Virtual Worlds as a Context Suited for Information Systems Education: Discussion of Pedagogical Experience and Curriculum Design with Reference to Second Life

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ABSTRACT

The context of Information Communication Technology (ICT) is changing dramatically. Today, Web 2.0 applications such as Facebook and MySpace are used ubiquitously in the general population, and Virtual Worlds are becoming increasingly popular in business, for example via simulations in Second Life. However the capacity of Virtual Worlds is underutilised in educational contexts. Educational institutions in general, but especially those offering Information Systems (IS) courses, must keep pace with emerging ICT and social trends or risk becoming irrelevant. Furthermore, there are particular pedagogical advantages in utilising emerging technologies such as Virtual Worlds in IS education. For instance, Second Life offers an intrinsically motivating, safe, and low cost environment in which to learn IS-related skills such as programming, requirements analysis, systems development, project management, and business process modelling. Drawn from the experience of the authors and current innovations in pedagogical research and practice, suggestions are made for curriculum design and implementation of Second Life in IS Education, including: the benefits of blending the real and Virtual Worlds; enhancement of students' intrinsic motivation; industry-relevant skill transfer; and innovative education that transcends traditional pedagogical practices. These points are illustrated with reference to case studies of IS student projects in Second Life from the University of Hamburg and Curtin Business School. Attention is given to current limitations of this emerging technology, regarding hardware, software, and connectivity. Future developments in both the technology and how it is implemented in educational contexts, integrating the real and virtual worlds via emerging technologies, are mentioned.

Keywords: Virtual Worlds, Information Systems (IS) Education, Pedagogical Experience, Curriculum Design, Second Life

1. INTRODUCTION

As the knowledge economy evolves, the increasing use of Web 2.0 and Virtual Worlds in business and the general population means that Information Systems (IS) Education must keep pace with current developments and anticipate future developments. The eager adoption of Web 2.0 has brought a range of innovations into mainstream use, such as user generated content, content sharing, socialising, community building, being interactive and collaborative. While we acknowledge that debate exists regarding the definition of Web 2.0, including whether it is anything more than just a marketing term, we use the term Web 2.0 to refer to the trend towards interactivity and interconnectivity in the World Wide Web (O'Reilly 2006; Web 2.0 2009).

1.1 Virtual Worlds: Immersion and Presence

Just as Web 2.0 evolved from the original World Wide Web, Virtual Worlds extend many aspects of Web 2.0 into a 3D Web-based environment. As a technology that is distinct from other Web-based applications, one appealing definition of Virtual Worlds is as "online environments that have game-like immersion and social media functionality without game-like goals or rules. At the heart is a sense of presence with others at the same time and in the same place" (Constable 2008). In this context, Witmer and Singer (1998) define presence as "the subjective experience of being in one place or environment, even when one is physically situated in another" (p. 225) and immersion as the perception of being "enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences" (p. 227).

Fenn et al. (2008) regard public Virtual Worlds as an emerging technology that will become increasingly influential over the next two to five years. To date, perhaps the most common uses for Virtual Worlds have been as socialising and networking forums for individuals (Sarner, 2008), as marketing or training platforms for businesses (Abrams, 2007; Second Life Business Communicators Wiki, 2008), and as educational and research environments for academics (Harris, Lowendahl, and Zastrocky, 2007). However, there are powerful pedagogical utilities of Virtual Worlds that are not yet fully evolved or utilised and are thus worthy of consideration.

1.2 Constructionist Pedagogy in Virtual Worlds

Some of the more important and often challenging aspects of teaching are to help students cultivate intrinsic motivation, critical thinking skills, autonomous learning skills, and knowledge/skill transfer between learning domains and applications (Krause, Bochner, and Duchesne, 2003; Woolfolk, 2006). One way to address these challenges, and a current trend in education, is Papert's constructionist method of teaching, which is related to Piaget's constructivist learning theory, and Vygotsky's socio-constructivist theory (Ackermann, 2004). These developmental learning theories consider knowledge creation and skill acquisition as active and interrelated processes (Woolfolk, 2006).

Papert's constructionist (Harel and Papert, 1991) educational method places students as active participants in the learning process with teachers as facilitators, and emphasises the utility of a socially demonstrable learning process in which students' learning is enhanced when the outcomes are publicly viewable and are shared/communicated with others (Ackermann, 2004). In order to implement this approach, several guidelines are recommended (Driscoll, 2000):

(a) the learning context must be personally relevant to the lives and future prospects of the individual students;
(b) the learning should be explorative;
(c) the student should be given a chance to both participate in groups and demonstrate his or her knowledge individually; and
(d) the instructor should guide and facilitate learning without spoon feeding students.

1.3 Relevance to Industry and the Interests of Younger Generations

Correspondingly, Virtual Worlds provide a unique environment and set of tools which Generation Y students find relevant and appealing due to their status as digital natives. The term "Generation Y" is used to describe those born between about 1980-1994 who have grown up using Information Communication Technology (McCrindle, 2006), and "digital natives" is a term describing the recent generations whose development is characterised by immersion in digital media and communications technology (Prensky, 2001, and Palfrey and Gasser, 2008). "Digital native" students value staying abreast of current technological innovation such as Virtual Worlds. This may be due to their inherent interest in the field, but also because doing so enhances their employable skills. Indeed, in the field of IS, unless one stays abreast innovation, they risk redundancy.

Virtual Worlds are inherently stimulating for "digital native" students because they immerse students in an explorative, fun, and interactive learning environment, and facilitate autonomous action via animated characters called avatars. Virtual Worlds also foster social and group participation by enabling communication through a rich array of media, including visual, contextual, nonverbal-gestural, voice, and textual communication media. As such, Virtual Worlds make the learning process and outcomes publicly demonstrable. Thus instructors are able to interact and observe, thereby adding to the educational milieu.

In short, Virtual Worlds are of particular pedagogical relevance because in such environments students are prone to explore, participate, discover new knowledge, and develop industry relevant skills with greater intrinsic motivation and autonomy. Section 3 below discusses our experience of student projects at the University of Hamburg, suggesting that Virtual Worlds contribute to a greater level of knowledge retention and a more dedicated approach to study.

1.4 Rationale and Overview

While there is increasing interest from educators in use of Virtual Worlds (SimTeach, 2009), the institutional use of Virtual Worlds in educational organisations is far from mainstream (Hayes, 2009), and the potential inherent in the pedagogical use of Virtual Worlds has yet to be fully explored. Often existing educational models are simply transferred into the new medium, ignoring the increased pedagogical potential available in alternate models. We

discuss these alternate models in subsequent sections. As an adjunct to traditional pedagogical approaches, we recommend mixed learning environments that integrate real-life learning contexts and Virtual Worlds. Furthermore, in our experience the most pedagogically useful Virtual Worlds are those that facilitate user-generated content via programming languages and 3D object creation such as Second Life (Second Life, 2009b). Consequently, this article will discuss the pedagogical advantages of Second Life for IS Education, suggest methods for integration of Virtual Worlds into IS curriculum, and comment on current limitations and future innovations of Virtual Worlds in IS Education.

We have chosen to focus on Second Life because it has certain advantages (e.g., content development and world-wide distribution). However, we are also aware of existing and emerging Virtual Worlds, and are monitoring two beta worlds for application in educational contexts, Project Wonderland (Java.net, 2009) and Croquet (The Croquet Consortium). For more information, Kzero (2008) summarises the Virtual World market and compares Virtual Words on a number of criteria such as number of users, user age, and main area of application.

2. PEDAGOGICAL ADVANTAGES OF SECOND LIFE FOR IS EDUCATION

Virtual Worlds in general, and Second Life in particular, offer a range of benefits when integrated into IS Education. They can function well as an aid to traditional educational contexts or in purely virtual environments. For instance, pedagogical outcomes in IS Education can suffer from a failure to intrinsically motivate students, as in the case where learning programming is not linked to real world relevance (Feldgen and Clua, 2004; Manning and Bucher, 2007). Through simulated real life experience we can address the issue of students graduating with limited practical experience due to lack of application, for example, regarding business process modelling, project management and implementation. Discussed below are a number of such benefits to IS Education, including learning programming skills, systems development, project management, industry/business experience, and benefiting from immersion in an innovative community of practice.

2.1 Learning Programming

Information and Communications Technology (ICT) corporations are responding to current economic conditions by more frequently sourcing IS-specific skills such as programming and database management in-house rather than by outsourcing them (Hoffman, 2008) as in the previous few decades. Developing proficiency in specific skills such as programming is doubtless a priority for educators and students alike, especially given the current industry demand (Hoffman, 2008). However, students often do not graduate with industry-ready skills and students often lack the intrinsic motivation to develop sufficient proficiency when using text-based programming editors or unsophisticated development environments. In comparison, the rich, 3D virtual environment that Second Life offers has a built-in programming language (Linden Scripting Language, LSL) that offers a stimulating and intrinsically motivating context for students to learn programming. In line with the constructionist learning principles outlined above in Section 1.2, we discuss below how learning programming in Second Life enriches the learning experience by providing more life-like and industry relevant learning contexts.

Learning and applying LSL offers the possibility of skill-transfer for students learning other popular programming languages such as C++, Java, and JavaScript. LSL is easy to learn once students have some introductory knowledge of programming concepts. It uses an intuitively appealing state and event based object-oriented approach to programming that facilitates the simulation of real world states such as open/closed or accelerating/decelerating, and interactions between objects. In this way, the Second Life environment makes learning programming more interesting and applied, which can pave the way for learning other programming languages (see Ramalingam, LaBelle, and Wiedenbeck, 2004 for mechanisms by which prior experience with programming can promote positive pedagogical outcomes). For students who already know languages such as C++, Java, or JavaScript, then LSL will be easy to learn. Furthermore, built into the Second Life environment are tags that identity authorship of in-world creations such as LSL scripts and objects and this assists instructors monitoring students' activity and authorship. The most delightful aspect of programming with LSL in Second Life is that the results are seen animated virtually as if in the real world; it allows programmers to test their code via application in context, thus resembling industry experience. The sophisticated capacity of Second Life to recreate real world systems makes it an ideal platform for teaching systems development.

It is debatable whether LSL is a good choice for students who are learning programming for the first time. Second Life does not provide advance tools for coding or debugging, which can nevertheless be substituted with external tools like Eclipse (2009). As such programming in LSL is rather restricted to the virtual world and therefore is not applicable to implementing larger stand-alone software. However, learning programming is about understanding the core concepts and gaining confidence in smaller projects before initiating larger ones. Here, LSL is valuable because it is an easy to understand object-oriented language that provides all the important instructions to structure and implement algorithms. In addition to being attractive because it allows direct visualisation of the outcome, LSL supports collaborative work because the full source code is part of the 3D objects (called primitives or prims) such that each team member can be responsible for specific parts of a project – assuming that the interface for connecting the primitives is defined in advanced and team members are precisely following the guidelines. This facilitates a useful learning experience for students who might later work on software projects in real business scenarios where the programming team might be very large and distributed world-wide.

2.2 Systems Development

The capacity to engage in systems development in a Virtual World that facilitates user generated content allows students to learn by modelling real world systems, at minimal

expense and negligible risk. As a Virtual World that allows user-generated content, Second Life allows students to engage fully in the systems development process, from analysis of the problem through to implementation and refinement in context via user testing. The capacity of Virtual Worlds to model real world systems enhances pedagogical outcomes due to the combination of the immersive 3D context (discussed above in Section 1.1) and constructionist learning principles (see Section 1.2).

In text-based programming editors, some programs cannot be fully implemented for their intended purpose due to physical, temporal, or financial limitations. In contrast, as an immersive 3D environment Second Life allows one to both implement programs and to model the appearance and functionality of real world systems or businesses. For example, models of real world machinery and infrastructure can be built easily and at negligible expense using the Second Life object editor, and commercial businesses are run in Second Life using an in-world currency that is exchangeable for real world currency. Such businesses can operate entirely within Second Life or can interface with the real world.

Second Life facilitates the implementation of systems in context so that students not only learn how to program specific applications, but they can implement them for their intended purpose. According to constructionist principles this is pedagogically sound because it provides first-hand feedback on one's learning, and is intrinsically motivating because students see the outcomes and relevance of what they are learning and doing. This process also advantageously facilitates the teaching and application of project management skills.

2.3 Project Management

Student projects implemented in Virtual Worlds enhance learning of project management skills by making use of each of the qualities discussed in Section 1 -- the immersive 3D context (see Section 1.1), a constructionist learning approach (Section 1.2), and relevance to industry and the interests of students (Section 1.3). The opportunity for student project teams to develop systems in a flexible, safe, inexpensive environment such as Second Life is useful for learning project management skills. Conceptual knowledge is important, but its practical application through developing relevant skill-sets is what is required by industry. Universities have been criticised for producing knowledgeable but unskilled graduates who must be trained on-the-job. This limitation is doubtless behind the requirement frequently made by employers that job applicants have relevant industry experience (in addition to educational qualifications), thus creating a catch-22 situation for graduates with no industry experience. The onus is on universities to both link with industry and to provide students with relevant industry experience while in training.

Project courses where groups of students develop systems in a Virtual World present a rich opportunity for project management knowledge to be applied and for the development of corresponding skills, both analytical and interpersonal. Regarding interpersonal skills, our experience has shown the rich variety of communication modalities that Second Life offers, including verbal and non-verbal gestures, voice chat, and synchronous/asynchronous text messaging, powerfully facilitate communication and networking in team-based projects. Regarding the application of project management knowledge, our experience with student projects in Second Life has shown that this immersive 3D environment helps students adopt project manager, team member, and client roles more easily and naturally than in real-life student projects. This is likely because the appearance of students' avatars can be changed to suit the role by changing clothing, physical appearance, and objects carried, and due to the immersive context helps students identify with their role more naturally. Additionally, the element of ubiquitous supervision in-world, by the teacher using the remote-viewing camera function, helps ensure students maintain their assigned roles. Furthermore, Second Life facilitates realistic replication of real-life project management scenarios wherein multiple users work on the same project simultaneously just like in real life. Correspondingly, this realistic experience in the Virtual World context assists the development and refinement of key skills such as programming, systems development, and project management, and thus primes students for industry experience, either through employment or as entrepreneurs.

2.4 Industry/Business Experience

It is pedagogically beneficial for students to gain real world industry experience either as employees via vocational placements or as entrepreneurs via commercially engaging the systems they have designed in projects. Such opportunities provided while still studying, are doubtless invaluable learning experiences in preparation for actual employment and commercialisation. However, these opportunities are not readily available in university IS schools, perhaps because vocational placements are competitive or academics are not sufficiently allied with industry, and conducting business can be a risky and costly endeavour. However, as outlined above in Section 1.3 Second Life provides a safe, inexpensive and highly adaptive environment in which to develop industry relevant skills and gain industry experience.

Specifically, the use of Second Life in IS Education helps prime students for industry as employees or entrepreneurs because Second Life simulates real world systems in physical appearance and functionality, and re-creates a virtual economy and community where each avatar is the in-world expression of a real person thus adding to the reality of the pedagogical training environment by going beyond simulation to virtual re-creation of a second world.

The opportunity of starting a real business in Second Life to gain applied business experience and skills while in education is remarkable because it allows students to gain real-to-life experience with minimal risk. The real-to-life experience is enhanced by the way users identify with their avatars and experience the range of emotions that are involved in real world social/vocational/entrepreneurial encounters. The use of Second Life to engage in vocational training or entrepreneurial activities is of minimal risk because residents own the IP of their creations (Second Life, 2009c), and the in-world currency (Linden dollars, L$) has an excellent exchange rate with real world currency at approximately L$270 to USD$1 (Second Life, 2009a). In

Second Life entrepreneurs can make modest profits that are exchanged for real world currency - in the third quarter of 2008 the user-to-user transactions in Second Life totalled approximately USD$100,000,000 (Second Life, 2009d).

From a pedagogical perspective, basing projects in Second Life enables students to transfer conceptual knowledge into a 'virtual life' setting. Subsequently, the bridge into 'real life' experience is made monumentally smaller by way of this virtual experience. Virtual in this sense is not to be confused with simulated. By the very nature of Second Life's immersive environment, the variables and possibilities available make it more than a simulated environment. In Second Life, complex parameters and variables exist similar to those in real life. A stock market simulation called SL Capital Exchange (SLCapex.com, 2009) is an example. In a simulated environment, one governed by programs alone, many of these variables can only exist if they are deliberately factored in. Consequently, experience with IS projects, applications and business ventures in Second Life enables students to become more job-ready by way of providing a virtual environment with similar characteristics to the equivalent real world environment, thus acquainting students with real-to-life challenges, and through familiarity and experience, easing anxieties about starting a new job or business in an unfamiliar environment. Students' acquisition of skills and knowledge through practical experience is enhanced by the technologically innovative community of practice that comprises Second Life residents.

2.5 Community of Practice

A key element of Virtual Worlds that was outlined in Section 1.1 is a sense of shared presence and community. Virtual Worlds such as Second Life immerse users in a technologically innovative community that both interact in-world and communicate via Web 2.0 applications such as blogs and user help wikis.

Already mentioned, is the prominence and use of Web 2.0 applications, not only in corporate circles, but in the general population too. Second Life itself is an emerging technology, and use of Web 2.0 applications is commonplace: a Wiki as a Second Life Help Portal (Second Life, 2009b), where both Second Life staff and users frequently post tutorials and help files; various multimedia tutorials; various chat client applications either built by Second Life staff (SLim which offers communication between users who are not 'in-world') or integrated from existing applications such as Twitter (2009).

Furthermore, there is a culture of innovation, both in finding new uses for existing technologies such as Twitter in Second Life, and in developing new technologies promoted by the open-source scripting language, LSL, and by the Second Life staff staying responsive to the communities' feedback. By immersion in this community through the associated Web 2.0 media, students may learn valuable knowledge and skills that are at the forefront of technology development itself. A prime example of this is a student involved in the University of Hamburg projects being asked to present at in-world as well as real world conferences due to the in-world visibility of their outstanding developments.

To reiterate, there are a number of pedagogical advantages to the use of Second Life, both general and specific to IS Education. Those discussed above include: learning programming skills; systems development; project management; and industry/business experience. We will turn the discussion now to suggestions based on our experience regarding the integration of Second Life into IS curricula.

3. CURRICULUM INTEGRATION

On a university level the value of new technology or a new teaching paradigm depends on how it is accepted by the faculty and students, as well as its integration into the curriculum. Over the last years, numerous universities have started their own Virtual World projects by investing time and money in the infrastructure. Visionaries began expanding their horizons and began using Virtual Worlds to blend these with their traditional teaching methods; the result was the creation of a superior teaching and learning experience. However, limiting factors such as educational infrastructure and a lack of clear long-term strategies for implementation of the new technology slowed the progress and impeded widespread implementation. In this Section, we exemplify projects that have demonstrated the difference between successful and unsuccessful educational settings for Virtual Worlds. Furthermore, we discuss the opportunities that Virtual Worlds provide for curriculum design by visiting, as case studies, current projects of the Curtin Business School and the University of Hamburg. Whilst our focus is on Information Systems, we will briefly describe the integration of Virtual Worlds in other areas in order to allow for the absorption of the larger picture.

3.1 Inter-World Teaching: where Reality meets the Virtual

3.1.1 Integration of new technology: As educators, we must ask ourselves about the motivation for integrating new technologies into pedagogy, particularly with respect to what we would like to achieve in the long run in regard to our teaching. To help find some answers, it is useful to reflect back to the integration of Web 2.0. This technology provided numerous tools that supported the lecturer in administering, preparing, teaching, assessing and evaluating the class. Nevertheless, the degree of usefulness that these tools were able to provide for teaching and learning was dependent upon the mode of study. In face-to-face classrooms the usefulness of Web 2.0 was less significant; even with the integration of the new tools, our student feedback still highlighted the less than stimulating classes, overcrowded lecture halls, and the teaching itself. Quite conversely, distance learning improved as the multi-media handling capabilities of Web 2.0 allowed for simpler distribution of lesson materials as well as enhanced communication and interaction capabilities, particularly with regard to socializing with other distance learning students. Services like Voice over IP, WebCams, Web-based Whiteboards, and improved tools for collaborating over the Internet (e.g. Google Documents) decreased the perceived "distance" and created a basic, virtual classroom atmosphere in which students and teachers were able to communicate in small groups with the possibility of instantaneous feedback. Yet

this virtual classroom was basic in the sense that the interactions were two dimensional, restricted to small groups for voice or video communication, and was often asynchronous despite the possibility for synchronicity.

The potential of new technology such as Virtual Worlds offers an opportunity to redesign pedagogical approaches rather than simply reproducing traditional teaching methods. Using Second Life to replicate a slide show in a lecture hall is an example. The presence of avatars as live, interactive, 3D communication tools in these interactions, are the only exception to the traditional and unstimulating face-to-face and Web 2.0 methods. Such an approach limits the innovative potential of Virtual Worlds by using only static communication, a single presentation area, and multi-media integrated from Web 2.0 only. The true potential for new influences on teaching and learning achievements is neglected. In short, the exciting and immersing possibilities of Second Life and other Virtual Worlds are commonly constrained by the pedagogical style. Used correctly, however, the Virtual World can offer exciting possibilities.

Virtual Worlds increase the possible pedagogical applications beyond Web 2.0, because they provide new communication channels, opportunities for collaboration, and new and empowering technology with which to discover practical, engaging, and innovative pedagogical applications. This is especially so in distance learning environments, but also in face-to-face classrooms. In recent years several projects have shown extended scenarios where Second Life technology and inter-world connections can be used to increase the overall experiences of students. However all of these projects are still in beta-status and are part of teaching and learning experiments. Special installations, that were not possible in the real world, were created to replace the 2D slides and even provide an immersive feeling for the learners. Such installations can showcase places that are difficult or problematic to visit, for example a model of the male and female reproductive system (Impact Lab, 2008) or historical sites such as Egypt (The Arch, 2007). Another example focuses on allowing for different perspectives on known settings (e.g. virtual hallucinations, role play; Antonacci and Modaress, 2005). A further example has gathered information in one location so that one might experience many different world-wide attractions in the one place such as museums (Wikia, 2008). These individual installations each hold a different degree of immersion and interaction on behalf of the user. The level of immersion and interaction is dependent upon factors such as how *real* the experience is, and if the avatar is a mere passive observer or whether they are able to influence certain aspects of the installation.

3.1.2 Inter-world programs at the University of Hamburg: Inter-world approaches, where the virtual and reality are merged, extend the idea of distant and blended learning, where the lecture taking place in the classroom can also be attended by off-campus students via video streams and other media. There are several examples of inter-world events especially conferences and lectures, that have provided a similar experience. At the University of Hamburg, we provided a setup where students could choose to either attend the lecture in the classroom or in Second Life. The intention for the lecture series "Production and Logistics in Second Life" was to take advantage of Second Life as we planned to visit at least production plants, have an international guest speaker, learn about the value of Virtual Worlds, have hands-on experiences, and most importantly to do this as one group with no limitations in communications and/or interactions. No student, independent of location, should have a lesser experience than any other. Therefore, we decided on the setting as shown in Figure 1.

The initial meeting point was at the virtual lecture hall, this being a virtual replication of the real world one. While we advocate that a static virtual classroom is in fact in its very nature undermining the potential of Second Life, it is however necessary to have a meeting point where all avatars can group together before beginning. As the University of Hamburg has a realistic representation of their main building, we used this as our logical and easily identifiable meeting place.

Student group 1 (SG1, approx. 20) attended the classroom and used computers, with Second Life installed. The Second Life view was projected in the classroom. The classroom action was recorded and streamed live to Second Life so that the Student Group 2 (SG2, approx 15) could follow the classroom interaction on a monitor in Second Life. Note that SG1 were also interacting in Second Life, but could not tell by the avatar which students were in the classroom and which were participating solely online; naturally then, the primary communications were chiefly about finding friends and colleagues. Inside Second Life, no distinctions were made to identify SG1 and SG2. The lecturer was supported by a designated moderator, who controlled the local chat and all incoming questions. Technical questions were directly answered whereas the others were filtered, summarized and sent to the avatar of the lecturer. Instead of interrupting the presentation, students could ask questions when they had one and the lecturer could decide when to include the answer.

The first session was used to introduce Virtual Worlds and their advantages for education, production, logistics etc. by a short presentation and, more importantly, a small guided tour to learn the basics. After learning about the controls for the avatars, we visited some local exhibitions and spent time in a sandbox, which is a free area to build in-world objects. It turned out that the sandbox was a motivation booster as everyone could realize ideas and projects that would not be possible in real classroom scenarios. In particular, limitations regarding resources are not present in the virtual world to the same extent because time and money can be saved by creating virtual items and copying them. In Second Life everything can be constructed, experiences can be shared in a real-time atmosphere, and feedback or help can be both immediate and interactive, such as congratulations for a good design in the form of a big smile and applause from another avatar.

Other possibilities we have taken advantage of include the capacity to invite international guests without the usual costs. Students could listen to an artist and successful Second Life producer from New York, ask questions and join a tour through their production plant for jeans. Instead of looking at slides, students could meet experts and spend time in the plant; unfortunately they could not interact, as the production itself was not allowed to be interrupted. In addition, the class

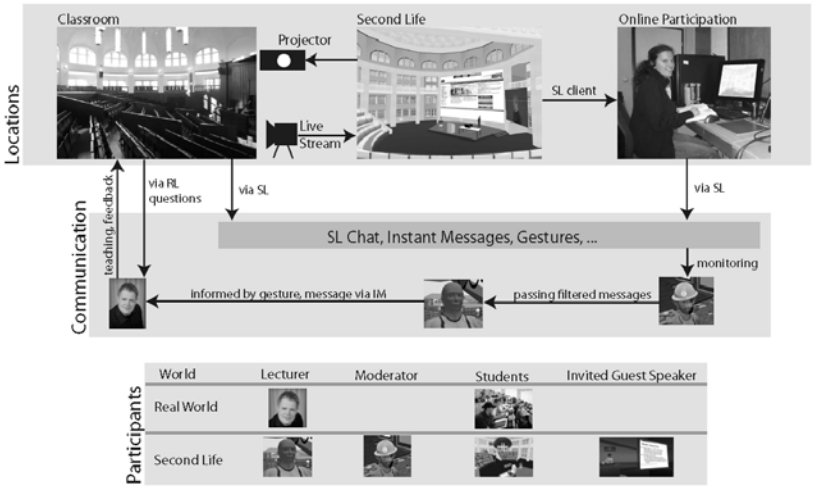

Figure 1. University of Hamburg Implementation of Second Life
Note: RL = real life; SL = Second Life

visited other plants for chips, cars, and ice cream and learned about different ways to integrate the Virtual Worlds.

In the context of providing students with practical experience in Virtual Worlds it is important for the educator to observe the results in terms of plausibility. That is, to monitor whether the 3D objects are fulfilling the learning objectives, and where required, whether this learning can be transferred to the real world. For example, architecture students might develop new designs in a Virtual World, and the learning objectives will influence whether the constructions should be built under the restrictions of nature laws or whether they can be more creative. Some flexibility applies to processes (e.g. in production), where abstraction is possible in the 3D simulation as long as the system is performing equivalent to the real world.

3.2 Creating Learning Experiences

"The limit is only the sky" is one of the advertisement slogans of Linden Lab in their promotion videos, an adaptation of a well-known phrase. The real world classroom on the other hand, is limited by nature's laws as well as space, money, time, and other resources. Similar to the lecture described above, we can use Virtual Worlds to hand out assignments that go beyond the limitations of the real world and ask students to demonstrate skills that otherwise may not have been able to be revealed. At the University of Hamburg we had two student projects that demonstrated how to take advantage of the new media. Each project comprised several teams of four working together for between four and six months.

The first project followed a lecture on "Simulation in Production and Logistics" and required students to perform simulations on a selected example. We decided on a supply chain, where incoming medical goods from sea containers needed to be processed and distributed to a pharmacy chain (Wriedt, Ebeling, and Reiners, 2008). The aim was to develop an accurate simulation as well as written visualization for later presentation. The students decided on Second Life as their medium rather than specialized simulation software for the following reasons. First, the specialized software is only available on the university computers, whereas Second Life can be used from home. Second, both software packages require a vocational adjustment and the simulation software is less likely part of future projects. Third, comments by students suggest they see Second Life as "cooler" and "more fun" because it feels more like gaming than work and the progress is rewarded as they can see their outcome immediately. Lastly, Second Life allows simultaneous collaborative work from different physical locations, whereas the simulation software is installed on separate computers and the software itself does not allow for networked, simultaneous collaboration.

Figure 2 (Left) shows the result of the project. Figure 2 (Right) shows the subsequent project outcomes as extensions on the original design (Burmester and Reiners, 2008). The final outcome included a complex implementation simulating interactive components, comprising all steps from the arrival of containers to the delivery of medications to customers.

A decision was made to allow students as much freedom as possible. This proved to be a particularly successful strategy as the students set to work – from their home computers, communicating via in-world voice chat and instant messaging (IM) – and constructed the main elements in the first night without using scripting. The highly efficient progress was achieved by the parallel and collaborative working environment of Second Life where each avatar could see the actual progress of the others in their group.

After the assignment was submitted, we interviewed the students about their experiences. A number of interesting outcomes were identified. The students reported consistent and lengthy work sessions. They expressed enthusiasm for learning the Linden Scripting Language, and showed creativity and eagerness to attend to even small details. They also developed applied communication, collaboration, and organization skills. Indeed the students preferred to meet in-world and rarely met in the real world. In sum, from the interviews we learned that the project was far more engaging

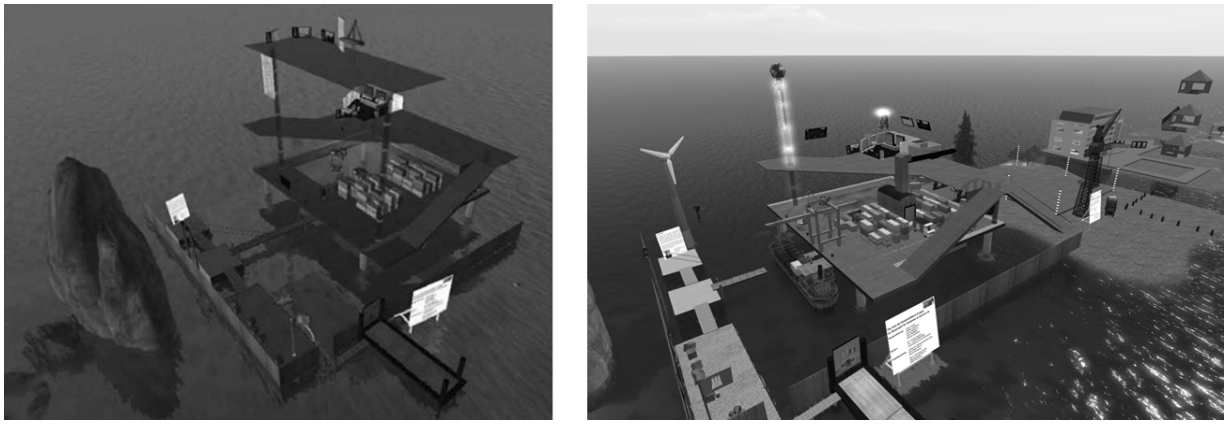

Figure 2. University of Hamburg Supply Chain Project

than any previous projects, and also far more effective in terms of students gaining a deeper understanding of the course content. Students had to do the same amount of research as in previous projects, but here they could integrate it into a 3D model and test the outcome immediately. In contrast, traditional work at this stage is entirely paper based. Another surprising outcome was the international visibility of the project. Students were invited as guest speakers to conferences and published several papers - something far beyond the outcomes of normal projects.

The second project was carried out by four students and involved the same prerequisites. All were unfamiliar with programming in Virtual Worlds and only one student knew about Second Life previously. Their task for the next six months was to demonstrate a production process including interactive components. In the process of finding the product and the required machinery the students contacted real world producers to have a look at examples of real productions. They decided on a bottle filling plant, where four different types of soda drinks are filled in bottles and shipped in boxes of six – see Figure 3 (Erlenkötter et al., 2008).

The student feedback was positive; all reported to have enjoyed the flexibility and freedom of being in charge of all stages of their project, from initial idea to implementation. As with the previously mentioned group, their main motivation was created through the possibilities to fulfil their plans and have a constantly growing 3D model of their results. The international community showed interest, a national newspaper published articles about the project focusing on the group work (Students@Work, 2009), and the students published a conference paper (Erlenkötter et al., 2008).

Another beneficial outcome is that the project students formed friendships – even while many students had not met before, they began to meet informally in the Virtual World, and then they started to socialize and become friends in the real world. Furthermore, they supported each other during the project stages by offering help and the exchange of knowledge learned from their experiences.

3.3 Course Outline for Software Development

In the Information Systems department of Curtin Business School, students are required to take the course ISP391/392. In this course, students are expected to apply the knowledge from several prerequisite classes in programming, systems analysis and design, and project management to develop larger software applications whilst applying a proper project management cycle at all stages of the software development process. In previous years, students have mainly used traditional programming languages such as Java or JavaScript and have developed either stand-alone or Web-based applications.

This course has been well accepted, even though several observations have indicated the need for changes. In particular, the workload amongst group members has not always been evenly distributed, as some students are naturally superior in designing, programming, or writing. This can cause problems with grades, as an evaluation of individual contribution is not always possible. Another concern is that students' motivation for the task has often been low with the result that students would often try to achieve the required work with a minimum of invested time and effort, and rarely extended the assignment with their own ideas. Additionally it was nearly impossible for the supervisor to constantly monitor student progress as they often worked from home. While using a repository such as Concurrent Versions System (CVS) would allow for a local installation of the software, most versions might not even be executable due to their development status.

Based on the experiences with and the success of the projects in Second Life at the University of Hamburg, we have reconsidered the outline of the abovementioned project course at Curtin Business School. As a result, Information Systems Project 391/392 has been offered using the Second Life virtual world environment, where ideas from Hamburg were merged with the requirements for the class. At Curtin Business School the course is structured in two phases, which are clearly separated from one another - introduction in Second Life and the programming language LSL, and implementation of a larger project assignment. The following objectives were planned for this course. Students were expected to work in teams of up to four and to each contribute approximately 15 hours per week. All stages of the project needed to be accompanied by written documentation and submitted for assessment. The final project was required to clearly show the business opportunity, design, user interface, implementation, documentation, and evaluation aspects.

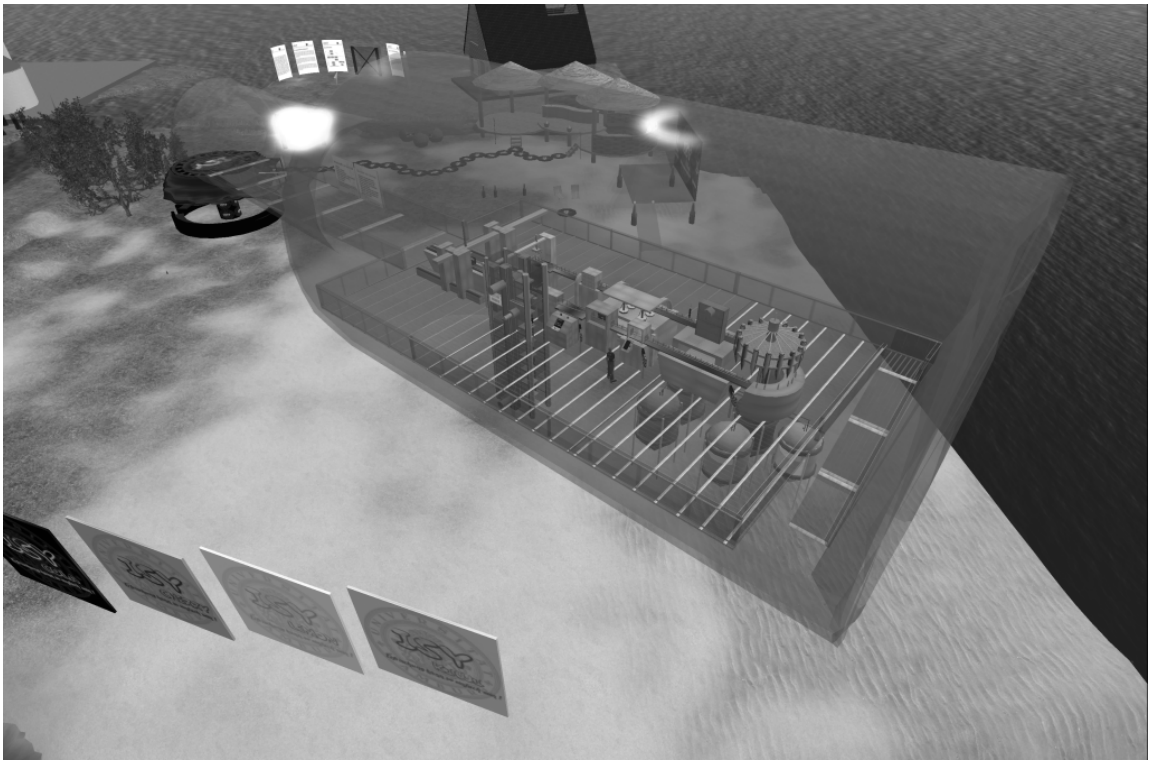

Figure 3. University of Hamburg Bottle Filling Plant Project

To outline this newly refurbished course, weeks one to four provided an introduction to Second Life and the Linden Scripting Language. The first lecture, where we introduced Second Life, was held in the main lecture hall on the educational island "Australis 4 Learning". This lecture hall itself is a small innovation for Second Life as it offers a rather large flexibility with the slides and presentation opportunities as well as so-called L-pods (learning units) where different functionality like slide navigation, request for talk, improved visualization, and teleportation is given. At the end of the course, this lecture hall was used for the project demonstrations and presentations conducted by the students. There is also a Web-board that allows the lecturer to write on a tablet PC and have the results automatically transferred to Second Life. For an impression, see Figure 4, a detailed description is not in the focus of this paper.

After the first lecture and demonstration acquainting students with the Second Life environment, students were required to solve small tasks individually. The goal was to create a "6-pack of software artefacts", each of the six artefacts having the potential to make a useful contribution to the overall business case. Group work was deliberately avoided at this stage in order to provide the opportunity for every student to gain the same background knowledge.

These weeks were taught with the assumption that most students were not familiar with Second Life and had to learn everything from scratch. Students who have had practice with online gaming or other Virtual Worlds might begin with an advantage, though in our experience most students achieve a comparable proficiency in programming with LSL. Tasks at the beginning of the course were based on the container terminal project at Hamburg University because this provided a working template of what was expected in the larger project that was scheduled later in the course. During week one, the students implemented the model of a van carrier that can pick up and set down a sea transportation container. In week two, students added scripting to the van carrier that allows avatars to sit in the operator's cab and drive the vehicle around the terminal. During week three, students implemented a remote control function that navigated the van carrier according to a pre-assigned route. Finally, in week four students used the interface to have the van carrier controlled via a Website. The idea here was to have the control carried out by a human scheduler. This smaller project was required to be implemented and demonstrated individually by all students. However, the planning stages could be carried out in groups.

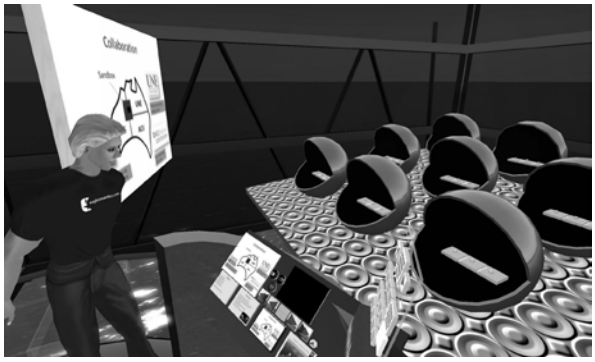

Figure 4. Lecture Hall on Second Life Island "Australis 4 Learning"

In Second Life, we can see which avatar has worked on an object. Detection bots allow us to see information about certain designated areas, such as which avatars have passed through a certain location and how long they spent there. So that we were able to do this, each student was assigned a specific location in Second Life on the Australis 4 Learning island. When the students were online, we could visit them, ask questions, or even investigate their implementation at any time, thus making the possibilities of cheating far more difficult. Unfortunately it is still possible for students to cheat by passing login information to other students so that they can implement the assignment for them. Furthermore, we checked for plagiarism, and informed the students of this at the beginning of the project. This was done so that each student had to make sure they used original code and that they could explain their code to a supervisor.

During weeks five to twelve, the students received a short description of what they should achieve. Details were purposefully kept to the bare essentials in order to provide students with as much freedom as possible. In weeks five and six, students undertook a preliminary evaluation and experimented with prototypes of how they could implement the final outcome, while writing all necessary reports. The supervisor monitored progress and answered questions about specifics, without interfering in the creative process. The project specifications were required to be finished by week seven and approved by the supervisor. The remaining weeks were used to conduct the implementation of the project. Groups were reminded that it was important for everyone to participate and provide evidence of this in the form of a report that detailed objects created and scripts written.

Project tasks were related to the main theme of the island. To increase the variety of projects undertaken, groups were allowed to implement the same tasks if they could come up with a different method of implementation. The first project task was an innovative lecture hall with tools to present slides and other media or objects, interactive student seats and other gadgets that might be new to Second Life. The second was a simulation of the Automated Assessment Lab (AAL; Dreher, Dreher, and Reiners, 2008), which includes a visual display of all steps in an interactive or automated exhibition. The third was a submission box for assignments of different lectures, providing consideration of the role such as student, lecturer, and marker.

Note that other tasks like exhibitions of course material or visualization tools for data can be planned if more students than were expected participate in the class. A requirement of each project task was an interface to the real world, such as a database connection to store assignments, a Website with presentation slides, or exhibition information from a wiki. Students were also required to create a business idea for their product, or give an outline as to how their development can be used as part of a business, and set up a business plan in conjunction with advertisement ideas. At the end of the semester, the business had to be at a stage where customers could find the product, and know about its value and usage. The final presentation of the projects took place in Second Life and the event was announced internationally to enhance the students' perceived value of their projects.

In summary, the learning experiences provided through the Second Life Virtual World projects were above and beyond those afforded by other projects, which implemented more traditional methods. Typical commentary provided in student feedback was: "*The unit provided me an unusual study experience which is exiting and interesting. Using Second Life to study is very helpful for me to help improve my study; it is not like the traditional unit which contains a lot of documentation work, it is more attractive, more fun. It makes me enjoy my study period. And also it is improving my study skills, like researching, coding, planning, communicating. It is just like what happens in real life. I can practise many things in SL, and I believe that will help me a lot in my future life … i realized that we had to do some planning before hand to create what i wanted. That was a big change for me, as i had never really planned anything out on paper before doing a project.*"

All Second Life student groups finished their projects in time without any negative feedback and all stated that they would choose the same type of project again. A few even decided to keep the focus by pursuing postgraduate studies in this field.

3.4 Empirical Research and Future Directions

The abovementioned examples illustrate how Virtual Worlds can support the learning process. That is, through the motivation and immersion gained from learning in an environment that is similar to reality. These observations based on our first-hand pedagogical experience are in accordance with several publications that did empirical studies, both those starting at the beginning of the virtual realities (Hall, Stiles, and Horwitz, 1998) as well as modern virtual worlds (Hartman et al., 2006; Jackson and Batstone, 2008). Major research can be observed with medical personnel where all processes from surgery to treatment are taught in real life as well as in Virtual Worlds (Gallagher et al., 2005; Stansfield et al., 2000s). In addition, the medical sector is demonstrating that the integration of emerging technology in teaching and learning can be based on the necessity that it is difficult or impossible to train with real patients in all situations, as is known in using flight simulators to train pilots for emergencies.

Nevertheless, we are currently also initiating an empirical study to examine the educational advantages of Virtual Worlds. The experimental design utilises three conditions/contexts. The first involves K-12 students, where the anticipated groups to be sampled are of age 6-8, 12-14, and 17-18 years. The second consists of students at university that participate in distance education and either use traditional learning material including video podcasts (VodCasts) or additional learning material in virtual worlds. The third regards life-long-learning in companies, where we cooperate with consultants to explore different training scenarios, introduce new business processes, and facilitate collaboration in virtual teams. In each condition or context we plan to assess groups that do and do not use Virtual Worlds on various measures of process variables such as motivation, engagement, and outcome variables such as knowledge retention and skill transfer to real life. This research plan draws on the ideas of Junglas et al. (2007), who suggest extending learning research into Virtual Worlds or similar environments.

4. CONCLUSION

The continued growth of Web 2.0 and Virtual Worlds will likely force educational institutions to move with the technology, or fall behind as social institutions that are increasingly irrelevant to industry and community life in general (Pesce, 2008). Indeed, institutions offering IS courses face the challenges of motivating students intrinsically and of presenting didactical material that is of relevance to industry, both now and in the future. A case in point is that while industry is increasingly valuing programming skills (Hoffman, 2008), graduates may lack the motivation to learn programming and fail to see the relevance to an industry centred around Web applications (Feldgen and Clua, 2004). Correspondingly, Virtual Worlds such as Second Life offer a number of pedagogical advantages to those IS educators for whom developing current, industry relevant, and intrinsically engaging IS curricula is a priority. As discussed in Section 2, these include benefits for learning programming skills, systems development, project management, and industry/business experience.

As discussed in Section 3, popular technologies such as Web 2.0 have only proven truly beneficial to the needs of distance learning students and have not optimally enhanced pedagogical outcomes in mixed/blended learning contexts. If not we are not careful, our use of Virtual Worlds will follow the same path and their full pedagogical potential will be missed. If integrated innovatively in IS curricula, Virtual Worlds can enhance intrinsic motivation, stimulate excellence in learning outcomes, and promote industry/research application. These points have been illustrated with case studies discussing educational applications of Second Life in curricula at the University of Hamburg and Curtin Business School. These examples can stimulate further innovations in design and implementation of IS curricula.

The use of Virtual Worlds in general, and in education, is not without challenges. For example, Virtual Worlds require relatively powerful computers, high bandwidths, and comparatively high usage quotas. These factors may be prohibitive for institutions that do not stay current with their ICT systems. However, this may be overcome by using institutional servers to host Virtual Worlds in-house. While Second Life is currently hosted centrally by Linden Lab on servers in the United States, there is call to provide geographically distributed servers. This possible development could facilitate private Second Life servers and may overcome criticisms about the security, speed and reliability of Second Life's service provision.

A benefit of working at the forefront of emerging technologies such as Virtual Worlds is the rich culture of innovation. This is a variety of existing developments that could be more thoroughly used in education. For example, users implementing 3D mice for intuitive and sophisticated navigation or using interactive whiteboards (smart boards) in Second Life using Nintendo Wii controllers. Perhaps Second Life could be hosted on 3G mobile devices. Users could immerse themselves even further in Second Life using the Nintendo Wii Balance Board. The educational possibilities will be extended even further by technological developments such as virtual reality goggles and body motion sensors (Ruddle and Lessels, 2009). These could facilitate even more interaction between real and virtual classrooms in a blended learning environment.

To conclude, there are rewarding opportunities to enhance IS Education for students through innovative use of emerging technologies such as Virtual Worlds. In particular, Second Life offers students the chance of immersion in a protected and privileged real world-like environment, with instant life-like feedback on their ideas, decisions, and constructions, without penalty associated with making errors and yet with the benefit of intrinsic reward for success. As the use of ICT continues to evolve in the general community, educational institutions face the challenge of staying at the forefront of innovation and industry relevance (Pesce, 2008), and Virtual Worlds are one way of doing so that is both inexpensive and pedagogically beneficial.

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Torsten Reiners is a postdoctoral researcher at the University of Hamburg, Germany, and University Associate with the Curtin University of Technology in Perth, Australia. His research and teaching experiences are in the areas of clustering and mining large data sets, online-algorithms and the incorporation of bio-analogous meta-heuristics in simulations models (applied to container terminals), fleet logistics, information systems as well as several topics in e-learning and software development. Within his PhD-thesis "Simulation and OR with SmartFrame" he demonstrated concepts for didactical models. Besides scientific publications, he is currently doing research in semantic networks to improve cross-border communication and (e)learning as well as machine translation. Another interest is about (virtual) worlds and their interconnectivity and exchange without barriers. This research includes the development of highly adaptive systems, automatic processing of documents and their analysis as well as evaluation, the usage for educational purposes in a multicultural setting, the usage of innovative platforms like virtual worlds integrating emerging technologies like mobile devices. Torsten Reiners is co-founder of the Second Life Island University of Hamburg and Students@work, an initiative to promote education in Web 3D as well as the value of students' work.

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APPENDIX

Glossary of Terms

3D environment: An application that facilitates the representation of (and perceived movement within) three spatial dimensions (a term that includes 3D Virtual Worlds).

3D Virtual Worlds: Virtual Worlds are "online environments that have game-like immersion and social media functionality without game-like goals or rules. At the heart is a sense of presence with others at the same time and in the same place" (Constable 2008, n.p.); 3D implies a three dimensional representation. Examples include Second Life, Croquet, Project Wonderland, Second Life, Twinity, and Habbo.

Avatar: A computer user's representation of himself/herself in the form of a two or three-dimensional model, as in computer games or virtual worlds.

Concurrent Versions System (CVS): A collaborative tool used to store source code and keep track of modifications.

Constructionist paradigm: Papert's educational method that is similar to Piaget's constructivist approach by placing students as active participants in the learning process, and additionally emphasises the utility of a socially demonstrable learning process (i.e., that students' learning is enhanced when the outcomes are publicly viewable and are shared/communicated with others; Ackermann, 2004).

Constructivist paradigm: Piaget's developmental learning theory that emphasises the role of active knowledge generation by the learner's interaction with the environment (Ackermann, 2004).

Digital natives: A term describing the recent generations whose development is characterised by immersion in digital media and communications technology (Prensky, 2001). A digital native is a person who is "Born Digital", that is one who has grown up with digital technology such as computers, the Internet, mobile phones and MP3s. (from Wikipedia)

Generation Y: A phrase used to describe those born between about 1980-1994 who have grown up using Information Communication Technology (McCrindle, 2006). Generation Y, also known as The Millennial Generation, is a term used to describe the demographic cohort following Generation X. Its members are often referred to as Millennial. Precise dates are disputed but Generation Y consists of those people born somewhere from the early 1980s to early 2000s, (from Wikipedia). See also (Palfrey and Gasser, 2008).

Immersion: The perception of being "enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences" (Witmer and Singer, 1998, p. 227).

Information Communication Technology (ICT): A phrase that describes Information Systems by highlighting their dual utilities of processing information and facilitating communication between entities.

Linden Scripting Language (LSL): A programming language in Second Life that is used to implement (inter)active objects. The scripts (code fragments) are stored in the objects and are used to provide (inter)action with them. LSL is event based and object oriented (i.e., the LSL instructions are called based on occuring events like the object is being touched or receives a message).

Presence: "The subjective experience of being in one place or environment, even when one is physically situated in another" (Witmer and Singer, 1998, p. 225).

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