Exploratory Learning in the ViStA Immersive Environment

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Abstract: Virtual Worlds have been used for teaching for several years but many issues of usage and evaluation still exist. In our Virtual St Andrews (ViStA) world, we aim to embed students within a virtual environment which is a duplicate of a real university to allow for an easier orientation to university life and a mechanism for reducing acclimatisation stress for (overseas) students. By allowing a multiple of learning approaches, including self-directed and constructive learning, our world grows organically as student groups develop areas and scenarios for future students and educators use the world for developing student skills. A variety of academic schools and English Language tutoring encourages student engagement and input. Further, Administrative and Support units within the University have been encouraged to support students by donating information or scenario scripts to be built by dissertation students. Effectively, VistA has become a cross-university educational and support system for a variety of potential and current students.

1 INTRODUCTION

The Virtual St Andrews University, ViStA, virtual world project has been developed to encourage prospective overseas students to learn and interact with the University prior to their arrival. It has engaged students and staff from several disciplines and units across the University and is the focus of student centred learning and development as well as interactive enquiry from overseas students.

Initially constructed by researchers in the School of Computer Science who have experience in other immersive environments, the project was also directed by a member of staff from the English Language Teaching service. Therefore the project considered non English native speakers as the primary client or student within the virtual world. Overseas postgraduate students coming to study in the UK for one year only for a Masters degree are faced with many urgent requirements; to be inducted and oriented within a few days, to understand the expectations of academic staff, the University's rules and regulations, to discover where buildings or staff reside as well as settle into residences or other accommodations and make contact with other students. The rationale behind the decision to build a virtual St Andrews was concluded from the experiences of many staff, and students, that one

year postgraduate overseas students, especially, need some help in understanding the University system and embedding themselves within their new physical environment.

The following paper outlines some of the approaches we have taken to alleviate student stress and to follow advice garnered from student interviews and staff requirements for information to be displayed in a more interactive and enjoyable way. Part two discusses Virtual Worlds (VWs) and considers how far the educational research into VWs has come and Part three summarises the developing Virtual St Andrews project. The paper concludes with discoveries from our user trials.

2 VIRTUAL WORLDS AND IMMERSIVE ENVIRONMENTS

Virtual Worlds (VWs) are an important tool in modern teaching as well as the entertainment industries. As immersive environments they can lead the user, via an avatar with some projected identity, through a series of escapist games and interactions, or through a series of learning defined objectives. In the last decade (Duncan et al., 2011) there has been an explosion in interest in using VWs for educational purposes, from primary and secondary

educational constructive learning through to Higher Educational constructs in which the student self learns and self directs.

Mennecke (2008) stated that VWs are part of the domain of multiplayer online games but without the organised gameplay. Consequently, the user can meander through a VW or interact with scenarios in a personally chosen path or meet with and work together with other users. VW examples are the Sims (http://thesims.ea.com/en_us/home), a game with multiple environments such as towns, hospitals, holiday islands to visit, or the online game worlds Second Life (http://secondlife.com/) and Active Worlds (www.activeworlds.com). In these online worlds personally designed avatars can roam, build, interact or quest. Both have educational islands (servers) from a large list of Universities and Colleges who have bought space to build an environment for their students to interact and learn in. Another system commonly used is OpenSim (http://opensimulator.org/) which is an open source VW simulator. The University of St Andrews School of Computer Science uses OpenSim to build multiple environments for students such as the Laconia Acropolis Project, St Andrews Cathedral and Castle, Linlithgow Palace, Brora Site and a Virtual Humanitarian Disaster (VHD) Simulation (http://openvirtualworlds.org/). Some of these have been built in conjunction with Scottish Heritage or with other academic schools in the University such as Archaeology or Management. The simulated worlds are rich in visual and cognitive entertainment. Users can wander through the worlds, or as in the VHD, interact with constantly changing scenarios.

Immersive environments cover a range of environments where the cognitive awareness of a user is altered by an artificial environment. The user effectively suspends partial or complete belief, enabling them to interact and react to stimuli in the artificial world. This is applicable to chess players being mentally immersed in their game, or to players within a virtual environment cave, where they have a total immersion within the world and their actions, through tactical or sensory motor accoutrements allow a complete sensation of being in that environment. Users of Active Worlds, Second Life or OpenSim have a narrative immersion when they feel emotionally invested in the experience. They may even progress to a form of spatial immersion when the game play is projected or they feel so convinced by the reality of the simulation that their awareness is totally embedded within the experience. Consequently we use the terms Virtual

Worlds as well as immersion as the simulations are growing increasingly real to afford the user a sense of being in-world.

Around the world, there are many users of Second Life and Active World, latest estimates suggest these are in the range of half a billion users. The world online population, as of June 2012, is 2,405 million users with North America, Australia and Europe with the highest online penetration of over 60% each (http://internetworldstats.com). The fastest growing regions are Asia, Africa, Middle East and Latin America with online user growth rates of circa 1000% over the last decade. Asia currently has 27.5% of its population online but at over 1,076 million people this demonstrates a vast target for online educational support as well as learning within games. It is therefore necessary to summarise the types of use that researchers have made of virtual worlds to enable an assessment of the state of the art.

One of the driving forces of this work was the knowledge that many students feel stressed when arriving in a new University and a new country. According to Smith & Khawaja (2011) acculturative stressors include language barriers, educational difficulties, loneliness and some basic practical problems with finding themselves in a completely new environment. The goals for students are to achieve adaptation, socialisation and have an awareness of the host country (Lord & Dawson, 2002). The OECD (2012) indicates that there are now over 4 million international students worldwide with over 52% from Asia. Since 2000 the number of foreign tertiary students in OECD countries has doubled. Consequently an attempt to reduce either language or educational or socio-cultural stressors is a valuable goal for any educational establishment.

2.1 A Virtual Educational Taxonomy

In a Virtual World Educational Taxonomy (Duncan et al., 2012) the authors consider the primary level differentiators to be the Who (Population), the What (Educational Activity), the Why (Learning Theory), the Where (Environment) and the How (Supporting Technologies). A sixth category allows current and active research to be noted.

The *Population* category demonstrates that researchers have worked on VWs for a variety of different age groups from primary school age children up to Higher Education students. Also, some worlds have been developed for physically disabled users. Most of the published work to date focuses on higher or further education.

The *Educational Activities* category is rich in diversity from problem based learning, role playing, enquiry based learning, collaborative work, virtual filed work or even simply attending classes in-world. Myller et al (2009) presented an Engagement Taxonomy which included simple viewing (of information), as well as responding, changing, constructing or presenting. This effectively reduces to no engagement, passive engagement and active engagement. Most of the activities in this category fall into the active engagement category with users constructing artefacts in-world or discovering information and forming solutions. Collaborative simulation and constructional activities comprised over 70% of the reviewed literature here.

Learning Theories refers to the philosophy behind the educational activity. Here we have constructivist, experiential learning, collaborative, experimental, instructional or didactive approaches used with the most common being constructivist and collaborative. It is noted here that Jestice and Kahai (2010) suggested that virtual worlds can offer unique experiences consistent with situated learning theory in which learning happens within the applied context and learning is active and acquired through experience. Jarmon et al. (2009) concluded that Second Life is an effective environment for a project-based experiential learning approach because of the connection between the real world and the in-world tangible experience. Not surprisingly, collaboration and experimental constructivism were the dominant categories in the reviewed literature.

The *Learning Environment* category include the Web 2.0 based Virtual Learning Environments (VLEs) and Learning Management Systems (LMSs) as well as the 3D web based technologies which include virtual worlds.

The *Supporting Technology* category lists the variety of technologies that are optional or required within environments. These include Chat and Instant Messaging (IM), audio, streaming technologies, infrastructural aspects such as virtualisation or networking requirements such as bandwidth and port dedication. As far as the user is concerned the communication aspects and visualisation and rendering speeds are vital in aiding immersion.

Lastly, the *Research Areas* category demonstrates that current researchers are not just investigating appropriate educational strategies, learning objectives and techniques, but are also inquiring into how identity and embodiment and even geo-spatial representation affects the user's immersion. Further challenges include understanding social norms and interactions within VWs and also how knowledge passing and co-ordination of knowledge can be supportive. A separate area of growing interest amongst linguists is the use of virtual worlds to aid language learning in a more contextual environment. However, a running theme amongst most work is the problem of evaluation and assessment. Most work reviewed was descriptive from case studies and did not engage with the assessment issues.

The Educational Taxonomy described above informed the design and development of the virtual world described in this paper. The original intent was to build a VW useful for acculturation purposes, an unusual learning or educational goal. Experiential or exploratory learning was the key learning theory considered at this stage. However, as the system was developed and trialled, it was noted that the world could be also be used for educational purposes such as training within Masters level research methods modules which cover a variety of topics taught at repeated intervals to different groups of students within the University. Consequently, the *Educational Activities,* and the levels of engagement, were passive learning through active engagement with project based work, instructional and collaborative scenario building. The *Learning Environment* was the ViStA world, but the *Supporting Technologies* were essentially basic interaction and manipulation through a laptop or personal computer. Our *Population* was primarily postgraduate overseas students and our inital *Research Area* was the investigation of what overseas students would engage with for orientation and induction, especially when those actual real-world periods were time reduced in the university calendar. Secondly we desired to investigate student based learning and student directed learning, for support purposes, around specific issues of concern for overseas students.

2.2 Educational Issues in VWs

Whereas much current research is focussed on experimental environments in which students have tasks or activities to perform, several issues have arisen from our experiences in the management of these activities:

- Educators find it hard to monitor students in-world without having a constant presence which may negate student discussion or alter behaviour.
- Without monitoring it is difficult to know whether student work is truly collaborative and whether all students are engaged and

have their comments taken into account by their peer group.

- Assessment and evaluation problems then follow from the above. Formally written student reports are often used to consider their learning experiences but these are not always a true reflection of what a student has learned both academically and about themselves from their experiences. More reflection is required and appropriate assessment and evaluation methods need to be developed.

- How much contextual information or directive information should be given to students is an important facet of teaching in-world. Essentially how much do educators lead the student or is this another element that must be layered as students develop their own skill sets.

- Inclusion and accessibility is of importance especially when dealing with non native speakers or students new to VWs. If instructions are in English or the use of idioms is common, then again, we must be aware of secondary problems posed by working in an immersive, but essentially foreign, environment for new students. We should not add to their educational or social stress factors.

These issues do not allow us to fully utilise the power of immersive environments. Virtual Worlds have great potential to reach a variety of students and give them a self directed and essentially free form mechanism to discover for themselves. If educators can leverage the power of immersion within VWs, students will gain benefit from doing and understanding rather than listening. The current work in virtual archaeological field work, visual representations and interaction with algorithms, biological models and the human body as well as architectural models and police scene reconstructions demonstrate the variety of uses of VWs. However, if there are problems with evaluation and assessment we run the risk of allowing students to enjoy these worlds, without correctly assessing their work. Feedback therefore becomes problematical and grading is unlikely to be accurate. A secondary issue here may be that the types of (taught) modules which incorporate VWs need to be peer assessed or report assessed, both of which cause separate problems with accuracy or peer transparency.

A further area that has not been well developed so far are the use of these environments for either language teaching such as TEFL or for learning research methods. Both of these are important fields for overseas students coming to study in the UK. Apart from learning the language, students must write reports and dissertations in (scientific) English, and learn our systems of academic integrity, laboratory practices, statistics etc. All of these are stressful for the novice student.

2.3 Exploratory Learning in VWs

Overseas students, especially, must come to understand the cultural and academic requirements when studying abroad. No matter the country overseas students decide to study in there will be many stressful and acclimatisation situations ahead of them in finding out travel information, accommodation, matriculation, fees and visa requirements let alone finding a suitable academic school in which to study. These may not be directly educational but orientation, and induction problems affect a student's ability to settle into academic work. By developing a VW to allow a student to engage with their prospective university in advance of arrival, it is posited that the student is more engaged, and more aware of important educational and support information.

An aspect of this work is to investigate whether students follow exploratory learning patterns of asking questions (about relevant issues), investigating further (URL usage, chat, email), creating (scenarios or information for future student usage), discussing (sharing ideas and knowledge) and reflecting (through online histories of their time in St Andrews). The initial user trials demonstrate that students have followed the first four stages and the latter two are under construction with current projects. These have been driven by the students and their own enquiries based on using the ViStA world as an online orientation tool. The use of the world as a TEFL environment or for supporting teaching will now be a later phase of our continuing research and we plan to monitor the learning patterns used.

The next section describes work in building the virtual university with the primary aim of helping overseas students through their orientation and induction into a UK university. If only a few students find that a virtual university delivers appropriate contextual information and helps them, and their families, understand the world in which they are physically going to be part of, then the virtual university has been a useful exercise.

3 THE VIRTUAL ST ANDREWS

To gain entry to the ViStA world go to the URL: http://openvirtualworlds.org/ViStA/register/ and following registration one can download a viewer before entering the virtual medieval St Salvator's Quad at the centre of the University.

ViStA was originally created as a Virtual World orientation site for overseas students and has been used and evaluated by current MLitt and MSc students from the Arts and Science faculties. The original research plan was to develop a safe and welcoming environment for students considering or intending to come to St Andrews to study with us. Students would be able to peruse and interact with the simulation of the university correctly placed within the city of St Andrews. Students would therefore feel familiarity with the geographical layout of university buildings as well as discover where key resources are physically placed.

One year postgraduate students have very little time to be inducted, oriented and then embedded into their course. They also have to settle into residences and the social side of university life before producing work at Masters level, quite commonly in English as a second language. As a university St Andrews has over 2000 overseas students a year, nearly 1/3rd of the student population. Helping students understand the geography of St Andrews as well as University procedures such as matriculation and registering for modules should allow students to be more aware of their situation. Recent changes in the University calendar also reduced time spent on orientation and put extra stress on academic and support staff to publish information in a short time frame. Therefore we considered it a useful exercise to discover what essential information both new students require to know and also, what University staff need to impart, to help new students through orientation. We decided that a simulated version of St Andrews would be a useful tool to impart knowledge and to guide students through their new physical environment. The use of virtual worlds and interactive technologies allows students to get to know the University, and possibly key staff or each other, before arrival. Although this does not directly impact onto teaching and learning, we expected a positive response from students and therefore a positive effect on learning from prior engagement and a welcoming attitude from the University.

The research plan allowed us to develop structured activities to encourage friendships and contacts to ease the transition into UK Higher Education student life. Current students were also encouraged to participate by both entering the world to chat to visitors as well as develop their own (virtual) areas and interests in-world.

3.1 Work Packages

The initial plan was to achieve key outcomes from the initial build time of six months. There were four main work packages, see Table 1, and the project was managed by weekly meetings to determine short term goals.

In Work Package One we concentrated on building a virtual world geographically identical to one of the oldest parts of the University; St Salvator's Quad and the Chapel and School buildings that surround the quad today. The area was extended to include the Student Accommodation Office and the Advice and Support Centre, the ASC,

Table 1: ViStA Work Packages.

WP 1	ViStA Build: Generate the prototype world in OpenSim concentrating on the oldest parts of the University and key student services.
WP2	Orientation: Interview key staff and build scenarios and interactive avatars to demonstrate services.
WP3	Technical Storage & Virtualisation: ensure that the system can take many visitors concurrently.
WP4	Evaluation: Test the system using current students and staff and feedback information into the system.

which is frequently used by prospective and current students and was therefore considered vital to the virtual world.On arrival inside ViStA, a student's avatar is centred in the Quad. Currently the Schools building and the College Halls that are sited on two sides of the Quad (see Figure 1) have rooms in which students can read posters with static and dynamic information embedded in them, or view short videos that are sited in picture frames of University life in St Andrews. These videos are a mix of official University videos and student made ones from their Bubble TV student society. In a later version of ViStA the lecture theatres and rooms will be exact in details to reality but for this prototype version we kept the physical facades of the buildings accurate but kept the space inside as one large room to enable multiple avatars to mingle.

Work Package two was concerned with interviewing key staff and current students to discover the information they considered vital to any new student arriving in the city. Although these are

only at an early stage of development, as befits a prototype, we will be building more scenarios and interactive displays and in-world content over the coming months as our Honours and Masters students develop more in-world content during their project and dissertation phases.

Work Package Three was the technical support for ViSta, and other worlds, ensuring that enough computational resources were available to enable multiple visitors to be in-world at the same time. ViStA has worked well with up to 20 avatars active in-world but a trial in early Spring 2013 is scheduled to test the system with many more concurrent users.

Figure 1: Inside the Quad facing the College Halls (ahead) and the Schools buildings (right).

Work Package Four has already taken place after the initial, primary build. Students from both MLitt (Arts) and MSc (Science) courses were asked to test the system in its prototype state and to give feedback. We were encouraged by the interest of many students who wanted to build constructs and scenarios as part of their research dissertations.

These work packages were designed to allow us to grow the immersive environment and to allow domain specialists to submit information for upload to the environment. Information about University facilities such as Accommodation, Library, ELT services, IT services and academic school information could be linked to via in-world posters or leaflets with embedded links or static information. Similarly avatars could "carry" information allowing visitors to read information when close to an avatar. For example, a student representative avatar wearing the bright red undergraduate gown could hold information on where a visiting student may wish to find information.

3.2 Challenges

As with many projects scheduled to last a few months, much time was lost in discovering who in the University held information about particular processes or who had the right to allow us access to videos or film in accommodation blocks. However, as the project is planned to grow organically over the next few years, then the lateness of some information was considered non essential to the success of the initial project.

As we advertised the virtual world within the University we discovered that several units were keen to add to our environment; the Advice and Support Centre were keen to advertise their facilities and support and to offset their massive workload in the early weeks of a new academic year and the English Language support services were keen to develop avatar scenarios and interaction for language practice. Further, commercial organisations in the city of St Andrews, a small city of around 16,000 population, offered images of store fronts and lists of available wares to add to the information content of ViStA. We installed URLs to commercial organisations in their shop fronts so that the information was dynamic and devolved to the commercial organisation.

The level of immersion offered in our prototype version was low; students did not wear game wear such as helmets or gloves. Only auditory queues were available along with chat mechanisms. The system was similar to Second Life wherein avatars can move around by walking or flying and could interact by chatting. One of the many research questions that we hope to consider in future experiments is the level of immersion required by students before a benefit is measurable. Many institutions will not wish to engage in expensive interaction equipment when, or if, students are willing to suspend belief or engage with learning at a lower level of an immersive environment.

3.2.1 Information Management

Management of information was one of our major concerns and it was important that we devolved the information back to the original sources by embedding URL links to web pages as much as possible. Some information was static but we decided that any frequently updateable information was best updated by the original source so that visitors were getting the latest updated information, such as train times or cost of accommodation. Local dissemination of information was therefore important to gain buy-in from the University and from city organisations that students would frequently use such as transport companies.

3.2.2 Language Support

The original plan for ViStA was to aid overseas students' orientation   so that they would engage with University work earlier and with less stress. Consequently multiple language information and interaction was a major consideration of our work. We originally planned to have in-world information in multiple languages but decided that, as the purpose was to help students orientate in a UK university, it would be appropriate to keep the main information in English. However, we also decided that it would be appropriate for some information to be offered in alternative languages, and what information this is and how it is to displayed is to be researched by students over their 2013 summer dissertations. Effectively we would have a multi-layered environment in which information could be transformed into Mandarin or Hindi if current students deem that to be necessary. Chat rooms for specific languages have been planned in the next iteration.

3.2.3 Sustainability

Essentially we see ViStA as student centred development for students and consequently the project itself should be self sustaining. As students enter the world and desire more interactivity or more language dependent information, then they can provide that functionality or resource for future students. For example, using interactive avatars to talk in a non English language was too complicated to be developed in the first prototype but this has been offered as a summer project for interested students to develop.

As the prototype demonstrates successful interaction as measured by structured interviews, questionnaires or user logs then more interaction and activities can be developed and the project should improve via student led development, subject to our analysis and evaluation. The project should have a direct effect on student activities and stress levels in the pre-sessional periods, staff- student relations and student socialisation.

3.3 Evaluation

Evaluation forms were given to two sets of students (Arts & Sciences) after a one hour ViStA taster session. Overall there were just over 30 students. The questionnaire is available online.

Most students felt they would not use the system very frequently after arrival at the University (with the system as it currently is) but they found the system easy to use and felt confident using it. They felt they knew more about the University and wanted to know more about St Andrews once they had been in-world. They found information easily and wanted to chat to more current students, but they were not keen on attending virtual lectures and there was a mix of responses for wishing to talk to staff in-world.

With the free form answers, students said they were pleased to find out more about the history and culture within the University and about Scotland and were fascinated by the 3D effects of the virtual world. They wanted to explore more of the town and University than is currently available. Some interesting points that were raised included the desire for students to see accommodation and transport systems. Whereas we had concentrated on the University as an entity with physical buildings, geographical correctness, history and basic facts, students wanted to know more about how to get to St Andrews, the cost of living and travel and what accommodation was offered.

The student questionnaire results also demonstrated an interesting facet about VWs. We call this the "Marmite Effect". Most students appeared to be fully engaged and liked the idea of a VW, wanting to be more involved as regards content, scenarios and even managing the project. A smaller but substantial group, about $1/3^{rd}$ of the initial cohorts questioned, did not see any benefit of the ViStA environment. They considered the University's own web pages to be sufficient along with Google maps to discover the university's environs. The second group appeared to find no benefit in perceiving the University in-world, meeting staff and students and interacting. It was posited that this may be due to immersion factors, the lack of game wear, of the simplicity of interactions currently available (until Summer 2013) in-world. It may be that some students simply prefer their own mechanisms for finding out information and therefore, as with all educational support tools, the usage should be an aid to those who want it and not enforced in any way.

4 CONCLUSIONS

ViStA was set up initially for overseas students to help them through a short orientation and induction period. Essentially our virtual world became a cross-university educational and support system. Students were engaged with the world and wanted to develop

more activities, buildings and interactions whereas staff wanted to deposit more links to information. Furthermore, staff and students both wanted to use the world for social activities, from advertising balls, sports of musical events to simply dropping into a room to have a chat with another member of staff.

Although it was originally posited that students would be keen to find out about a University's traditions, life-style and ethos, as well as necessary procedures such as matriculation and financial it was discovered that, pre-arrival, overseas students were mainly worried about accommodation and travel. Overseas students tended to hear about ancient universities through news reports or historical programs about which famous people attended the University. Online information tells the prospective student in general terms about the University and its research status, but students really want to know about non-academic issues such as travel to the City, accommodation and University social life. Consequently, we realised that it is important to listen to what students actually want, including the perspectives of EU and overseas students as well as UK national students.

The major recommendation that comes out of this project, so far, is that more time be given to a project of this nature; where there is a technical build and information gathering phases followed by evaluation. Although most of what was planned was completed, the timescale of the project has not been conducive to finessing our scenarios or extending our information base. Neither have we achieved the language aspects that will be the focus of the next research phase of our work. However, as a prototype, the project has most definitely been a success in terms of interest from the University and from students who wish to participate for the benefit of future students.

As John Stuart Mill stated in his Inaugural Address to St Andrews in 1865 when installed as Rector, "What an utter failure a system of education must be, if it has not given the pupil a sufficient taste for reading to seek for himself those most attractive and easily intelligible of all kinds of knowledge." We have posited that by allowing students to self learn in a restricted but organic immersive environment, we have encouraged self learning and awareness through social interaction and knowledge exchange. This may not be Mill's vision of reading but it is a major form of knowledge gathering for today's students.

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