include the culturally important carved kava bowls, Pacific sea shells, and/or coconuts, etc. Additionally, there is evidence that thermoceptive stimuli in the form of heat create a more immersive experience for the user than merely providing a visual stimuli in the virtual world (Jones, & Dawkins, 2018). Smell, or more aptly olfaction, have been successfully used in a museum context for several decades to create multimodal exhibits. Examples include cigar smoke in the Britain at War experience and the American Museum of Natural History which uses gunpowder smell and odours of the tropical rain forest (Stevenson, 2014). There is consensus that the presence of smell can have a major impact on the sense of immersion (Jones, & Dawkins, 2018) as well as our ability to memorise a situation or environment (Chalmers & Zányi, 2009). Of particular significance in an educational context is Aggleton and Waskett's (1999) finding that exposure to odour cues lead to a highly significant improvement in recall of a museum's content, even though the interval between the recall test and the last visit to the museum can be a full six years.

The integrated and complex nature of the material studied in the virtual SEEE's also received considerable attention by the respondents, thus validating that this key feature of SEEE was clearly embodied by the virtual world. As discussed earlier, the level of complexity commented on by the respondents can in fact be classified as relatively high on the scale in Figure 1. This is because complexity is not only discussed in relation to the detailed nature of the SEEE and situation under study, but also in the context of the complexities and ethics inherent in a visit

to the real SEEE; and how this would contribute to the challenges already faced by the island. The nature of the complexity commented on also suggests that the pedagogical aims of the SEEE are being supported, with students reporting awareness of the interplay of factors affecting tourism development in the island.

The last of the three major elements of the model presented in Figure 1 is interaction. The current version of the VR environment is limited to 'single player' mode which limits the direct human interaction possible 'in-world' but there are opportunities for a passive interaction with island people in the simulation, and students are able to engage actively with each other and teaching staff as they debrief and process their experiences. The environment itself is also interactive to the extent that students can make choices about their movements and when engaging with the activities provided. Other SEEE VR environments could provide greater interaction as technological improvements enable multiple simultaneous users, some of which could be teachers acting in roles or artificially intelligent agents that respond according to defined parameters.

Conclusions

Situated experiential education is an important pedagogical approach for the many disciplines that seek to expose students to real world, complex problems as part of their curriculum. The ongoing development of virtual reality technologies is enabling motivating learning activities with high levels of fidelity to be offered at a relatively low cost. The paper's assessment of the key features of SEEE, as conceptualised in Figure 1, highlighted that the virtual Fijian SEEE 'visited' by using the Oculus Rift VR headset embodied complexity and provided the respondents with a strong sense of immersion, but rather more limited interaction. While limitations with regard to these features are acknowledged in the context of the virtual SEEE,

the logistical, resourcing and ethical implications of a real visit to a SEEE versus a visit to a virtual SEEE also need to be considered here. Nevertheless, the model in Figure 1 provides a framework for elaborating the design of SEEEs and ensuring the various components combine to create a pedagogically integrated system that stimulates student learning.

This study reports on the experience of a relatively small group of users and as such the findings should be seen as indicative rather than as establishing an empirical evidence base. Research with a larger group of users is needed as well as with different VR headsets to explore whether differences exist between headset models with regard to the user experience of virtual SEEE. For all forms of situated experiential education, the environment, situational context, and learning activities are critical and the SEEE framework presented in Figure 1 emphasises the need to consider whether the learning activities aimed at developing students' intellectual abilities are pedagogically robust, balancing immersion with effective educational interaction and cognitively complex experiences. As this important aspect was beyond the scope of this paper targeted research is required to examine it in depth in the context of virtual SEEE and to develop a broader theoretical framework of pedagogically sound learning activities in virtual SEEEs. Other areas for further research include a more targeted assessment of the third key feature of SEEE by examining the important interaction feature in virtual SEEE; both with regard to interaction with other students as well as the teaching staff.

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