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Project Document Cover Sheet

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JISC Project Plan

Overview of Project

Title: ***DE****sign of* ***L****earning Spaces in 3-D* ***V****irtual* ***E****nvironments* ***(DELVE)***

1. Background

Immersive education involves combining digital media and 2-D and 3-D technologies in ways to support distance learning, self-directed learning and collaborative learning. Immersive education is designed to immerse and engage students in the same way that today's best video and computer games grab and keep the attention of players (http://immersiveeducation.org/, last accessed 20th June, 2008). Immersive education gives students a sense of "being there" even when attending class in person isn't possible, practical, or desirable, which in turn provides educators and students with the ability to connect and communicate in a way that greatly enhances the learning experience.

3-D virtual environments, in contrast to the 2-D Web, can offer immersion[1], realism and interaction through multimedia communication. A 3-D Virtual Environment (VE) can be realised through virtual reality (VR) applications or 3-D virtual worlds (VW) such as Second Life. A 3-D VE offers a sense of social presence where the user actually feels as if he or she is present in the VE (as opposed to present in the physical world). This sense of presence and sense of place in a 3-D VE can make learning, and indeed socialising in a virtual world, a more 'human' experience than in 2-D environments such as Virtual Learning Environments (VLEs) or social software applications such as Facebook. Socialisation is an antecedent for effective operation of a virtual team and for technology-enabled collaborative learning (Irwin & Berge, 2006). Further, a 3-D VE enables creation of learning spaces to enhance experiential learning, allowing individuals to practise skills, understand course concepts via 3-D simulations and experiment with them, collaborate through role-playing activities and have real-world-like experiences (e.g. Kamel, et al. 2007).

However, there is little published research on the design of 3-D learning spaces. Therefore, when institutions aspire to set up a 3-D VE, there are no studies or guidelines available to inform them about the design of the 3-D learning spaces, or the scope that 3-D Virtual Reality applications might offer in contrast to 3-D Virtual Worlds. This project will evaluate a range of 3-D learning spaces in VR and in virtual worlds with students and educators, in order to propose models of 3-D learning spaces for a variety of pedagogical requirements.

3-D Virtual Environments

Computer-generated 3-D graphics and other associated technologies are giving rise to increasingly realistic artifacts that blur the distinction between reality and its representation. Computer systems enable real-time and 'natural' interactions between users and objects and other individuals within a simulated environment or 'world' called a virtual environment (VE). Virtual environments). VEs are defined as "synthetic sensory information that leads to perceptions of environments and their contents as if they were not synthetic" (Blascovich et al., 2002, p.105). In VR applications the sensory information of the VE is more psychologically prominent and engaging than the sensory information of the outside world.

[1]The term 'immersion' is used to describe the psychological reaction of most users when they begin to use virtual environments. At first they feel detached from the simulation, but after a very short period of time, begin to experience the virtual environment as though it were reality, e.g., they become "immersed" in the experience (Roche, 2007).

Another kind of VE is a 3-D virtual world. This category includes the popular Second Life which is a primary focus of this research project. 3-D virtual worlds are multimedia immersive simulated environments, often managed over the Web, which users can 'inhabit'. Castronova (2005, p. 11) prefers to use the term 'synthetic world' which he defines as: "an expansive, world-like, large-group environment made by humans, for humans, and which is maintained, recorded and rendered by a computer". 3-D virtual worlds are being used in many applications: education/training, gaming, social networking, marketing, and commerce. Users of 3-D virtual worlds can interact via their own graphical, (usually) humanoid, self-representations known as 'avatars' (Meadows, 2008). Therefore, a virtual world is a cyberspace which has simulated bodies in simulated places. Second Life has a very strong user-community, and its content and narrative is constructed and owned by the 'residents'. The lack of a guiding narrative in some virtual worlds, such as Second Life, provides flexibility for educators and course designers in defining their pedagogy. Educators can design the learning space for the pedagogy, rather than the other way around, as in some off-the-shelf VLEs.

The promise of 3-D VEs is that they will enable educators and learners to be more creative and to develop new ways of teaching and learning. Consequently, educational institutions are increasingly exploring the affordances of 3-D VEs for instruction and research. However, it is important to identify and focus on what 3-D VEs are best at; those learning activities that can only be effectively carried out in VEs and not just as effectively in any other electronic medium. We must also determine and disseminate the optimal combination for blended approaches that combine collaborative learning tools, such as blogs, forums and wikis, with 3-D VEs. As with the design of physical learning spaces, 3-D learning spaces should engage and motivate learners, promote learning as an activity, support collaborative as well as individual practice, and utilise the 3-D affordances for persuasion and immersion. In addition to the choices educators or institutions could make between VR and virtual worlds, there are possibilities that designers of 3-D virtual worlds such as Second Life can exploit the extra capabilities that VR offers and in fact, aspire to create virtual worlds with a VR interface to provide a more realistic and immersive experience (e.g. Bartle, 2004).

3-D Virtual Environments: Present Scope and Constraints

Examples of virtual reality and virtual worlds can be thought of as existing on a continuum between a detailed computer representation of what are real (e.g. photorealistic models) and the imaginary (e.g. fantasy spaces). Consequently, there are several models of learning spaces in VR and virtual worlds, ranging from representations of reality, to partial reality, and to fantasies. For example, in Second Life, there are replicas of a real campus which either have photographic realism or are artistic interpretations (e.g. Liverpool University, UK), or use metaphors such as that of a zoo, or learning spaces which are abstract or fantasies and have elements which have no resemblance to reality and defy physical laws. By contrast, examples of using semi-immersive VR facilities to allow the environmental impact of physical developments in the landscape to be investigated require a detailed replication of the physical environment (e.g. Burton et al. 2008).

Irrespective of the level of realism, the central difference between VR and virtual worlds is whether the user experiences the virtual environment in the first person, or through an avatar – and, therefore, the extent to which immersion is achieved. In VR, the environment surrounds the user, allowing them to experience it in the first person, often through haptic control (Loomis, et al., 1999). By contrast, 3-D virtual worlds utilise avatars, controlled through mouse and keyboard, with the user experiencing the environment through a constructed representation of themselves, as opposed to through the first person. Allied with this, environments such as Second Life render 2-D representations of a conceptually 3-D space to a computer screen, whereas VR undertakes a true stereoscopic rendering of the 3-D space, providing true perspective views. These differences result in the spatial interactivity and immersion available to the user/learner being very different across VR and virtual worlds. Where skills to be learnt in the virtual learning space require significant spatial cognition, where simulations are inherently spatial, or where the spatial configuration is of importance (e.g. in geography teaching), there may be advantages provided by 3-D immersive spaces as compared to 2-D screen rendering (Burton, et al. 2008). This raises questions about how the learning experience might change when a 3-D virtual learning space moves from 2-D screen-rendering to 3-D immersive VR environments: do VR environments provide more realism than virtual worlds and how does this impact on the learner?

3-D Virtual Environments: The Move towards Greater Immersion

The dual focus of this project on both 3D-virtual worlds and virtual reality technologies is particularly timely given ongoing developments towards more fully integrating the two; hence providing greater immersion for users of Second Life. Presently, a 3-D sensing camera which can translate hand and body motions into avatar's movements in Second Life is under development, with 3D navigators, which help to make actions such as moving, flying and designing more intuitive and the experience more immersive, becoming available from mid-April, 2008. Since February 2006, the availability of inexpensive VR headsets has made it possible to experience a semi-immersive version of Second Life; as reported in the Second Life Herald (http://tinyurl.com/ywrtzp, last accessed, 20th June, 2008). Therefore, this project not only serves to consider questions of the here and now, but provides important insights into future research agendas. Indeed, it is well placed to play an important role in setting these agendas.

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2. Aims and Objectives

There are several models of learning spaces in 3-D virtual environments, ranging from 3-D VR applications to 3-D virtual worlds. The question that an educator may face is:

"How should 3-D learning spaces be designed for learner engagement?"

The degrees of immersion and realism vary across these 3-D environments. For example, in terms of immersion, 3-D virtual environments can be:

- fully immersive Virtual Reality applications (where one doesn't experience the surrounding physical and real environment);
- semi-immersive Virtual Reality applications (where a certain degree of immersion is gained, for example via stereo projection);
- 2-D screen renderings of a conceptually 3-D space (as in Second Life).

Similarly, in terms of the degree of realism, a 3D virtual environment could be, for example:

- a photo-realistic representation of a real physical location;
- a representation of a conceptual university campus;
- a metaphorical or fantasy environment such as a virtual zoo.

However, there is little published research on the design of 3-D learning spaces and the benefits and limitations of different degrees of realism and immersion. Therefore, when an institution aspires to set up a 3-D learning environment, whether in a virtual world such as Second Life or by using a 3-D VR application, there are no studies or guidelines available to inform them. Therefore, as a first step towards answering the research question "How should 3-D learning spaces be designed for learner engagement?", we will, in this project, compare learners' experiences in learning environments which have:

- different degrees of 'immersion'; and
- different degrees of 'realism'.

This project will evaluate a range of 3-D learning spaces, immersive and non-immersive, realistic and non-realistic, with students, in order to propose models for a variety of pedagogical requirements.

The project will:

(a) investigate the existing models of learning spaces in a 3-D virtual world (Second Life) and the rationale for their designs;
(b) compare students' and educators' experiences and perceptions of the design of 3-D learning spaces on their collaborative learning and teaching, for three distinct models of learning spaces in Second Life;
(c) investigate the pedagogic benefits provided by a semi-immersive 3-D Virtual Reality environment (large screen, stereo projection, for audiences up to 40), as compared to the less immersive learning space offered by Second Life;
(d) propose a suite of models for the design of 3-D virtual learning environments for different pedagogical requirements (e.g. for different disciplines or types of activities) and contexts (e.g. online learning versus face-to-face education).

The research will be based on theoretical underpinnings from geography, education and human-computer interaction. It will make use of the two Universities Second Life islands and ongoing research initiatives in 3-D virtual environments. It will use the expertise and facilities of the Virtual Reality Laboratory at the University of Nottingham, one of the facilities created for the Nottingham arm of the HEFCE-funded Spatial Literacy in Teaching (SPLINT) Centre for Excellence in Teaching and Learning (CETL).

3. Overall Approach

The project will involve activities based at: (1) The Open University (OU); and (2) University of Nottingham (NU). The primary focus of work at the OU will be investigating the 'realism' strand of the project. The primary focus of NU's work will be the 'immersion strand. Our aim is to bring these strands together to answer the questions – how should 3-D learning spaces be designed for learner engagement?; and how much immersion is required and what sort of realism should we be aiming for when designing 3-D learning spaces?

The two threads of the research will be drawn together as follows:

- by comparing students' experiences in three learning spaces of different levels of realism in Second Life.
- by moving the OU and NU students between (1) the immersive environment of NU's VR lab and (2) Second Life;
- by comparing the students' experiences in (1) and (2);

3.1. Open University ('realism' strand)

3.1.1 Strategy/methodology and structure

The focus of the OU's contribution will be an evaluation of learning spaces with different degrees of realism within the Second Life 3-D virtual world. The researcher based at the OU will gather data on different types of learning environments within Second Life. The researcher will study a range of such environments, which exhibit different degrees of 'realism', in order to consider the different design models, and how these support different learning purposes. The researcher will elicit views and perceptions of learners and educators about the spaces they have created or used, and the value of these for teaching and collaborative learning.

Structure

There will be three main phases in the OU strand:

a. Identify three courses from different disciplines at the OU in which a set of students along with a tutor will use Second Life for at least three course activities.

b. Choose 3-4 educational islands in Second Life of different degrees of realism; the empirical research will be conducted on these islands.

c. Conduct empirical research with OU students: students will participate in course-related activities on the chosen islands in Second Life in order to investigate how the degree of realism of the 3-D learning spaces affects learner engagement and learner experiences, particularly:

   - learner preferences for learning spaces with varying degrees of realism in Second Life;
   - the elements of learning space design in 3-D virtual worlds that impact learning.

In the project set-up stage, we will identify three courses from different Faculties/disciplines at the OU who would be interested in participating in this project. We will require 6-10 students per course to perform at least three course-related activities on a variety of learning spaces in Second Life. We will also identify one tutor per course on each of the three identified courses to facilitate activities with students in Second Life.

The research in the OU strand will commence with a literature review. This review will focus on three areas which will feed into the empirical research. The three areas are: design of 3-D learning spaces in Second Life; guidelines, norms, and practices of interactions in Second Life; and design of pedagogical activities in Second Life. The first area relates to investigating the rationale for the designs of 3-D learning spaces, the theoretical underpinnings from disciplines of design and architecture and any relation to the design of learning spaces in real-life. Interactions in Second Life are guided by a set of social norms and practices. These guidelines will be consolidated in the second area of literature review. In the third area of the literature review, we will investigate any case studies, experience-stories or principles that can help in guiding the pedagogical activities in 3-D virtual worlds. The literature review will also help to develop and refine a set of research questions related to learners' experiences with learning spaces of different degrees of realism in Second Life.

For the second phase, we will invite participation from educational institutions/educators who have presence in Second Life and who would be willing to share their experiences and the rationale for their designs of 3-D learning spaces. Further, we will need access to their islands for running activities with OU students. An invitation e-mail will be posted on several mailing lists including JISC's Virtual worlds List, Linden Labs' Second Life Education and Research mailing lists. In addition, where we are aware of individual educators using Second Life whose islands would be of interest us, we will write to them directly (if we are able to get their contact details). From the replies received, we will choose 3-4 islands which have different degrees of realism (ranging from photo-realistic buildings, to semi-real and pure fantasies).

For the empirical research involving students, we will design three activities for each of the three identified courses and which could be performed in Second Life islands of different degrees of realism. These activities will be designed in conjunction with the OU course teams, to meet some learning outcomes of the respective courses. The students and the tutors will be trained to interact

with Second Life through 2-3 training sessions within Second Life. A pilot run of some of the activities will be conducted.

Over a period of 3-4 months, student groups from different courses will take part in their course-related activities in Second Life and on the various selected islands. A qualitative and student-centred approach for data collection will be undertaken. We will employ techniques such as unstructured de-briefing interviews after the tutorial/activity; semi-structured interviews to elicit data on specific research questions, reflective accounts (diary studies) of students; and focus groups or discussions with a group of students and their tutors within Second Life, to capture their experiences and perceptions of learning space designs. An inductive analysis approach of identifying common themes and sub-themes will be utilised for data analysis. The research team has previous experience of conducting qualitative research of student and educator data related to experiences of technology-enabled learning.

The evaluation material related to the empirical research will be scrutinised by the Student Research Project Panel and the Ethics Committee at the OU. Time for submission and clearance by these committees has been catered for in the project plan.

3.1.2 Important issues to be addressed.

Issues to be addressed include:

- clearance for the empirical research from the Student Research Project Panel and the Ethics Committee of the OU
- interest and commitment of OU course teams and students to conduct learning activities in Second Life as a part of this project
- consent from all participants (students, educators) will need to be obtained according to the guidelines of the Student Research project panel and the Ethics committee of the OU
- to keep continued participation and engagement of the students and tutors over 3-4 months of empirical research on this project
- access to islands of varying degrees of realism in Second Life; that is, access to owners (educators and educational institutions) who would be willing to share their Second Life learning spaces for carrying out OU course activities on their islands

3.1.3 Scope and boundaries of the work

The OU part of the work is concerned with realism, and the scope of this work will depend on the range of different Second Life educational settings which can be investigated with students. The work will also be bounded by the courses used, and the activities which can be developed in Second Life to support learning on these courses. Finally, this strand of the work will all be carried out with learners who are studying part-time, at a distance.

3.1.4 Critical success factors

Success in the realism strand is dependent on:

- Identification of a set of learning spaces within Second Life with different degrees of realism, together with co-operation of the educators who use these spaces;

Although the OU will have three islands in Second Life by August 2008, the learning spaces in these islands have the same degree of realism. Hence, access to islands which don't belong to the OU will need to be requested. We already some contacts in the Education UK Second Life initiative (Derby University: Dr. Simon Bignell) and with the Sloodle initiative (funded by Eduserv: Dr. David Livingstone) which will prove helpful.

- Identification of courses at the OU from which OU student participants can be drawn, together with cooperation from the corresponding Course Teams in designing suitable learning activities for Second Life;

At the OU, there are at least three courses in which Second Life activities have been conducted. There is a growing interest in Second Life at the OU which will ensure that an adequate number of courses and students will participate in the empirical investigations of the OU strand.

- Gaining initial and ongoing participation from OU students on who are studying these courses

Since Second Life is not a core component of the courses at the OU (as yet), we will be requesting for participation of the students as volunteers on this project and over a period of time. In our ongoing Second Life research at the OU, students have engaged with the Second Life activities as volunteers) which encourages us to believe that there will be continued participation and engagement of students during the course of this project.

3.2. University of Nottingham ('immersion' strand)

3.2.1 Strategy / methodology and structure

The University of Nottingham's approach builds on existing expertise in semi-immersive VR, and will encompass newly-developed learning activities within the MSc in Geographic Information Science (GISc) programme. It will also involve the development of a Second Life learning space in which immersion will be investigated in conjunction with the MSc students' learning activities. In addition, students from the OU will visit NU to undertake learning activities in both VR and Second Life; thereby expanding the range of students used to investigate the immersion strand of the project.

Structure

There are two main strands to NU's work:

a. the investigation of immersive possibilities in Second Life and the replication (to the extent that it is possible) of a virtual wind farm, in Second Life, to be used as the basis for comparative empirical studies with an existing virtual wind farm in the VR laboratory;

b. a set of empirical studies that investigates the ways in which students use the VR and Second Life wind farm spaces and draws out the extent to which the level of immersion impacts their use of the space and the learning benefits that can be gained from it.

Developing the immersive wind farm models

The elements of the project that involve the semi-immersive VR lab are already well developed. A fully-functioning, semi-immersive wind farm exists and has been the basis of previous learning activities with NU's students. This will be used throughout this project in its existing form. The creation of the Second Life wind farm is the major technical aspect of NU's work and this will be developed on either the University of Nottingham's island (currently in the process of being purchased), or on one of the Open University's islands. This development will involve the transfer of geographic data, including topography, surface textures, vegetation and 3D structures, into the Second Life environment; thereby producing the closest possible comparison with the VR wind farm model given the technical constraints of the Second Life 3D modelling language and supported graphical standards. Development will begin with background research into existing approaches for placing geographic data into Second Life, using the JISC-funded Digital Urban project and other existing Second Life exemplars as a guide to NU's development. A number of potential approaches from scale models or scaled avatars, through to true-scale models of limited geographical scope will be considered. Development will pursue the approach best placed to deliver an investigative test-bed within the time and budgetary constraints of the project.

Empirical studies

Existing learning activities in the MSc in GISc programme require students to interact with a small, semi-immersive wind farm model in the VR lab, and to use the immersive capabilities of the lab as a

basis for presenting, describing, justifying and defending their wind farm development. This activity will form the framework for the first empirical study, which will investigate the ways in which learners interact with, and make use of, the high level of immersion offered by the VR lab and the pedagogic benefits it offers. Students from the MSc student cohort will be evaluated using inductive analyses of focus groups and individual interviews, coupled with video records of the students' interaction with the technology, where appropriate (see below).

The same group of MSc students will then carry out the learning activity, later in the course, within the Second Life wind farm model. Again, the student cohort will be evaluated to determine the influence of the different level of immersion achieved within Second Life. Second life is particularly relevant to MSc in GISc students studying the 'Frontiers in GIS' module at NU as it represents a new, emerging domain for the presentation of, and interaction with, geographic information. Indeed, the Second Life learning activities to be undertaken as part of the immersion strand of the project necessarily engage with geographic information in Second Life. Therefore, an adaptation of the wind farm learning activity, in which learning outcomes are focussed on the effectiveness of the integration of Second Life and geographic information in delivering an immersive wind farm model, is of pedagogic value to the participants. As with the semi-immersive VR activities, the student cohort will be evaluated to determine the extent to which the different level of immersion achieved within Second Life impacts on their ability to undertake the activity. The evaluation will specifically be directed towards identifying how immersion has impacted on the student's learning in the two activities, rather than how the overall Second Life environment has impacted. As with the previous evaluation, students from the MSc student cohort will be evaluated using inductive analyses of data obtained through focus groups and individual interviews, coupled with video-recordings of interactions with the technology where appropriate.

To overcome the limited range of students involved in the NU strand of the project (i.e. all MSc students in GISc), a third element of the evaluation will involve a group of OU students coming to NU to interact with the VR and Second Life wind farms. These students will be drawn from a range of courses at the OU and will have prior experience of using Second Life. The specific nature of the learning activities undertaken by this group will be determined according to the learning outcomes of the OU courses from which the students are drawn. Again, the focus will be on evaluating the extent to which the different levels of immersion offered by the two learning spaces impacts on their learning, and the same evaluation methods as above will be used.

Analytical Approach

Qualitative / inductive analysis of focus groups and supporting individual interviews will be undertaken to extract the emerging themes. Coding will be achieved on the basis of notes made by the researchers, supported by audio, rather than full transcription and coding. To provide an element of cross-validation, themes will be independently extracted by more than one researcher and compared, for a sample of the data.

3.2.2 Important Issues to be Addressed

Issues to be addressed include:

- The location of the Second Life wind farm. Nottingham University is in the process of buying a Second Life island and, should this purchase be completed in time, it should be possible to develop here. If not, space on one of the OU's islands may be required during the early stages of the development work-package.
- Consent from all participating students will need to be obtained according to the requirements of their universities.
- Development activities in Second Life should be undertaken using existing and evolving standards (see section 8) capable of providing the widest possible transfer and reuse of the learning space developed.

3.2.3 Scope and Boundaries of the Work

The NU's element of the work is concerned with immersion, ranging between the semi-immersive capabilities of the VR lab and Second Life. Fully immersive VR is outside of the scope of this work, although it will feature in research agenda setting. The extent to which the learning spaces in the VR lab and Second Life are comparable will be limited by the 3D modelling and rendering capabilities of Second Life and this is likely to result in compromises of scale within Second Life (see section 9).

3.2.4 Critical Success Factors

Success in the immersion strand is dependent on:

- The success with which the Second Life wind farm can be created.

To address this, an RA will be appointed with graduate and post-graduate qualifications in computing and geographic information science, together with proven experience in software development. Advice from existing Second Life developers, including those currently supported by JISC funding (e.g. Andrew Hudson-Smith at UCL) will be sought where appropriate.

- The recruitment of students for evaluation

The activities incorporated into this project form core elements of NU's MSc in GISc programme. Therefore, an adequate sample of students is guaranteed.

3.2.5 Success in both the strands is dependent on:

- The quality of the evaluation protocols and analytical approaches

The research team includes individuals with experience of carrying out student-centred e-learning research focussed on a qualitative approach of eliciting learner experiences. The inductive analysis approach to data analysis, of the kind proposed in this project, has previously led to journal publications. This set of expertise, coupled with our proposed internal evaluation process (see section 16), will be used to ensure quality.

4. Project Outputs

The project deliverables will include:

Deliverable 1: A document which defines a framework for models of 3-D learning environments along with pedagogical activities supported in these learning environments. The framework will be presented in a highly accessible, diagrammatic form. The framework will capture students' and educators' perceptions of teaching and collaborative learning within the specific 3-D learning spaces investigated during the project.

Deliverable 2: In one of the existing Second Life island of the OU, a resource-library will be set up to demonstrate (show-case) various examples of learning spaces in Second Life included within the framework (Deliverable 1) This will involve enabling access to different pages of the project website (at the OU and/or at JISC) within Second Life.

Deliverable 3: Empirically-grounded exemplars and use cases developed from students' learning experiences and their perceptions of key variables such as immersion and realism. These will be linked to the framework (Deliverable 1). These examples will also demonstrate whether and how 3-D VR applications might be preferable to 3-D virtual worlds (and vice versa) for certain disciplines, contexts and pedagogical activities.

Deliverable 4: Guidelines for designing and implementing 3-D virtual environments for learning. These will include issues related to the training of educators and students, as well as technical aspects of developing and using 3D learning environments. The guidelines will also incorporate or identify relevant training resources that are already available on the Web and in Second Life.

Deliverable 5: A technical review document. This will:

1. review the present possibilities and constraints surrounding the creation of realistic, immersive spaces in Second Life, and highlight existing examples;
2. present the technological hurdles to developing immersive spaces in Second Life, and solutions developed during this project;
3. identify the range of emerging technological developments capable of impacting the level of immersion and realism available into the future.

Deliverable 6: A developed space in Second Life for investigating immersion (the wind farm model).

Deliverable 7: A research agenda, developed on the basis of the project outcomes, that identifies and structures key pedagogic and technical research questions that should form the basis of future work

Deliverables 1, 3, 4, 5 and 7 will each form a section of an online **'Handbook'** on the design of 3D virtual environments for learning. This will be made available to the HE community via JISC, and will also be freely downloadable from the project website. This website will be hosted and maintained by the Open University both during and after the project.

The knowledge, and experience gained during the project will also be disseminated via conference and journal papers. Future possibilities for dissemination may also include consultancies and collaborations with other educators, trainers and researchers.

5. Project Outcomes

The ultimate aim of the project is to provide guidance and support for practitioners in designing 3-D virtual environments for learning. The findings of the project will be of value to any institution or practitioner who wishes to make use of virtual 3D environments for the purposes of learning. The project will stimulate positive and informed change, based on enhanced understanding of the potential of 3-D virtual environments in a range of learning and teaching contexts.

The project will produce empirically-grounded data on the various types of learning spaces in 3-D virtual worlds such as Second Life, and how they affect students' experiences of collaborative learning. This will shed light on how the degree of 'realism' in a 3D learning space affects students' experiences. The project will also compare the pedagogical effectiveness of 3-D virtual worlds and semi-immersive 3-D virtual reality applications. This will provide information on the importance (or otherwise) of 'immersion'. The project will use evidence in order to establish which types of 3-D virtual spaces are of value for different learning approaches and purposes. This evidence is currently lacking in the research literature.

The findings of the project will be shared with the HE community, leading to improved understanding at practitioner and senior management level of the potential of 3-D virtual environments to support learning and teaching, and of the design approaches needed to support this. The findings of the project will help course teams to best exploit the technologies of 3-D virtual environments (virtual worlds and/or virtual reality) in their course design and delivery. It will help institutional decision makers to make effective choices about the deployment of 3-D technologies as part of their learning and teaching strategies. The project will thus ultimately lead to more engaging and effective collaborative learning experiences for students.

The project will draw on, and collate experiences of practitioners who are already using 3D environments with their students. It will interpret and share these experiences with the wider community of learning practitioners. The project will explore the possibility of using an open social networking site to share good practice in designing 3D environments for learning. This site is under development at the Open University, and we understand that it forms part of a proposal in response to JISC's recent Curriculum Design call (05/08).

In summary, the research outcomes will be of interest to course designers, facilitators, staff developers and policy makers who are involved in integrating 3-D virtual worlds and/or 3-D virtual reality environments within the curriculum of their programmes and institutions.

6. Stakeholder Analysis

Stakeholder	Interest / stake	Importance
Educators, policy makers and e-learning managers who use or aspire to use 3-D virtual environments in their teaching and institutions. For example: • at the Open University, staff running the Schome project for gifted young people; associate lecturers offering online tutorials in Second Life; • at NU, staff teaching the MSc in Geographical Information Science and the MSC/MA in Environmental Management; • at other HE institutions, staff teaching courses which use Second Life or other virtual 3D virtual environments, or staff who are considering using these for learning.	Educators, policy makers and e-learning managers will gain an understanding of the dimensions of 3-D virtual environments (e.g. degree of realism, degree of immersion) which affect their suitability for different learning and teaching contexts. A selection of educators who already have experience of teaching using 3-D virtual environments will be asked to contribute their knowledge and perspectives to the project.	High
Students on courses using 3D virtual environments. For example: • At the OU students on courses where some tutors are offering 'online tutorials' in Second Life; • At NU students of the MSc module Fundamentals of Geographical Information Science;	Students will benefit from the enhanced understanding of their teachers, as described above. They will be able to experience 3D environments which best support their learning. Students from a range of Open University courses and postgraduate students from NU will be taken into 3D virtual environments (virtual reality and virtual worlds) and asked to contribute their experiences and perspectives.	High
Developers of 3-D virtual environments. For example: • Developers of learning spaces within 3-D virtual worlds; • Developers of VR systems used by .NU	Developers will be able to design and implement 3D environments on the basis of good educational, sociability and usability principles. Those who are employed as consultants for specific educational projects will be better able to match the environments they design to the specific learning context.	Medium
Researchers of 3-D virtual environments for education	Researchers will be able to identify the major issues in relation to learning and	Medium

	teaching in 3-D virtual environments which warrant further investigation beyond this project.	

7. Risk Analysis

Risk	Probability (1-5) Low = 1 High = 5	Severity (1-5) Low = 1 High = 5	Score (P x S)	Action to Prevent/Manage Risk
Staffing 1. Delay in the recruitment of the research associate at the Open university 2. Delay in the recruitment of the research associate at NU	5 1	2 4	10 4	1. Part-time consultants from the Associate Lecturer (tutor) pool of the Open University will be identified who will be able to fill the gap until the OU research associate is appointed. 2. Identify staff from the existing RA pool of NU who would be able to fill the gap until the NU's RA is appointed.
Organisational 1. Delay in the clearance from the OU's Human Participants and Materials Ethics Committee (HPMEC) and the Student Research Project Panel (SRPP) at the OU 2. Delay in reaching agreement over cross-institutional access rights to Second Life islands	2 2	2 3	4 6	1. Make an early start on the ethical clearance process. Alert HPMEC and SRPP in advance so that they can schedule the activities. Ensure that the deadlines for submitting the documents ahead of the scheduled meetings of HPMEC and SRPP (the schedule is available from their website) are met. 2. Make immediate start on determining a procedure for gaining agreements and undertake consistent and frequent follow-up with relevant departments until agreements are in place.
Technical 1. Delay in the purchase of Nottingham's Second Life island, requiring initial development to take place on OU's islands 2. To have access rights in certain areas of the Second Life islands of other institutions to be able to set up teaching resources and development 3. Availability of Second	4 2 1	3 4 3	12 8 3	1. Liaise immediately with those at Nottingham involved in the purchase of the island. Liaise with owners of OU islands to arrange contingency plan if Nottingham island not available 2. Ensure early access and user rights agreements are in place 3. Second Life is progressively becoming stable and the schedule of updates (mostly on Wednesdays) is well-publicised; so evaluation sessions with the students will

Life on days when the evaluations with students are planned 4. Difficulties or delays in developing a Second Life environment to mirror the Virtual Reality wind farm environment already used at NU	2	5	10	be planned accordingly 4. Similar work has been carried out elsewhere (see conference abstract [add footnote with URL]). Early contact will be made with these researchers, and a prompt start made on the development work, so that the situation is clarified and finalised well in advance of students' activities.
External contacts 1. Access to islands in Second Life of other Universities to conduct activities with students of NU and OU	3	3	9	1. We already have contacts with some of the Universities in the UK and in the US; we will discuss our project's objectives and requirements early on in the process
Legal / Ethical issues 1. Second Life's regulations could be violated (for example, students over 18 years of age are not allowed in the Teen Grid of Second Life)	1	3	3	1. The students (participants in the two institutions who will be over 18 years of age) will be informed of Second Life's regulations, guidelines and norms of practice ahead of their participation in the evaluations and their acceptance of the guidelines will be included in the consent forms.

8. Standards

Name of standard or specification	Version	Notes
OpenFlight (.FLT)	15.8 and 16.2	Openflight is the selected Virtual Reality model format for use with the specialised software pre-existing in the SPLINT VR Theatre. The laboratory's distributed rendering setup is integrated with Multigen's Vega-Prime software and the accepted model input format is OpenFlight.
Image Standards JPG PNG GIF RGB and RGBA		The first three are selected as well established standard formats, the latter 2 are selected as they are the silicon graphics formats recommended for use as textures with Vega Prime and OpenFlight models for use in the VR lab
GIS Standards	ISO 19111:2003 ISO 6709:1983 ISO 19115:2003	Geographic information -- Spatial referencing by coordinates Standard representation of latitude, longitude and altitude for geographic point locations Geographic information – Metadata
Georeferencing		JGW files accompany jpgs to locate them in the 3D space.

formats JGW		This format is one of our supplied data sources.
Programming Standards - C++	Microsoft	Some programming is required in order to adapt functionality of the Vega Prime executables for additional functionality. This requires the use of C++ to edit and combine Vega Prime classes and compile code.
GPS	GPGGA	GPS sentence format for linking 3D visualisations with location based services on devices in the SPLINT VR facility.
KML / KMZ	2.2	Keyhole Markup Language (KML) is an XML-based language for representing 3D geospatial data as used in Google Maps and Google Earth. KMZ is the compressed version. KML 2.2 became an Open Geospatial Consortium standard in April 2008.

9. Technical Development

The project has two strands of technical design of learning environments:

1. The use of the VR laboratory at the University of Nottingham to generate semi-immersive visualisations of a wind farm encompassing real geographic data
2. The development of an immersive learning environment in Second Life in which the VR wind farm is replicated (to the extent that is possible within Second Life) and that is capable of enabling the replication of the learning activities carried out within the VR laboratory (see section 3 for details).

The VR Laboratory for semi-immersion

Data from multiple sources and of multiple formats including OS Master Map polygons, Get Mapping Aerial Photography, NextMap terrain Data and ground based photography and photogrammetry have been combined to produce the 3D Virtual Reality environment. These data sources will be combined using Bionatics Blueberry, a plugin working with Multigen-Paradigm's Vega Prime. This combination of software, although non-standard in the research field, has been used widely for development of simulations and for two years at NU. The software combination enables clever manipulation and tiling of both terrain and ground image drapes, and various levels of detail of vegetation and urban developments which can be rendered in real-time to produce virtual landscapes of a quality not possible in other more standard VR systems. The workflows used to create models for the lab are more standard. Much of the modelling is carried out using 3D Studio Max, the industry standard 3D CAD modelling package. This package allows easy export into VRML and .dxf formats. These have a high transferability and can be converted for use in Second Life. The VR lab is also set up to deliver a user position in the form of a mimicked GPS string via Bluetooth linkage to mobile devices in the lab. This opens the possibility to deliver further learning technologies to students whilst immersed in the stereoscopic virtual environment.

Second Life Development

Second Life offers an in-world builder to allow users to construct objects from individual 3D primitives (or 'prims'). Most objects within Second Life are composed of multiple prims and the construction of building-like spaces can be achieved wholly within the in-world environment. Where geographic information is concerned, and where some kind of model of a real landscape or terrain is to be simulated, more complex surfaces are often required, onto which other objects or image drapes can be placed.

Land in Second Life is organised into square regions of limited size, 256 x 256 metres with the terrain capable of being modified from real data by importing .RAW terrain files. Each region is represented by a 256x256 height grid giving a maximum virtual grid resolution of 1m. However, this Second Life data model has implications for the design of learning spaces which mimic large geographic spaces. The purchase of huge numbers of Second Life regions would be required to create spaces at 1:1 scale with the avatars populating the virtual world. Consequently, the development of scale models fed by real geographic data is currently an attractive alternative to attempting 1: 1 modelling for applications involving large areas, as is the case with the wind farm development.

The idea of using virtual worlds to showcase geographical data was the focus of the 'Virtual GIS room' project (Neves et al , 1999) although now Second Life allows us to develop this idea using avatars as a scaled point of reference but, importantly, as a mechanism for real people to collaborate and discuss the 3D models via their avatars. In order to implement scale models 'sculpted prims' or 'sculpties' can be considered. These are more complex prim objects whose shape is derived from image files where the Red, Green, Blue (RBG) values map to X,Y,Z surface positions. The size of these is however limited to 30 x 30 terrain values and so some tiling would be required to create large models. Data can be processed in third party 3D modelling packages such as Blender, AC3D or 3D Studio MAX and exported as 'Sculpt Maps'. Also plugins are being developed to export increasingly complex 3D data from SketchUp using the Ruby scripting language, which converts facets of models in SketchUp into rectangular primitives (prims) in Second Life

Several examples exist of spaces which combine scale models (static and dynamic) with some kind of viewing or learning space, an example being the 'Exploratorium' (http://www.exploratorium.edu/worlds/secondlife/). Combining this idea with data from Google Earth and live data feeds creates a potentially interesting way to interact with 3D data using the familiar scale of the avatar and the ability to move around within the model, to explore the three dimensional interrelationships present.

Exploring, trialling and selecting from these options, followed by Second Life wind farm development using the selected approach, will form the backbone of the Second Life development work package.

Reference:

Neves, J.N, Goncalves, P, Muchaxo, J and Silva, J.P (1999) A Virtual GIS room: interfacing spatial information in virtual environments in Spatial Multimedia and Virtual Reality (Research Monographs in GIS) Camara, A. S. and Raper. J (1999) Taylor and Francis, 147-156.

10. Intellectual Property Rights

It is anticipated that rights to the Second Life development work carried out by Nottingham University will be held by them. However, this assumes that the development will take place on a Second Life Island belonging to Nottingham. The project team at NU is currently investigating whether they would be able to start development on the SL island at NU from August onwards (please see Sections 2.2 and Section 7).

Project Resources

11. Project Partners

The project partners are:

- The Open University (lead institution);
- Nottingham University

The Open University will primarily be responsible for investigating the 'realism' strand of the research, using Second Life. Nottingham University will primarily be responsible for investigating the 'immersion'

strand of the research, using their Virtual Reality laboratory, and developing a new environment in Second Life.

Dr Shailey Minocha will be the main contact at the Open University, and the Principal Investigator for the project. Dr Nick Mount will be the main contact at the University of Nottingham.

12. Project Management

Dr Shailey Minocha, of the OU will be the project's PI. At Nottingham, Dr. Nick Mount, project leader of the NU strand, will have the overall responsibility and decision-making for the NU strand of work, and will be the communication-point at NU for liaison with the OU. Dr. Karen Kear, project leader of the OU strand, will have responsibility and decision-making for the OU strand of work, and will be the communication-point at OU for liaison with NU.

The teams at the OU and NU will work closely together, particularly on decisions that affect the consolidation phase of the two strands. The staff at the two sites will maintain close communication with each other via phone, face-to-face meetings and video-conferencing. The project strand leaders of the two institutions will have regular phone-calls for sharing progress and thoughts. The core project team involving Shailey Minocha, Karen Kear, Nick Mount, Gary Priestnall and the two researchers will carry out tri-monthly reviews of progress and plans. Other team members based at NU will join these meetings as and when required and advised by Nick Mount.

Team members at the Open University

Dr Shailey Minocha, Open University, P.I. (s.minocha@open.ac.uk)
Responsible for:
- managing the project overall
- managing the OU elements of the project budget
- co-supervising the Research Associate at the OU
- liaising with and reporting to JISC
- overseeing activities to review a range of educational settings in Second Life
- formalisation of access agreements to Second Life islands
- contributing to the production of conference and journal papers resulting from the project

Dr Karen Kear, Open University, Co-investigator, (k.l.kear@open.ac.uk)
Responsible for:
- co-supervising the Research Associate at the OU
- liaising with NU on technical issues and progress
- liaising with OU course teams for participation in the research
- overseeing activities for participant recruitment, evaluation, data collection and analysis
- contributing to the production of conference and journal papers resulting from the project

Research Associate (RA), Open University, to be recruited.
Responsible for:
- carrying out tasks as listed in OU work packages
- providing material for the JISC's website at regular intervals
- setting up and maintaining the project website at the OU
- interfacing regularly with the NU team and, particularly, the NU RA to ensure compatibility in project activities
- jointly organising the session for OU students at NU
- contributing to the production of conference and journal papers resulting from the project

Team members at Nottingham University

Dr Nick Mount: Nottingham University P.I. (nick.mount@nottingham.ac.uk)
Responsible for

- the NU work packages and ensuring the timing and quality of NU outputs and deliverables
- day-to-day decision making and direction of NU's project team
- appointing the RA and managing their activities
- interfacing with the OU team and OU P.I.
- formalising any necessary agreements (internally at NU or with the OU) about access to island space in Second Life for development work
- managing the NU elements of the budget (through contract agreement with OU)
- supporting co-investigator in adapting / developing existing NU modules for use in this project
- the production of conference and journal papers resulting from the project

Dr Gary Priestnall: Nottingham Co-investigator (Gary.Priestnall@nottingham.ac.uk)
Responsible for

- organising the adaptation and development of existing NU modules to be used in this project and the production of new teaching materials where necessary
- jointly organising the session for OU students at NU
- managing the work of Dr Andy Burton in supporting VR activities
- supporting the RA in the Second Life development work package
- organising the VR road shows
- the production of conference and journal papers resulting from the project

Dr Andy Burton: Research Fellow in Virtual Reality Development
Responsible for

- the technical support of the VR lab
- organising the use of the VR lab in the NU evaluation work packages
- supporting the RA in the transfer of data from VR to Second Life

Ms Claire Chambers: e-Learning coordinator
Responsible for

- supporting the RA in the development of evaluation materials
- supporting the RA in the analysis of collected data
- providing NU system access to project team and visiting OU students as required
- supporting Dr Nick Mount in the formalisation of access agreements to Second Life islands

TBC: Research Associate
Responsible for

- the development of the NU wind farm exemplar in second life
- the development of evaluation materials for NU work packages
- conducting the evaluation focus groups and interviews with students
- (jn association with another project team member), analysing and coding data collected by NU work packages
- drafting technical documentation and reports as stipulated in the NU work packages
- providing material for the project website as requested by the OU
- interfacing regularly with the general OU team and OU RA to ensure compatibility in project activities

13. Programme Support

- Request the programme manager early on in the project for a mentor (a colleague who has extensive experience with JISC and its processes) from whom the project team could seek advice on regular intervals;
- Request for a half-an-hour phone-conversation between the principal investigator and the programme manager, and schedule these conversations every two months if possible, in order to: inform the programme manager of the progress made; confirm that the project is on track; and seek advice on any concerns or queries.

14. Budget

See Appendix A.

Detailed Project Planning

15. Workpackages

See Appendix B.

16. Evaluation Plan

As well as the informal, continuous evaluation that will be undertaken through the reflective practice of all project members, formal internal evaluation will be undertake through tri-monthly meetings, scheduled a week ahead of the JISC interim report deadlines. These meetings will involve as many team members as are available and will be held either in person, or via video conferencing. At each meeting, milestones identified in the work packages that fall within the three months up to the meeting will be presented by those responsible for them. The outputs from these milestones will be critically discussed by the entire team, providing an internal peer-review process to assess the projects outputs. As a guide, and where appropriate, other JISC-funded projects will be cited as a comparison against which milestones and outputs might be evaluated. Crucially, the team associated with this project is multi-disciplinary, providing a breadth of experience with which to assess the milestones. Where necessary, updates and amendments to project outputs will be made following the meeting as directed by the project PI and project leaders at OU and NU.

An alternative form of evaluation and feedback will be provided from dissemination activities. Where VR road shows or conferences occur within the duration of the project, critical feedback to the disseminator will be noted and reported back to the project team for reflection and advice, with adjustments to activities made as necessary and as agreed by the project PI.

The evaluation will be based on the ethos of JISC's User Innovation Development Model (UIDM) – that is, the project aims, research and outcomes will be user-centred. We will focus on the practical aspects of the uptake of the knowledge generated in this project and the internal review and evaluations in the project will be guided by the user-centred UIDM – understanding the stakeholders (particularly the learners' and educators') requirements, designing and developing the artefacts in the project to meet those requirements, and evaluating the outcomes through steps outlined in the evaluation plan below.

Timing	Factor to Evaluate	Questions to Address	Method(s)	Measure of Success
September, December, March and June	Progress towards, completion and quality of milestones to be delivered between July and September as identified on the work package appendix.	Are the quality of the identified milestones adequate and where could improvements be made? Do outputs meet the quality and scope of similar outputs achieved in other, related JISc projects (e.g. Digital Urban). How can feedback from the milestones	Internal peer review	A clear and successful mapping of the work undertaken towards each milestone and that detailed in the work plan Acceptance by the meeting and, ultimately, acceptance of the interim / final report by JISc where factors under evaluation are

		reviewed in this meeting be used to improve work towards milestones to be presented at future meetings? Does the work achieved against each milestone presented at the meeting adequately represent that expected / detailed in the work plan?		to be represented within the report.
During dissemination activities as detailed in the work packages	The quality of the outputs being presented as part of the dissemination activities	How does the work stand up to critical appraisal by informal and formal, external peer review	Informal and formal external peer review	Criticism of the work is minor with constructive, positive feedback returned to the project for consideration.

17. Quality Plan

Output					
Timing	**Quality criteria**	**QA method(s)**	**Evidence of compliance**	**Quality responsibilities**	**Quality tools (if applicable)**
Every three months (and ahead of the interim-report submission to JICS)	Meeting of the tasks and deliverables	Project plan will guide the work involved and the expected outcomes	Meeting the deadlines for the deliverables	OU + NU	----
At specific stages in the empirical research	Preparation of documents as per the quality tools/requirements (e.g. consent form for participation)	Submission for approval to Student Research Project Panel and the Ethics Committee as per their set templates and forms	Acceptance by the Ethics Committee and Student Research Project Panel	OU	Guidelines for compliance and student participation in research; guidelines and social norms of conducting research in Second Life
At specific stages in the empirical research	Preparation of documents as per the quality tools/requirements (e.g. consent form for participation)	Follow the procedures for educational research at NU	Acceptance by the Educational consultant at NU	NU	Internal review by the educational consultant at NU
Dissemination	Meeting the	Choose the	Acceptance	OU + NU	Internal

during the project (please see Section 18)	submission guidelines; aligning research outputs to the theme(s) of the publication or conference	dissemination technique or content appropriate to the target source/audience.	or positive reactions from the reviewers		peer-review by colleagues other than the core project team before submission

18. Dissemination Plan

Timing	Dissemination Activity	Audience	Purpose	Key Message
Project start (July-Sept 2008)	1. Create project website template accessible via JISC and set up a website at the host institution. 2. Submit a paper to RELIVE08 (www.open.ac.uk/relive08): a conference at the OU in November on Learning and Teaching in Virtual Worlds 3. Announce project via mailing lists and online forums e.g. JISC, ALT, HEA, Second Life educators. 4. Announce and promote project within the Open university and NU.	1. Educators and educational researchers in HE and FE; JISC, HEA and ALT communities. 2. Second Life Educators. 3. Developers of 3D environments for learning. 4. The Open University and NU academic communities.	Raise awareness of the project. Make initial contact with educators who use 3D virtual environments.	What the project aims to achieve and why this is important. Invitations to educators to get involved.
Project mid-point (Dec 2008)	1. Present at RELIVE08 conference at the OU (November 23rd -24th) 2. Update project website with main activities and findings to date, together with planned activities. 3. Write short 'press release' style article for JISC, HEA & ALT newsletters & web sites. 4. Disseminate initial	1. Second Life educators and researchers in UK and abroad. 2. Educators and educational researchers in HE and FE. 3. JISC, HEA and ALT communities. 4. Second Life Educators; Developers of 3D	Present the findings and receive peer-feedback from an international audience. Provide information on the project activities and interim findings. Encourage further engagement and input from:	Design of learning spaces in Second Life and the influence of the design on learning and teaching. What the project has achieved and discovered to date. Invitation to educators and developers of 3D virtual environments to provide their

	findings and issues via Second Life educators list.	environments for learning.	educators (and their students); developers; educational researchers.	feedback, comments and experiences.
January – February, 2009	Paper to be submitted to an e-learning Conference	Learning and Teaching Community; Policy Makers; E-learning managers; 3-D educational developers	Consolidation of results; to elicit early feedback from peers	Students' experiences with virtual environments
May-June 2009	Road-shows	---as above---	Part of the exit and sustainability plan (please see next section)	Best practice guidelines and frameworks for the design of 3-D virtual environments in education
At the end of the project	Handbook (as described above in the Deliverables section)	---as above---	---as above---	----as above---
After the end of the project	Journal papers (at least one by each of the institutions and one joint paper)	---as above---	--as above---	Empirical investigations of learner experiences in 3-D environments

19. Exit and Sustainability Plans

Project Outputs	Action for Take-up & Embedding	Action for Exit
Deliverables as listed in Section 4 above	Documentation of the explicit knowledge generated via an online 'handbook' for the design of 3D virtual environments for learning; Dissemination via project website; Dissemination via conference and journal papers.	Continued free availability of the 'handbook', downloadable from the project website, which will continue to be hosted by the OU after the project.

Project Outputs	Why Sustainable	Scenarios for Taking Forward	Issues to Address
Role of 3-D Virtual Environments (Virtual reality and virtual worlds) in Education	Empirically-grounded research of students' experiences at two Universities with different learning and	Dissemination of results: e.g. Project outputs on JISC's website as a part of the end-of-project final report; Handbook;	The field of 3-D virtual environments and the interaction devices is continuously evolving.

	teaching contexts; will set up the research agenda for the future.	conference and journal papers.	
Influence of the degree of 'immersion' and 'realism' of 3-D Virtual Environments in students' learning experiences	---as above---	---as above---	---as above---
Framework with best practice guidelines and exemplars for design of 3-D learning spaces	---as above---	---as above---	---as above---
Training and skills of students and educators in Second Life	Even though the user interface and functionality of Second Life will change with time, the training requirements for 3-D virtual worlds will, to a certain extent, be generic.	Making the training documents and the experiences available on JISC's website, and on the project website.	It is difficult to ensure completeness and accuracy of training materials and skills, because the Second Life interface and associated support is evolving all the time.
The wind farm model in the NU Second Life island	Will be used for future teaching activities both within the MSc in GIS programme and in the Undergraduate Digital Earth module at NU Due to the above, the wind farm will remain a maintained exemplar for all visitors to NU's Second Life island	Update module outlines and learning outcomes for relevant modules to allow inclusion of Second Life elements Secure agreement with Information Services at NU to maintain island space for the wind farm project	Future students will need introductory training in Second Life to ensure they can access the wind farm exemplar. These will be produced as part of this project but will need to be updated as necessary.
Research agenda for creating learning spaces in 3-D environments with different degrees of realism and immersion	3-D virtual worlds and Virtual Reality are influencing the trends in technology-enabled learning and teaching	Respond to calls for funding	Will be subject to future calls for funding by JISC and research councils

Appendixes

Appendix A. Project Budget

Appendix B. Workpackages

JISC Project Budget

Directly Incurred Staff	**Year <07-08>**	**Year <08-09>**	**Year <yy-yy>**	**TOTAL £**
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total Directly Incurred Staff (A)	**£2924**	**£50847**	**£**	**£53771**
Non-Staff				
Travel and expenses	£	£2220	£	£2220
Hardware/software	£	£	£	£
Dissemination	£	£3000	£	£3000
Evaluation	£	£	£	£
Other	£	£	£	£
Total Directly Incurred Non-Staff (B)	**£**	**£5220**	**£**	**£5220**
Directly Incurred Total (A+B=C) (C)	**£2924**	**£56067**	**£**	**£58991**
Directly Allocated				
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Estates	£	£	£	£
Other	£	£	£	£
Directly Allocated Total (D)	[redacted]	[redacted]	[redacted]	[redacted]
Indirect Costs (E)	**£3136**	**£41744**	**£**	**£44880**
Total Project Cost (C+D+E)	**£7056**	**£116460**	**£**	**£123516**

Amount Requested from JISC	**£4284**	**£70716**	**£**	**£75000**[2]
Institutional Contributions	**£2772**	**£45744**	**£**	**£48516**
Percentage Contributions over the life of the project		**JISC 61 %**	**Partners 39 %**	**Total 100%**

Nature of Institutional Contributions

Directly Incurred Staff				
Post, Grade & % FTE	£	£		£
Directly Incurred Non Staff				
Hardware/Software etc.	£	£		£
Directly Allocated				
Staff, Estates etc.	£	£4000		£4000
Indirect Costs				
Indirect Costs	£2772	£41744		£44516
Total Institutional Contributions	**£2772**	**£45744**		**£48516**

[2] On Friday, 20th June 2008, we received a letter from JISC (ref. LTDEVA01) advising the payment procedures for this project , that is, the total funding of £75,000 will be given as follows: £60,000 in the 2007/2008 AY and £15,000 in the 2008/2009 AY. We have informed the Research Manager and the Accountant at the OU on 23rd June 2008 and they have advised that we (OU) will abide by the JISC suggested payment schedule.

JISC

JISC WORK PACKAGE

WORKPACKAGES	Month	1	2	3	4	5	6	7	8	9	10	11	12
		Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
1: Project set-up													
2: Literature review													
3: Investigation of learning spaces and activities within Second Life (OU)													
4: Empirical research by OU with OU students on the 'realism' strand													
5: Empirical Research by NU with OU and NU students on the 'immersion' strand													
6: Second Life Development at NU													
7: Consolidating the Realism Strand of research (OU)													
8: Consolidating the Immersion Strand of research (NU)													
9: Consolidating the research outcomes at OU and NU and setting up a research agenda													
10: Dissemination of the project outcomes													
11: Evaluation of the project and its outcomes													
12: Formal Reporting to JISC													

Project start date: *<July 2008>;* Project completion date: *<June 2008>;* Duration: <12> months

Note: The last completion dates in the Table below indicate the end of the month.

Key: NU Strand | OU Strand | Joint tasks

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
				Milestone	**Responsibility**
YEAR 1					
WORKPACKAGE 1: **<u>Objective</u>: Project set-up**	**July**	**September**			**OU + NU**
1. To revise the project plan in response to feedback from JISC	July	July	**Revised project plan**	July	OU + NU
2. Arrange for a mentor in discussion with the JISC programme manager and the project team	July	July			OU (with advice from NU + JISC programme manager)
3. To provide JISC with the content for the JISC website (as per the JISC website template for projects)	July	July	**JISC project website template** (duly filled in)	July	OU (with contributions from NU)
4. Consortium Agreement between the OU and NU	July	August	**Consortium Agreement to JISC**	Sept	OU + NU
5. To set up the project website at the OU	July	September	**Project website**	Sept	OU (with contributions from NU)
6. To appoint a part-time/short-term Research Associate from the tutor-pool of the OU	July	July	A part-time (or short-term) team member		
7. To develop the recruitment materials for the research associate at the OU and initiate the Human Resource processes; to appoint a research associate who can start as soon as	July	September	A new team member		OU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
possible on the project					
8. To develop the recruitment materials for the research associate at NU and initiate the Human Resource processes; to appoint a research associate who can start as soon as possible on the project	July	August	A new team member		NU
9. Second Life induction (training session for OU and NU project teams)	August	September			OU + NU
10. Introduction to VR facilities and activities at NU	August	September			NU + OU
11. Preparing for the student recruitment procedures and the approval processes of the Human Participants and Materials Ethics Committee (HPMEC). Ethical guidelines at the OU applicable for this project	August	September			OU
12. Identify three courses from different disciplines at the OU (in consultation with the respective Faculties) in which a set of students (6-10) will use Second Life for course-related activities	July	September			OU
13. Identify at least one tutor per course for each of three identified courses to facilitate the activities with students in Second Life	July	September			
14. Paper to RELIVE08 Conference (if the abstract is accepted, a full paper will be submitted and revised over July and until September; the conference is in November (20^{th} -21^{st}, 2008)	July	September	**Conference paper** (RELIVE08)	November	OU
15. Establish contacts with projects on Second Life in other institutions in the UK and which	July	September			OU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
have been funded by JISC and Eduserv (e.g. JISC's EMERGE programme and London Knowledge Lab)					
16. Familiarise with the User Innovation Development Model (UIDM) of JISC	July	September			OU + NU
WORKPACKAGE 2: **<u>Objective</u>: Literature review**	**August**	**November**			**OU**
17. Literature review on 'Design of 3-D learning spaces in Second Life'	August	November	**Literature review** (a document of 10-15 pages) based on tasks in this WP	November	OU
18. Literature review on 'Guidelines, norms and practices of interactions in Second Life'	August	October	----to be consolidated in the Literature review document (see above)----		OU (with inputs from NU)
19. Literature review on 'Design of pedagogical activities in Second Life'	September	November	----see above----		OU
WORKPACKAGE 3: **<u>Objective</u>: Investigation of learning spaces and activities within Second Life**	**September**	**November**			**OU**
20. Develop and refine a set of research questions related to learners' experiences with learning spaces in Second Life of different realism	September	October	**Research questions** (a document of 2-3 pages) situated in the project's objectives and the literature review	November	OU
21. Derive the criteria for inviting educational institutions (who have Second Life presence) to participate in the study	September	September			OU
22. Develop an e-mail to invite participation from institutions/educators: to share	September	September			OU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
experiences/rationale of their designs of 3-D learning spaces; consent for access to their islands to OU students, facilitators and the researcher for conducting activities					
23. Obtain Clearance for this e-mail from the HPMEC (Ethics Committee) of the OU	September	September			OU
24. Post the e-mail on Virtual Worlds –related mailing lists: JISC's Virtual World's list; Linden Labs mailing lists: Second Life Education Mailing List and the Second Life Research List;	October	October			OU
25. Short-list 4-5 islands for empirical research and perform a check that the islands which are chosen are appropriate for running the OU course-specific activities	October	November			OU
WORKPACKAGE 4: **<u>Objective</u>: Empirical Research by OU with OU students on the 'realism' strand: this will involve conducting activities with OU students in learning spaces of varying realism in SL**	**September**	**March**			**OU**
26. Consolidation of induction and training documentation related to Second Life	September	October	Induction and Training in Second Life (a guide for students and facilitators)		OU
27. Designing 3-4 activities for each of the courses which can be conducted in the selected islands	September	November	Packs of teaching materials for the three courses		OU
28. Develop evaluation materials for OU students for study involving different learning spaces	October	November	Data collection and data analysis pack (or evaluation pack)		OU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
within Second Life: semi-structured interview protocols; post-observation interview protocols; reflection-templates for diary studies, data collection sheets and data analysis protocols.					
29. Obtain Clearance of the evaluation materials from Student Research Project Panel and HPMEC (Ethics Committee) of the OU	October	November			OU
30. Recruit students of the three courses at the OU	October	November	Consent forms from the participants (tutors and students) and educators/owners of the chosen islands		OU
31. Training of OU students and tutors (facilitators)	November	November			OU
32. Conduct a pilot of one activity per island	November	November			OU
33. Conduct and evaluate activities with the students on the three courses and on the chosen islands; collect data from interviews and observations (audio and video recordings), and reflective accounts	November	March	Research data for the 'realism' strand		OU
34. Consolidate and analyse research data	November	March			OU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
WORKPACKAGE 5: **<u>Objective</u>: Empirical Research by NU with OU and NU students on the 'immersion' strand: this will have the following phases:** a. Conducting observation study with NU students interacting with VR applications (wind-farm example) at NU; b. Conducting observation study with NU students interacting with wind-farm example developed in SL; c. Conducting observation study with OU students interacting with VR applications (wind-farm example) at NU; d. Conducting observation study with OU students interacting with wind-farm example developed in SL.	**September**	**April**			**NU**
35. Develop evaluation materials for OU and NU students for study involving different immersion levels: semi-structured interview protocols; post-observation interview protocols; data collection sheets and data analysis protocols.	September	February	Data collection and data analysis pack (or evaluation pack)		NU
36. Adapt existing NU semi-immersive VR wind farm exercise undertaken by NU MSc students in the 'Fundamentals of GIS' module to ensure compatibility with the objectives of this project and provide updated teaching materials where necessary	September	November	Pack of teaching materials for semi-immersive VR exercise		NU
37. Develop 3 weeks of new sessions in NU's MSc	February	March	Pack of teaching materials for Second		NU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
in GIS 'Frontiers in GIS' module to incorporate Second Life wind farm exercise and provide teaching materials			Life exercise		
38. In collaboration with the OU, develop learning activities for visiting OU students to ensure that learning outcomes integrate effectively with OU courses and relate effectively to OU students.	February	March	Pack of teaching materials for OU students		NU + OU
39. Make arrangements of a 1 to 2-day session for OU students to undertake wind farm exercise within both VR lab and Second Life at Nottingham	February	March			NU (in consultation with OU)
40. Undertake semi-immersive wind farm project with NU students	November	December			NU
41. Undertake second-life wind farm project with NU students	March	April			NU
42. Undertake both semi-immersive VR and Second Life wind farm project with OU students	April	April			NU (in consultation with OU)
43. Carry out phase (a) of the empirical research	November	December	Research data for the 'immersion' strand		NU
44. Carry out phase (b) of the empirical research	March	April	----as above----		NU
45. Carry out phases (c and d) of the empirical research	April	April	----as above----		NU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
WORKPACKAGE 6: **<u>Objective</u>: Second Life Development at NU: To replicate existing wind farm case study from semi-immersive VR lab to Second Life for use in 'immersion' strand at Nottingham.**	**August**	**February**			**NU**
46. Gain written permissions and access to NU's Second Life island and agree island space for wind farm development with Information Services.	August	October			NU
47. Undertake review of existing techniques for integrating geographical data in Second Life including face-to-face visit to researchers on the Digital Urban project for additional advice	August	October			NU
48. Create background document identifying the state-of-the art in immersive technologies and their potential within VR and Second Life.	September	December	**Background (literature review) document** (10-15 pages) identifying current research trends in immersive technologies and 3D virtual worlds, immersive capabilities of Second Life and work-arounds, and future research directions (i.e. closer coupling of VR and Second Life).	December	NU
49. Transfer geographic data from VR environment into Second Life within the constraints of the immersive capabilities of Second Life identified above.	September	February	**Base line Second Life environment for the replication of the VR wind farm exercise**	February	NU
50. Construct wind turbines for placement within Second Life base line environment	December	February			NU
51. Undertake technical review of capabilities and	January	March	**Technical Review document** (15-20	March	NU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
restrictions encountered when attempting to replicate geographic data in Second Life			pages) to be delivered in conjunction with literature review.		
WORKPACKAGE 7: **<u>Objective</u>: Consolidating the 'Realism' strand at the OU**	**December**	**April**			**OU**
52. Analysis of data gathered during WP-4 to derive generic design principles specifically related to realism	December	April			OU
53. Develop a framework encompassing models of 3-D learning spaces in virtual worlds (e.g. Second Life) along with pedagogical activities supported in these learning spaces.	March	April	The framework will link to examples and use cases, best practice guidelines for learning and teaching within the different models (types) of 3-D learning spaces in virtual worlds such as Second Life.		OU
54. Identify future research agenda and suggested future research questions related to degree of realism and learning spaces in virtual worlds	May	May	Research Agenda Document outlining the research agenda / research questions surrounding levels of realism and learning space design in 3D virtual worlds (5 pages)		OU
55. Consolidate the outcomes for the final project report and completion report for JISC	March	May	Content for the final report and completion report to be submitted to JISC		OU
WORKPACKAGE 8: **<u>Objective</u>: Consolidating the 'Immersion' strand at NU**	**December**	**April**			**NU**
56. Analysing data gathered during WP-5 to	December	April			NU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
derive generic design principles specifically related to immersion					
57. Develop a framework encompassing models of 3-D learning spaces for the 'immersion' dimension in semi-immersive virtual reality and virtual worlds such as Second Life along with pedagogical activities supported in these learning spaces.	April	April	The framework will link to the wind farm example and other examples and use cases from other projects/literature (if available), along with best practice guidelines for learning and teaching within 3-D virtual environments (Virtual Reality and Virtual Worlds).		NU
58. Identify future research agenda and suggested future research questions related to degree of immersion and learning spaces in virtual worlds	May	May	Research Agenda Document outlining the research agenda / research questions surrounding levels of immersion and learning space design in 3D virtual environments (5 pages)		NU
59. Consolidate the outcomes for the final project report and completion report for JISC	May	May	Content for the final report and completion report to be submitted to JISC		NU
WORKPACKAGE 9: **<u>Objective</u>: Consolidating the research outcomes at OU and NU; and setting up a research agenda for the future**	**May**	**June**			**OU + NU**
60. Two-day internal project team workshop at OU in early May: both the teams will present their results on the first day; and on the second day, the consolidation activity will commence, resulting in a draft of the Handbook which will include the research agenda in addition to the other deliverables identified in the project plan.	May	May			OU+NU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
61. Consolidating the Handbook and the research agenda document	May	June	**Handbook on the design of learning spaces in 3-D learning environments** (15-20 pages). This will include a section (approximately 5 pages) outlining the research agenda / future research questions surrounding degrees of immersion and realism for learning space design in 3D environments	June	OU+NU
WORKPACKAGE 10: **<u>Objective</u>: Dissemination of the research outcomes**	**September**	**June**			**OU + NU**
62. Project updates via the website	September	June 09	**Project website**; the Second Life related outcomes will be linked to the website from within Second Life		OU (with inputs from NU)
63. Paper to be presented at the RELIVE08 conference at the Open University, UK	July	September	Paper will be developed over July and revised over September if the abstract is accepted.	Nov	OU
64. Paper(s) to a conference	March	March	Depending on the progress of the two strands, either a paper, or a proposal for a workshop/poster will be submitted to a conference		OU + NU
65. VR road show at the Learning Futures conference, Leicester.	January	January		January	NU
66. VR road show at the Geographic Information Science Research UK (GISRUK) conference, Newcastle.	April	April		April	NU
67. As discussed in the work plan, some of the deliverables will be consolidated in a handbook	May	June	**Handbook** (as discussed in the work plan and in WP9)	June	OU +NU

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
68. Journal and conference papers	-	-	At least one journal paper will be prepared for submission within the **one-year time period** of the project. However, because of the peer review process, publication is likely to be after the project has ended.	**-**	OU + NU
WORKPACKAGE 11: Evaluation of the project and its outcomes **<u>Objective</u>: Internal, ongoing peer review and evaluation of project activities**	**July 08**	**June 09**			**OU + NU**
69. Undertake tri-monthly meetings (July, September, December and March) to review and evaluate project status / outcomes. Meetings will also provide materials for, and review of, draft interim reports for JISC. Two of these meetings to occur one week prior to interim report submission. The two project teams will meet at the OU for a 2-day (internal) workshop in early May to review and consolidate the research outcomes of the individual strands.	End-July	March			OU + NU
WORKPACKAGE 12: **<u>Objective</u>: Formal reporting to JISC and informal interactions with mentor and programme manager**	**July 08**	**June 09**			**OU + NU**
70. Regular (Bi-monthly) interactions with the Programme Manager in a half-an hour phone	July	June	Sharing progress; and seeking advice and support on any concerns/queries		OU (along with NU)

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
conversation					
71. Submit budget and interim project reports to JISC	July	March	**Two such set of reports** (end of July and in January)	end-July, January	OU + NU
72. Prepare Draft end-of-project Report to JISC	May	May	**Draft end-of-project Report**	May	OU + NU
73. Prepare Final end-of-project Report to JISC	May	June	**Final end-of-project Report**	June	OU + NU
74. Prepare Completion Report for JISC + Final Budget Report	May	June	**Completion Report and Final Budget report**	June	OU + NU
75. Share experiences and progress with the mentor on a regular basis (at least once in two months)	End-July	June	Sharing progress; and seeking advice and support on any concerns/queries		OU + NU