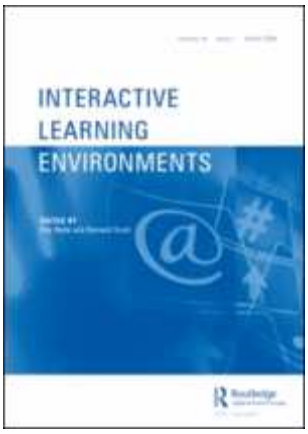

Evaluating a Second Life PBL demonstrator project: what can we learn?

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Example of PBL Scenario in Second Life: Road traffic accident
228x134mm (96 x 96 DPI)

Example of PBL Scenario in Second Life: Cedars Care home
207x121mm (96 x 96 DPI)

Evaluating a Second Life PBL demonstrator project: what can we learn?

Abstract. This article reports the findings of a demonstrator project to evaluate how effectively Immersive Virtual Worlds (IVWs) could support Problem-based Learning. The project designed, created and evaluated eight scenarios within Second Life (SL) for undergraduate courses in health care management and paramedic training. Evaluation was primarily qualitative, using illuminative evaluation which provided multiple perspectives through interviews, focus groups and questionnaires with designers, facilitators, learning technologists and students. Results showed that SL provided a rich, engaging environment which enhanced authenticity of the scenarios, though there were issues of access and usability. The article concludes by drawing together the lessons learned which will inform educators who seek to design and develop learning scenarios in this medium.

Introduction

In recent years there has been growing interest in the use of immersive virtual worlds (IVWs) for education, since they open up new opportunities for teaching and learning which go well beyond virtual learning environments (Warburton, 2009). Not only do IVWs provide relatively unconstrained possibilities for simulation but they also include a rich social dimension. When combined, these two factors represent a new form of learning space, which Salmon and Hawkridge (2008: 402) consider to be a 'paradigm shift in education' which affords 'infinite imaginative educational possibilities' (Salmon, 2008:526) and one where there is still 'a paucity of research' (Good *et al*., 2008: 163), particularly in the area of pedagogical value of IVW's (Savin-Baden, 2008) where instructional design principles are 'only beginning to emerge' (Mayrath *et al.*, 2011).

At the same time there has been a debate about the nature of knowledge, and knowing, beyond Gibbons *et al*'s (1994) concepts of Mode 1 (propositional knowledge) and Mode 2 (knowledge produced in, and validated by the world of work) to the acknowledgement of uncertainty (Barnett, 2004) and knowledge that is 'disregarded' by the academy, often knowledge related to emotional intelligence. The richness of the learning space provided in IVWs provides a context in which to explore these notions of knowledge and to research pedagogical approaches that are appropriate to situations with a social context and enabling students 'to function

skilfully in a practical world' (Haggis, 2004:347). For example, problem-based learning acknowledges both the social context of learning and enables students to grapple with the uncertainties of messy problems (Uden & Beaumont, 2006). It is therefore a pedagogical approach that appears suitable to make the most of the features afforded by an IVW.

This article provides an evaluation of the PREVIEW demonstrator project (Problem-based Learning in Virtual Interactive Educational Worlds) which sought to combine pedagogy with technology, and which investigated the creation and testing of PBL scenarios in Second Life (SL). This project, funded by the JISC emerged out of concerns that IVWs were being adopted and adapted for higher education with relatively few pedagogically driven motives. Any future impact on the field of technology enhanced learning will require pedagogically driven solutions that are derived from user (learner and teacher) needs and requirements. The PREVIEW project sought to achieve its objectives by working with end users to create, trial and evaluate pedagogically informed learning scenarios that were be simultaneously accessed by groups of learners with the principle aim of working together to achieve the desired learning outcomes. It explored the use of novel features such as Chatbots, together with different ways of presenting scenarios in two learning contexts: A Foundation degree in Paramedic Science and BA Social and Health Care Management. An important aspect of the evaluation is that it considers multiple perspectives and diversity of scenarios.

In the following sections we consider the background and informing literature for this work, the design of the evaluation and a discussion of the results which highlight important factors when considering the use of an IVW.

Background

Learners from any discipline are ultimately being prepared for the workplace and therefore need to develop transferable problem-solving skills, and be able both to adapt within their own discipline and to transfer knowledge and skills across contexts. Thus learning through case-based scenarios is an excellent method for acquiring sound knowledge and developing decision-making and problem-solving skills (Bergin and Fors 2003; de Jong 1991). An increasing number of curricula are based on a

variant of a case-based approach to learning, problem-based learning (Conradi *et al,* 2009) and there is a shift towards incorporating online and immersive spaces (Savin-Baden, 2007).

Problem-based learning (PBL) was popularised in the 1980s by Barrows and Tamblyn (1980), partly in response to the predominantly content-driven transmission educative model of the time. While there are many variants of PBL, often differentiated by the epistemological views and aims of the tutors, it is generally characterised by collaborative small-team organisation where learning is driven by an ill-defined, real-world scenario and students work together to solve or manage a problem (Savin-Baden, 2000). However, facilitating this collaborative approach is considerably more challenging in distance learning contexts, due to difficulties associated with effective discussion between geographically distributed learners (Chew and Beaumont, 2006). Online PBL, using a VLE may help, but for students it is sometimes difficult to create online learning opportunities which are both sufficiently immersive (i.e. inducing a feeling of being directly involved in the case) and collaborative, outside the tutorial room. (Conradi *et al*, 2009).

The potential of virtual realities for education has been recognised for many years, possibly influenced by the success of the flight simulators (Furness, 1986) and more recently collaborative massively multi-player online role-playing games (MMPORGs) (Whitton and Hollins, 2008). Furthermore, Winn (1993) suggested that there is a strong similarity in the psychological processes that become active in immersive virtual realities and those that operate when people construct knowledge through interaction with objects. Virtual environments offer students safe practice, procedural experience, exposure to unseen conditions or diseases, and above all, the immersive decision-making opportunities (Vozenilek *et al*, 2004).

The advent of a number of freely available virtual worlds has opening up new opportunities for learning. These include Active Worlds, Second Life (SL), Sims and There (Hendrickson, 2007), which all take very different approaches to creating an alternative reality, varying in their depiction of the alternative world (photo-realistic or impressionistic), the authenticity of the world (realistic or fantastical) and the depth of the interaction (prescriptive or relatively unconstrained). Second Life is perhaps

the most popular platform currently in use, and there is increasing interest in utilising it within education with many universities constructing their own campus island in SL. Furthermore, the number of health and medical education projects using SL is also proliferating. Boulos *et al.* (2007) provides a survey and discusses the potential of IVWs, discussing relevant issues and challenges, such as effect of avatar appearance, student participation and influence on reflective practices, though none of the examples refer to PBL.

Certain features of IVWs appear to offer considerable opportunities for promoting learning, particularly the support for synchronous interactions and collaboration together with the flexibility for instructors to construct customised learning environments (Livingstone *et al.* 2008). Minocha and Roberts (2008: 188) also highlight that the illusion of immersion in a 3D virtual world is important for providing a sense of social presence, which in turn promotes socialisation and leads to a 'more human experience than 2D environments'. Indeed, there is a rich environment for developing identity, which Hollins and Robbins (2009) consider to be one of the five educational affordances of IVWs (along with space, activity, tools and community).

However Livingstone *et al*. (2008) point out that IVWs have not generally been designed for teaching and learning, and lack many features widely used within current Virtual Learning Environments, such as support for asynchronous communication, learner privacy and assessment. They propose a way of achieving the best of both worlds through Sloodle – an integration of Second Life and the Moodle VLE. Clearly technological features of an IVW are important, but the most critical requirement for successful adoption of an IVW is the pedagogy that underpins its use. Consequently recent projects have explored the use of IVWs in specific learning contexts within Higher Education, for example MOOSE (Salmon et al., 2009) explored in-world socialisation and facilitation for Archaeology and Digital Photography and Open Habitat (White and Le Cornu, 2009) investigated how an IVW can support creative collaborations and discussions for Art and Design, and Philosophy students.

Open Habitat concluded that IVWs work best with less authoritarian pedagogies

based around exploration, where there is no 'correct answer'. Problem-based Learning would therefore appear to be well positioned to take advantage of IVWs. In a study by Good *et al*., (2008) the combination of PBL and SL was seen as beneficial by reinforcing the facilitator's role, providing an authentic environment and being motivational. However, while an analysis of a PBL 'classroom' in *ActiveWorlds* by Omale *et al.* (2009) showed that the IVW promoted social presence and problem identification and analysis, it was less effective for the problem solution phase of PBL, and students could easily be distracted.

It is notable that in many published cases references are made to the *potential* of IVWs, particularly the flexibility to use a variety of pedagogical approaches. The nature of these findings shows that they are still at an embryonic stage of development, and further systematic research is required to evaluate the opportunities in a wide range of learning contexts.

The novel approach taken in this project was that it did not seek to create knowledge management systems for learning or merely create formal classrooms in 3D spaces. Instead the focus was on combining the advantages of a strong and well tested pedagogical approach (problem-based learning) that could be adapted to fit diverse disciplinary needs within 3D virtual worlds. Providing scenarios within an immersive virtual world was perceived as a method of overcoming one limitation of 'traditional' paper-based scenarios, namely that they often restrict students' decision making and are linear in nature, whereas interactive online scenarios allow students to consider options as the scenarios unfold, and allow students to explore the consequences of their action (Poulton et al, 2009).

Practicing skills within a 3D virtual world also offers advantages over learning through real-life practice, in particular the exposure of learners to a wide range of scenarios (more than they are likely to meet in a standard face-to-face programme) at a time and pace convenient to the learner, together with consistent feedback. It offers learners the chance to make mistakes without real-world repercussions. Furthermore, with the increasing use of distance learning programmes, learning that takes place in virtual environments creates online opportunities which are immersive and collaborative outside the tutorial room, in ways that current VLE systems do not.

The next section outlines the aims and method for evaluating one particular pedagogical approach (PBL) in Second Life as a contribution to this developing discourse.

The PREVIEW Project

The aims of the PREVIEW project were to develop, deliver and test eight PBL scenarios within SL for paramedic and healthcare management education; ensure user-guided development and share technology and good practice. Over a period of 9 months two categories of PBL scenarios were initially designed: *Information-driven scenarios*, *(IDS)* and *Avatar-driven scenarios (ADS).* Information-driven scenarios presented information through virtual world content, such as video footage, images, and audio with links to external content, such as relevant web pages. Avatar-driven scenarios use non-player characters (NPCs) as 'chat bots', where the student interacts with the NPC to gather necessary information. These scenarios were developed, tested and adapted over the 9 month period.

For paramedic scenarios a realistic environment was created including an orientation area; motor cycle accident street scene; a house; an underground station; a benefits office; a nightclub and a hospital. Teleports facilitated navigation between scenarios. Scenarios were constructed a minimum of 20 metres apart to avoid crosstalk. On arrival, students assess the virtual patient (NPC) and environment and discuss the treatment/action. Information is gathered through a heads up display (HUD) which presents the media content associated with the virtual patient; text-chat to question the virtual patient, which responds to certain keywords; touching (left-click the mouse) parts of the patient which displays possible actions and paramedic equipment including monitoring tools.

The four health care management scenarios took place in a virtual care home. An example scenario (see Figure 1) is a difficult situation about an outbreak of disease within the facility. The role of the students is to gather and discuss information and to formulate an action plan. Information is elicited from NPCs, the virtual environment and information presented in-world as text or video. In these scenarios, NPC dialogue used a sophisticated approach where natural language input was processed (using an

artificial intelligence-based pattern matching method) through a separate server outside of SL linked to the NPC.

(Figure 1)

Example of PBL Scenario in Second Life: Road traffic accident.

(Figure 2)

Example of PBL Scenario in Second Life: Cedars Care home.

Evaluation Method

The evaluation encompassed formative elements to inform the project team and summative elements to establish the worth of what has been achieved. The objectives of the evaluation were

1. To explore the impact of problem-based learning scenarios in 3D virtual worlds on learning.
2. To assess the usability of the learning environments and the user acceptance.
3. To evaluate the effectiveness of feedback mechanisms and guidance materials
4. Offer an analytic account of the experience of the project from the perspective of all the key stakeholders.
5. Be responsive and flexible enough to capture unintended outcomes, and unanticipated effects.
6. Provide an overall summary of the project, highlighting strengths, weaknesses and areas of development.
7. Inform current and future developments, paying particular attention to their structures, procedures, working practices, relationships and practices.

The evaluation was planned at the start of the project, informed by JISC guidelines (Glenaffric Ltd, 2007) and illuminative evaluation, which is argued to take account of wider contexts than more traditional evaluation and, is primarily concerned with description and interpretation rather than measurement and prediction. (Parlett & Hamilton, 1972). In practice this meant a focus was on

1. Technical perspective:

a) Integration of tools and applications in the learning environment.

b) Functionality of the tools for use in PBL.

2. Organizational perspective:

a) Knowledge and skills of academics for development and assessment of teaching and learning.

b) Acceptance and user satisfaction of the tools.

3. Pedagogical perspective:

a) Content and structure of the scenarios.

b) Coherence of technology in use with pedagogical principles.

Data collection

A primarily qualitative method was used, with semi-structured interviews and focus groups being the principle data-gathering approach. Questionnaires were also used to collect student perceptions. Data were collected and analysed from three main sources: internal and external project documentation; interviews with key respondents (project leader, three subject matter experts who designed and facilitated scenarios three learning technologists and the technical developer) and finally evaluation activities involving students.

Student evaluation data was collected from activities known as 'Testing days'. The paramedic scenarios were evaluated on three occasions during June and November 2008. In June participants were first year paramedic students (n=10) familiar with PBL but not Second Life; testing was carried out in a computer lab. The first testing days in November involved four of the original ten participants and one new student. A further test in November used a different opportunity sample of ten mixed first and second year paramedic students. The structure of tests consisted of SL orientation (1hr), demonstration scenario (1hr) followed by group rotation around different scenarios (approximately 1hr per scenario). This was followed by a paper questionnaire and focus group (1hr). Scenarios were facilitated with groups of 2-4 students. The SME facilitated student interaction and provided suggestions at appropriate points.

The health care management scenarios were tested on two occasions with 12 volunteers drawn from health-related professions, (not students on the target course) and almost all had no experience of PBL. None had prior experience of SL. These activities generated considerable volumes of data comprising in-world chat logs,

video screen capture; video footage of the students interacting with scenarios, post testing focus group responses (video-recorded) and questionnaires.

The methodology adopted provided multiple perspectives on a complex learning environment. The small sample size and contextual differences in students, scenarios and mode of learning means that any generalisation of findings is inappropriate. However, this does not mean that the results are invalid; within the context of this project, high validity has been ensured thorough multiple perspectives/ data sources (triangulation) and most importantly, member validation procedures. While context is important in any course or learning environment, this evaluation aims to discover design and development issues which need consideration by others adopting a similar approach.

Data analysis and processing procedures

Analysis

Data collected from interviews and focus groups were analysed interpretively to examine the subtext of data and identify themes and patterns of response in relation to the areas of enquiry. Findings were transformed into developmental models and practice materials. Questionnaire data consisted of both quantitative and qualitative responses and ensured that all student participants' voices were heard. The quantitative data was analysed with simple descriptive statistics, qualitative data supplemented that collected from the focus groups.

Results

This section critiques pedagogical aspects of the project and starts by analysing in detail the preparation of students and usability of Second Life and the scenarios. Subsequently, the paper considers pedagogical issues of scenario design, facilitation and collaborative behaviour. Table 1 lists frequencies of students' comments in open questions in the questionnaire regarding advantages/disadvantages of SL.

(Table 1)

Emergent themes

A number of themes were identified from the qualitative data which illustrate the challenges of using this medium for learning. The themes include Student Preparation, Pedagogical Design and Collaboration and Interaction. Whilst there were data that transcended these themes, data here have been categorized to illustrate the troublesomeness and difficulties experienced by staff and students.

Student Preparation: Access, usability and orientation

Technology can be an enabler of learning, or a barrier, depending on usability and alignment to task. Second Life provides a rich and novel environment, requiring control of the avatar, camera, objects and interaction with Non-Player Characters (NPCs) and collaboration with colleagues. The bandwidth and PC performance requirements also impose greater demands than conventional e-learning (VLE) environments. Three main concerns were identified within this category:

Access

Several students reported problems downloading Second Life on their computers in halls of residence. A subject matter expert also reported that only five out of 30 of his students perceived that they had computers that met the hardware specification. Furthermore, the quality of the experience depends on network bandwidth and during one test the use of wireless laptops was curtailed since the performance was unacceptable. It is also important to note that there are accessibility problems with Second Life; inability to use a mouse or visual impairment effectively excludes the student from participating. At all testing sessions some of the students experienced Second Life crashes, which excluded the student from the scenario for a few minutes. Whilst this was judged a minor annoyance by those testing the scenarios, collaborative users of the system within a course may consider this much more important.

Clearly access was a significant issue, given that one of the perceived benefits of the project was for distance learning. However, PREVIEW can be regarded as an early adopter of the technology, and the issues can be expected to diminish with time.

Usability

Usability is a function of both the Second Life interface, technical and scenario design. From a Human Computer Interaction perspective, the affordance provided by Second Life objects (how to interact with them) was not intuitive for many novices consequently labelling of widgets/objects within the scenarios was needed to enhance their visibility (and affordance). For example, such labelling enabled teleporting to be achieved easily without error. However, students commented: *'Sometimes it was hard to realise what you could and couldn't do'*.

The complexity of the interface also provided a high memory load for novices, and all student groups commented that sometimes there was *'too much going on'*. Information could be provided through several means simultaneously, voice, local chat, HUD, dialogue boxes. However, despite the complexity and these issues, students suggested it was *'mostly straightforward'* and observation of the students returning for a second session showed that they retained Second Life skills after 5 months without further practice.

While students in focus groups reported enjoying the experience and considered that usability issues were not serious, some subject matter experts/ facilitators were more cautious, suggesting that poor usability impeded students from achieving learning outcomes:

> *'This is my greatest concern. In order to get the student close to a point where clinical reasoning/learning is both valuable and the prominent area of concern, it seems to take a large amount of effort to overcome the heavy interface of Second Life'*.
>
> *'..facilitation would be heavily influenced with technical (i.e. Second Life instruction..)'*.

Student preparation and orientation

Student preparation sessions took twice the time allocated (originally half an hour) and while questionnaire responses from the paramedic students revealed that 80% (n=20) agreed/strongly agreed that the preparation was sufficient, 65% requested

more time to practice. Students encountering the environment for the first time liked to experiment, for example in modifying avatar appearance. There was a large variation in students' ability to adapt to Second Life; some took many minutes to learn the simple task of attaching a HUD. Assisting novice students through Second Life was not easy, and facilitators commented that real-world communication was helpful at this stage. Students also requested a guide to accompany the training.

When arriving at a paramedic scenario, students stated that they did not find it intuitive how to progress, and needed facilitator guidance to communicate and use the tools. Activities such as examining the patient and using and attaching equipment to a patient must be carried out differently in Second Life, and this required learning. Similar orientation difficulties occurred in the health care management scenarios and several students said they 'felt lost' 'confused' and 'helpless' at the start. Some of this related to the Second Life factors, controls, the unfamiliarity / multiple sources of information and confusion over avatar names, but other aspects were scenario-specific, (e.g. understanding of individual and NPC roles) and others related to group dynamics (leadership, collaboration).

Pedagogical design

When evaluating SL as a tool for supporting PBL, it is necessary to consider how well it facilitates the PBL process. Typically, PBL involves tutor-facilitated groups of students who collaboratively co-construct knowledge through identification of learning issues, individual research, group sharing and application to the problem scenario. Scenarios are deliberately designed to be authentic, realistic and messy and students can explore various paths (Uden & Beaumont, 2006).

Authenticity

The development team expended considerable effort constructing a realistic virtual environment, including specialist tools for the paramedic scenarios. The scenarios were scripted to be professionally authentic by the subject-matter experts (SMEs) who considered that SL supported PBL by providing both an *immersive* and an *unstructured* environment. An SME stated that these features supported his pedagogical aims by adding realism, which assisted the role play that he envisaged

within the scenarios, and the unstructured nature of SL empowered participants and '*lends itself very strongly to creating a rich and valuable decision making exercise'*.

Paramedic scenarios included simulation of medical equipment, enabling tests on the patient by clicking/ dragging operations. When students evaluated the experience in focus groups they stated that '*seeing everything*' in the simulation assisted decision making and 14% of advantages they identified related to realism and suitability for professional education. Students found customised in-world resources particularly useful (e.g. an electrocardiogram (ECG)). This prompted them to request more external resources e.g. guidelines to look up drug dosages.

Furthermore, a key theme that ran through the focus groups was feedback and these can be divided into two categories: *intrinsic* feedback and *performance* feedback. Intrinsic feedback adds to authenticity, since the consequences of actions are evident in 'real time' in the scenario (for example in the patient's condition or reaction to treatment) and students requested that this aspect should be enhanced, typical comment being: *'you can't know if you are clinically correct'*. All focus groups highlighted an advantage of second life as being able to provide this kind of realistic feedback. Indeed, they pointed out the unrealistic behaviour (e.g. patient not guarding a wound in the road traffic accident and burn scenarios) as being confusing and questionnaire open questions regarding disadvantages yielded most responses on this aspect (table 1).

This student preference for realism and presence within the scenarios was also demonstrated as they expressed the view that information driven scenarios did not add any value over traditional VLE and web-based presentations, in fact the complexity of SL added a barrier to learning. However, in contrast students evaluating the health care management scenarios considered IDS to be appropriate for presenting information. Such findings are not contradictory, but emphasise the importance of contextual factors in any learning situation. The pedagogy employed in health care management scenarios largely focussed on collaborative discussion using presented information, rather than the more directly active approach within paramedic scenarios. This is important since a number of authors describe presence as the sense of being 'in' or 'part of' a 3D virtual world (for example, Slater and Wilbur, 1997). Thus the

sense of presence in Second Life means not only feeling 'there' with other staff and students and guided to learn, but also feeling as if they are actually present in that environment (Beer *et al*., 2003). This absorption and engagement of the student in the learning experience is argued to focus and improve learning (Kang *et al*., 2008; Richardson and Newby, 2006). Furthermore, Dede (1995) suggests that within learning environments, immersion can be created through the capacity to execute actions, through semantics and semiotics, and through physical and sensory provision that creates a feeling that the user is surrounded by the 3D virtual world. Approaches to teaching in Second Life seem to differ not only because of the medium being used but also because of the nature of immersion that occurs in that environment.

Scenario purpose and facilitation models

In the paramedic scenarios, one SME confirmed that the scenarios assumed students had a level of knowledge that they could apply and the scenario focussed on developing clinical reasoning and decision making in simulated real-life situations. However, his original intention for the pedagogic model required that prerequisite knowledge (background) would be incorporated within the Second Life scenario and that the scenario could therefore be used to promote learning of theory in addition to application to practice. He envisaged an active facilitator approach; which would vary as students repeatedly visited a scenario and would *'direct them how to learn and where to find information … and follow them until I make sure they are heading the correct way'*. This background information was not able to be incorporated within Second Life during the project.

The technology also had a strong influence on the pedagogical model, as explained by another SME:

> 'SL *lends itself to individuals or pairs consolidation or decision making exercise …. . like to see it as a standalone exercise without facilitation'*
>
> *'I don't feel it lends itself very well to a group (3-4)…– quite high boredom factor for those not directly participating with NPC, … they were checking email, adjusting appearance – so from facilitators point of view it is a good decision making exercise but not for what we understand as traditional PBL session'*.

Thus, the outcomes were not classical PBL learning issues that students identified, but application of existing knowledge, development of decision making, reasoning and reflection on their performance at the end of the PBL cycle. Yet as Ramsden (1984, 1992) suggested students' perception of the learning context is an integral component of their learning. The learning context is created through learners 'experience of the constituents of the programmes on which they are studying, namely teaching methods, assessment mechanisms and the overall design of the curriculum. Therefore learners, Ramsden suggests, respond to the situation they perceive, which may differ from that which has been defined by educators. However, regardless of content or principles of problem-solving, it is the context in which the initial problem is presented that tends to affect the degree to which transfer of knowledge takes place. For example, a learner's ability to transfer knowledge gained from the first problem situation into the second problem presented will be affected by whether the learner expects the principles used in solving the two problems to be related.

However, the subject matter expert related this to real-life acquisition of knowledge, related closely to the early stages of the PBL cycle.

> *'[I'd] expect students to discuss what the problem was, identify areas where need more knowledge as in real life – e.g. for C-difficile get specialist knowledge, but also actually undertake … a series of actions to manage crisis'.*

Reactions of subject matter experts undertaking the facilitator role varied, possibly reflecting their personal view of facilitation: one SME tutor saw his role as 'a quiet role', guiding students by interjecting with pertinent points, encouraging or leading discussions. He perceived this to have worked well and reported that student debate had occurred several times. This contrasted with another SME who saw facilitation as

> *'much more for us to direct them how to learn and where to find information … to respond & reflect on information' .*

This SME also perceived the facilitator role as providing appropriate guidance and performance feedback. All SMEs identified an additional role in Second Life- that of facilitating the use of the technology as well as the scenario.

One of the difficulties of problem design that occurs in many curricula is that little attention is paid to the different types of problems available, how they might be used and the level of the curriculum where they are used. For example, in some medical programmes problems change in terms of complexity and capability as the learners progress through the first two years of the programme, yet the level of criticality the learners are expected to develop towards learning and knowledge often changes very little. The assumption in many programmes is that learners will be able to recognise and describe knowledge and issues before being able, in their final year, to defend and evaluate that knowledge.

Collaboration and interaction

Second Life affords collaboration through a rich multi-media environment of voice, text and shared objects in a shared 3-D environment. However, it became evident that a protocol is required to ensure that effective learning takes place. Such a protocol in real life is generally well-learned by the time students reach university, but in Second Life this socialisation requires negotiation of acceptable behaviour and protocols. Students and facilitators highlighted the chaos that could occur if multiple participants communicate simultaneously in Second Life. Students expressed a preference for communication through voice rather than text chat and facilitators' perceptions were that levels of collaboration increased and students made more rapid progress using this mode. However, mixed use of voice and chat was problematic since information was presented in text tended to be ignored (in favour of voice contributions) by others in the group.

Group dynamics and intra-group communication was raised as an issue, echoing Minocha and Roberts' (2008) emphasis on the need to make avatars more expressive. Students explained that a lack of social cues in the Second Life environment impeded them from 'taking control' to ensure progress was made in a systematic rather than haphazard way. One student stated that he felt *'baffled… on the fringe'*.

The student response to Second Life, and these scenarios as an effective collaborative environment varied significantly; 75% (n=20) of first-time user paramedic students agreed/strongly agreed that 'it is easy to collaborate in the Second Life scenarios', and students volunteered positive views, for example:

'communicating with others helped assess the situation… gave better understanding'.

Indeed, comments regarding the benefits of collaboration were the second highest ranking advantage listed in student questionnaires.

However, paramedic students strongly identified an advantage of being able to use the scenarios individually to consolidate learning or as a means of revision; convenience of working on their own was the most-identified benefit from open comments in the questionnaire (44% open comments). As one student put it:

'..but I would have liked to do it alone as well so I have time to think about what to do at my own speed'.

The project chose to incorporate NPCs which would respond to text communication from participants' avatars. Restricted keyword driven dialogue in the paramedic scenarios was viewed as useful by students. More ambitious use of chatbots to respond to natural language dialogue in the health management scenarios was not sufficiently sophisticated to provide realistic responses to student queries.

Discussion and lessons learned

The project used an innovative approach to address difficulties of distributed collaborative problem-based learning and take advantage of the new opportunities afforded by IVWs. Key issues for effective PBL are authenticity of the environment, collaboration and facilitation. The capacity for providing authentic scenarios incorporating a good degree of realism and the lack of constraints on actions students could take was identified as strength of Second Life.

Furthermore, Second Life is sufficiently flexible to enable scenarios to be developed which promote individual, pair and group collaborative learning or application of learning. Technology such as chatbots and Machinima can effectively enrich the experience. The pedagogical design of the ADS appears highly promising in providing opportunities for developing clinical reasoning and including intrinsic feedback. However, careful consideration needs to be taken of the communication

requirements and methods used in-world to ensure that they promote appropriate behaviour. Considerations should include student-student sharing of information and discussion, and the communication with Non-player Characters and objects. Whilst the authors expressed the view that the scenarios produced were appropriate and fit for purpose, it is revealing that none would currently consider adopting them in a live presentation of a course, although they have been adopted and adapted by a number of UK courses.

However, the principle stumbling block concerned usability and access to Second Life. In particular the relatively high technology demands (graphics/cpu/bandwidth) were considered a barrier for these cohorts of students. Furthermore, the novelty and high information content in the interface was considered by facilitators to be a significant hindrance prior to reaching the learning outcomes. When designing for learning in an IVW, authors also need to consider identity and socialisation (Warburton, 2009). All participants regarded the orientation and preparation sessions as essential to help overcome these issues.

Given the limited use of the scenarios at this stage in the project, it was not possible to explore facilitation in detail. However, it was evident that each facilitator in this study had differing views which impact on their perception of how a scenario should be used, and the consequent suitability of that Second Life scenario. An interesting consequence of the richness and authenticity of the Second Life scenarios is the large amount of detail provided, much more than is usual in paper-based face-to face PBL sessions. It is not clear at this stage if or how such detailed virtual reality impacts on the way the scenario is used and facilitated. Savin-Baden & Wilkie, (2006) points out that facilitation of PBL is itself a source of concern for many teachers and that there are differences and tensions to be resolved between online and face to face facilitation. Second Life can provide a more authentic learner environment than classroom based PBL and therefore changes the dynamic of facilitation. This is an important area for further research.

A key point that was learnt from our experience in the PREVIEW project is that the focal point of design should be around what it means to learn in Second Life and therefore consideration of the relationship between learning and design is imperative.,

scenario writing can be time-consuming, a lot depends on the case-writers, and it is not always easy to verbalise the scenarios and how they should run. One mechanism used assist the design process was to film staff role-playing the scenarios. From this it was possible to create a script for the chatbot and work out how to design the environment in which the scenarios were to take place.

Perhaps what is most important is to leave sufficient time for developing and testing. Boardman (2009) argues that some of the questions that should be asked of staff can subsequently save designers and technologists considerable time. For example, does it matter that the dwelling is a texture or a hut? Are staff concerned about the appearance of objects and buildings, especially if this appearance is unlikely to affect the learning outcome? In the PREVIEW project it did matter both that the audio sound (ringing) came from a telephone, and it was something students would recognise, so they would realise they should touch the telephone in order to get instructions. Boardman suggests then that staff need to consider issues of design that relate to ensuring students engage, that the buildings, objects and activities are both relevant and believable, that they are easily navigable and help students to focus on what is to be learned. Thus questions she suggests you need to consider are:

1. What do you want built?
2. What is the learning outcome?
3. How detailed does it need to be?
4. Do you have a picture?
5. Do you have a mental model and can you draw it?

This demonstrator began as a project to explore the extent to which it was possible to use problem-based learning in Second Life. The evaluation indicated that despite a number of difficulties it was in fact more of a possibility than the project team initially envisaged, which promises well for the future. However, what is clear is that discipline-based pedagogies, staff perceptions and sound planning and design should be seen as central components when designing a PBL scenario for an IVW.

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Table 1: Categorised open responses from paramedic student questionnaires (n=20)
Brackets indicate frequency of responses.

Advantages	Disadvantages
1. Can work at own pace, convenience and on your own for practice/revision (44%) 2. It was good to bounce ideas off other people regarding treatment promotes team working (14%) 3. Scenarios are realistic, applicable to professional education (14%) 4. Cannot harm the patient, can experiment with treatments and learn from errors (12%) 5. Suits people who prefer interactive learning to reading/notes, more fun (10%) 6. Scenarios can be built to suit needs of students (4%) 7. Cost effectiveness (2%)	1. Lacking detailed realism: Inadequate feedback doesn't show adverse reactions, some treatments missing, can't know if you are clinically correct (54%) 2. Technical issues: High spec, crashes, Learning Second Life / applying equipment, (32%) 3. Not face to face or hands on – not a substitute for these (10%) 4. Group working issues(only one can interact with patient at a time, prefer to use on own (4%)