

Student views on how role-playing in a virtual hospital is distinctively relevant to medical education

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Virtual worlds have the potential to enact the experiential learning of professional practices in simulated environments. The Otago Virtual Hospital (OVH) is one such virtual world where medical students role-playing as junior doctors make diagnoses and manage realistic clinical cases. To integrate the use of virtual worlds into existing curriculum, their distinctive relevance needs to be determined. A case study was conducted to find out how role-playing in the OVH is distinctively relevant to medical education. Following a trial involving 11 medical students completing the same scenario, three areas of relevance were identified: “making the call”; self-organisation; and “going through the whole process”. These areas can provide guidance to educators and staff developers who plan to recommend and sustain the use of virtual worlds in fields such as medical, legal, and management education.

Keywords: virtual worlds, technology integration, medical education

Introduction

Interviewer: But you guys are busy people, why would you spend two hours in one [virtual] scenario like this?

Medical student (fourth-year): Can't, can't get it anywhere else. Can't get that same experience. I mean, the [physical] wards are great and you get a lot of time with patients, but you don't get the responsibility. Basically making the decisions.

While medical educators agree on the dangers of allowing fourth-year medical students to make decisions that directly affect a real patient, we continue to debate when and how medical students should learn clinical decision-making safely during their medical education. Avatar-based three-dimensional (3-D) virtual worlds offer a promising way forward: medical students role-playing as doctors could make clinical decisions and live through the consequences of their actions in such simulated environments (Boulos, Hetherington, & Wheeler, 2007). In this paper, we provide empirical evidence on how role-playing in a particular virtual world is distinctively relevant to medical education, with a view to incorporating avatar-based virtual worlds within the current medical curriculum.

The increasing interest to harness virtual worlds for education is reflected in the number of special issues published on the topic in recent years (e.g., de Freitas & Veletsianos, 2010; Lee, Dalgano, & Farley, 2012; Twining, 2010). Accompanying the trend are numerous conferences around virtual worlds for learning (e.g., 5th Virtual Worlds Best Practices in Education Conference, 2012; 2nd Experiential Learning in Virtual Worlds Conference, 2012).

Among the numerous publications on the topic are studies that identified potential uses of 3-D virtual environments by surveying existing teaching practices. The uses range from the delivery of virtual lectures to geographically-disparate students, virtual conversations between foreign language students and native speakers, to the experimentation of gender / ethnic identities. A common use identified by three studies (Dalgarno & Lee, 2010; Hew & Cheung, 2010; Salmon, 2009) is the enactment of experiential learning in virtual ‘off-campus’ locations (e.g., students role-playing as archaeologists in virtual monumental sites, as lawyers in virtual courts). Experiential learning—‘learning by doing’—emphasises students’ bodily activity *in situ*, their deliberate reflection on and reconstruction of the experience, thus upholding “the organic connection between education and personal experience” (Dewey, 1938, p. 25). In the same vein, our work around the Otago Virtual Hospital

(OVH) is underpinned by the learning of clinical practice via student participation in and reflection on clinical practice, all within a safe environment.

The OVH

The Otago Virtual Hospital is a 3-D virtual hospital in which medical students role-playing as junior doctors make diagnoses and manage realistic clinical cases within the Emergency Department. Using their avatars, students are able to move around the hospital, communicate with patients, relatives and peers via text chat (see Figure 1 and the two-minute video at <http://bit.ly/xZ0Net>), perform a 'physical' examination of patients (e.g., clicking on the patient's chest allows students to listen to a series of heart sounds), order laboratory and radiology tests (e.g., CT scan of patient's head), check the results of those tests, prescribe from an extensive range of medicines, and write patient admission / discharge / handover notes. The OVH is built on the OpenSim-based New Zealand Virtual World Grid (<http://www.nzvvg.org/>).



Figure 1: Medical students role-playing junior doctors taking patient history

Experiential learning is a key modality of medical education within the Otago Virtual Hospital. Many medical educators have speculated that virtual worlds are appropriate for the experiential learning of clinical practice (e.g., Boulous, Hetherington, & Wheeler, 2007; Hansen, 2008; Stott, 2007). However, we recognise that experiential learning can be enacted in multiple ways (e.g., during clinical attachments in brick-and-mortar hospitals) and must give sound pedagogical reasons to recommend the use of virtual worlds over other ways (Loke, in press). Hence, in order to recommend and sustain the use of the OVH in existing medical curriculum, we need to determine its distinctive relevance (Roblyer, 2009).

To ascertain the effectiveness of experiential learning in virtual worlds, many studies have measured the changes in learning outcomes such as level of inquiry (e.g., Ketelhut, Nelson, Clarke, & Dede, 2010) and self-efficacy (e.g., Creutzfeldt, Hedman, Medin, Heinrichs, & Felländer-Tsai, 2010; Henderson, Huang, Grant, & Henderson, 2012). Responding to Kozma's (1994) call to concentrate instead on learning *processes*, we focus here on the differences in the quality of learning experiences. How is the experience of role-playing in the OVH different from existing medical education?

While Gregory et al. (2011) considered this question from the quantitative perspective, in this paper, we provide qualitative empirical evidence identifying the areas where medical students judged role-playing in virtual worlds to be distinctively relevant to medical education. To do this, we interviewed 11 students who had participated in a scenario within the OVH. To better contrast the learning experiences within and without the OVH, we first

provide a description of medical education at the University of Otago before we give an account of scenario-based learning in the OVH.

Medical education at Otago

The six-year Medical course at the University of Otago leads to the degrees of Bachelor of Medicine and Bachelor of Surgery. The Year 1 programme (approximately 1800 students) is common to all health professional courses (namely medicine, dentistry, physiotherapy, pharmacy, and laboratory science) and aims to give students a foundation in the biological sciences (e.g., molecular biology, musculoskeletal systems). Interested students then apply to Year 2 of Medicine (limited to 270 places). Other students may seek admission to other degree programmes such as Oral Health, Pharmacy, and Medical Radiation Therapy.

In Years 2 and 3, the focus of the curriculum shifts from the biological sciences towards the medical and clinical sciences. Responding to student calls to increase the day-to-day clinical relevance of the curriculum, the Year 2-3 programme was revised in 2008 to include more case-based learning, clinical skills (e.g., communication skills), and community-based learning in order to increase patient contact (Perez et al., 2009). The case-based learning consists of small tutorial groups reviewing and engaging in tasks related to realistic patient scenarios. These scenarios are used to illustrate the application of medical science to clinical practice and integrate material from other course components. This format is similar to the case-based style of questions found in the end-of-year examination (e.g., <http://bit.ly/M0D5fe>).

The Years 4-5 see the students divided between three clinical schools of medicine: Dunedin, Christchurch, and Wellington. In each school, the students undertake supervised clinical activities in hospitals, community-based clinics, and general practices (GP). In groups, students will also engage in mannikin-based scenarios for the development of emergency management and clinical skills. During their General Practice rotation, students at the Dunedin School of Medicine participate in simulated consultations with human actors at the Safe and Effective Clinical Outcomes (SECO) clinic (Williamson & Egan, 2011). Their learning experience at the SECO clinic most closely resembles that in the OVH, though student perceptions of key differences will be shared in our findings.

The final year (Year 6) is the Trainee Intern year, a transition-to-practice year where the students are located in clinical practice with supervision from the senior clinical team. They are paid a small stipend and are expected to assume day-to-day clinical responsibility for up to one third of the clinical load of the team. However they remain under the jurisdiction of the medical school, with the focus of their time on education, rather than service delivery (Dare, Fancourt, Robinson, Wilkinson, & Bagg, 2009).

To complement the medical curriculum, we built the OVH to further emphasise authentic clinical practice. Like Butler (2012), we sought to correct the imbalance between knowing and doing (highlighting the latter); but unlike him, we went beyond letting students view virtual world scenarios (i.e., Second Life machinimas) to having students actually participate in such scenarios.

Scenario-based learning in the OVH

The learning design underpinning the OVH is best categorised as scenario-based learning, a form of experiential learning (Hmelo-Silver, 2004) in which “an authentic or contrived scenario forms the basis of all learning, teaching and assessment activities” (Naidu, 2007, p. 251). The scenarios in the OVH were written by the authors of this paper who are practitioners in the fields of education, medicine and nursing. Each scenario is drawn from real-life events and aims to reflect the actual practices of a New Zealand emergency department.

The scenario reported here can be run in the OVH with a minimum of two participants (one playing the patient and another the doctor), hence reducing some of the logistical barriers of gathering enough participants before students can engage in role-playing. Additionally the scenario is flexible enough to include other characters such as senior doctors (e.g., a registrar), nurses, and the patient’s relatives. The patient guides her behaviour based on a pre-written script (e.g., <http://bit.ly/o8vUDQ>) and can be played by a student or a faculty member.

At the start of the scenario, the junior doctors receive an admission / triage form (e.g., <http://bit.ly/rbxI50>). Typically, they then apply the patient care framework and take the patient’s history, examine the patient, order laboratory tests, negotiate the treatment plan with the patient, prescribe medications, and finally submit patient admission / discharge / handover notes. Because we aim to mimic actual professional practices, we do not provide any superfluous guidance by, for example, walking the students through the correct steps in patient care.

It is important that advanced level medical students (our target audience) learn to make decisions in authentic and “relatively uncued conditions” (Tishman, Jay & Perkins, 1993, p. 149). Guidance is given via a post-scenario debrief with clinical educators, during which students reflect on their decisions and suggest alternative actions (if any). In experiential learning, this deliberate reflection phase makes experience meaningful (Dewey, 1916). The students are also formatively assessed based on the framework described in Loke, Blyth, and Swan (2012).

We built the OVH in 2010 with a one-year university teaching improvement grant. In order to sustain the use of this virtual hospital, its distinctive role within the existing medical curriculum needs to be determined. Because virtual worlds require relatively higher resourcing (compared to most other e-learning projects), sustainability should be an important consideration (Stewart & Davis, 2012). So, in what ways is the OVH specifically relevant to current medical education?

Method

A case study was conducted to evaluate how relevant the OVH might be to the medical curriculum. All fourth- and fifth-year medical students were invited via email and an in-class presentation to participate in the study. To take part, students registered their interest on a website (<http://ovh.otago.ac.nz/>) and gave their consent for the results to be published. These documents and processes were part of the successful application for ethical approval by the University’s Faculty of Medicine. We carried out the case study with 11 advanced level medical students (Students A-K, comprising 5 fourth-year students, 5 fifth-year students and 1 sixth-year student). These students were selected to have a wider familiarity with clinical practice as well as with the full medical programme. This was the first experience with OVH for all of the selected students.

The students worked on the same clinical case in five groups (of 2-3 students each) during five separate runs. Each run lasted 70 to 90 minutes. The clinical case involved a female patient in her mid-70s, Mrs Gertrude Macfarlane, whose neighbour had found to be increasingly forgetful (e.g., not feeding the cat) and generally unwell (e.g., feverish). In this case study, the patient was played by the same faculty member in all five runs.

After each group had completed their run, a semi-structured interview was conducted with the group and all three authors of this paper. Each interview lasted 25 to 35 minutes. The five interviews had three foci:

1. a group reflection on the decisions made (e.g. “How did you arrive at the diagnosis of UTI (urinary tract infection)?”) and learning points (e.g. “What, if anything, did you learn the last 90 minutes?”);
2. the nature of the virtual learning experience (e.g. “How did it feel playing house-surgeon?”); and
3. the distinctive relevance of the OVH in medical education (e.g. “What role, if any, can this virtual hospital play in your medical education?”).

Although this paper concentrates on the third focus, student views on the three foci were interrelated and were all taken into consideration (e.g. some key learning points signalled areas where the OVH was relevant).

The five interviews were recorded (150 minutes of audio recording in total) and fully transcribed. We analysed the transcripts based on Thomas’s (2006) general inductive approach. This approach was chosen because we sought—from our transcripts—to identify themes pertaining to the role of the OVH in medical education. In other words, we were less interested in generating a theory (grounded theory), in exploring multiple meanings in language (discourse analysis), or in describing students’ lived experiences (phenomenology).

Each of the authors first read the full transcript in detail. Then, each author created and assigned categories to segments of the transcript individually. As expected, some segments were not assigned to any category because the post-scenario interview had three different foci. The authors then met to negotiate their categories, combining or breaking up categories as well as selecting suitable quotations to communicate the meaning of each category. After reducing the overlap among categories, we arrived at three areas where medical students judged role-playing in virtual worlds to be distinctively relevant in medical education.

In designing this study, we attempted to maximise the “trustworthiness” (Guba & Lincoln, 1989, p. 233) of our findings in the following ways: validity was enhanced by triangulating two sources of evidence (namely students’ in-scenario performances and group interviews). Reliability was increased by carrying out five identical runs of the same scenario with five different groups. Indeed, assertions #1 and #3 are supported by evidence from all five interviews, and assertion #2 by four interviews. Insider (tutor) and outsider (researcher) perspectives were maintained and cross-checked throughout the study. Emerging assertions were tested in the

entire data corpus and negative examples were actively sought. For example, the assertion that role-playing in virtual worlds was appropriate for developing patient interaction skills was eventually discarded after negative examples were found (e.g., Student K described the text-based interpersonal communication within the OVH as being “a wee bit stilted”).

Findings and discussion

We now present the findings of the study around the three areas where role-playing in virtual worlds was judged to be distinctively relevant to medical education: “making the call”; self-organisation; and “going through the whole process”.

“Making the call”

This category refers to the ability to be fully responsible of the patient and to make clinical decisions that affect the patient. Many students highlighted how the OVH allowed them to actually make decisions and to take action:

J: Well, you actually *do* the things here. Whereas in the SECO clinic, you write down or you think about what you’re going to do, but you don’t have to practically go and do them. So there’s a bit more here.

H: Yeah, definitely getting to order the bloods was the best. And prescribing things. (...) Yeah, that kind of thing is useful.

E: Most of it, like taking history and knowing what tests to order, is really useful. I mean, we don’t get to order any of that, at the moment.

Indeed, during their medical education, students typically do not get to order any laboratory or radiology tests. A study conducted at the University of Manchester Medical School reported that students on clinical attachments often perceived themselves to be unskilled members of the medical team with no responsibilities (Dornan, Boshuizen, King, & Scherpbier, 2007). While students are involved in clinical decision-making to various degrees, their decisions are always checked by their supervisors to ensure patient safety:

G: Normally you’d be asked by the house surgeon to fill up the blood form or fill up the X-ray form. In this thing [OVH], (...) you’re actually doing the forms yourself.

H: Generally, what we would do would be, I mean, again it depends on the registrar. In a nice cooperative environment, if they were OK with it, then you could write out the admission notes and examination findings, even though they will want to repeat the examinations anyway. So, they would check it over, I’d probably check with them, and they would check it over and say - Interviewer: Have you done that [writing examination findings] before, in your four years?

H: Kind of.

I: Yeah.

H: To a certain extent. But I mean, I certainly wouldn’t be the one making the call. I wouldn’t *want* to be the one making the call.

Allowing students to actually make the call is hence one way that role-playing in the OVH is distinctively relevant to medical education. Dewey (1916), an important advocate for experiential learning, lamented how students often find themselves isolated from professional practice, leading to “the abnormality of the situation in which bodily activity is divorced from the perception of meaning” (p. 141). Based on our students’ views, not being able to make decisions results in at least two disadvantages. Firstly, the students’ learning experience is arguably truncated:

J: So, when you have like rural GP or something, you get your own clinic, then you get to think a lot. But in the hospital, often, you don’t (laughs).

K: I know, at my level, often they stop asking the questions at the point where you need to learn most. Like they’d say, “What would you do?” You’d say, “Prescribe fluids.” And they stop. Not how much, which fluids, how long.

Secondly, if students are not allowed to call the shots and to live through the consequences of their decisions, they might find it hard to develop a sense of responsibility toward their patients:

K: Well, part of it is what supervisor you're getting, how much they try and make sure that you are able to cope with situations and put responsibility on your shoulders. And part of it is making the mental shift yourself. I have to take the attitude with every patient that I see, that I have that responsibility. And sometimes it's a difficult mental shift because you're just thinking, "I'm just a student, it doesn't matter, my decisions don't really count for much." So you've got to physically make that mental shift so that you can prepare yourself for later on.

Similarly, in his anthropological study of medical training in a London medical school, Sinclair (1997) reported that the sense of responsibility is best developed when medical students get to take real action on "hot patients" (p. 32) instead of hypothetical action on 'cold' patients (whose diagnoses have already been established by another senior doctor, for example). While the existing curriculum stresses case-based learning, students' responses in 'paper' cases remain purely hypothetical. In a unique way, virtual patients may be perceived as being simultaneously 'hot' and 'cold': student actions result in 'real' consequences (e.g., virtual patient's blood pressure decreases), but the consequences take place within a virtual world. It is important to note that allowing medical students to take full responsibility of a patient is only reasonable because the scenario takes place in a simulated environment:

Interviewer: Do you think this would be a legitimate experience for you to gain that kind of experience of making decisions?

G: Yeah.

F: Yeah, I think so.

E: It's less scary too, it's not a real patient. If something goes wrong, it's not going to kill them.

The provision of a safe environment makes this learning experience possible. On the downside, two students admitted that, because they were treating a virtual patient, they did take the scenario more lightly. At the same time, their group mate provided the counterexample that their group took a long time to make decisions impacting their virtual patient. Overall, in using computer simulations, we acknowledge and accept the interminable tension between the provision of a safe, virtual environment and the ease of suspending disbelief.

Self-organisation

This category refers to the need to organise one's approach to provide medical care in a fluid yet comprehensive way, adapting the generic patient care framework to the situation at hand. Comparing role-playing in the OVH with a 'paper' case (where all the necessary information to work through the case is laid out), one student expressed the effort needed to adapt his approach instead of simply following the pre-formulated framework:

B: When you're in the hot seat, like knowing what to do next doesn't come naturally. (...) And when you get a paper case, it does all that work for you already. So there's still a gap in between that [and when] you get in the hot seat. But if you get a paper case, it has already *done* that work for you (...) you're not even tackling the problem, you're just kind of going around it. But whereas in this kind of situation [OVH], you suddenly realise that there's that gap there and you can't get around it except if you go listen and do some of the things.

Indeed, role-playing in the OVH requires the students to first "probe the virtual world" (Johnson, 2005, p. 45) to gather enough information before moving on to the next steps, and not to simply follow pre-determined steps in patient care. Being inherently linear, paper cases channel all students down a single path, doing the work of adapting the approach for the students, and may be limited in developing clinical reasoning (Poulton, Conradi, Kavia, & Round, 2009). The need to adapt one's approach to manage a clinical case was also observed when fourth-year Pharmacy students used a similar (but text-based) role-playing computer simulation (Loke et al., 2011). Adjusting a general idea to the particulars of a situation, as opposed to 'plugging in' what was learned, can be considered as evidence of student *understanding* (Wiggins & McTighe, 2005).

The medical students' varied abilities to self-organise was evident in the number of elements they missed out. During their interviews, students were able to identify missed elements ranging from checking the patient's home situation (Student F), ordering blood tests (Student A), to asking the patient about bowel movements (Student J). To explain their mistakes, many students admitted that they had found it challenging to stay focused during the scenario because of the messiness of the situation: for example, the side-tracking while conversing

with the confused patient; the patient's daughter's impatience with their lengthy history-taking; and the simultaneous lines of questioning. Beyond remembering all the appropriate elements in the patient care framework, the students also had to judge whether they had done *enough* before moving on:

Interviewer: And what did you learn? Or did you learn anything the last 90 minutes?

K: Just that, things that present very simply, sometimes when you think about them a wee bit more, you start to wonder: "Am I doing it right? Have I done enough?"

Interviewer: And in this specific scenario, were there things that looked deceptively simple?

J: I think yeah, I went from doing the write-up, then I realised I should go back and talk to the patient (laughs). A few things I'd missed, because sometimes, when you're in that spot, you don't think about asking those things [e.g., asking about a possible stroke].

The need to judge the adequacy of one's actions supports our call to reconceptualise medical education as the fostering of doctorly dispositions (Loke, Blyth, & Swan, 2012). As such, learning to become a doctor can be thought of as the 'tuning' (i.e., optimal level, not maximal) of dispositions such as doctorly compassion and responsibility. We speculate that the tuning of dispositions is best learnt through experience and practice. While the medical curriculum focuses on teaching the patient care framework and its components, the OVH provides repeated opportunities for medical students to apply the framework in practice:

A: I thought that the thing that we never get in med school is the global decision making. (...) What do I do now? Do I call a registrar? I mean, this is the result that you might expect in a dipstick in a UTI, but to take that knowledge and to *apply* it to the care of the patient, from the time they arrive till discharge is a lot different.

The difference between knowing and doing (i.e., application) is also evident when Student C professed to know what a compassionate doctor is like ("Whether you smile, or you're nice to the patient, you introduce yourself, and you ask them how they're feeling"), but then admitted to not having introduced himself to the patient during the scenario.

How one thinks and acts differently *in context* is related to situative theories of cognition. Students used at least three different ways to describe the distinctive moment when they are role-playing junior doctors: "when you're in the hot seat" (Student B); "when you're there" (Student D); and "when you're in that spot" (Student J). They then went on to say how they had behaved or reasoned differently during those in-world moments. This supports the theory of situated cognition which holds that the ways in which human beings think and act are inherently coupled with their environment (Brown, Collins & Duguid, 1989) and that the transfer of learning from educational institutions to the workplace is not straightforward (Lave, 1988).

"Going through the whole process"

This category refers to the need to provide medical care to the patient from the beginning to the end, from the time the doctor first meets the patient until the moment the doctor admits the patient to hospital, discharges the patient, or sends the patient to the operating theatre:

D: Well, it does help to sort of combine presentation with like, investigation and then treatment. It's always helpful. I mean, back in my mind, I know, "Oh, UTI presents with this, and you give this, and blah blah." But it's still nice to sort of be hit in the face with the simulation.

H: It's nice to tie it all together.

J: It's quite good going through the whole process from beginning to the end, having to think about the tiny, the little things, not just (...) the more straightforward bits. The little aspects of making it actually flow. So quite real, realistic.

Building the "flow" in patient care is related to the second category of self-organisation. In fact, it appears that the open-endedness and the need to go through the whole process are pre-requisites to having students weave their own approach through taking history, ordering investigations, and so on. This continuity is often lacking in the existing medical curriculum. For example, the objective structured clinical examination (OSCE) is a form of scenario-based assessment that is widely used in medical education today. One of its weaknesses is testing students only on "isolated aspects of the clinical encounter" (Smee, 2003, p. 705) in a stations-based structure

(e.g., history-taking station, examination station). By going through the whole process, students discover their own strengths and weaknesses:

J: The whole continuity from beginning to the end, you don't get very much of it. (...) So it's quite useful because it makes you think about what you don't know as well. It sorts of shows what you're not so strong at, so it's good for your own learning. You go back and say, "I need to learn more about this."

A: One thing is a safe way to experience the global decision making. It brings out all sorts of different things that you may not be shown that you don't know. We do an exam in an OSCE, ask a couple of questions from the whole list, a huge list. In OSCE, there are ten stations and 150 topics, so you have no idea what you don't know. What do you do? An ECG? What do you do with the [oxygen] saturation?

The student's last question regarding oxygen saturation is important. Too often, medical students' learning experiences are truncated at the most crucial learning points (as expressed by Student K above): for example, they are asked by their supervisors to measure the patient's oxygen saturation, but not to take any action based on the measurement. Role-playing in the OVH gives medical students the opportunity to provide medical care for a single patient from beginning to the end, requiring them to consider and live through the consequences of their decisions.

Conclusion

We sought to find out how role-playing in a particular virtual world is distinctively relevant to medical education by conducting a case study with 11 medical students. The students identified three areas of relevance: "making the call"; self-organisation; and "going through the whole process". These three areas suggest how role-playing in the OVH can complement as well as extend existing medical curriculum. They can also provide guidance to educators and staff developers who plan to recommend and sustain the use of virtual worlds in other fields such as legal education (e.g., Butler, 2012) and management education (e.g., Pidd, 2004).

While our findings offer pedagogical reasons for us to recommend the use of the OVH within the current medical course, we recognise that curricular relevance is but one of the many factors affecting technology integration. A scoping study on the use of virtual worlds for higher education in Australia and New Zealand revealed that educators should also take funding, support, and other institutional issues into consideration (Dalgarno, Lee, Carlson, Gregory, & Tynan, 2011). Our findings will nonetheless provide pedagogical support for a broader strategy to embed virtual world experiences such as the OVH into medical education.

References

- Boulos, M. N. K., Hetherington, L., & Wheeler, S. (2007). Second Life: An overview of the potential of 3-D virtual worlds in medical and health education. *Health Information and Libraries Journal*, 24(4), 233-245.
- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32-42.
- Butler, D. (2012). Second Life machinima enhancing the learning of law: Lessons from successful endeavours. *Australasian Journal of Educational Technology*, 28(3), 383-399.
- de Freitas, S., & Veletsianos, G. (Eds.). (2010). Crossing boundaries: Learning and teaching in virtual worlds [Special issue]. *British Journal of Educational Technology*, 41(1).
- Creutzfeldt, J., Hedman, L., Medin, C., Heinrichs, W. L., & Felländer-Tsai, Li. (2010). Exploring virtual worlds for scenario-based repeated team training of cardiopulmonary resuscitation in medical students. *Journal of Medical Internet Research*, 12(3), e38.
- Dalgarno, B., & Lee, M. J. W. (2010). What are the learning affordances of 3-D virtual environments? *British Journal of Educational Technology*, 41(1), 10-32.
- Dalgarno, B., Lee, M. J. W., Carlson, L., Gregory, S. & Tynan, B. (2011). Institutional support for and barriers to the use of 3D immersive virtual worlds in higher education. In *Changing demands, changing directions. Proceedings ascilite Hobart 2011* (pp. 316-330). Hobart: University of Tasmania.
- Dare, A., Fancourt, N., Robinson, E., Wilkinson, T. & Bagg, W. (2009). Training the intern: The value of a pre-intern year in preparing students for practice. *Medical Teacher*, 31(8), e345-e350.
- Dewey, J. (1916). *Democracy and education: an introduction to the philosophy of education*. New York: Macmillan.
- Dewey, J. (1938). *Experience and education*. New York: Collier Books.

- Dornan, T., Boshuizen, H., King, N., & Scherpbier, A. (2007). Experience-based learning: a model linking the processes and outcomes of medical students' workplace learning. *Medical Education*, 41(1), 84–91.
- Gregory, S., Dalgarno, B., Campbell, M., Reiners, T., Knox, V., & Masters, Y. (2011). Changing directions through VirtualPREX: engaging pre-service teachers in virtual professional experience. In G. Williams, P. Statham, N. Brown, & B. Cleland (Eds.), *Changing Demands, Changing Directions. Proceedings ascilite Hobart 2011*, 491-501.
- Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation*. Los Angeles, CA: SAGE.
- Hansen, M. M. (2008). Versatile, immersive, creative and dynamic virtual 3-D healthcare learning environments: a review of the literature. *Journal of Medical Internet Research*, 10(3), e26.
- Henderson, M., Huang, H., Grant, S., & Henderson, L. (2012). The impact of Chinese language lessons in a virtual world on university students' self-efficacy beliefs. *Australasian Journal of Educational Technology*, 28(3), 400-419.
- Hew, K. F. & Cheung, W. S. (2010). Use of three-dimensional (3-D) immersive virtual worlds in K-12 and higher education settings: A review of the research. *British Journal of Educational Technology*, 41(1), 33-55.
- Hmelo-Silver, C. E. (2004). Problem-based learning: what and how do students learn? *Educational Psychology Review*, 16(3), 235-266.
- Johnson, S. (2005). *Everything bad is good for you: how popular culture is making us smarter*. New York: Allen Lane.
- Ketelhut, D. J., Nelson, B. C., Clarke, J., & Dede, C. (2010). A multi-user virtual environment for building and assessing higher order inquiry skills in science. *British Journal of Educational Technology*, 41(1), 56-68.
- Kozma, R. B. (1994). Will media influence learning? Reframing the debate. *Educational Technology Research and Development*, 42(2), 7-19.
- Lave, J. (1988). *Cognition in practice: mind, mathematics, and culture in everyday life*. New York: Cambridge University Press.
- Lee, M. J. W., Dalgarno, B., & Farley, H. (Eds.). (2012). Virtual worlds in tertiary education: An Australasian perspective [Special issue]. *Australasian Journal of Educational Technology*, 28(3).
- Loke, S. K. (in press). Framed by technology. *British Journal of Educational Technology*.
- Loke, S. K., Blyth, P., & Swan, J. (2012). In search of a method to assess dispositional behaviours: the case of Otago Virtual Hospital. *Australasian Journal of Educational Technology*, 28(3), 441-458.
- Loke, S. K., Tordoff, J., Winikoff, M., McDonald, J., Vlugter, P., & Duffull, S. (2011). SimPharm: how pharmacy students made meaning of a clinical case differently in paper- and simulation-based workshops. *British Journal of Educational Technology*, 42(5), 865–874.
- Naidu, S. (2007). Instructional designs for optimal learning. In M. G. Moore (Ed.), *Handbook of distance education* (2nd ed.) (pp. 247-258). Mahwah, NJ: Erlbaum.
- Perez, D., Rudland, J. R., Wilson, H., Robertson, G., Gerrard, D., & Wheatley, A. (2009). The revised 'Early Learning in Medicine' curriculum at the University of Otago: Focusing on students, patients, and community. *New Zealand Medical Journal*, 122(1292), 1122–1123. Retrieved Jun 13, 2012, from <http://journal.nzma.org.nz/journal/122-1292/3540/>
- Pidd, M. (2004). *Computer simulation in management science* (5th ed.). Chichester, UK: Wiley.
- Poulton, T., Conradi, E., Kavia, S., & Round, J. (2009). The replacement of 'paper' cases by interactive online virtual patients in problem-based learning (PBL). *Medical Teacher*, 31(8), 752–758.
- Roblyer, M. D. (2009). *Integrating educational technology into teaching* (5th ed.). Upper Saddle River, NJ: Pearson Education, Merrill.
- Salmon, G. (2009). The future for (second) life and learning. *British Journal of Educational Technology*, 40(3), 526–538.
- Sinclair, S. (1997). *Making doctors: an institutional apprenticeship*. Oxford, New York: Berg.
- Smee, S. (2003). ABC of learning and teaching in medicine: skill based assessment. *British Medical Journal*, 326(7391), 703-706.
- Stewart, S., & Davis, D. (2012). On the MUVE or in decline: reflecting on the sustainability of the Virtual Birth Centre developed in Second Life. *Australasian Journal of Educational Technology*, 28(3), 480-503.
- Stott, D. (2007). Learning the second way. *British Medical Journal*, 335(7630), 1122–1123.
- Tishman, S., Jay, E. & Perkins, D. N. (1993). Teaching thinking dispositions: from transmission to enculturation. *Theory into Practice*, 32(3), 147-153.
- Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation*, 27(2), 237-246.
- Twining, P. (Ed.). (2010). Virtual worlds and education [Special issue]. *Educational Research*, 52(2).
- Wiggins, G. P., & McTighe, J. (2005). *Understanding by design*. Alexandria, VA: Association for Supervision and Curriculum Development.

Williamson, M., & Egan, T. (2011). Aligning “assessment for learning” with “assessment of learning” in health professional education: the SECO clinic. *Akoranga*, 7, 12-13. Retrieved Jun 8, 2012, from <http://hedc.otago.ac.nz/akoranga>

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