Development of Engineering Project Management Simulations in a Virtual World to Enhance Students’ Engineering Project Management and Employability Skills

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Abstract
The purpose of this project was to use the Virtual World (VW) of Second Life (SL) to support students in the development of deeper understanding and application of Engineering Project Management (EPM) whilst offering flexibility and continuity of remote access to interactive materials. This will be achieved by using previously developed and evaluated scenarios* in Second Life (for example, a YouTube video) and redeveloping them for EPM and employability skills. Evaluations by the London Engineering Project (LEP) highlighted the benefits of remote access interactive teaching materials for issues faced by engineering departments in curriculum delivery to a diverse student base.(WP) (Hanson, et al. 2008a;b, Nagy, et al. 2008, Wilson-Medhurst, 2008)

*Scenario is a term used to represent the idea of a case, problem or challenge that a student is required to manage as a component of the learning process

Keywords: Project Management, Second Life, Simulations.

Background
Project Management is a very experiential subject. It is relatively easy to teach students the tools and techniques associated with project management but actually to give students practical experience in using these tools and techniques is more complex. Traditionally this has tended to be done through the use of computer / paper based simulations, often designed more for internal company training as opposed to an undergraduate situation.

The grant holder teaches on a Level 3 project management module based in the Faculty of Engineering at Coventry University. The module is quite challenging, in that, aside from problems of teaching PM raised in the previous paragraph, the module is taught to over 400 students (predominantly international students) and has now been developed into a ‘distance learning’ module that students study in their home country prior to beginning their studies at Coventry.

In addition to this Coventry University’s Engineering Faculty is becoming internationally known for its movement towards ‘Activity Led Learning (ALL)’ which, whilst similar to Problem Based Learning (PBL), is far more focused on the needs of industry than has traditionally been the case with PBL. Many of the undergraduate courses have ALL at the heart of their first and second year delivery and many education innovations within the Faculty have ALL at their centre.

It was taking these three points into consideration that resulted in this bid and the piloting of teaching PM in a virtual world.
Rationale

PM is a subject best learned experientially, making it challenging to deliver using conventional delivery modes. Previous methods used to address such issues include simulations (paper and computer based) but these have been found to be time consuming, restrictive for students, lacking in flexibility in delivery. Several publications generated through the LEP have highlighted the need for flexible, accessible, interactive teaching materials as a means of engaging learners (Hanson, et al. 2009, Hanson, et al. 2008a;b, Nagy, et al. 2008). Considering this and the positive research results in the area of Activity Lead Learning (ALL) conducted by Coventry University (Wilson-Medhurst, 2008, Booth and White, 2008, Lambart, Basini and Hargrave, 2008, Dede, 2009.) the evidence for locating further innovative ways to deliver the engineering curriculum generally (and in particular PM) is overwhelming. ‘Second Life’ has been shown to be an innovative, pedagogically robust teaching tool (Galas and Ketelhut, 2006, Hemmi, Bayne and Land, 2009, Saven-Baden, et al, Warburton, 2009, Conradi, et al. 2009) and has been used to develop scenarios successfully to demonstrate real life (RL) situations otherwise unavailable to students, such as healthcare and disaster management (Conradi, et al. 2009). One of the major drawbacks of these scenarios is the time required to generate and build each individual scenario. A key benefit (in cost, time and experience) of this work is that it drew on developed scenarios and trained members of staff to adapt complex scenarios to fulfil PM and employability learning outcomes.

The Approach

Activity 1

The first thing that we did was to build a dedicated area in Second Life that we would be able to use to deliver our simulation. As Coventry University is spending in the region of 60 million pounds to build a new engineering building dedicated to ALL delivery it was decided to construct this building in Second Life and to develop an ALL classroom to deliver our work in. Figures 1 and 2 show the new building in Second Life and an ALL classroom.

![Figure 1 – The new engineering building](image1)

![Figure 2 – ALL Classroom](image2)

All these areas are open access so that anyone wishing to use the simulators can gain access to the classroom and the information held in Second Life.

Activity 2

This was followed by an evaluation of the simulations that had already been developed for the Faculty of Health and Life Science. In order to evaluate these simulations, several avatars were gathered together in Second Life and executed while being videoed. This allowed the author to review the simulation and to map the learning outcomes achieved with the outcomes of the level 3 module they were designed for. The final simulation chosen was one surrounding issues encountered by a Care Home if there was an outbreak of a virus in the Care Home. The students take on the role of a senior management team at the Care Home and have to develop a strategy
as of how they are going to deal with control and containment of the virus and how they are going to communicate their situation to the outside world.

Activity 3
Once the author had an idea of what actual actions were involved in the simulations she was then able to assess which of the required learning outcomes and indicative content of the PM module could be covered by use of a simulation. These were:

1. Learning Outcomes addressed
   - Define the aims and objectives of a project
   - Identify the effect of the project on stakeholders
   - Select PM tools and techniques and methodologies to use

This was ¾ of the learning outcomes for the whole module. The areas felt unsuitable for this simulation were centred on procurement and detailed strategy development.

2. Indicative content practiced (NOT theory taught)
   - Setting aims and objectives
   - Stakeholder management
   - Project communication
   - Risk identification
   - Risk analysis

This was just under 1/3 of the whole indicative content of the module. Whilst there were other areas that could have been covered with simulation it was decided to limit the indicative content and focus on these. There were several reasons for this, including a limitation on time for the execution of the simulation and the knowledge that these are areas with which students struggle regularly to understand.

Activity 4
Within the simulation several pieces of information were provided through objects (a newspaper, a filing cabinet) and various touch panels in the ALL classroom. These had to be modified to be more suitable for the new PM simulation. Once this was complete the simulation was recreated in the ALL classroom.

Activity 5
3 pilot groups of 7 volunteers were formed. These included a mix of nationalities, gender and ethnicity but all had completed the level 3 PM module in that academic year. Group sizes were dependent on how many students volunteered to attend the session and their availability. Originally it was planned to run one session with all 21 students but finally it was decided that the simulation runs effectively with between 6-10 students, and the 3 groups offered the opportunity to pilot different amounts of support. Each pilot group received half hour training on Second Life to introduce them to Avatars and how to operate in a virtual world. Whilst the students were all in the same room, they were instructed not to communicate through any medium other than the virtual world. Each of the pilots was run in a slightly different way:

- Pilot one
  - Very basic introduction minimal intervention

- Pilot two
  - Deeper introduction but minimal intervention in Second Life
• Pilot three
  – Deeper introduction and facilitating avatar in Second Life.

The basic introduction for all three pilots included a sheet of A4 that explained the simulation and the learning outcomes that it was designed to review.

At the end of each session all the students were asked to complete a questionnaire to give feedback on their experience. The questionnaires were those that had been developed and used in the Health simulations originally, because they were robust and tested and also allowed some comparison between the two simulations.

Activity 6

In the final pilot a Project Manager from a large international defence company that has an interest in Second Life joined the group and reviewed and assessed the simulation from an industrial perspective giving further feedback on its operation and usefulness to industry. Due to confidentiality, it is not possible to name the company but their feedback has been included at the end of this report.

Assessment

It was not the purpose of this development to assess the students on their understanding of Project Management tools and techniques, but to prove the feasibility of this approach. However, possible mechanisms for assessment were discussed and decided upon; these could include the students being able to take snapshots of the white board that contains their work and send it to the module leader. This would allow the same type of assessment as presented by students who engage in the module but who do not engage with the scenario on Second Life.

Evaluation

The purpose of the evaluation of this project was three fold; primarily we were interested in the fundamental question “could Project Management be taught in this manner?” Secondly we were interested in the students’ reaction to being taught in this manner and finally we wanted to understand Industry’s perception of what we were attempting to do.

Several evaluation techniques were used; observation, questionnaire and focus groups. Each running of the scenario was recorded, allowing us to revisit how the students responded in the scenario: this will allow us to generate further research. In previous Second Life research projects several questionnaires have been developed to assess participants’ reaction to the work and these have been tested and refined. It was decided to use one of these pre-developed questionnaires to record student feedback. Finally, informal focus groups were run with all the students and the industrial partner to obtain further feedback for the project.

An example of the questionnaire is in the attached file.

General findings

• Training in Second Life was not an issue; all students managed it in a very short time.
• Language was an issue as some of the words in the material had to be translated (For the majority of students English was not their first language).
• In Pilot 1, the students struggled due to lack of information. Technical problems included the fact that the Island was closed down by Linden Labs in the middle of the pilot; this was unavoidable, but unfortunately unknown to us.
• Pilot 3 was the most 'successful' in that the students got furthest in the task and began to
tackle more or the PM materials and issues. It should also be noted that a contributing factor
could be the experience of the facilitators and the results of Pilot 1 and 2.
• Some students returned to Second Life after the pilot, although it is not yet certain why or what
they actually did in Second Life.

Student feedback/quotes:
• Improve the whiteboard.
• I hadn’t thought that it was going to be so interesting; I thought it would be boring but it was
really interesting.
• Great idea – worth developing this tool.
• This was extremely interesting and fun.
• The only problem for me was that there were too many other things to do to distract you from
the main objective.
• I do not think that virtual worlds are any good for teaching in. The interaction with people
should be part of the task.

Industry Feedback:
• Would have expected to see verbal communication possible (this is possible in Second Life if
headphones are used)
• Great scope for other training aspect, particularly named were brain storming, 6-sigma and
bid/proposal planning.
• Use of the facilitator was a definite requirement.
• Whiteboard needs to be more functional.
• Wanted to see more of how the simulation fitted into the grand scheme of the module as a
whole.
• Suggested the possibility of several interlinked simulations relating to the same underlying
story

Discussion, Summary
The key outcomes of the project are:
• Successful building of the new engineering building in Second Life.
• Successful mapping of learning outcomes against actual activity.
• Successful transfer of previous scenario into a Project Management scenario.
• Well received pilot which when evaluated, was enjoyed by the students and seen as a useful
learning tool.
• Positive feedback from industry regarding the teaching of Project Management in this style.
This pilot has shown positive results for the teaching of PM in Second Life and shows that it
warrants further investigation. The feedback from the students suggested that they had an
improved learning experience in this environment. One reason for this could be that they were all
inexperienced in Second Life and were not encountering the differences often encountered in
multicultural group work.
When the potential assessment possibilities were reviewed against the assessment of the current module what can be seen is that students provide a written ‘aim and objectives’ for their project, a work breakdown structure, communication plan and risk analysis. It would be feasible to use the model previously piloted in the original Health scenario, where students set up their work on the white board in the Second Life classroom and email it to their Lecturer. It would also be possible for the Avatar of the Lecturer to engage with students in the classroom and mark their work directly from the board. This is an area that requires further investigation.

With the current pilot there is no solid evidence that engaging in Second Life actively increases a student’s employability. But what can be noted is that the industrial participants saw positive benefits by having students engaged in this activity and the students volunteered in order to enhance their CV’s and to highlight that they had engaged in activities other than those in the basic curriculum.

Although there is not much in this project that would be done differently, it would have been beneficial to have run the pilots earlier in the project and then have an option to run the scenario with students while they were actively engaged with the module rather than after the module had been completed.

Further Development

Internal funding has been supplied to develop the engineering building in Second Life. Investigations are under way to look at other areas of the curriculum that can be taught in Second Life with a focus on disaster engineering. Work with ‘Engineers Without Borders’ to look at support materials for their volunteers before placement overseas, will allow the use of scenarios that cannot be implemented in real life.

Industry Feedback

This is feedback from the company exactly as received:

Dear Professor Saven-Baden,

My attendance of the demonstration of the SL PM scenario was worthwhile from both industry and personal perspectives. Liz and I had previously discussed the scenarios developed at Coventry and I was eager to see it in action. I did take some notes during the demo and have been mulling it over since then. I have summarised my thoughts below:

- The use of a narrative worked better within SL than in RL because it is easier to suspend reality in SL than if a trainer were asking you to read a scenario description while they work through a presentation. Factors that reinforce this advantage would improve the traction of the SL approach within industry. Training/teaching environments that are on-site within industry are often diluted by the presence of current RL work demands – people come and find you or tannoy you even when you are on a course. I think that it would also help to drive the narrative from within the scenario, in that progress through the narrative can be tracked visually (traffic-lighting through the steps and required outputs, for example) as well as the ability to snapshot the group’s output during the process, a common factor in most training I have had in industry.

- Although I understand that it was necessary to restrict all communication in the demo to provide reviewable data on interactions, I would expect the process to be greatly enabled by voice communications. If this is the intention then siderooms or equivalent would be required in order for side discussions to take place. We also have a separate company-wide system – I would expect that if a company such as ours were using the scenario, then this external system would be used for off-piste communications. I don’t know how this would affect the scenario but it is worth considering the impact of such uncontrolled communications on the efficacy of the scenario.
I think the scenario lends itself directly to project planning, but also to bid/proposal planning, brainstorming, 6-sigma and related activities. Invariably such activities involve outbriefs to senior stakeholders not present during the activity. Being taught/trained or working within an SL scenario for industry needs to be directed towards a well-defined output like a presentation that is given to the outbrief attendees within SL but with the option for those outside SL to see it too. We in industry are a simple breed and need a glaringly obvious objective to maintain focus.

The use of a facilitator within the demonstration was a definite requirement. The students in the demonstration did consider nominating someone to act as a secretary for the group, and this mirrors what happens in industry. It is worth considering that specific powers be granted to a group-nominated secretary such that he/she can co-ordinate the group’s output. It might even be as basic as providing a whiteboard within the scenario that only the secretary can use. The objective of PM training or undertaking a planning activity depends on the ability to come to a consensus on a (sometimes never-ending) succession of decisions whilst pulling out risks. Handling of risks needed firming up, as I would prefer to be able to split out project delivery risks from those risks that I would associate with the subject matter of the scenario.

The white board needs to be much more functional or you risk turning your project management training session into a SL training course. There’s some wonderful scope to build up a business that sells plug-ins to the scenario. Anything that facilitates the information ordering and recording process will inure industry users to the SL approach. Most people dislike change and having something new to learn unless it makes life easier. Even things like embedded buttons that will generate organisation diagrams, simple graphic tools for drafting schedules, risk registers (typically just tables in Word or Excel).

I would be keen to see a scheme of how the scenario approach fits within the larger process of project management teaching – the build-up to it, those things that happen alongside it, and those things that follow it, as well as the relationships between these activities.

One final thought on narrative. One thing that is attractive to me is the concept of a sequence of interlinked scenarios all relating to the underlying story. For example the demonstration may represent the strategic plan, but subsequent modules might relate to planning the raising and management of finances to address the scenario, recruitment of personnel, the acquisition of hardware, the transportation of personnel and hardware to the scenario location. All of these modules reinforce the SL approach and improve the association of the student with the scenario but also offer opportunities to reveal the obvious and subtle differences between overall project planning techniques and those used specifically by HR, finance, logistics, supply chain.

References


- Hanson, Culmer, Gallagher, Page, Read, Weightman, Leversley (2009), ‘ReLOAD: Real Laboratories Operated At a Distance’, IEEE Transactions on Learning Technologies.


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