Becoming Pandits Through Avatars: Leveraging Multi-User Virtual Environments for Education in the Digital Age

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***Abstract*- There are more than 200 educational institutions currently utilize Multi-User Virtual Environments (MUVEs) as teaching tools, suitable for today's digital generation. Research on educational MUVEs is for the most part in the early phases, aiming on proof of concept and utility of various design elements. As proposed in the U.S. Department of Commerce's 2020 Visions, there should be more studies to explore the potentials of the MUVEs while minimizing negative outcomes of their applications. This paper thus intends to classify MUVEs and explore current educational applications. It outlines the potential feature and challenges of MUVEs. In addition, it presents research on applications of MUVEs for social studies, sciences and medical education and their pedagogical values.**

***Keywords*- Avatar, Multi-User Virtual Environment, Second Life**

I. INTRODUCTION

A Virtual world or Multi User Virtual Environment (MUVE) is an interactive computer simulation of a geographical area, such as, a city or an island, where feature of the environment like buildings, forest, sky, oceans or persons are represented by computer graphics (Blaisdell, 2006). It is a virtual world where participants represent themselves through avatars and interact simultaneously with other participants and their virtual surroundings.

The educational applications of multi-user virtual environments (MUVEs) such as Croquet and Second Life have been increased significantly. Since 2003, there are more than 200 educational institutions participating in Second Life, representing 35 states in the United States, 4 provinces in Canada and 15 other countries (SimTeach, 2008). Not only are there more education institutions participating in this MUVE, the number of Second Life residents has also increased significantly. There were 350,000 residents in August 2006, a year later, over 8.5 million in August 2007.

Considering MUVEs' popularity and advantages, such as, role-playing, three-dimensions graphical interfaces, collaboration tools, more educational institutions have adopted multi-user virtual environments as teaching tools. For example, in the virtual Sistine Chapel on Vassar College's island, avatars can fly to the ceiling to inspect paintings, tapestries and its decoration.

The National Oceanic and Atmospheric Administration (NOAA) runs a Second Life island on which a number of teaching stations and situations have been created. These include watching what happens as a glacier melts, and standing on the shore as a tsunami wave comes in.

Fig.1 An avatar visiting NOAA in Second Life

II. CLASSIFICATION OF MUVES

Second Life, There, Active Worlds, Project Wonderland and Croquet Project are currently the most popular MUVEs available to the public. There is a suggestion by Christopher Zwiers that these MUVES can be basically classified into content class (Second Life, Active Worlds and There) and business class (Croquet, IBM's Metaverse and Project Wonderland). The content class virtual worlds are those with more emphasis on contents than specific business applications. In comparison with their counterparts, business class virtual worlds emphasize more on supporting business and communication processes than content or visual appeal (Zwiers, 2008).

However the classification suggested by Zwiers is not a clear-cut one. As Second Life can be used for conducting business, so can Croquet be also used to set up virtual learning environments or non-profit activities, such as the University of British Columbia's Arts Metaverse project. The following MUVEs represent types of virtual worlds that can be used for content (Second Life) and business (Croquet Project) usages. The third type is an example of a hybrid of a MUVE and a learning management system (Sloodle).

A. Second Life

Second Life (SL) is a 3D online digital world or metaverse imagined, created and owned by it residents. Only the Orientation Island and the landscape are sculptured by Linden Lab, all other content else is created by users. SL is an Internet-based, multi-user, 3D construction set that underlines creativity, collaboration, socializing and self-government. Users can participate in SL for free by simply downloading and installing the SL client (Rymaszewski, et al., 2007; Guest, 2007). Residents represent themsevles by their customized avatars. They can teleport to islands, villages or street blocks in SL.

B. Croquet Project

Croquet Project is a powerful open source software technology that can be used by software developers to create and deploy deeply collaborative multi-user online virtual world applications on and across multiple operating systems and devices. Croquet features a peer-based messaging protocol that dramatically reduces the need for server infrastructures to support virtual world deployment and makes it easy for programmers to create collaborative applications. Croquet is more extensible than Second Life, because SL does not set up a computational environment that belongs to it users. On the contrary, Croquet users and developers may freely share, modify and view the source code. The technology is not hosted on a single organization's server (The Croquet Consortium, 2007).

C. Sloodle

Sloodle is an open source project with a goal of bringing together the learning support and management features of web-based Learning Management Systems (LMS) or Virtual Learning Environment (VLE) with rich interactive game-technology based 3D Multi-User Virtual Environments. Currently all Sloodle development is based on integrating Moodle Learning systems' useful features, such as structured lessons, treaded discussion, self scoring quiz with Second Life virtual environment. (San Jose State University School of Library and Information Sciences, 2008).

III. EDUCATIONAL APPLICATIONS OF MUVES

In 2008 nearly every leading educational institution is exploring some form of virtual reality, either in direct learning applications taking place in Second Life or Croquet project, or in research settings, where enhanced visualization tools are inquiring the depths of data sets for new learning and knowledge. (NMC & ELI, 2008). The following are some examples of current educational applications of MUVEs.

A. Arts Metaverse

Developed by the University of British Columbia's Arts Instructional Support & Information Technology unit, Arts Metaverse, an immersive 3-D virtual learning environment, provides an opportunity for scholars, teachers and students to create and share their own virtual space with others. Arts Metaverse is based on the open-source Croquet platform, which allows users to integrate high-end graphics with sound, simulations, collaborative technologies, and other tools, enhancing virtual interactions and communication with others. Within the Arts Metaverse, participants will be able to create 3-D environments that could include buildings or spaces developed alongside their related video and audio clips, websites, and other media.

Virtual Machu Picchu is one of the prime projects developed by UBC Arts Metaverse. Dr. Marvin Cohodas developed this virtual world with the idea of taking students from the lecture hall to the ancient ruins without actually having to make a trip there. While in the Machu Picchu virtual word, students can study 3-D artifacts, interact with others through text messages or microphones. Instructors can lecture, play video clips and webpages at the ruins. Students can gain unique experiences, which cannot be acquired from looking at pictures or viewing a video clip of the ruins (Arts Instructional Support and Information Technology, Faculty of Arts University of British Columbia, 2009).

Fig.2 UBC's virtual Machu Picchu

B. River City

In the Harvard University's River City, visitors travel back in time to a 19th century city called River City, bringing their 21st century knowledge and technology to solve 19th century problems. Students work together in small research teams to help the town residents understand why they are becoming ill. They use technology to keep track of clues that hint at causes of sickness, form and test hypotheses, develop controlled experiments to test their hypotheses, and make recommendations based on the data they collect, all in an online environment. In this MUVE, there are over fifty digital artifacts from Smithsonian museums at the visitors' fingertips. Students also have access to online microscope and digitized Smithsonian artifacts. They explore these artifacts for clues that may lead to solutions of health issue in the virtual world (The River City Research Team, 2007).

C. Virtual China's Forbidden City

The Forbidden City: Beyond Space and Time is a joint venture between China's the palace Museum and IBM. This IBM Corporate Citizenship project provides the means for global audience to explore Chinese culture and history. It is the world's first online virtual world dedicated to a country's cultural heritage.

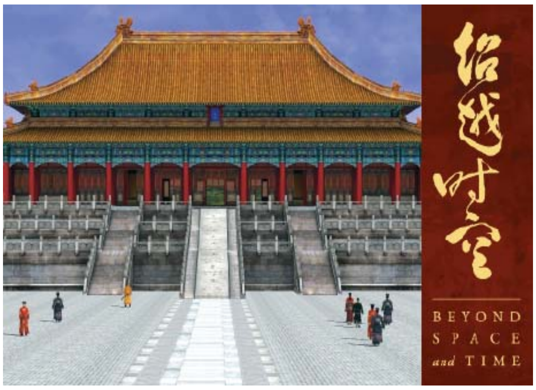

Fig. 3 A group of avatars visiting the Virtual Forbidden City

In the virtual City visitors can see and interact with each other, volunteers, staff, and automated characters. As they explore the Virtual Forbidden City, visitors can choose to observe or participate in activities that provide insights into important aspects of the Qing dynasty, or even take guided tours that uncover new insights into the stories of the Forbidden City. Moreover, the Virtual Forbidden City also provides an unequalled way for people to plan a visit to the real Palace Museum. Because of their experiences in the Virtual Forbidden City, visitors to the Palace Museum can easily find their ways and understand the significance of places and things they encounter (IBM, 2008).

D. The Virtual Neurological Education Centre

The Virtual Neurological Education Centre (VNEC) in Second Life is developed by Lee Hetherington at the University of Phymouth, Devon, UK. The project's goal is to promote awareness of neurological disorder to the general public. It also provides medical professionals an online virtual environment for training and demonstrating a virtual experience of a neurological disorder. This project brings a large number of audiences including medical research, training, education and assist in contributing knowledge of neurological disorders to patients, their family and friends visiting the centre in Second Life. For example, patients and their peers can learn information about organizations providing supports and consultation at the VNEC's information point. Additionally, the VNEC also allows persons with a neurological disability a second identity and a place for social networking that are not possible in their real world (Hetherington, 2008).

IV. POTENTIAL FEATURES OF MUVES

A. Role-playing

MUVEs are a great tool for role-playing. Role-playing in the MUVEs can be virtually realistic. Not only can users assume certain roles or identities, but they can also create their avatars' appearances to match the roles they adopt. For example, at VNEC, after assuming the role of patients and selecting types of neurological symptoms, Second Life residents' avatars will animate the conditions of the disorders. MUVEs allow a person to experience more than one role and to see the experience from different perspectives.

B. Risk-Controlled Environments

Another benefit of the virtual environments is that participants have complete control over the virtual worlds. MUVEs offer participants risk-controlled or even risk-free experimental labs. In Whyville and River City, sixth-grade students study virtual contagious diseases for five months. They gathered information from infected avatars and used various tools to track contaminants (Kao, Galas, & Kafai, 2005). The same experiments in school labs with real germs would be unacceptable. Another MUVE, which provides risk-free experiments, is UC Davis' Virtual Hallucinations. In this lab, any participants can experience being hallucinated, without taking drugs or being put in hallucination stages.

C. Collaboration

Ability to collaborate is one of virtual worlds' unique strengths. MUVEs are not only venues for social networking, but they are also place where participants from different countries and backgrounds can work together on projects, such as designing buildings, or composing music. MUVEs provide the surroundings that can allow true collaboration. For example, some participants create remarkable designs, while others add content spaces in those designs, which are relevant to real life (Bransford & Gawel, 2006). Another example is the International Spaceflight Museum, which has provided pavilions for three Real Life organizations (Elon University's Second Life Planetarium, U.K. National Physical Laboratory and U.S. NOAA) to reach their appropriate audience. As a result, this provides opportunities for collaboration between the museum's developers and the external organizations' in-world staff (Cochrane, 2006).

D. Cost-Effectiveness

Developing projects, conducting classrooms and trainings in MUVEs can yield cost savings. Participants do not need to travel to offices or classrooms. Thus they can save their time as well. The costs of training sessions are minimal because MUVEs can reach thousands of participants at a single interval and training materials are reusable. University of Illinois at Chicago's School of Public Health Center for the Advancement of Distance Education has developed emergency preparedness training exercises on the Public Health Preparedness Island. Doing the virtual exercises in SL reduces the training costs significantly. The cost of live emergency preparedness exercises in two U.S. states is about 16 million dollars. This same amount can fund real-time virtual training in all states of the U.S. and other countries at all levels of the National Incident Management System (Ullberg, L., Monahan, C., & Harvey, K. (2007).

E. Versatile Educational Tools

MUVEs' convenience of telecommunications, abilities to reach out to large audience and game-like features make them great tools for learning and teaching activities. For example, educators can benefit from SL and LMS's features of Sloodle. Seamless Second Life's web integration allows browser integration with in-world contents. Students and teachers can also gain benefits of accessing teaching artifacts from other perspectives, which are not possible in their real lives, e.g., on the Texas Wesleyan University Biology professor Mary Ann Clark's Genome Island, students can walk through the walls of a human cell (Clark, 2008).

V. CHALLENGES

A. Technological Barrier

One of the challenges of using MUVEs for educational purposes is technological limitation, which includes computer hardware and network connectivity. For example, students' computers and network connectivity may not meet Second Life's minimum requirement. As MUVEs demand much higher network bandwidth and computing power on the user's desk, they would likely reduce participant access, which is a fundamental goal of any form of education (Anderson & McKerlich, 2007).

B. User Readiness

New users without previous experiences of MUVEs may not know enough basic skill to navigate around the virtual world. Setting up their avatars' profiles takes time to learn. Learning how to move or look is also a challenge to some inexperienced residents. However, the user readiness can be improved by educating the basic knowledge of computer usage. A student from the Technology College wrote "with technical understanding of computer programs and in general, Second Life was fairly easy to learn. It too me about 2-3 hours to figure most things out" (Bedford et al., 2006)

C. Limitation of User Interfaces

Some MUVE user-interfaces, especially those not in production version (beta version), may be inadequate for certain applications or cannot handle the high demand of large audience. For example, in search of ideal MUVEs for military training, Lieutenant Kent L. Sanders pointed out that although Second Life has many advantages over others, its graphical resolution is too low and unappealing for virtual military exercises (Sanders, 2007). Another example is voice interaction that has recently been added to Second Life; however it is not easy to use with large audience and requires additional technical skills and equipment to operate smoothly (Anderson & McKerlich, 2007).

D. Chaotic Content

A virtual world, which is built bit by bit by its eight million residents like Second Life, can develop into jarring combinations of simulations closed to virtual campuses. Casinos, nightclubs, and other adult themed entertainment complexes might surround the virtual classrooms. To avoid this chaos, educators opt to acquire their own private islands. This can reduce the intolerable content that a designer is attempting to get rid of, however it does not prevent a nasty avatar from wandering through (Sanders, 2007).

VI. PEDAGOGICAL VALUES OF MUVES

With MUVEs' great potentials of role-playing, risk-controlled environments, social networking and collaboration, learners can become pandits in ways that are impossible outside the virtual world. This is because MUVEs offer learners opportunities to interact in ways that pass on a sense of presence lacking in other media, i.e., the ability to connect with friends and connections to communities (NMC & ELI, 2007).

MUVEs can also provide conditions for authentic learning. According to Clarke and Dieterle, authentic, situated, and distributed across internal and external sources are the best learning environments. Yet these conditions are often difficult to create in classroom settings. Nevertheless, MUVEs open up a new world of possibilities for creating learning experiences that not only are authentic, situated, and distributed, but also provide a context to change educators' standards by which student achievements are judged and the methods by which students' accomplishments are evaluated (Clarke and Dieterle, 2006).

VII. CONCLUSION

A successful MUVE application for education depends on planning, development and research. However, research on educational MUVEs is for the most part in the early phases, aiming on proof of concept and utility of various design elements (Center for Implementing Technology in Education, 2008). Harvard's River City researchers pointed out that MUVE research is still in its infancy, so it needs appropriate research strategies and methodologies. They adopted a designed based research approach, which is a combination of quantitative and qualitative methods (Dede, 2004).

Chwen Jen Chen suggested that there should be more studies that help identifying the suitable theories or models for Virtual Reality design and development (Chen, 2006). Also, as proposed in the U.S. Department of Commerce's 2020 Visions, there should be more studies to explore the potentials of the MUVEs while minimizing unintended or negative outcomes of their use (Dede, 2002). Many of the related educational potentials still need to be exhaustively identified, explored in various settings or scenarios, and carefully researched, developed and evaluated to document best practices (Maged N. Kamel Boulos et al., 2007). The downsides of MUVE applications for education should be studied and avoided, so that the applications are ready as learning tools suitable for the virtual world pandits.

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