SLACTIONS 2012

PROCEEDINGS

OF THE 4TH INTERNATIONAL RESEARCH CONFERENCE ON VIRTUAL WORLDS – LIFE, IMAGINATION, AND WORK USING METAVERSE PLATAFORMS

November 15-17, 2012

EDITED BY:
LEONEL MORGADO| YESHA SIVAN | ANA MARGARIDA MAIA | GONÇALO CRUZ MATOS | RICARDO RODRIGUES NUNES | DANIELA PEDROSA | FERNANDO JOSÉ CASSOLA MARQUES | MARIA DA GLÓRIA FRAGA | VINÍCIUS LOUREIRO

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SLACTIONS

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LOCAL CHAPTERS AT:

PORTUGAL

OPEN UNIVERSITY, LISBON, PORTUGAL

COORDINATORS: ANTÓNIO QUINTAS-MENDES (OPEN UNIVERSITY) | LINA MORGADO (OPEN UNIVERSITY) | ISABEL VALVERDE (LISBON TECHNICAL UNIVERSITY).

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CONFERENCE FORMAT

By Leonel Morgado, Nelson Zagalo, and Ana Boa-Ventura

SLACTIONS 2012 was the fourth edition of the innovative SLACTIONS conference series. It was held in the Second Life® virtual world, but also in physical ("real-life") auditoria over 3 continents. It was a mixed event, with diverse modes of participation and involving several communication flows – all the way from those taking place between participants sitting side-by-side at a real auditorium in real life, to those between audience and speakers in a real or virtual podium, or to the communication between participants attending the conference from the comfort of their offices or homes.

When we set out to organize an international conference on scientific research involving the use of virtual worlds – or metaverse platforms, as this expression renders the concept more precise – our first idea was to hold it traditionally, in a Portuguese academic setting. But why make it so local? Why should we drop a rich online environment where we cooperate with colleagues and partners across the world for one where most people would have to allocate significant budget for participation?

We decided to organize it in Second Life. We were now left with the problems of the much needed interaction during any conference what about the informal moments of physical proximity, of eye contact, of physical handshakes, and those healthy discussions while sipping coffee or a hearty tea? What about coffee breaks, conference dinners, evening tours, social moments where one can relax and get a more humane feeling of where fellow participants stand on the topic at hand? Sometimes conferences end up being the single moment in a given year where colleagues who cooperate remotely have a chance to meet. Wouldn't we be missing that?

To solve this dilemma, we devised the SLACTIONS format as we describe next.

The conference would be held on a single location – in Second Life. From here on we will call this the in-world chapter.

Participants and speakers would be able to attend and present their papers from physical rooms across the world. From here on we will call these locations our local chapters.

Presentations taking place in the in-world chapter would be projected on screens at the local chapters, so people could follow the presentations, and still interact with fellow participants attending the same physical location.

And why not let participants at local chapters follow the proceedings with their own computers? Well, they could! But by following a projection, we ensured that a camera operator kept the video flowing from presenter to slideshow to audience, and people could follow proceedings even if they were not acquainted with the Second Life interface.

Furthermore, by having less people online, the conference could be enjoyed by many more people than the small crowds typical of Second Life events given the limits imposed by the very technological platform, and local chapters could be held even if their bandwidth allowed only a handful of Second Life avatars.

Paper Session

Travellers Of The Art, II Summit of Latin American Art by Museum Karura Arts Centre (MKAC)

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The MKAC, a virtual museum, helps artists to show their art works to the entire world through the virtual world of Second Life, approaching culture to this metaverse environment at the time that promotes and helps artists to innovate in the way they can arrive to international public. The Direction of the museum has tried with the organization of this II Summit of Latin American Art to spread the art made inside Hispanic culture context to an international audience, to promote "real life" Latin American artists, to establish professional bonds between all the taking part artists and to offer, across the exposed works, a varied and rich sample of styles, subject-matters, skills and diverse and different resources. Other purpose was to establish a comparison with the I Summit, celebrated in 2009-2010 and that was exposed in SLACTIONS 2010, revealing the evolution and differences between them.

Introduction

The II Summit of Latin American Art, also called Travellers Of The Art, organized by the MKAC (Museum Karura Art Centre) was a virtual exhibition made between October'11 and January'12 conceived to commemorate the "Día de la Hispanidad" (Columbus Day, October 12, 2011) and to contribute to increase the presence of Hispanic plastic arts in the international contemporary art scene, trough New Media Technologies inside a transmedia dissemination of artists and woks displayed in Second Life for this summit via in-world and out-world.

The name of the exhibition was chosen intentionally in order to show the creative dynamism of artists, the variety

of techniques, styles, media, materials used, and to highlight the creative and artistic dynamism but especially the activity performed by artists in space and time.

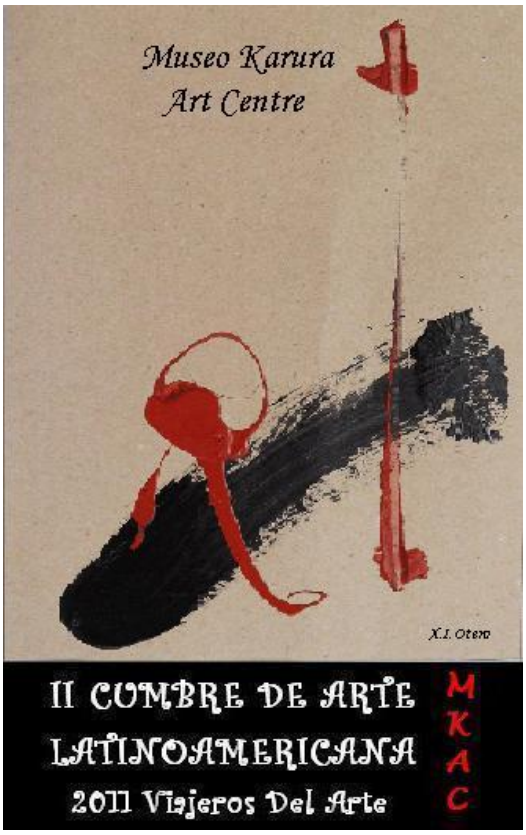

Figure 1: Poster of the II Summit of art of the MKAC

Artists that participated in this second Summit in alphabetical order: Xosé Luis Otero, (author of the exhibition's poster), Patricia Altmark, Antonio Amaral, Beatriz Ansede, Mirna Morinigo Bentos, Ramon Caban Brizzie, Gustavo Candellero, Tatiana Cañas Montes, Obander Ceballos, Helena Coelho, Cecilio Colón Guzman, Cesar Correa, Rudy Cotton, Peter A. Cruz Sunn, Bygocha d'Amalia (Byron Gomez), Claude Dambreville, Elina Damiani, Luz Darriba, Yoel Diaz Galvez, Mario H. Figueroa Archaga, Vidalia Gonzalez Noel Guzman Bofill Rojas, Osvaldo Herrera Graham, Paula Lopez, Victor Lopez, Asad Lopez de Castilla, Alexandre Magalhaes Pereira Pinto, Xavier Magalhaes, Anna Marten, Mario Matta (Netómar), Arquimedes Mejia, Nora Muñoz, Claudia Olivos, Samuel D. Pinell, Arlindo Pintomeira, Sonaira Piñero, Jean P. Richard (Zomo), Magnolia Rivera, Mario De Rivera, Joyce Rose, Vivianne Salinas, Olga Sinclair, Rolando Tamani, Ines Tolentino, Francisco Velásquez Zambrano, Lorena Villalobos and Adriana Villarga.

Figure 2: Spanish artists participation in the summit

Description of the of II Summit Latin American Art

The painting exhibition, Travellers Of The Art, brought together 47 artists, 93 works and 21 Latin American countries, Spain and Portugal. Spanish artist Xosé Luis Otero designed the poster of the exhibition.

The basic criteria followed in the selection of works and artists was by the quality of the works as fundamental requirement, the strength of the careers of the artists, the variety of themes that allowed us to verify the richness of topics, plurality in the use of techniques (watercolour, oils, collage, etching, acrylic...) and the proliferation of artistic styles that provide a richness and diversity to the exhibition.

This way, it was possible to maintain the educational and pedagogical objectives of the MKAC too, plus to achieve the objectives of the exhibition, providing a broad overview of Latin American, Spanish and Portuguese art.

Figure 3: MKAC's Main Building second floor

General and specific objectives

The objectives to achieve inside this second summit were divided into two types depending on general and specific objectives.

General objectives included:

- To celebrate the "Día de la Hispanidad" (Columbus Day, October 12) of 2011;
- To disseminate Latin American art;
- To break stereotypes about Latin American art;

- To link the arts to other artistic and creative disciplines;
- To demonstrate the enormous importance of the ICTs in projects of artistic character;
- To demonstrate the transcendence of metaverse platforms in the promotion and dissemination of art as something prolonged on time.

And specific objectives were:

- To promote and disseminate the work and careers of the artists participating in this summit;
- To publicize the variety of artistic resources, (themes, materials, technical...) of Hispanic art;
- To disseminate and promote the art through 3D virtual worlds;
- To demonstrate to the painters the importance of New Media tools in the dissemination of their works and career;
- To establish professional links between the participating artists;
- To create links between the plastic arts and other forms of artistic creation as per example literature and ceramics, among others;
- To highlight the importance of the social and geographical environment in artistic production.

Opening of the exhibition

The exhibition Travellers Of The Art, was located in three buildings which form the museum complex: the Main Building and Schumann's Building welcomed the 93 works, distributed by country areas, appearing in each panel or zone the four works of two artists with their names, pictures, curriculum and country flag.

Figure 4: Main and Shumann's Buildings, two of the three buildings of the MKAC dedicated to the summit

The third building, the Aularium, hosted a documentary exhibit with informative panels and texts about general data from all Latin American countries, Spain and Portugal (art, economics, demography, education, science and technology, health, sports, literature...).

Figure 5: Aularium building

The opening was in the "Día de la Hispanidad" (Columbus Day, October 12) of 2011, at 23:30 h. Spain (02:30 PMT; SLT), in the Lecture Hall of the museum. The Director of the museum, Yolanda Arana (a.k.a. Ina Karura in Second Life), greeted and welcomed all attendees and gave a brief presentation on the planning, organization and objectives of the exhibition, after which she introduced the lecture given by W.M. Schumann The challenge of metaverse platforms in artistic fields conference.

Figure 6: II Summit opening presentation

After the lecture, there was a guide tour showing the exhibition and a spectacle of light and sound at the facilities of the Museum Karura Art Centre (MKAC).

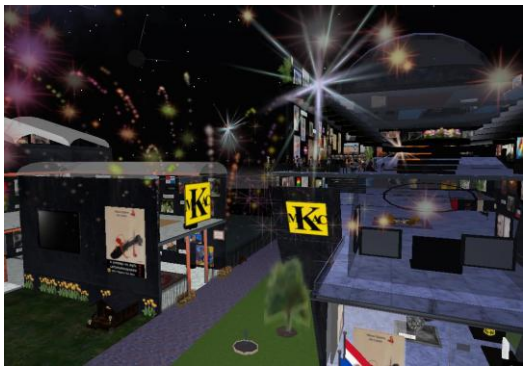

Figure 7: II Summit opening spectacle of light and sound

Methodology and dynamism: activities and events

To ensure the maximum diffusion of the summit, all the information texts of the exhibition was presented in Spanish and English and the MKAC organized activities and events that contributed to the dissemination of it, all planned promptly. Also, the museum management scheduled the times in order to hold events that could came spontaneously too.

The following activities and events, specified below, were done while the duration of the Second Summit of Latin American Art:

a) *Day of the Artist*: Activity in which and artist participating in the summit was highlighted during one day, going deeper inside its work and career. Apart of its information panel in the Velazquez Room of the museum (with their two pieces, photography, name and curriculum), the MKAC wrote a special post about the artist in its blog of the museum, forums, social networks, the official website of Second Life and also published internal notices in eleven Spanish and English spoken groups related to culture and education inside this virtual world.

This activity was carried out over 47 consecutive days (excluding Saturdays and Sundays) and lasts from October 14th until the 19th of December. (Example: Yoel Díaz Gálvez).

b) *Art and Literature*: Activity that provided information about a writer born in each country and its literary works. Writers selected were: Augusto Roa Bastos, Óscar Acosta, Camilo José Cela, Danny Laferrière, Enrique Jaramillo Levi, Fabián Dobles Rodríguez, Gabriel García Márquez, Hilma Contreras, Isabel Allende, Jacinta Escudos, Jorge Enrique Adoum, José Saramago, Laura Antillano, Mario Benedetti, Mario Vargas Llosa, Miguel Angel Asturias, Octavio Paz, Paulo Coelho, Silvia Ocampo, Víctor Montoya, Zoe Valdés.

c) *Guided tours*: Six guided tours of the exhibition were organized and six other arose spontaneously.

Figure 8: Guided tours around the exhibit

d) *Debates*: The talks were held about the topics "transcendence of Latin American painting in the international art" and "pictorial essence of Latin American art".

e) *Speech*: The Cuban painter Yoel Galvez Diaz gave a talk in which the artist explained his two works shown at the exhibition and provided information on his sources and career.

Figure 9: Talk of cuban painter Yoel Galvez Diaz

f) *Journey of poetry*: At the Journey about poetry was released the poetry of twelve Latin American poets. Some of them were Gioconda Belli, Antonio Isaza, Ruben Marquez, Sor Juana Ines de la Cruz and Amado Nervo.

g) *Musical events*: It was performed a concert and a musical evening by Karma Auer and Morlita Quan.

Figure 10: Artist Morlita Quan on concert

h) *Radio interview*: on January 21 of 2012; attended by artists of the summit and the director of Museum Karura Art Centre

j) *Interpersonal communication between the participating artists*: at the end of exhibition, the museum director provided to all the artists involved a list of email addresses of all of them so they can contact each other.

k) *Multimedia Events*: During the exhibition were displayed on the screen in the museum gardens the following videos corresponding to different artistic and cultural categories:

- Painting: "*Pintura Argentina Latinoamericana*" y "*Cundo Bermúdez, un día de trabajo*";
- Sculpture: "*El último gran escultor Latinoamericano de todos los tiempos, Víctor Corleone*" y "*José Martín: proceso de producción*";
- Literature: "*Carlos Fuentes: Producción Literaria*" y "*Pablo Neruda: Entrevista 1971*";
- Film: "*Diez años con el Cine Latinoamericano*" y "*Cine Latinoamericano: Presente en Berlinale*";
- Documental machinima: *II Summit of Latin American Art Video*.

The closure of the exhibition *Travellers Of The Art* was covered entirely (works, biographies, careers, art criticism...) in the museum's blog.

Reflection on the transcendence of the contents and activities

With the completion of the activity Day of the Artist, the MKAC managed to advertise the work and career of the artists and create bonds between them, facilitating the contact with each other, and involving the users of Second Life that visit the museum facilities with the exhibition, bringing them closer to the world of art.

This was achieved through the guided visits to exhibitions where the audience was invited to ask questions and to comment the works displayed. The debate was complemented with the implementation of gatherings and lectures given by art experts and the own artists participating in the summit such the Cuban painter Yoel Diaz.

With activities such as Multimedia Events, Plastic Arts and Literature and Musical Events, the plastic arts were related with other areas of creativity, areas that can influence an artist and generate the environment in artistic production. This transcendence was stressed throughout the entire event with the exhibition of various videos.

It was confirmed the relevance of the radio interview with the participation of the artists Pedro Cruz Sunu, Yoel Diaz Galvez, Luz Darriba, Arquímedes Mejia, Gustavo Cabalero and Samuel Pinell, interview which allowed to establish a closer relationship and binding between them and between audience due to real-time sharing of their own experiences.

Finally, the publication of the exhibition in the museum's blog and the production of a video of the event (uploaded to YouTube and shared on social networks) that leaves a permanent record of this collective exhibition, emphasizes the importance of the New Media Technologies in the diffusion of art and artists promotion; importance that was demonstrated, among other things, by the number of compliments and favourable reviews sent from many users of many social networking sites to the Direction of the Museum Karura Art Centre.

The II Summit of Latin American Art in numbers

The following data in numbers demonstrates the interest generated in this II Summit of Latin American Art of the MKAC.

a) General information:

- Number of artists: 47;
- Number of works: 93;
- Number of countries: 23 (all of Latin America, Spain and Portugal).

b) Number of visits to the museum buildings:

- Main Building, (works of artists and curriculum): 4,940 visits;
- SCHUMANN Building, (works of artists and curriculum): 5,516 visits;
- AULARIUM (information on 23 countries): 1,203 visits.

c) Number of visits to the museum's blog and forums:

- MKAC's Blog: 10,537 visits;
- Second Spain Forum: 90,441 visits;
- Irene Muni's Forum: 12,727 visits.

d) Visits to the museum during the first 24 hours: 183.

Expectation is demonstrated in particular by the large increase in visits (exposition, museum, blog and social networks), related to those received at the I Summit of Latin American Art of the MKAC in 2010 (*Proceedings of SLACTIONS 2010*, P. 130). In general numbers and comparing just the visits in-world to the museum, the first Summit was visited by 6,506 avatars while 11,659 avatars visited this second Summit.

II Summit of Latin American Art (2011) versus I Latin American Summit (2009)

The planning of the second summit events were scheduled and conducted in a different way to the ones made in 2009, although many of them were considered important and maintained for positive, due the results achieved two years before. This has resulted undoubtedly

not just in a better dissemination but also a higher expectation. The main differences were, among others, the following ones:

- The dissemination of the exhibit inside more social networks, as LinkedIn and Twitter, apart from Facebook;
- The introduction of activities that allow to link art to other creative ways (for example, literature) through the event Art and Literature, with film, sculpture and American cinema;
- Press realizes were send this time to English speaking Mas Media apart to just send them to Spanish speaking Mas Media as in the first summit;
- Haitian and Portuguese painters were included in the exhibition;
- The creation of a replacement list of 16 artists, in case of the failing of some of the first chosen artists.

Diffusion

All activities and events around the summit were advertised through the following channels of communication and in the following way:

a) Disclosure on our digital media channels (Apt. *Blog, Forums, Social Networks And Photographic And Audiovisual Material Links*).

b) Disclosure in Second Life: in-world press notes in eleven groups of Second Life (seven Hispanic and four Anglo-speaking) with a total of 9,983 recipients, a general weekly notice on the exhibition, a daily notification of a specific character (Day of the Artist, Latin American writer or author, broadcast video...).

c) Disclosure means of written and oral communication: Press releases to newspapers and radio stations, virtual and not virtual, in Spanish and English.

Virtual – Physical relationships

The relationship established from the collective exhibition *Travellers Of The Art* is manifested in different ways as the spread of this summit beyond the channels of communication of the museum (in other sites, blogs, forums... that aren't related to the MKAC), in the relationship that many of the artists set up through their emails and social networks between them and with the MKAC, including one of the Puerto Rico artists of the fist summit (Orlando Castro) came to the opening and met one of the artists of his same country (Cecilio Colón Guzmán), in the fact that seven artists become users of Second Life, in the desire of many artists to perform solo exhibitions at the Museum Karura Art Centre, in the increase of visits to the exhibition related to the first summit organized in 2009, in the recommendation that some of the artists did to other artist friends to participate in this summit and future ones, in the interest, through e-mails to the MKAC from institutions and arts associations, private and public, the radio interview held to several artists, the interview in the digital magazine Suite 101.net (*II Cumbre de Arte Iberoamericano del MKAC en Second Life*) and in other publications (El arte dominicano en cumbre internacional, MKAC un referente en la difusión del Arte en el Metaverso, Viajeros del arte, II Cumbre de Arte Latinoamerica del Museo Karura Art Center "Viajeros del Arte 2011", Cultur@ Apt. Artistas de interés and Arquímedes Mejía, Biography).

Evaluation

There are two types of evaluations conducted on the exhibition *Travellers Of The Art*: on one side, a specific evaluation was applied to each of the activities and events and, on the other side, a global analysis was performed at the end of this summit. The results of the evaluation process performed on the exhibition have been optimal and have been perceived, in an objective and verifiable way, on the increment of the visits received in this virtual museum, the in-world and out-world communication channels used by the museum and the interest shown by individuals and groups related to the world of art.

Conclusion

The relevance of the performance of an event as the II Summit of Latin American Art by the MKAC, a virtual museum born to disseminate art in an innovation way, it's confirmed by the information provided in paragraphs 7, 9 and 10 of this document and the interest shown by organizations and institutions that, thanks to this project, have realized the importance of using 3D metaverse platforms based in Second Life model, that includes a part of CG design edition for users and works as social network, for the realization of artistic projects of great importance, in the relevance they have in the dissemination and disclosure for the work and career of the artists, particularly as a propagation of artistic creations, in general, and in the transmission of the information and the knowledge of the art.

Figure 11: Some of the works displayed of Latin American artists inside Schumann's Building

Figure 12: The article of the interview about the II Summit of Latin American Art displayed in the first page of the digital magazine Suite101.net

BLOG, FORUMS, SOCIAL NETWORKS AND PHOTOGRAPHIC AND AUDIOVISUAL MATERIAL LINKS

MKAC's blog.

I Summit of Latin American Art SLACTIONS 2010.

MKAC's Facebook Group.

Twitter.

LinkedIn.

MKAC Forum in Second Spain.

MKAC Forum in Irenemuni.com.

Flickr.

An Exploratory Research Agenda for 3-D Virtual Worlds as Collaborative Learning Ecosystems: Extracting Evidences from Literature

António Correia[1], Fernando Cassola[1], Diogo Azevedo[1], André Pinheiro[1], Leonel Morgado[2], Paulo Martins[2], Benjamim Fonseca[2], and Hugo Paredes[2]

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Computer-supported online 3-D virtual world environments have been waxed and waned in interest and representativeness for supporting collaborative- and simulation-based practices. In a post-modern societal framework that requires inexpensive solutions for high-risk situations, research efforts in virtual worlds have developed a basis for understanding the use of virtual reality for multidisciplinary scenarios such as distance learning, training, therapy treatments, and social interaction. In this context, a recurrently updated research agenda for virtual worlds can characterize the current needs at a systematic way. This paper presents a meta-analysis of 35 publications to identify gaps and opportunities for research in collaborative three-dimensional environments based in content analysis. At a general perspective, there is a lack of established approaches to measure the influence and research potential of sociocultural factors in virtual worlds' usage, autism spectrum and other healthcare-related settings, learning outcomes, content characteristics, task support for groups and crowds, and online data collection.

Keywords: Bibliometrics, Collaborative Virtual Environments, 3-D CVE, Learning, Meta-analysis, Research Agenda, Second Life, Virtual Worlds.

1. Introductory remarks

Virtual worlds and metaverse platforms have appeared in literature as viable solutions for learning, working and other real-world simulation tasks, expecting a large and growing impact on teaching and learning in higher education for the near future (Hew & Cheung, 2010). Virtual world platforms have been adopted in a vast range of application fields such as healthcare, military training, economics, urban planning, architecture, education, or engineering (Jarmon et al. 2009). These hybrid virtual ecosystems provide an experience that transcends cultural, social, language, distance and temporal limitations through different modes of interaction (Anstadt et al. 2011). Nevertheless, an integrated approach is needed to recognize how experiential collaborative activities can be enhanced using Collaborative Virtual Environments (CVE), in order to support the innovation processes imposed by the increasing competitiveness among organizations.

Synoptically, CVE provide different features to create an online presence that can simulate real-world settings, enable socialization through several communication channels, and support cooperative work (Jarmon et al. 2009) based in the possibility to communicate synchronously via chat or audio, coordinating actions and manipulating digital objects using shared applications. In this sense, team members can jointly look at and interact with digital artifacts in a shared virtual world (Schroeder et al. 2006). Studies in cooperative work using 3-D virtual environments identified some features for social interaction and sharing artifacts enhancing peripheral awareness (Bentley et al. 1992). However, there is a lack of ethnographical approaches to identify supported tasks and collaboration mechanisms used by groups and crowds.

With the advent of the new millennium, CVE presented a set of research challenges related with new kinds of human factors and needs, distributed architectures, scalability and interest management (Benford et al. 2001), taking lessons from Computer-Supported Cooperative Work (CSCW), 2D interfaces, and anthropological research. However, research needs are constantly changing and it becomes necessary the understanding of current working and learning activities in 3-D virtual environments to identify gaps and opportunities. In this perspective, bibliography can be a basis to identify a research agenda partially aware of technical innovations.

This study presents a meta-analysis for three-dimensional CVE focused on 35 journal papers, conference proceedings and technical reports, supported by a literature review using the guidelines of Kitchenham et al. (2009) to measure the current research possibilities. Bibliometrics (Price, 1963) is also applied as a method for measuring/analyzing scientific and technological literature. The contribution of this study is mainly sustained in an identification of the state of the art of a little portion of 3-D CVE literature, bringing a context

to new researchers that are taking the first steps in this field.

Section 2 presents some background of virtual worlds and its applicability for several purposes. Section 3 presents the method, selection criteria and sample dimensions. Section 4 presents a bibliometric perspective of the sample analyzed in this paper to measure literature characteristics. Section 5 shows codified evidences from review identifying research gaps in 3-D CVE. Finally, some final remarks are presented in section 6 based in qualitative and quantitative evidences identified from the literature review process.

2. Entering the 'cave': A brief exploration of three-dimensional CVE in a social era

Historically, CVE have been around since the early 90s, and some even before as 'hardware-only systems' (Joslin et al. 2004). These platforms included technical improvements such as simulators, stereoscope, 'cinerama', head-mounted displays and trackers (Grady, 1998). Some topics studied in the first decades included location and time dependencies, reality *vs*. virtuality, anonymity *vs*. true identity, human *vs*. technological factors, level and scale of immersion, play *vs*. work, and presence *vs*. telepresence. In this context, Jäkälä & Pekkola (2007) argued that the research efforts on virtual worlds have transited from "considering them as tools to examining their use, from technology engineering to social engineering". While the focus relapsed on the technological aspects of 3-D CVE, there has been a need to understanding social interaction, comparing the magnitude of co-presence (Bailenson & Yee, 2008). A key purpose of "social virtual worlds" resides in the co-construction of a shared meaning through object handling, and communication with different people within a world (Damer, 2008). In a vast comparison between game- and social-oriented virtual worlds, Stangl et al. (2012) summarizes their success factors from scientific studies, pointing the support for a critical mass of residents as one of the several success factors attracting users.

A notable portion of the recent literature studies suggest that 3-D CVE can be well suited for experiential learning settings (Jarmon et al. 2009), military tactics and operations that require the latest innovations employing sophisticated technologies to prepare troops for a real combat (Pierzchała et al. 2011), mechanical processes related with maintenance tasks executed in military hangars (Fonseca et al. 2011), or healthcare-related approaches such as dentistry (Phillips & Berge, 2009), cardiopulmonary resuscitation (Creutzfeldt et al. 2010) or general medical learning (Wiecha et al. 2010).

In the context of higher education, researchers have been centered in the identification of requirements and potential benefits of project-based instruction and collaboration. In particular, researchers have found opportunities associated with social interaction, collaborative learning, an increased sense of shared presence, lowered social anxiety or partially liquefied social boundaries. In this sense, the Collaborative Learning Environment with Virtual Reality (CLEV-R) was developed to enhance the afore-mentioned aspects (Jarmon et al. 2009). The benefits with the use of simulation tasks in this kind of 3-D virtual environments may range from cost saving to efficiency and security, and their amplification of sociability and scalability (Grimstead et al. 2005) can be far greater that of collaborative multi-user enabling systems.

Research in the K-12 and higher education suggests that interactions in three-dimensional CVE can stimulate users and produce conceptual understandings of the main subject matter (Jonassen, 2004), and the characteristics of this kind of virtual environments may promote collaboration to make the work more dynamic and engaging (Reeves et al. 2008). 3-D CVE have potential to support crowded online settings where hundreds of participants can reach social engagement by dynamically forming subgroups (Schneider at al. 2012).

Metaverses can be conceptualized as 'immersive' three-dimensional virtual worlds within which people can interact with software agents "using the metaphor of the real world but without its physical limitations" (Davis et al. 2009). The development of digital ecologies has been marked by media spaces, CVE, mixed reality and hybrid ecologies that merge the mixed reality with ubiquitous computing "to bridge the physical-digital divide" (Crabtree & Rodden, 2008). In this sense, 3-D CVE can be described as authentic collaboration ecosystems that minimize the risk of complex tasks through simulation features.

Virtual Interpersonal Touch (VIT) appears as a phenomenon in which people can interact synchronously via haptic devices with a virtual environment. However, psychological effects related to the haptic communication need research to explore this issue. The addition of a haptic tool in 3-D CVE where users can touch each other may increase co-presence (Bailenson & Yee, 2008), introducing a different 'mode of immersion' that can enhance spatial interaction between participants and objects.

In order to meet these evidences with an integrated view, a bibliographical review process gives a holistic perspective of literature production in the 3-D CVE domain, measuring bibliometrics from the scientific papers, unsolved gaps that claim for further research, and semantic metadata that can complement results with probabilistic correlations.

3. Method

A portion of CVE literature is studied using an evidence-based methodology (Kitchenham et al. 2009) to provide a synthesis of literature reviews, taxonomic studies, and other classification schemes related with 3-D CVE. This proposal relies on the identified need for recurring systematic studies to measure the evolution of topics, gaps, and opportunities for research in this field. Systematic literature review (SLR) is a method adopted by multiple domains (e.g.,

economics, software engineering, social policy, and nursing) to collect and review research results from other studies using a pre-defined set of search terms. The purpose of this paper is to identify a research agenda for 3-D CVE aware of its current status and needs. Specifically, we distillate journal papers, conference proceedings and technical reports that present a literature review, classification model, or research agenda.

3.1. Research questions

The formulation of Research Questions (RQ) respected a reflection process, stimulated by reading scientific papers in the field of 3-D CVE using the Google Scholar's advanced search to collect bibliographical data. The central question established in this paper relies on the definition of potential evidences about 'research gaps' recognized in bibliography, leading to the following RQ:

***RQ1*:** What contributions can be provided by a systematic review about three-dimensional CVE?

***RQ2*:** What are the unsolved gaps in 3-D CVE taking into account the existing literature reviews, taxonomic schemes, meta-analyses and research agendas?

***RQ3*:** How to validate the achieved results and construct a reliable research agenda for three-dimensional CVE?

In order to answer these questions, this study is centered in a review of citable papers and technical reports to trace an integrated research agenda for 3-D CVE. In this context, we identified some contributions of a SLR in the following terms: i) provide qualitative data about the effects of a spec-ific phenomenon across a vast set of settings and empirical methods (Kitchenham, 2004); ii) allow to combine research data using meta-analytic techniques (Kitchenham, 2004); or iii) allow to assess impacts and challenges of technological development and human interventions (Mallett et al. 2012). In the specific case of 3-D CVE, recurring updated agendas can bring perspectives about new collaboration features and requirements. However, there is a need for further research into the potential of SLR methodological approach.

Concerning the second question, a search by terms related with the identification of possible gaps in literature presents a possible solution, including only publications with this set of characteristics. With respect to the third question, results can be validated through scientific references using a 'snow ball' approach. Reliable sources can validate this research agenda, representing a point of departure for future agendas aware of innovations verified in the bibliography.

3.2. Search process

According to McGowan & Sampson (2005), systematic reviews and meta-analyses have a great importance to keep well-informed of literature implements and make informed decisions. Our review aims to identify evidences, selecting and classifying studies for possible inclusion, synthetizing results, and interpreting findings. To validate this approach, we were involved into a bibliographic retrieval process with some complexity, organizing a specific amount of data and subsequent documentation, and restructuring the findings in a context of research agenda. The necessity for a systematic review of 3-D CVE relies on the summarization of existing data in literature, refining hypotheses and estimating sample dimensions to define a research agenda (Cook et al. 1997).

Table 1 represents an overview of the search criteria (C) adopted in the presented meta-analysis, establishing a set of keywords introduced in Google Scholar's advanced search to show a bibliometric perspective about scientific research in virtual worlds with emphasis on collaboration.

Table 1. Characteristics of the search process

Keywords and correlated terms	Search index	Criteria
K1: Collaborative Virtual Environments K2: CVE K3: Virtual Worlds 'AND' CT1: Systematic review CT2: Taxonomy CT3: Classification scheme	Google Scholar advanced search to filter papers by citation number and subject matter	C1: Journal papers, conference proceedings, and technical reports related with CVE in a virtual worlds' perspective C2: Systematic reviews, historical approaches, taxonomies, research agendas and classification models intended to classify virtual worlds

In the first stage, keywords (K) and correlated terms (CT) were introduced to retrieve a total number of 136 studies in accordance to bibliometric indicators (i.e., total number of citations) provided by Google Scholar's citation index. This process was complemented by a 'snow ball' methodological approach to identify potential related studies. The retrieved papers was reviewed according to their following sequence: i) keywords and general topic (defined from title), author(s) name, affiliation, country and additional identification data, ii) abstract, iii) full reading to identify possibilities and gaps and create an opening research agenda, and iv) bibliometric indicators (e.g., number of citations, topics, and countries).

3.3. Inclusion and exclusion criteria

The sample of the present study is a result of an inclusion/ exclusion process based in the guidelines of Sampson et al. (2003). Initially, a total of 136 papers and technical reports were retrieved taking into account the search terms showed in Table 1. In the next phase, three duplicated papers were removed. The lack of quantifiable metadata for two studies was also an exclusion criterion. Subsequently, a total of 46 papers were removed due to an inadequacy of their subjects for a meta-analysis focused in 3-D CVE and their unsolved gaps. Finally, a set of 50 papers were not analyzed in depth because they do not fit the second criteria (C2) represented in the Table 1. The remaining sample is constituted by a set of 35 publications associated with 3-D CVE that present an identifiable set of challenges and opportunities for research. From this analytical corpus, a wide range of studies related with learning (e.g., K-12, higher education) were identified.

A review of the resulting universe was made according to their bibliometric dimensions. Table 2 represents a basis for a research agenda partially aware of 3-D CVE requirements and shows the properties identified with the review process, structured by reference data, country of author's affiliation, publication venue, citations, method, subject, and research possibilities (RP) identified through content analysis.

Table 2. Sample dimensions retrieved from literature

Author(s) and year	Country of author's affiliation	Publication venue	Total citations[1]	Method	Subject(s)	Research possibilities
Inman et al. (2010)	USA	Journal of Interactive Online Learning	20	Qualitative	Virtual Worlds, Education	[RP1]
Hew & Cheung (2010)	Singapore	British Journal of Educational Technology	65	Qualitative	Virtual Worlds, Education	[RP2]
Mikropoulos & Natsis (2011)	Greece	Computers & Education	33	Qualitative	Interactive Learning Environments, Education	[RP3]
Stanney et al. (1998)	USA	Presence	313	Qualitative	Human Factors, CVE	[RP4]
Parsons & Cobb (2011)	UK	European Journal of Special Needs Education	10	Qualitative	Autism Spectrum, Education, CVE	[RP5]
Bellani et al. (2011)	Italy	Epidemiology and Psychiatric Sciences	1	Qualitative	Autism Spectrum, CVE	[RP6]
Dalgarno et al. (2010)	Australia, USA	Australasian Journal of Educational Technology	14	Mixed Method	Virtual Worlds, Education	[RP7]
Zhou et al. (2008)	Singapore, New Zealand	IEEE International Symposium on Mixed Augmented Reality	132	Qualitative	Augmented Reality	[RP8]
Wright & Madey (2009)	USA	International Journal of Virtual Reality	6	Qualitative	CVE	[RP9]
Grimstead et al. (2005)	UK	IEEE International Symposium on Distributed Simulation and Real-Time Applications	28	Mixed Method	Collaborative Visualization Systems	[RP10]
Messinger et al. (2009a)	Canada, USA	Decision Support Systems	118	Mixed Method	Virtual Worlds, Business, Education	[RP11]
Messinger et al. (2009b)	Canada	Journal of Virtual Worlds Research	37	Qualitative	Virtual Worlds, Education, Business	[RP12]
Jäkälä & Pekkola (2007)	Finland	The DATA BASE for Advances in Information Systems	23	Qualitative	Virtual Worlds	[RP13]
Schmeil & Eppler (2008)	Switzerland	Journal of Universal Computer Science	21	Qualitative	CVE, Education	[RP14]
Olivier & Pinkwart (2007)	Germany	Ifl Technical Report Series	1	Qualitative	CVE	[RP15]
Baladi et al. (2008)	USA	International Journal on Interactive Design and Manufacturing	3	Qualitative	CVE, Collaborative Design	[RP16]
Schmeil & Eppler (2010)	Switzerland	Facets of Virtual Environments	6	Qualitative	CVE	[RP17]
Otto et al. (2006)	UK	Virtual Reality Continuum and Its Applications	33	Qualitative	CVE	[RP18]
de Freitas (2008)	UK	JISC e-Learning Programme Report	85	Mixed Method	CVE, Education	[RP19]
Duncan et al. (2012)	Scotland, China	British Journal of Educational Technology	4	Mixed Method	Virtual Worlds, Education	[RP20]
Mennecke et al. (2011)	USA	Decision Sciences	8	Mixed Method	Virtual Worlds	[RP21]
Jarmon et al. (2009)	USA	Computers & Education	124	Qualitative	Virtual Worlds, Education	[RP22]
Bailenson & Yee (2008)	USA	Multimedia Tools and Applications	26	Mixed Method	CVE	[RP23]
Salmon (2009)	UK	British Journal of Educational Technology	75	Qualitative	Virtual Worlds, Education	[RP24]
Benford et al. (2001)	UK	Communications of the ACM	233	Qualitative	CVE	[RP25]
Davis et al. (2009)	USA	Journal of the Association for Information Systems	81	Qualitative	Virtual Worlds	[RP26]
Brown et al. (2011)	Australia	Business Process Management Journal	9	Qualitative	Virtual Worlds, Business	[RP27]
Joslin et al. (2004)	Switzerland	IEEE Communications Magazine	42	Mixed Method	CVE	[RP28]
Crabtree & Rodden (2008)	UK	Personal and Ubiquitous Computing	36	Qualitative	CVE, Ubiquitous Computing	[RP29]
Prasolova-Førland (2008)	Norway	Computers in Human Behavior	22	Qualitative	CVE, Education	[RP30]
Hasler et al. (2009)	Switzerland	International Conference on Human-Computer Interaction	6	Qualitative	CVE	[RP31]
Pinkwart & Olivier (2009)	Germany	Electronic Markets	4	Qualitative	CVE	[RP32]
Montoya et al. (2011)	USA	Decision Sciences	12	Mixed Method	CVE	[RP33]
Damer (2008)	USA	Journal of Virtual Worlds Research	21	Qualitative	Virtual Worlds	[RP34]
Wallace (2009)	USA	The International Journal of Technology, Knowledge and Society	0	Mixed Method	Virtual Worlds, Education	[RP35]

[1] Bibliometric indicators retrieved from Google Scholar's citation index in October 2012.

4. Bibliometric indicators of 3-D CVE research production

In the review scheme presented in Table 2, it can be seen a predominance of qualitative research studies followed by mixed method (qualitative and quantitative). The distinction between CVE and virtual worlds rely on the following crite-ria: i) at a CSCW perspective, CVE "represent a technology that may support some aspects of social interaction not readily accommodate by technologies such as audio and vi-deoconferencing and shared desktop applications (Benford et al. 2001), encouraging peripheral awareness and 'sharing artifacts' (Bentley et al. 1992), and ii) virtual worlds can be seen as 3-D virtual environments that incorporate multi-use and immersive presence, inhabited by avatars and providing a 'day-night context' (Morgado, 2009). In this perspective, collaboration support tools such as Moodle and Facebook can be understood as CVE whilst Second Life is one of the most-known virtual worlds.

According to De Bellis (2009), bibliometrics can be esta-blished as a set of methods to analyze quantitatively scienti-fic and technological literature. In this perspective, citation and content analysis are adopted as bibliometric methods to correlate a set of data aspects provided by literature. Figure 1 represents the number of studies reviewed in our study by author's affiliation country. In this graphical representation, a greater scope from USA, UK and Switzerland was clearly identified. Although Australia does not show a major focus in our study, it is one of the countries with more studies in the current research scenario in virtual worlds. The results can point to the study of collaboration associated to virtual worlds by North American researchers as a practice of their work purposes. The total number of fourteen countries is a notable indicator that brings an intercultural approach to the 3-D CVE research from several universities geographically distributed around different continents.

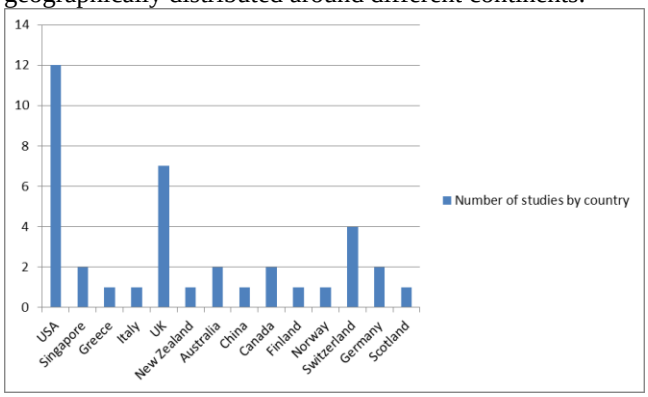

Figure 1: Number of reviewed studies by author's affiliation country (1998-2012)

In the qualitative analysis represented in Figure 2, we can identify the related subjects for each study at a holistic way. CVE represent the main subject studied in our sample, and it is followed by virtual worlds. Education is another field strongly examined in the recent years and in which there is a range of subareas to explore scientifically. Autism studies can be seen as a domain of notable importance to the future researches. Business remains as an interesting research field for CVE. Ubiquitous computing, Augmented Reality (AR), and collaborative design and visualization systems are other explored subjects. Finally, human factors are explored in a transversal way to the above-presented domains.

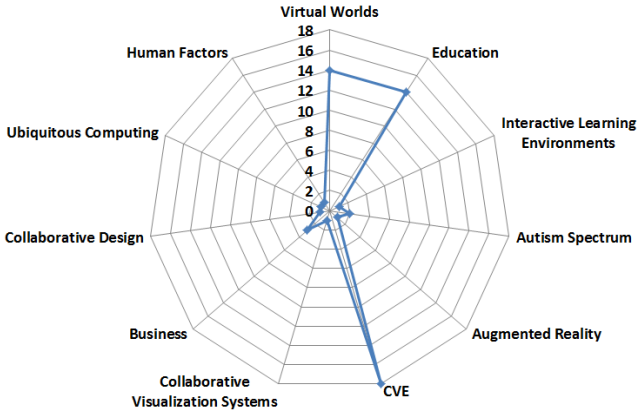

Figure 2: Subjects identified from review

Nevertheless, content analysis can be error prone due to the inherent human interpretation complexity. Limitations can be also established in the restrictiveness of the sample, which may not represent a large portion of current gaps and challenges of research in 3-D virtual environments taking in consideration the learning and working needs of society.

5. Towards a research agenda for three-dimensional CVE

It is time to reposition the state of research in the field of CVE to mobilize researchers, students and practitioners in order to achieve new goals and improve their capabilities to bring a context for complex tasks in learning, healthcare, working, or leisure. The codified research possibilities (RP) were based in a reading process focused on the aspects that provide an unexplored research topic, a set of guidelines to raise awareness on learning, cooperative work and human factors that claim for a compilation of fragments introduced in bibliography but without a scientific validation.

The research gaps and opportunities were achieved with a full-reading process, complemented with keyword search in the documents to obtain a new perspective about particular aspects. Some research notes were taken as a supplement to this bibliography-based analysis (e.g., sample size of review papers, and non-covered quotes). In this venue, we trace an overview of research gaps and possibilities for CVE (Table 3), extracting semantic evidences that can be suggestive for a more accurate meta-analysis with an extensive, granular, and flexible framework oriented to the current requirements of three-dimensional CVE.

Table 3. Codified data from review to identify research possibilities for 3-D CVE

Code	Description
RP1	It may be time for researchers and educators to collaborate developing a more safe and secure environment for all students in K-12. Future studies may examine reasons why little research with K-12 education is taking place in virtual worlds (e.g., Second Life) when compared with higher education.
RP2	A field for further exploration would be the use of avatars in terms of androgyny, anthropomorphism, credibility, homophily and selection criteria during an interaction. There is a need for more research examining the unique attributes or affordances of virtual worlds. Future research is required to examine the influence of sociocultural factors and country contexts on the use of virtual worlds.
RP3	Few studies have incorporated intuitive interactivity and settings that use immersive virtual environments reporting positive results on users' attitudes and learning outcomes. Characteristics of virtual reality (e.g., immersion) and features such as the sense of presence (e.g., perceptual features, individual factors, content characteristics, and interpersonal, social and cultural contexts) seem to be essential for education and have not been studied extensively since 2003.
RP4	Challenges related with human factors can be established into three primary fields within CVE: human performance efficiency, health and safety concerns, and social implications.
RP5	We still need to understand how to use the features of virtual reality to best support learning. Questions about the nature of the representation itself remain unanswered. There is much potential in the use of virtual reality technologies for autism and other healthcare contexts, but this potential remains substantially under-explored in research terms.
RP6	The use of virtual reality tools for habilitation in autism is therefore very promising and may help caretakers and educators to enhance the daily life social behaviors of autists. Future research on virtual reality interventions should investigate how newly acquired skills are transferred to real world and whether virtual reality may impact on neural network sustaining social abilities.
RP7	The compilation of an annotated bibliography of published research into, and evaluations of, 3-D immersive virtual worlds in Australian and New Zealand higher education will provide a solid platform for further research that can be generalized to all countries. There is a need for an accurate picture of the 'state of play', including current, past and planned tools at various institutions, so as to help direct research, development and use.
RP8	Augmented reality technology creates opportunities for exploring new ways to interact between the physical and virtual world, which is a very important field for future research. Three research paradigms (i.e., ubiquitous computing, tangible bits, and sociological reasoning to problems of interaction) can be explored to create new interaction techniques. Projection-based displays can have an optimistic future.
RP9	A possible study relies on the refinement of this evaluation in a different perspective (such as the classification of functional elements of CVE with a specific taxonomy).
RP10	Contributions can be suggestive with the expansion of publication spectrum to 2006-2012.
RP11	Attitudes and purchase intentions should be further examined so that companies can make decisions on the investment in their presence into virtual worlds and the marketing strategies most appropriate for their products (including co-creation and collaboration with consumers).
RP12	Are standards of social behavior in virtual worlds evolving differently from those in the physical world? What social values? Norms? Do behaviors and attitudes learned in virtual worlds affect behaviors and attitudes in the real world? Should virtual worlds be regulated? Will laws and regulation influence creativity and productivity in virtual worlds? How does the nature of the platform influence people's behavior? Do synchronous and asynchronous forms of interaction differ in meeting people's information needs, stimulating social interaction, or engendering trust? Does the monetary system in virtual worlds influence behavior? How can virtual world platforms be used for virtual service delivery and Customer Relationship Management (CRM), electronic retailing, teaching, and libraries? What types of services, products or courses are most suitable? How should the appearance of an avatar sales agent or instructor be designed? Are different platforms more or less conducive to self-governance? For media placement, what are the demographics, psychographics, geographic characteristics, membership sizes, and participation levels of various virtual worlds? Do virtual worlds influence consumers' self-concept? Will virtual worlds support themselves with a single up-front fee, periodic subscription payments, advertising, pay-as-you-go extras, or sales of ancillary products?
RP13	A framework for studying and classifying individual users, virtual worlds, collaboration mechanisms and their relations can be proposed. Relevant themes and research items can be identified (e.g.., by using qualitative methods such as Grounded Theory).
RP14	Further steps will include the definition of additional patterns, different classification approaches, and also the development of well-grounded guidelines for the creation of effective experiences for virtual environments. The current classification model is subject for on-going revisions, and scientific proof is still to be developed to help researchers, designers and practitioners to assess a 3-D collaboration and learning scenario in terms of its scope and benefits. Future work could include an experimental comparison of collaboration tasks in three-dimensional CVE against corresponding tasks in text-based CVE and real-life collaboration. To go deeper into collaboration, investigating the question of which theories help to explain 3-D interaction for collaboration and learning would be useful and interesting (e.g., the actor-network theory, Gibson's theory of affordances, and the cognitive scaffolding theory may be applied to 3-D environments). So far it is unclear what enhancements are needed to make a CVE a really useful environment for serious distributed collaborations.
RP15	Some research is still needed to fully understand the strengths and weaknesses of avatars in 3-D worlds in CSCW settings. Some possible research topics to explore are: (i) workplace adoption, which depends on how easy and useful do people perceive the CVE, (ii) success factors, related with the increased interactions, positive self-awareness and social bonds (trust), or are there other yet undiscovered factors?, and (iii) design elements can help to improve productivity in CSCW settings, the design factors – 'building blocks' – that led to the effect are not explored in depth yet.
RP16	The taxonomy should be refined and expanded in accordance with the new issues that are continuously discovered.

RP17	This framework does not provide indications associated with the possible value added by collaboration patterns in virtual environments.
	Further research is needed through the use of controlled on-line experiments and in-situ participatory observation within organizations.
RP18	Until recently, supporting closely-coupled collaboration between remote people was considered to be very difficult to achieve. However, little is known about the influences of different factors on such collaboration.
	Many issues need still to be addressed, including an effective haptic implementation for immersive projection technology, as well as more research into the importance of gaze, facial expressions and body postures during concurrent object interaction.
RP19	It will be interesting to see how the license-fee based worlds will survive against the open source ones.
	The tension between participation, learner control, educational standards and quality assurance may provide a framework for ongoing work in this space, and accurate benchmarking metrics for evaluation and validation are still a primary goal.
	In the future, it is envisaged that multiplayer role play games and mirror worlds also will offer real opportunities for learning.
	A commitment towards participatory approaches at all levels of engagement seems a central requirement of future development, but we also need a commitment to ensure that the basic levels of education are maintained for future generations.
	Forthcoming functionalities may also include the ability for users to create their own content, using tools such as Sketchup and 3ds max.
RP20	There are several fields for potential research and development, such as appropriate educational activities, suitable learning environments, correct supporting technologies, revised learning theories, and experimental and verifiable evaluation practices for all population groups.
	There is a need for both finely grained categorical work and a holistic approach to research and practice in virtual education, encompassing multiple categories of the taxonomy.
	A more fine-grained research survey is recommended within 5 years to elicit trends and advances in this fast-moving field.
RP21	The current classification is subject to on-going revisions. Future research should focus on examining the research model to determine its validity, particularly for organizational applications such as product sales, organizational meetings, or informational briefings.
RP22	Future research would benefit from gathering data about the students' levels of technical ability in Second Life prior to the educational activity under study.
	While online 3-D virtual worlds are expected to have a large impact on teaching and learning in the near future, the understanding of their instructional use is still limited.
	With the use of virtual worlds, experiential learning opportunities can be vastly expanded.
	Some limitations include the fact that it represents a single case study, one graduate course and semester in length, and five graduate students from different academic disciplines.
	More research is needed to understand how experiential project-based collaborative activity may apply to other instructional contexts using Second Life.
RP23	It would also be interesting to study the effects of being touched in a virtual environment, while previous studies have explored mutual force-feedback, it would be interesting to study whether an agent that touched other would be perceived as more likeable in the same way that waiters get tipped more when they touch their customers.
	A task using avatars of different skin tones or ethnicities might reveal user's attitudes towards different racial groups.
	Future studies might employ instead a paradigm where the touch itself is social.
RP24	At present, Second Life offers the most powerful object creation toolset of any 3-D MUVE, and we need to contemplate many possible futures, engage in dialogue and undertake evaluation with different stakeholders about choices available to us.
	Awareness of teachers' visions about the potential of virtual worlds, especially in the teaching of history and science.
	Transfer of pedagogical concepts from other electronic environments to frame group development and group working.
	Creation of realistic environments for practice.
	Integration with other learning technologies with a view to creating 3-D virtual classrooms.
	Predictions of interest from commerce and industry for skills development.
RP25	Some of the various research challenges facing CVE are scalability (that will continue to be a core challenge for CVE) and interest management, distributed architectures, migrating lessons from 2-D interfaces and CSCW, as well as new kinds of human factors.
	The ever-expanding variety of multiplayer games and simulators demonstrates the potential of CVE in leisure and entertainment.
	How can we understand the nature of social interaction within a CVE?
	Ubiquitous, mobile, and wearable computing promises to make universal and continual access to digital information.
	A future research challenge concerns the relationship between the shared digital world, manifested through CVEs, and a shared physical world enhanced with digital information.
RP26	A research gap that needs to be filled relies on understanding how metaverses are different from traditional virtual collaboration and what theories are relevant for enhancing understanding of behavior, management, and technology phenomena in this environment.
	It is important to further investigate how teams balance in-world and out-world work, as well as what tasks are amenable to metaverse technology capabilities and what tasks are not.
RP27	The emergent themes of intuitiveness, ease of application, and enhanced knowledge sharing ability provide interesting conjectures that could be tested in further, more controlled, empirical research.
	Easy to use computer-supported networked collaborative process modeling is an emerging important challenge for the process modeling community.
	Future research can focus on the application of this approach in real-world collaborative process design scenarios to be able to evaluate efficacy and usability, and to examine potential benefits and changes to collaborative design processes carried out normally by business analysts.
	There is a need for usability analysis to be applied in the modeling interactions to improve their affordance for collaborative process tasks.
	A stream of research might want to examine the individual behaviors exhibited by analysts when working with the new approach to collaborative process modeling.
	There are opportunities for research on process modeling quality to examine the final outcomes of the collaborative modeling process, namely the process model produced, in terms of how well it corresponds to established quality notions such as soundness, usefulness, or user acceptance.
	Further extensions will be necessary to ensure scalability to larger and more complex process scenarios.

RP28	Most systems address forms to provide basic CVE platforms to users so that they can expand and develop more complex interaction methods addressed mainly by the use of component/plugin-based architectures (i.e., modular systems), and how to increase overall usage and make CVE platforms a standard rather than a specialty through the use of Java applications, PC-based software, and Web interfaces.
	This review can be expanded to a post-2003 analytical spectrum.
RP29	Understanding the nature of cooperative interaction within digital ecologies has been a longstanding concern within design and the emergence of a new class of interactive environment that spans the physical-digital divide warrants similar attention as computing moves away from the desktop and the workplace to disappear into the fabric of everyday life.
	Examining how novel interaction mechanisms are articulated across multiple physical and digital ecologies is essential to understanding the collaborative character of emerging physical-digital environments and, thereby, of informing design.
RP30	An important issue to consider during an analysis of CVE systems is to what extent other factors than the virtual place design influence their suitability in a concrete educational situation.
	How should three-dimensional educational CVE be designed to suit different educational purposes?
	What place metaphors are typically used?
	Which design features are beneficial and which are not?
	How could the virtual place design in such worlds be analyzed in a systematic way?
	The paper discusses the suitability of the adopted characterization framework as an analytical tool for future analysis of educational CVE, suggesting some revisions and additions.
RP31	A factor that has often been neglected in virtual team research is the physical environment from which team members access the virtual environment.
	A possible research agenda is focused on behavioral indicators of high- and low-performing teams, sociability factors and usability factors, toward a theoretical foundation for research on collaborative work in 3-D CVE.
	The authors believe that the automated behavioral tracking approach is an important step towards the systematic analysis of group interaction processes.
RP32	A future question relies on the possible classes of group work that can be enhanced through CVE. Where do the rich interaction options that they offer actually make a difference in practice?
	Recognizing gestures and facial expressions of the user and projecting them into the virtual world through the avatar needs to be advanced and the full potential of this interaction technique needs to be explored through ongoing CSCW research.
	The system requirements of many existing CVE (especially the non-gaming ones) are still beyond the standard office PC.
	Beyond basic HCI-related research and technological advancement, an open issue is concerned with the adoption of CVE in organizations, it is not generally clear what needs to be done for CVE to make inroads into the everyday work practices of users, probably one of the most crucial aspects to deal with it is privacy.
	There is a lack of systematic empirical research investigating the risks and chances of the new options that CVE technology offers within collaborative work contexts.
RP33	Given the social relational affordances offered by 3-D CVE, future research should examine the content of communications and the relationship with performance, for example, team transcripts could be content coded to reveal the proportion of communications devoted to task-related interactions (conveying ideas, decision making) and social/relational exchanges.
	Recent attention has turned to inter- and intra-organizational uses including collaborative virtual teamwork.
	There is a need for systematic and foundational research that examines the impact of 3-D CVE on team behaviors and ultimately performance-related outcomes.
	Further research is needed to gain a deeper understanding of the relative importance of affordances on both team processes and outcomes, particularly as they may vary by 3-D platform.
	There is a growing body of research on virtual teaming that examines how communication technology use is related with aspects of mediated team collaboration.
	Future research is needed to explore the learning curve associated with a 3-D CVE. From a practice perspective, this insight will help managers to understand what start-up costs will be needed to support a virtual team into a 3-D platform.
	Future longitudinal research engaging real teams in the context of real projects is required.
	Further empirical testing via both controlled experiments and field studies is necessary to gain a deeper understanding of these environments, what sets them apart, and how they can become valuable platforms for organizational teams.
RP34	Today, with the second coming of the avatar/social virtual worlds medium, predictably it is meetings and larger events from interviews on stage to fashion shows that are a driving force behind the growth and attraction to live in-world.
	There are emerging a large community of object makers, builders and marketers that can be monitored by researchers to trace a continuum of collaborative application fields.
RP35	While focusing on affiliativeness and sociability is an interesting first step in the investigation of collaboration in virtual worlds for education, it is recommended that further research be undertaken to examine other personality traits related with collaboration in virtual worlds between avatars of different ethnicities, species and other forms, where further studies could examine such facets of personality as emotional empathy, arousal and sensation seeking, affect and emotions.
	In order to both understand and foster the sense of community, the development of positive social attitudes that participants in distance learning environments hold toward their classmates' avatars is an important field of research.

6. Concluding remarks

This paper represents an initial agenda with research gaps and possibilities related with 3-D CVE. Nevertheless, a set of limitations are established in the bibliometric level (e.g., limited sample in terms of size, restrictiveness, and lack of more papers from journals with a great impact factor), some methods, heuristics and interpretations of literature-based evidences are error prone, and there is a need to reinforce the creation of future agendas aware of technical and social requirements. Holistically, this meta-review shows that 3-D CVE find their place as alternative ecosystems to enhance learning and collaboration capabilities between humans and computerized residents and objects. There has been an incr-ease in the use of 3-D immersive virtual worlds in Australia and New Zealand. It is pointed that ubiquitous augmented reality has been arising, and ubiquitous tracking is on the track for future exploration. In a technical domain, Xj3D can be a platform well-suited to build and deploy 3-D CVE. The integration between CVE and CSCW application tools can increase user's self-awareness, improving social bonds between them and facilitating interaction and coordination. Additionally, this study needs future revisions and different perspectives on the current status of research in 3-D CVE, reinforcing a working line for several disciplines interested in the study of these collaboration support ecosystems.

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A Pattern-based Classification Model for 3-D Virtual Environments: From 'Building Blocks' to Religious Buildings

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This paper presents a classification model that includes a set of pattern-based categories to examine the architectural elements and interaction capabilities of the current 3-D virtual environments' buildings, upon the conceptual framework of building blocks. These blocks can be used to accurate a more specific answer to the technical issues, including styles (e.g., gothic) and other architectural elements. Furthermore, it is presented a case study of a religious island with a comparative analysis of the different components of the buildings. The practical study is based in the classification model proposed in this paper, which can contribute to assess the main features of 3-D virtual buildings.

Keywords: 3-D Virtual Environments, Building Blocks, Classification Model, Patterns, Religious Buildings, Second Life, Taxonomy, Virtual Worlds.

1. Introduction

Virtual worlds have revealed a huge impact at learning, collaboration, and real-world tasks representation, which such online 3-D virtual environments are expected to have a large and growing impact on the teaching and learning in higher education domain for the near future. There are many organizations that currently use the popular virtual world platforms for a range of fields, such as education, healthcare, engineering, architecture, urban planning, or economic development. Furthermore, more research is needed to recognize how experiential project-based collaborative activity may apply to other instructional contexts, like the analysis of the content building in virtual worlds. Virtual environments offer the ability to create an online presence that closely simulates or enriches upon real-life communication and collaboration between groups of people (Jarmon et al., 2009), and further gather the fields of Virtual Reality (VR) and Computer-Supported Cooperative Work (CSCW).

In the real world, everything is built from atoms that make it hard for human construction, because of the atomic scale, money spent, hard work, potentially risky, and the undesirable outcomes, like traffic and pollution. Therefore, virtual worlds make an important point on this domain. This kind of environments makes use of building blocks specifically designed for human-scale creation. Building blocks are all types of shapes from cubes to cones and using a constructive solid geometry approach residents create collaboratively in virtual worlds, in real time. Building blocks come in simple 3-D geometric shapes: cones, cubes, pyramids, cylinder, sphere, a torus, a tube, or a ring, and can be modified as well as combined to create objects and structures ranging from basic chairs to skyscrapers (Vallance et al., 2009). While building blocks are intended to be simple enough for anyone to use, they can be difficult to master, at least initially, and creating more elaborate designs requires the use of additional software (Diener et al., 2009).

In the remaining of this paper is presented a model with a set of categories that can contribute to examine the architectural elements of the virtual worlds' buildings. After that a practical study with an examination of architectural properties of various buildings is presented to assess the model. We take the suggested model to analyze structures made on virtual worlds, more precisely in the University of Queensland's Religion Bazaar Second Life Island. With this model, is possible to identify some interesting gaps and make a fast reading about the main characteristics of each building.

2. Building Blocks: the 'atoms' of Second Life

In the real world, everything is built from atoms and they are generally not convenient tools for human construction. Nanotechnology, where products are built at the atomic scale, is expensive, difficult, and potentially risky. Construction at the macro level requires large amount of time, raw materials, and energy. Large-scale creations, at real world, of artifacts require economies of scale that generate undesirable outcomes like traffic and pollution (Ondrejka, 2004). Unlike the real world, Second Life uses building blocks specifically designed for human-scale creation. Building blocks is the principle, on which the

designers of Second Life call atomistic construction. However, the tools used for creating objects and environments are sophisticated and do not differ that much from computer-based application development. All types of shapes from cubes to cones are the basic building blocks of Second Life (Warburton, 2009). Using a constructive solid geometry approach (Ondrejka et al., 2003), residents create collaboratively in world, in real time. Therefore, while it seems that CVEs can help to improve productivity in CSCW settings, the design factors – the "building blocks" – that lead to the effect are not explored in depth yet.

The basic building blocks in Second are "primitives", and are also known as "prims". Primitives are the atoms of Second Life. These prims come in simple 3D geometric shapes: cones, cubes, pyramids, cylinder, sphere, a torus, a tube, or a ring, and can be modified as well as combined to create objects and structures ranging from basic chairs to skyscrapers (Vallance et al., 2009). Simple primitives are combined to build interesting structures and behaviors, and are designed to support maximum creativity while still being simple enough for everyone to play with and use (Ondrejka, 2003). With the addition of simple scripts, users can add motion, sound, and other animations and modify the properties of created objects, such as textures, materials, and other existing properties. In addition, avatars may also be customized, using built-in options for attributes, such as facial features and clothing, or by importing resident-designed "skins", body shapes, makeup, and fashions (Vallance et al., 2009).

While prims and scripting tools are intended to be simple enough for anyone to use, they can be difficult to master, at least initially, and creating more elaborate designs requires the use of additional software, such as Adobe Photoshop (Diener et al., 2009). Furthermore, objects are linked groups of individual prims containing from 1 to 255 prims (Rymaszewski et al., 2007) allowing objects to be built. For instance, a Second Life user can build a functional piano object out of virtual building blocks (prims) endowed with various physical and behavioral properties. Therefore textures can be mapped onto the objects to give them a more realistic appearance, and are assigned to specific "owners" who have exclusive building rights on the parcel.

However, to build objects in Second Life it is needed land, which a basic parcel of land measures 256m by 256m and supports approximately 14160 prims (Diener et al., 2009). For every 4.3m of land there is 1 prim with a maximum size imposed on one prim of 10 meters (imposed by Second life to operate efficiently). When an object is said to be high prim, it means the object contains a large amount of building blocks and therefore requires more time for the software to load. Linden Lab (LL) has created "sandboxes" where residents can experiment with prims and creation tools. Residents also share information about various aspects of creation through topical list servers as well as through resident-created websites, for instance one resident has created a huge self-guided "library" with step-by-step instructions for basic and more complex tools (Diener et al., 2009).

It has been notorious the need of a model that is capable of describing different buildings in all its aspects while identifying group interactions patterns of collaborative work and learning in the virtual world Second Life (Schmeil & Eppler, 2010). The pattern-based model is a useful and concise approach to classify and describe different forms of online collaboration, communicative, navigational, buildings and learning, and therefore the use of real-world social patterns as basis for virtual environment interactions that might result in usable and acceptable solutions (Manninen, 2000).

The pattern approach is defined as the description of a solution to a specific type of problem (Gottesdiener, 2001), which can be expanded to a set of tools, techniques, behaviors, and activities for people who meet at a place to work on a common goal, together in a group or community (Schmeil & Eppler, 2010). A set of patterns have been researched and combined with other patterns to achieve our interests, such as identification and categorization of buildings inside the Second Life. There are a set of patterns that focus on collaboration and learning (Table 1) (Schmeil et al., 2009; Schmeil & Eppler, 2010). These set of patterns are divided into artifacts, collaboration, learning and design effort. The pattern required artifacts have different features, such as places to sit, information displays, designing tools, sketching tools and plans; the collaboration pattern is related to the risk of not making use of 3D features where the design can be influenced by limited functionality of design studio; the learning pattern focused on the fact that students can get lost, neglect the learning content, and not playing the particular historic character right of the current subject; and finally the pattern design effort that is related with the learning content design, hints design and placement, scenography, and animations.

The other set of patterns where listed by (Otto et al., 2006) and are related to the environment where it can be: a scene for natural collaboration and communication, and the Objects, which are the artifacts that can be of interests, persons, and non-persons related. Moreover and especially at Second Life there is the pattern Communicative Actions, which is related to verbal and non-verbal features. The former, verbal, distinct the following features: talk, chat and present; and the latter, non-verbal, has more extensive set of features, such as show, affirm, decline, vote, point, show perspective, draw attention, demonstrate, gesture, posture and facial expression. All of these verbal and non-verbal features are common things in the real world but we cannot forget to include, to implement and to represent them in virtual worlds. It is also common in virtual worlds features and functionalities that are not possible in the real world, such as Teleport and Fly, which are also important for our model but only if features like swim and

communicate are present in the same category because they are all navigation patterns. Through the study made at building blocks there were natural features that call our attention and that were added to the Object pattern of our model, such as number of objects, number of prims, person, and non-person related. Furthermore it is important to add these features to our model, so that it can be more accurate and rich while we compare different buildings (next section makes this distinction in a more practical way).

Table 1. Generic patterns (Adapted from Schmeil et al., 2009; Schmeil & Eppler, 2010)

Pattern name	**Features**
Required artifacts	Places to sit, information displays, designing tools, sketching tools, plans
Risks at collaboration	Not making use of 3D features, design influenced by limited functionality
Risks at learning	Getting lost, neglecting learning content, not playing the particular historic character right
Design effort	Low to medium: learning content design, hints design and placement; medium: scenography, animations

After gathering the studied patterns, a new model was created (Table 2), where the entire patterns are presented and the related features are associated to each pattern. So, it is now possible from a set of different buildings, at Second Life, identify the category, the collaboration, and the learning level that are present on that specific building. Furthermore, there is the need to add other patterns because of their relevance in identifying different categories of buildings in virtual worlds, such as the context that can be representative of buildings in general, or religious, touristic, monuments, and so on. Collaboration and learning patterns are also object of further research.

Table 2. Building, collaboration and learning patterns

Pattern name	**Features**	
Context	Buildings, religious buildings, historical buildings, touristic buildings, monuments, others	
World realism	Real world, virtual world, both	
Required Artefacts	Places to sit, information display, designing tools, sketching tools, plans	
Risks at Learning	Getting lost, neglecting the learning content, not playing the particular historic right	
Design Effort	Low to medium	Learning content design
		Hints design and placement
	Medium	Scenography
		Animations
Communicative Actions	Verbal	Talk
		Chat
Communicative Actions (Cont.)		Present
	Non-Verbal	Show
		Affirm
		Decline
		Vote
		Point
		Show Perspective
		Draw attention
		Demonstrate
		Gesture
		Posture
		Facial expression
Navigation	Communicate	
	Decision or assessment answer	
	Teleport	
	Fly/Swim	
	Set the scene for natural collaboration and communication	
Environment	Multimedia	Audio
		Video
	External Links	
	Artefacts of interest	
Objects	Person related	
	Non-person related	
	Number of objects	
	Number of prims (1 prim = 64m)	
	Create, Insert, Upload documents	
Object-Related Actions – Dynamic - (Number of objects that can be interacted with (feedback, modified)	Modify – co-edit documents	
	Model	
	Sketch	
	Annotate	
	Select – select objects or parts	
	Fixed – symbols and/or field subdivision	
	Places to sit	
	Environment of the object	
Automated Objects – position interpreter for automated data analysis and statistics	Execute Animation	
	Follow behavior (static displays)	
	Input/Output	
Interactive Objects	Tools	
	Instruments	

The contexts of the specific attributes are generalizable to each architectural element, which are indicators that will characterize specific elements and guiding a particular type of building and functionalities of interaction and support. So, the aim of this model is widely applicable to all kinds of existing buildings of 3-D virtual environments. Furthermore, a classification rating will be created, based on the results of the various attributes of each design pattern (Table 1), allowing each building to have a classification based on Table 2. With this approach it is possible to compare buildings based in these characteristics, and if the building is of interest to a potential user he can see in detail all the attributes that were previously classified (based on Table 2).

3. Religious buildings in Second Life: a practical study of the University of Queensland Religion Bazaar Island

After the approach made on the previous section about the building blocks on the Second Life, that presents and suggests a model to analyze structures made on virtual worlds, it is now time to apply the model in a practical way.

For that, we have chosen a set of religious buildings that exists on Second Life. This choice was taken because of the huge variety of options in this virtual world, so a search on the Second Life web site[2], about "religious buildings" was made and 27 places were found. Naturally after this result, it was needed to limit the list and choose our sample, which was the University of Queensland Religion Bazaar Second Life Island[3].

Our choice has fallen on this virtual space because in this island we have represented 7 buildings, all related with the religion thematic. So, first of all, let's present and describe the studied island. It consists of a Second Life island situated in the New Media Consortium educational precinct and boasts a number of religious builds including a church, a mosque, a synagogue, an ancient Greek temple, a Zen Buddhist temple and a Hindu temple to Ganesha. The island was used in two large first year classes and for supervising distance postgraduate students, of the University of Queensland, Australia (Farley, 2010).

3.1. Applying the model to analyze structures made in Virtual Worlds

After an exhaustive and extensive research on the chosen island, we consider that we have enough knowledge to analyze the buildings with the previously presented approach model to analyze structures constructed on virtual environments.

Table 3 shows in detail the analysis made to these seven buildings. In this perspective, each building can be analyzed based in different patterns. Each 3D structure will be evaluated separately and the major differences and most interesting artifacts will be described.

Table 3. Analysis based in the classification model

Pattern Name	Features		B1[4]	B2[5]	B3[6]	B4[7]	B5[8]	B6[9]	B7[10]
Context	Buildings		×	×	×	×	×	×	✓
	Religious Buildings		✓	✓	✓	✓	✓	✓	×
	Historical Buildings		×	×	×	×	×	✓	×
	Touristic Buildings		×	×	×	×	×	×	×
	Monuments		×	×	×	×	×	×	×
	Others		×	×	×	×	×	×	×
World Realism	Real world		×	×	×	×	×	×	×
	Virtual world		✓	✓	✓	✓	✓	✓	✓
Required Artifacts	Places to sit		×	✓	✓	×	×	×	×
	Information displays		✓	✓	✓	✓	✓	✓	✓
	Designing tools		×	×	×	×	×	×	✓
	Sketching tools		×	×	×	×	×	×	✓
	Plans		×	✓	✓	✓	✓	✓	✓
Risks at Learning	Getting lost		×	×	×	×	×	×	✓
	Neglecting the learning content		×	×	×	×	×	×	×
	Not playing the particular historic character right		×	×	×	×	×	×	×
Design Effort	Low to medium	Learning content design	✓	✓	✓	✓	✓	✓	✓
		Hints design and placement	×	×	×	×	×	×	✓
	Medium	Scenography	✓	✓	✓	✓	✓	✓	✓
		Animations	×	✓	✓	✓	×	×	✓
Communicative Actions	Verbal	Talk	✓	✓	✓	✓	✓	✓	✓
		Chat	✓	✓	✓	✓	✓	✓	✓
		Present	✓	✓	✓	✓	✓	✓	✓
	Non-Verbal	Show	×	×	×	×	×	×	×
		Affirm	×	×	×	×	×	×	×
		Decline	×	×	×	×	×	×	×
		Vote	×	×	×	×	×	×	×
		Point	✓	✓	✓	✓	✓	✓	✓
		Show perspective	✓	✓	✓	✓	✓	✓	✓
		Draw attention	×	×	×	×	×	×	×
		Demonstrate	×	×	×	×	×	×	×
		Gesture	×	×	×	✓	✓	✓	✓
		Posture	×	×	×	✓	✓	✓	✓
		Facial expression	×	×	×	✓	✓	✓	✓
Navigation	Comunicate		✓	✓	✓	✓	✓	✓	✓
	Decision or assessment answer		✓	✓	✓	✓	✓	✓	✓

[1] http://search.secondlife.com.

[2] http://world.secondlife.com/region/ca7c645f-9084-4379-926e-7a48f4930e71

[3] B1 – Islamic building

[4] B2 – Jewish building

[5] B3 – Christian building

[6] B4 – Buddhist building

[7] B5 – Hindu building

[8] B6 – Mystery religions of the ancient world building

[9] B7 – Information center island building

Navigation (Cont.)	Teleport		✓	✓	✓	✓	✓	✓	✓
	Fly/Swim		✓	✓	✓	✓	✓	✓	✓
	Set the scene for natural collaboration and communication		✓	✓	✓	✓	✓	✓	✓
Environment	Multimedia	Audio	✓	×	×	×	×	×	×
		Video	×	×	×	×	×	×	×
	External links		✓	×	×	×	×	×	✓
	Artifacts of interest		✓	✓	✓	✓	✓	✓	✓
Objects	Person related		✓	✓	✓	✓	✓	✓	✓
	Non-person related		×	×	×	×	×	×	✓
	Numbero of objects		13	36	33	60	8	156	81
	Number of prims (1 prime = 64m)		337	512	506	326	283	336	1075
	Create/Insert – upload documents		×	×	×	×	×	×	×
Object-related actions – dynamic (number of objects that can be interacted with, feedback, modified)	Modify – co-edit documents		×	×	×	×	×	×	×
	Model		×	×	×	×	×	×	✓
	Sketch		×	×	×	×	×	×	✓
	Annotate		✓	✓	✓	✓	✓	✓	✓
	Select – select objects/parts		×	×	×	×	✓	✓	✓
	Fixed – symbols and/or field subdivision		×	×	×	×	×	×	×
	Places to sit		×	✓	✓	×	×	×	×
	Environment of the object		✓	✓	✓	✓	×	×	✓
Automated objects – position interpreter for automated data analysis and statistics	Execute Animation		×	✓	✓	✓	×	×	✓
	Follow behavior (static displays)		✓	✓	✓	✓	✓	✓	✓
	Input/Output		✓	✓	✓	✓	✓	✓	✓
Interactive objects	Tools		×	✓	✓	✓	×	×	✓
	Instruments		×	✓	✓	✓	×	×	✓

3.2. Analysis of the Islamic building

The Islamic religious building, called mosque, presented on the Second Life island, has the architectural traditional style of the Ottoman Empire (Blair & Bloom, 1996). While we consider the data in Table 3, we can see that this building is the only one that has an audio presence, but unfortunately it does not have any kind of animation. Instead they have an external link, to learn more about this religion.

Looking at the religious building, we can assume that he had all kind of objects, and other artifacts, to be used in the teaching field of the religious buildings.

When we enter on the mosque we are invited to drop our shoes and to cover the head, clearly a common practice in this kind of religious buildings.

Figure 1: Picture outside the Islamic building

Figure 2: Picture inside the Islamic building

3.3. Analysis of the Jewish building

The Jewish religious building, called temple or synagogue, presented on the Second Life island, has the architectural traditional style defined with straight lines (Lloyd & Copplestone, 1996). While we consider the data in Table 3, we can see that this building is poor in animation, and it has some places to sit. When we enter on the temple we are invited to drop our shoes and to cover the head, clearly a common practice in this kind of religious buildings.

A common architecture for churches is the shape of a cross (a long central rectangle, with side rectangles, and a rectangle in front for the altar space or sanctuary). These churches also often have a dome or other large vaulted space inside to represent or draw attention to the heavens. Other common shapes for churches include a circle, to represent eternity, or an octagon or similar star shape, to represent the church's bringing light to the world. Another common feature is the spire, a tall tower on the “west” end of the church or over the crossing. (Lloyd & Copplestone, 1996).

Figure 3: Picture outside the Jewish building

Figure 4: Picture inside the Jewish building

3.4. Analysis of the Christian building

The Christian religious building, called church, presented on the Second Life island, has the gothic architectural traditional style (Lloyd & Copplestone, 1996). While we consider the data in Table 3, we can see that this building has some interesting animations, and places to sit. However, there is also a set of architectural objects, which we can interact, and with a magnificent design effort. For example, we can light a virtual candle at the entrance of the Church.

Figure 5: Picture outside the Christian building

Figure 6: Picture outside the Christian building

3.5. Analysis of the Buddhist building

The Buddhist religious building, called temple, presented on the Second Life island, has the unique and usual traditional style (Lloyd & Copplestone, 1996). While we consider the data in Table 3, we can see that this building has very interesting animations. The atmosphere presented in this temple, with many objects spread in the surrounded area and the water lake, transmit a calm and peaceful place.

Figure 7: Picture outside the Budhist building

Figure 8: Picture outside the Budhist building

3.6. Analysis of the Hinduism building

The Hinduism religious building, called temple, presented on the Second Life island, has the unique and usual traditional style (Lloyd & Copplestone, 1996). While

we consider the data in Table 3, we can see that this building has some objects to interact, with very interesting options.

There is a set of wall pictures related with the mysticism presented in this religion, and an interactive object that shows religious messages.

Figure 9: Picture outside the Hinduism building

Figure 10: Picture outside the Hinduism building

3.7. Analysis of the Mystery Religions of the Ancient World building

The Mystery Religions of the Ancient World religious building, called temple, presented on the Second Life island, has the unique and usual traditional style of the Greco-Roman buildings (Lloyd & Copplestone, 1996). While we consider the data in Table 3, we can see that this building was very poor, and does not have many objects to interact with. Obviously a perfect reference to this kind of spaces is: the minimalism, and the absence of images or other objects. The fact that the building is positioned on the top of a mountain shows that details were taken into consideration, since it is an important factor in this religion.

Figure 11: Picture outside the Mystery Religions of the Ancient World building

Figure 12: Picture outside the Mystery Religions of the Ancient World building

3.8. Analysis of the Information Center building

The Information Center building, presented on the Second Life island, was the only one that has not religious related issues. While we consider the data in Table 3, we can see that this building was the most interesting in order to configure the avatars, using the presentation object, and a special building to have nice and interesting meetings.

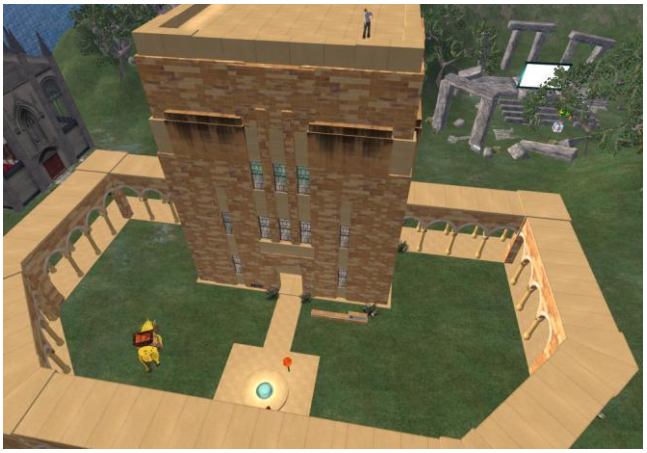

Figure 13: Picture outside the Information Center building

In other hand, this place had some great external links to the most important religious buildings on the Second Life. The interaction presented on this space shows various potentialities of the virtual worlds (education, tourism, fun, etc.).

Figure 14: Picture outside the Information Center building

Concluding remarks

Building blocks are the core of virtual worlds, without them there will not be possible to create and represent the real world buildings and infrastructures at virtual worlds. Furthermore they provide an exciting glimpse of the future of user creation and world building. The physical simulation supports moving objects and motor forces, so users rapidly began exploring for example different types of vehicles, including realistic motorcycles that could be driven and inclusive sold to other users. The study made gather patterns to distinct the different buildings that are represented at virtual worlds.

On the case study some limitations were found, because we choose to analyze the buildings that exist on only one island. This factor is limiting the research of the buildings analyze, so for future work this research will be following the approach of Pereira (2010), which is expanded to other set of fields, such as the academic field. Other limitation it's because the religious buildings that we choose weren't representative of all the others that exists on the Second Life. May be on next studies we may have to choose more religious buildings of other different builders, because it's obvious that it was the same builder that builds the buildings presented. Furthermore, we could have risked more and analyzed buildings with representation in both worlds (SL and the world), for example the Sistine Chapel, St. Paul's Church, Cologne Cathedral, and Mecca. So on future studies, this could be a nice and objective approach.

On the other hand taking into account the study of the buildings blocks, it becomes obvious that the tables obtained could be applied to achieve a transect of several virtual spaces such as religious, museums, governmental, or academic.

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Beginning to explore constructionism in virtual worlds

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Abstract: While non-goal orientated 3D virtual worlds continue to be used in educational settings, many of the reported learning experiences lack pedagogical underpinning (Savin-Baden et al., 2011). Based on the alignment of pedagogy to technology, constructionism has been identified as a pedagogy which can leverage the wide range of perceived educational affordances of non-goal orientated virtual worlds. This paper outlines a four year qualitative study currently in progress, which aims to explore constructionism in action in virtual worlds.

Introduction

The reported use of 3D, non-goal orientated virtual worlds that support user-generated content, has increased in recent years, particularly in third-level education. With the growth of open source applications and institution run private servers, it is anticipated that the literature in the K-12 sector will grow substantially over the coming years.

However the 2011 Horizon Report for higher education (Johnson et al., 2011) clearly identified virtual worlds in the 'trough of disillusionment', predicting that it would take a further five years before the technology would impact education. In order to move onto the 'slope of enlightenment', we argue that educators need to see the potential of virtual worlds, beyond replicating their current classroom practices. Demonstrating that virtual worlds can be a disruptive technology may encourage educators to explore the potential of virtual worlds.

To support educators in their move away from replication towards innovation there needs to be a clear understanding of how the affordances of the technology can support pedagogically informed teaching and learning. However, there is little understanding in the literature with regard to which pedagogies are most appropriate for use in non-goal orientated virtual worlds (Savin-Baden et al., 2011).

In this short paper, the authors present an overview of work in progress which aims to explore the alignment of virtual worlds with constructionism. Following on from a brief review of the literature, the approach to aligning pedagogy and technology is presented, with an overview of the alignment of constructionism and the perceived educational affordances of virtual worlds. This alignment informs the design of a constructionist learning experience implemented with multiple groups of post-graduate learners in *Second Life*. Open interviews, chat logs, participant-observations and learner's reflection documents are qualitatively analysed to explore learners' experiences of engaging in a constructionist learning experience in a virtual world.

Background

Educational use of virtual worlds

Despite the variety of reported learning experiences, the natural reaction of early adopters of any new technology is to replicate what has gone before (Winn, 2005). As McCaffery et al. (2011) note, reported learning experiences involving more than discussion and presentations in-world are uncommon. Yet as virtual worlds have the potential to support communication and collaboration, there is an opportunity to design innovative learning experiences in virtual worlds, underpinned by constructivist and social constructivist pedagogies, which learners can engage in at distance.

Many learning experiences in the literature are broadly described as constructivist or social constructivist. However while some justify their pedagogical choice with reference to the features of non-goal orientated virtual worlds, they rarely align the design of the learning activity to pedagogy (e.g. Papadamou et al., 2010). Rather than explore pedagogical theory, the literature tends to focus on praxis. The lack of justification for choosing teaching and learning approaches with reference to the technology, is compounded by a lack of discussion of the chosen

pedagogical theory following implementation, with the exceptions of Girvan and Savage (2010) and Savin-Baden et al. (2011).

Aligning pedagogy and technology

Vrellis et al. call for "guidelines and principles for designing and evaluating effective learning activities" (2010, p 210) in virtual worlds. To achieve this we argue that there needs to be a systematic approach to aligning pedagogy to technology, in order to design pedagogically informed learning experiences.

In the broader literature, several authors have discussed the importance of pedagogy in the design of technology enhanced learning experiences. John and Sutherland (2005) highlight that pedagogic opportunities emerge from the affordances of specific technologies. Although they do not provide any clear process to align pedagogy and technology, earlier work by Conole et al. (2004) describes mapping pedagogical praxis to tools and resources. However this approach lacks the broader understanding of how a technology such virtual worlds can be used to support the features of a chosen pedagogical theory.

Developing on from this work, we have developed a four stage process to identify and implement a potentially appropriate pedagogy to underpin the design of learning experiences in non-goal orientated virtual worlds (Girvan & Savage, 2010). This begins with the identification of the perceived educational affordances of the technology which are then aligned to the features of various pedagogies. Through this process a pedagogy is identified which could strongly leverage the affordances of the technology and this alignment is used in the design of the learning experience. The designer identifies which affordances need to be leveraged or minimised to provide opportunities for the features of the pedagogy to emerge as appropriate for the learning context. Through this approach both pedagogy and technology can be employed to their full effect in the learning experience with pedagogy remaining central to the design.

Aligning constructionism and non-goal orientated virtual worlds

Following the process described above, constructionism has been identified as a strongly aligned pedagogy for use in virtual worlds (Girvan & Savage, in press). Although commonly associated with the teaching of mathematics, this approach to learning can be applied to any discipline.

Constructionism emphasises the importance of constructing personally meaningful and shareable artefacts to support learning (Papert, 1991). As part of this process, Hoyles et al. (2002) maintain that programming is a key aspect of constructionism. These can be supported by the construction and programming of persistent objects.

Immersion may support a sense of the technology becoming 'invisible', while the flexible nature of the technology together with embodied social presence may support learners engage in *in-situ bricolage*. Finally as the features of virtual worlds are often described as supporting collaborative learning, it may be possible for learners to collaborate on constructions.

Design of the learning experience

To support the pedagogical underpinning of the learning experience, the alignment of constructionism to the perceived educational affordances was drawn on. While this mapping suggests that constructionism is strongly aligned to the key perceived educational affordances, it is important to ensure that the perceived educational affordances are leveraged in the design of the learning experience. In addition, the context of the course had to be considered. The intended outcomes were for post-graduate learners to experience a constructionist learning activity and gain an understanding of programming.

To achieve the intended learning outcomes an open task was chosen by the module facilitator. The task required each group to create an interactive installation over several weeks. Learners worked in pairs and were expected to collaborate. However, as the learners were only required to attend the institution part-time, an opportunity to collaborate at distance was important. At the end of the module, the learners were required to present their installation and reflections on the experience to the class.

As the learners' artefacts were to be assessed as part of their accredited course, each pair was provided with a discrete learning space with clear boundaries. While the space could be accessed by other learners the activity took place on an access controlled island.

Second Life was chosen for implrmentation as there was existing institutional support and it has rapidly become the most commonly used virtual world in higher education (Kirriemuir, 2010; Carlson et al., 2011). Prior to taking part in the learning experience, learners participated in a five hour in-world introduction to *Second Life* as a teaching and learning environment, at a distance. Thus learners had been given an opportunity to familiarise themselves with the technology prior to the commencement of the learning experience.

Lowering the floor to programming and construction

Constructionism places an emphasis on learners engaging in the construction of personally meaningful and shareable artefacts, as well as engagement in programming. However there is a steep learning curve which needs to overcome before learners can engage in the construction and programming of objects in virtual worlds (Sanchez, 2009).

Due to the high-floor (steep learning curve) barrier for novices to overcome, *Scratch for Second Life* (S4SL) (Rosenbaum, 2008) and *SLurtles* (Girvan, et al., in press) were used by the learners. S4SL provides learners with a low-floor graphical programming interface in which users

'snap' blocks together to create a programme. On the click of a button, the corresponding *Linden Scripting Language* (LSL) is generated and copied to the clipboard. In *Second Life*, learners paste this code into a new script located inside a *SLurtle*. Once executed learners are able to observe the SLurtles move according to the programme. Using the 'pen' commands learners can programme SLurtles to create persistent objects in the virtual world as shown in Figure 1.

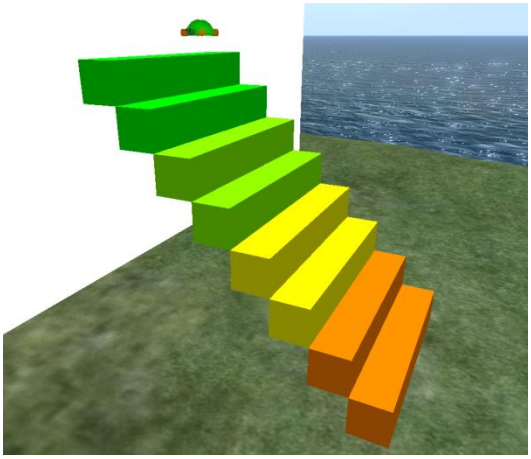

Figure 1: Staircase created by a SLurtle

Methodology

So far 78 learners, through three implementations, have participated in the SLurtle-based constructionist learning experience. The final planned implementation as part of this research, with an anticipated 26 participants, is scheduled for early 2013.

During each implementation opportunistic participant-observations have been made. Due to the flexible nature of the virtual world, learners were able to engage in the learning experience at any time and as such observational data was difficult to collect. Therefore interviews form the primary source of data for analysis. 32 open interviews have been conducted so far with an opportunistic sample of participants following each of the learning experiences. Additionally, participants' reflections and artefacts created for assessment purposes have been collected. Table 1 presents an overview of the data collected from each of the three implementations completed to date and anticipated data from the fourth implementation.

Table 1: Data collected from each implementation

Implementation	1	2	3	4
Total participants	24	26	28	~26
Interviews	14	9	8	~10
Observations	5	12	12	~12
Artefacts	12	13	14	~13
Reflections	24	14		26

Following an exploratory case study approach (Yin, 2009), the first implementation provided an opportunity to pilot *SLurtles*, the learning experience and research study. In addition it provided an opportunity to refine the research questions for subsequent implementations. As such analysis of data from the first implementation followed the constant comparison approach using open coding. This allowed the researcher to remain open to emergent themes which could be explored in more depth in the subsequent studies. Following the construction of categories the secondary data sets were analysed for supporting or refuting evidence.

From the content analysis a number of emergent categories and sub-categories have been developed: thinking, programming and barriers. Unfortunately within the confines of a short paper it is not possible to go into these in any depth.

As low-floor barriers are a key concept within constructionist learning experiences, the second case study aims to examine the extent to which barriers are encountered by learners and to identify those which limit engagement and those which are quickly overcome through engagement. This work is currently underway following a multiple case study approach. To prevent 'bleed' (Yin, 2009), the data from the first case study will be excluded from the multiple case study. Data from three case studies will be collected and analysed following Krippendorff's (2004) approach to content analysis.

Discussion

Findings from the exploratory case study demonstrate that learners are able to engage in constructionist learning in non-goal orientated virtual worlds, with *SLurtles* providing an easy to use tool with which to create a wide range of complex, personally meaningful and shareable artefacts (as presented in Girvan & Savage, in press). Examples of some of these artefacts are shown in Figure 2 which illustrate the variety and complexity of artefacts created.

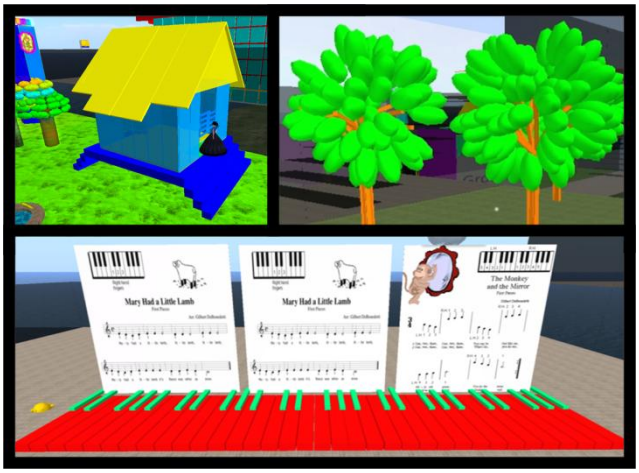

Figure 2: Sample artefacts created by learners

The second case study is a multiple case study which is currently ongoing. However initial results suggest that while there continues to be basic virtual world skills barriers for learners to overcome, these are temporary and have limited impact on learning. For example, while learners describe the avatar movement controls as an initial barrier, avatars still support collaboration and the sense of co-constructing artefacts in a shared space. This is particularly important in constructionist learning environments as barriers should not limit engagement.

Although implemented in *Second Life*, it will be possible to generalize the findings to other non-goal orientated virtual worlds that support user generated content. At a micro level, the initial pilot study has lead to research with primary school children learning together in *OpenSim* (Devlin, 2012). At the meso level the developing understanding of constructionism in action within virtual worlds will support educators and researchers in the design and implementation of constructivist learning experiences in virtual worlds. Finally at the macro level the approach to mapping the perceived educational affordances of virtual worlds with potentially appropriate pedagogies will support educators in the design of innovative, pedagogically informed learning experiences in virtual worlds.

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For a definition of cyberformance

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The object of this paper is to define cyberformance as a rising kind of performance and as the future of digital performance. Cyberformance is developed through the internet using digital technologies, like the computer, a narrower category than digital performance, that is defined for taking place through any digital means not necessarily networked. To define it, we work within a hybrid paradigm of theatre and performance happening in cyberspace.

Cyberformance happens live – be it in a chat room or a virtual world – and its performers and audience are distributed physically, sometimes around the globe, creating virtual presence. It is risky, deals with post-modern subjects and it is liminal in its experimentation. It uses different sources, although it is mainly digital and dependent on the computer and tends to never be finished and, so, to be an Open Work in Humberto Eco's sense.

Key words: Cyberformance, Digital Performance, Virtual World, Second Life, Multi User Virtual Environment.

Introduction

The designation cyberformance was created by Helen Varley Jamieson putting together the terms cybernetics and performance. In her Master of Arts thesis *Adventures in Cyberformance* (2008), this performer, with experience in theatre, net art, software development and digital performance, defined some of the characteristics of this form of art from which our theoretical framework departs..

A hybrid of theatre and performance

In this investigation we do not aim to dwell in the definition of the term performance, since a cyberformance may be closer to either dance or theatre as much as to performance in a more strict sense. What matters to us is defining how this kind of performance developed in the internet – often within virtual words – and is characterised, independently from the fact it has a theatrical origin (e.g. Gion Kabu, Hamnet Players), it includes a choreography of possible gestures (e.g. Ballet Pixel, Senses Places) or that it is, in its content, closer to politically and socially conscious *live art* (e.g. Second Front). Thus, note that, although we are working on a meaning for cyberformance, many of the examples of this kind of art are closer to theatre or dance since what matters in this analysis of performance in virtual worlds is not so much its content as the conditions of its production and development.

However, although it is not the main aim of this study, it may be useful to workout the essence of theatre and performance, trying to get to a workable term to fit cyberformance since, as Helen Varley Jamieson determines, it departs from a hybrid paradigm.

The known resistance of performance to a linguistic strait jacket does not cause us much problems since that hybrid quality coincides with the characteristics of cyberformance.

John Reaves argues that theatre is an inclusive art that incorporates dance, music and painting and suggests all interactive art is theatre:

"Why not be aggressive in the tumultuous context of the Digital Revolution? Why not claim all interactive art in the name of theatre?" (Reaves, 1995, quoted by Jamieson, 2008:17).

This idea denotes the fluid nature of theatre – and the reason for the adoption of different and sometimes contradictory terms by different scholars in the fields of theatre, performance and cultural studies.

If even theatre resists a definition what can we say about performance?

"By its very nature, performance defies a precise or easy definition", points RoseLee Goldberg (2001:9).

Until the 70's, in the Anglo-Saxon world, all theatre involved performance and when this one came out as a new genre, theatre was the common denominator against which performance could be defined.

During the second half of the 20th century the term gained weight in theatre semiotics and in contemporary culture. In the arts it appeared as performing art, performance art, performance studies and just as performance. For Steve Dixon it is a term that as been

stretched and reconfigured (2007:x) that can be applied to games, sports, rock concerts and success in various areas – academic, professional, technological – or to the simple performance of daily rituals. Theatre on the other end implies a separation from everyday life and a relationship performer/audience. Carlson says:

"The very presence of an audience watching an action, however neutral or non-matrixed, and presented in whatever unconventional space, inevitably called up associations with theatre" (1996:114).

RoseLee Goldberg, in the American tradition, claims performance for the visual arts in opposition to the British tradition that derives *live art* from theatre. For Goldberg performance is "live art by artists" and appeared as a means by which visual artists freed themselves from traditional media and structures (2001:9). This author presents the absence of the character and plot and the presence of the artist as performer as key elements to distinguish theatre from performance.

However, although we can apply these characteristics to most performances – but not to all – we can also apply them to theatre. Just look into some of Samuel Beckett plays, like *Breath* (1969), a play without characters, or the quite well know example given by Peter Brook, of a man crossing an empty stage as a drama action (1972:11).

Non visual narratives can always be built, and a visual artist, when he performs, is always coming out of his everyday role even if he is not creating a specific character.

Some authors claim that the difference between theatre and performance is a question of aesthetics, content or attitude, having performance a desire of transgression as its motivational strength (Herbert, 1994:11). This does not take us much further since you can also find that desire in theatre.

In reception theory we find some attempts at a definition that we consider productive. Robin Nelson proposes as theatrical event "the collective witness in a given space at a given time of a more or less intentionally constructed sequence of things happening through time" (2004:304).

However, this idea of the here and now – or at least of the simultaneity in relation to time but not literally to space - the idea of an experience that is shared by the performer and the spectator in real time is ontological, both to theatre and performance. And to cyberformance.

Hybrid, liminal, intermedial

A main characteristic of cyberformance comes from its intimate connection with the term *live art*, of British and theatrical origin. This one is an attitude as well as a performative practice, and it is a hybrid refusing to be classified.

Susan Broadhurst prefers the term liminal (term she adopted from Turner, 1982) to deal with the performance that is in the edge of what is possible (1999:2).

"Quintessential aesthetic features of the liminal appear to be hybridization, indeterminacy, a lack of 'aura' and the collapse of the hierarchical distinction between high and popular culture" (Broadhurst, 1999:1).

Janet Murray used the same term in relation to computers while liminal objects located in the frontier of external reality and our minds (1997:99).

On a similar migration the term intermedial – applied first to the computer – appears in theatre as «a meeting point in-between the performers, the observers, and the confluence of media involved in a performance at a particular moment in time … a space where the boundaries soften» (Chapple e Kattenbelt, 2006:16).

It is in this liminal and intermedial spaces that new hybrid genres like cyberformance appear. Thus we depart from an hybrid paradigm to develop our approach to performance in virtual worlds.

This hybrid performance includes all live work where actions are performed with an intention - beyond everyday life – and witnessed by a spectator. So, the performance that is the focus of this work is the one where experience is activated and shared in real time by an audience that can be present physically and/or virtually (Jamieson, 2008:23).

Produsers networked in a hypersurface

All events that are created through a network of computers can be considered networked performance which includes video conferencing by groups such as The Wooster Group (Dixon, 2007:422) and the telematic performance that became so popular from de 90's on (Dixon, 2007:423).

In 2004 Joanne Green, Helen Thorington and Michele Reil defined networked performance as: "any live event that is networked enabled" including "any form of networking in which computational devices speak to each other and create a feedback loop" and qualified networked performance as being live, or "experienced at the moment of creation or reception" (quoted by Jamieson, 2008:27).

Networked performance may also be seen as a subsidiary of net art or as existing beyond it, for example in works connected by LAN (Local Area Network) or mobile phone, the successors of fax, mail and phone art. In the Networked Performance Blog[1] we can see how the term became general, loosing sense. Thus, cyberformance cannot be defined merely as networked performance.

Gabriella Giannachi introduces another term that can be useful in the definition of cyberformance: *hypersurface* "where the real and the virtual meet each other … a liminal space [where] the viewer can *double* their presence and be in both the real and virtual environment simultaneously"

(2004:95). For this author "Hypersurfaces are places of exchange, fleeting intertextual strata in which dialectical opposites interact and continuously contaminate one another" (2004:99).The author gives examples of liquid architecture, telematic art, intelligent agents and virtual reality ambiences.

The screen itself may be considered an hypersurface if we overlook the tendency to consider that digital art must be expensive and accessible only to a few directors as Matthew Causey does through his concept of cyber-theatre that, has he puts it, will only attract producers of mass entertainment like sports, thematic parks, television and cinema (2006:49).

By opposition to these big productions, technologies oriented to the user like mobile phones, digital video, photo cameras, Ipods, PCs and the internet allow for a content production in the way of the *produser* defined by Axel Bruns (2008) that takes us into a democratization of art.

"In collaborative communities the creation of shared content takes place in a networked, participatory environment which breaks down the boundaries between producers and consumers and instead enables all participants to be users as well as producers of information and knowledge - frequently in a hybrid role of *produser* where usage is necessarily also productive. *Produsers* engage not in a traditional form of content production, but are instead involved in *produsage* - the collaborative and continuous building and extending of existing content in pursuit of further improvement"[2].

Cyberformance is intrinsically connected to that concept while low tech art although there can be variations in its cost depending on the kind of interfaces used.

From textual performance to more developed interfaces

The first cyberformances were mainly textual and happened in chat rooms. Later they were presented in graphic virtual worlds using two dimensional avatars – photos and drawings – and, sometimes, video image through webcams like the works of Avatar Body Collision[3] that developed into the internet festival UpStage, created by Helen Varley Jamieson among others.

In virtual worlds like Second Life, cyberformance happens in festivals like Interact (sponsored by the Lindens, the creators of that virtual world) and Odyssey (created by artists connected with the collective Second Front).

Figure 1: Senses Places, cyberformance in Second Life by Valverde & Cochrane, 06-09-2011

Meanwhile, the potentialities of platforms like Second Life began to be explored in more ambitious projects like *Weathering In/Com Tempo and Senses Places* – two projects conceived by Isabel Valverde and Todd Cochrane with which I have been collaborating. Those are dance-tech works that question the reduction of our corporal intelligence in nowadays world by creating a hybrid and corporeal environment were the participants interact physically and virtually – through their avatars – with one another and the ambience that is connected to meteorological sensors in Portugal and New Zealand. Wearable sensors used by the participants allow for the addition of biometric data into the equation of performers, avatars and ambience[4].

In nowadays society we loose embodiment in favour of communication and knowledge. Technology changes rapidly but we are still attached to the audio-visual, the computer as a boxed interface the hand-eye minimal movement (Valverde, 2010). That is normally what happens when we interact in virtual worlds. Thus, it is necessary to create more «out of the box» experiences more haptic, where there is an augmented virtuality, like *Senses Places announces*.

In my own project *Me Myself and I* (2010), I try to explore the possibilities of virtual worlds and the connection between cyberformance and *machinima*, between a performance executed and captured – according to the rules of machine cinema – in Second Life and real image resulting in a work of video-art or, better, cyber video-art.

The performance was developed in "La Dama" Second Life, July 22, 2010, at 21 GMT. During the performance, in which my avatar moves with an attached photo of my real body, a long shot was used to capture the action and later other angles were introduced. The footage of my real body – introduced later as well – reproduces the movements and gestures of the avatar creating a doubt:

"Is it the avatar that imitates me or do I imitate de avatar? Maybe we are part of the same Self, an unfolding of identity that allows an augmentation of my body and the statement of my post-human condition. 'Avatars have no

organs' said Stelarc, or, better, is Prosthetic Head avatar, a sentence that has a resonance in *Me Myself and I*. Lux Nix, my performing avatar, does not age, her joints do not hake when she jumps, it is a projection of my ideal Self, a development of myself in another universe through communication. Lux Nix is beyond my self. However Lux Nix does not exist without myself" (In the project brief of *Me Myself and I*, Clara Games, 2010).

Me Myself and I is an example of a cyber video art project resulting from a live cyberformance.

Conclusion

We can conclude that:

a) Cyberformance happens live – there is an interaction between performers and the public and any documents produced as a result (photos, video) should not be taken as the work in itself.

b) This kind of work is developed in cyberspace – using chat rooms (IRC, Internet Relay Chat), virtual environments like MUVE (Multi User Virtual Environment) computer games like MUDs (Multi User Dungeon or Domain), MMOG (Massively Multiplayer Online Game) or MMORPG (Massively Multiplayer Online Role Playing Game), graphic chats, like Athemoo or Lambdamoo, virtual worlds used in real time by various users, like The Palace or Second Life, or platforms created to exhibit cyberformance like UpStage or Odyssey).

Figure 2: Me Myself and I, 2010, cyberformance in Second Life by Clara Games, 22-07-2010.

c) Another characteristic of cyberformance is that it is distributed and shared – the performers and the audience are distributed physically and the experience of performance is shared and activated in real time.

d) Since it is dependent on the connection to the internet it is also telematic, which means there is a convergence of telecommunication networks with computers (Ascott 2005) but it is not video conferencing or a distribution of videos or recordings. In its construction performers generate telepresence in the sense used by the International Society for Presence Research[5], and/or virtual presence[6], more, or less immersive.

e) Cyberformance is also an attitude: as its medium is instable, it is risky, goes beyond borders and is experimental in form as well as in content.

It deals with contemporary issues incorporating technology in its content and representing the contradictions and idiosyncrasies of the post-modern world.

f) The juxtaposition, contrast and frustration of expectations transforms cyberformance into liminal performance (Broadhurst, 1999), reminiscent of the *avant garde* which means its rules are discarded, deconstructed in openness to experiment and innovation.

g) Cyberformance uses different sources in terms of technology as well as form and content, which means it is *intermedial* (Chapple e Kattlenbelt, 2006) and *hybrid* (Kaye, 1996).

h) Cyberformance in unfinished, incomplete, the real Open Work of art of Umberto Eco (1989). The work does not exist until it is presented to an audience, which means it only exists in interactivity.

i) Cyberformance is digital performance, it is dependent on digital technology and cannot happen without the use of the computer (Dixon, 2007). And, we dare say, an expert use of the computer keys, because the manipulation of ambiences and avatars demands accurate typing skills. Cyberformance is so digital that we could say "break a digit" instead of the traditional theatre wish "break a leg" (Jamieson, 2008:40).

j) However, the fact cyberformance is dependent on digital technology does not imply it is reduced to the eye-hand binomial, since, with the adding of interfaces, other parts of the body or all the body may be used; for instance when we add motion capture, using a simple webcam, the console of some games (like Microsoft Kinect or Nintendo Wii) or wearable sensors. That is the case of the referred project Senses *Places*.

Steve Dixon in his book *Digital Performance* (2007) writes that the late 90's were the golden age of digital performance due to the development of the internet and digital technologies in those years. We disagree - we cannot state that this form of art entered a decadence era since the new possibilities of the virtual and the development of interfaces open new perspectives for a cyberformance even more immersive, interactive and participated.

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Notes

[1]http://transition.turbulence.org/blog/

[2]http://produsage.org/node/9

[3]http://www.avatarbodycollision.org/

[4]My avatar, Lux Nix interviewed the avatar of Isabel Valverde, Butler2 Evelyn, in Second Life, about the project *Weathering In*/ Com Tempo: http://youtu.be/w1Z_Pnvp8MU.

[5]"Presence (a shortened version of the term 'telepresence') is a psychological state or subjective perception in which even though part or all of an individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience". in http://ispr.info/about-presence-2/about-presence/

[6]"As David Z. Saltz points out, 'virtual reality systems fully immerse a subject in a computer-simulated environment, a purely virtual space with no physical real world spacial coordinates. Telepresence, by contrast, uses computers, telecommunications and robotics to conjoin two or more real-world locations' (Saltz 2001:70). Although, as Saltz points out, there is a substantial difference between virtual reality and telepresence, both create a virtual environment which, in the case of virtual reality, is totally simulated; and, in the case of telepresence, is the remediatised merging of two real locations. In neither case is the environment actually there" (Giannachi, 2004:10).

Language Learning in Virtual Worlds: The Role of FLA and Technical Anxiety

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This project examines whether or not learners feel less foreign language anxiety (FLA) in an online multiuser 3D virtual world simulation than in the real world classroom. Previous research has shown FLA to have negative effects on learner performance and learning outcomes. Research into learning in virtual worlds has indicated that performance anxiety may be lessened in these environments, however, the use of such virtual environments also places demands on the learner to develop a range of technical skills to facilitate interaction. The project examines whether or not learners feel less FLA in an online multiuser 3D virtual world simulation than in the real world classroom and also attempts to establish what impacts these demands have on learner performance and FLA. This work-in-progress paper, on the basis of preliminary analysis, has found 1) there are multiple sources of FLA in both classroom and virtual environments; 2) students found the virtual environment less stressful in terms of language use and 3) there was not a significant inherent level of technical related anxiety.

Introduction

In recent years there has been an increasing interest in and move towards online and blended learning across all disciplines in the tertiary sector. This interest has been generated from both an institutional and an educational perspective. Institutionally, these modes of learning potentially address issues of limited resources, equity of access and changing learner preferences and circumstances. Educationally, they may offer new ways of learning and of addressing different learning styles. While traditional modes of learning continue to remain important, relevant, and in demand, all disciplines need to embrace the challenges and opportunities online and blended learning bring. This is no less true for the discipline of language and culture learning.

Foreign language learning in a classroom environment can be stressful (E. Horwitz, M. Horwitz, & J. Cope, 1986; Tóth, 2008). Known as "foreign language anxiety" (FLA) (E. Horwitz, et al., 1986), this kind of stress in face-to-face (f2f) learning can have a detrimental effect on learners in foreign or second language classes (Elkhafaifi, 2005). Students may feel comfortable during drill practice or prepared dialogues, but may freeze in 'role play' (E. Horwitz, et al., 1986). Hauck and Hurd (2005) report that anxiety is greatest during output, due to fear of negative evaluation by the teacher or fellow peers. Horwitz et al. (1986) further comment that:

"Anxiety levels are likely to be lowered if students can learn in a non-threatening environment which encourages them to try things out and have fun, which builds confidence and promotes respect for different learning styles, approaches and personality traits".

Virtual worlds have often been portrayed as "nonthreatening" environments for learning (Broadribb & Carter, 2009; Cuoto, 2010; Levy & Stockwell, 2006). In addition to an absence of real

world consequences (e.g. physical injury), the mediating effect of interacting within the 3D environment in terms of anonymity, emotional distance and enactment of the "possible self" (Schultz & Leahy, 2009) have been argued to lower anxiety during communication (Broadribb & Carter, 2009).

Brown et al., (2004) found that computer anxiety and oral communication apprehension contribute to computer-mediated communication (CMC) anxiety which in turn impacts on attitudes towards CMC, and potentially learning outcomes, and Matsumura and Hann (2004) also claim that use of technology in teaching has been accompanied by na increase in students experiencing computer anxiety.

Background and purpose of the study

The current study is being conducted under the auspices of seed funding from the LCNAU1[11], and involves collaboration between University A, University B, University C, and University D. In the first stage, 55 students of Chinese at University A completed pre- and post-lesson online surveys. In stage two of the project, students from the Chinese program at University B and the Spanish program at the University C will also complete surveys. This paper will report on stage one of the study.

Since Horwitz et. al. (1986), there have been a number of investigations into FLA in Spanish, French, Hungarian EFL and Arabic (M. Hauck & S. Hurd, 2005; E. K. Horwitz, et al., 1986; Hussein, 2005; Toth, 2008), in f2f and distance settings (M. Hauck & S. Hurd, 2005), and via digital technologies (Felix, 2004), however, there has not yet been an in-depth study of FLA in virtual worlds. Our goals are to examine (a) whether there is a reduction in FLA in virtual worlds compared to f2f classes as previously claimed, (b) what levels of "technical anxiety" are generated by the use of this technology and (c) whether the technical anxiety outweighs any reduction in FLA.

The lesson and methodology

As part of the formal curriculum for introductory Chinese at University A, students undertake thee 1.5 hour lessons each semester in a simulation of a Chinese township in Second Life. The virtual township has a number of venues used to conduct task-based learning activities related to themes in the textbook. The lesson on which the study was based took place in a restaurant and farmers' market. Each lesson involves tasks where students must use Chinese character text-chat to communicate with non-player characters (NPCs) programmed to recognise and respond to student input. Students must use conversational language learnt and practiced during classroom-based lessons in freeform, i.e. they must formulate what they want to say or ask, then send their message to the NPCs via chat. Where communication breaks down due to incorrect language, mistakes in characters, or where sufficient information to move on with the task has not been elicited by preceding interactions, students must re-formulate their output until they obtain the information or artefacts they require.

Prior to commencing the lesson, volunteer students completed an online pre-lesson survey made up of 12 demographic questions, 16 questions on computer/chat use, and 24 focused on their feelings relating to learning Chinese in general and in the classroom specifically. The language-related questions were adapted from the Foreign Language Classroom Anxiety Scale (FLCAS) developed by Horwitz et.al (1986), and the questions on computer/chat use were adapted from the multi-item scales developed by Brown et.al. (2004). A five-point Likert scale was used for both sets of questions. The post-lesson survey was made up of 27 questions related to the use of Chinese within the virtual environment and 10 questions relating to the use of technology in the form of the Second Life virtual environment. The first set of questions was designed to elicit information about FLA, while the second set was focused on technical anxiety. Each of these sets of questions also used a five-point Likert scale. A total of four open-text questions were also included in the surveys, not analysed here.

Progress to date

Part one of the study has concluded and preliminar quantitative analysis has commenced, including 2-tailed Pearson Correlations used to test the statistical significance between factors obtained from the demographic survey questions and general computer/text-based chat anxiety, FLA in the classroom/virtual environment, and technical anxiety related to the virtual environment; 2-tailed Pearson Correlations to test the statistical significance of the correlations between factors; analysis of the prevalence of FLA in the classroom/virtual

[11] Languages & Cultures Network for Australian Universities, http://www.lcnau.org/

environment and of technical anxiety in relation to computers, chat, typing Chinese, the virtual environment and user interface (UI) specifically.

Some preliminary findings

Respondents (55) were roughly half female (25) and half male (30), mostly undergraduates aged 18-20. Around twothirds had previously studied another second language before undertaking this course. Many indicated that they spent 2-4 hours a day using computers (42.5% of students), or even longer (37.1%), and most of this time was spent online. Email, study, watching or downloading music or movies, and social networking (each undertaken by over 80% of students) were the most popular activities. Less than a third of students, however, played 3D games like World of Warcraft, and an even smaller proportion (12.5%) engaged in other 3D environments like Second Life. Very few (less than 15%) played games regularly.

Computer and text-based chat anxiety

Overall, students had a reasonably low level of inherent computer anxiety, reflected in the responses to propositions such as "Computers make me feel uncomfortable" (79% disagreed), "I get a sinking feeling when I think of trying to use a computer" (80% disagreed), and "I feel comfortable using a computer" (88% agreed). In relation to the use of chat in general, 68% of students indicated that they had a lot of experience with chat, 68% felt comfortable using chat and 59% indicated that they chatted several times a week. However, only 55% indicated that they "liked conversing in text-based chat", with 41.9% non-committal. These figures suggest that students do not experience any inherent anxiety from the use of chat, although it may not be their preferred form of communication.

For those who do experience computer/chat related anxiety, the 2-tailed Pearson Correlation analysis found a significant correlation (all p.<.05) with gender, the amount of time a student spent on the computer (82% more than 2 hours a day, 37% more than 4 hours a day) and the frequency with which they play interactive games (13% daily, 16% weekly, 48% not regularly, and 14% never). Overall, males were more comfortable with chat and those who spent more time on the computer/playing games were less likely to be anxious.

FLA in the classroom

In terms of anxiety tied to classroom performance, there was a fairly even split between those who worry about making mistakes (37%) and those who do not (34%). Even so, making mistakes in class is a source of anxiety for a significant percentage of students. Furthermore, 29% of students said they were afraid other students will laugh when they speak Chinese, and another source of anxiety for just under a third was knowing they were going to be called on to perform in the language. Not understanding what the teacher says in the language “frightens” 42% of students. Other manifestations of anxiety come in the form of panic when having to speak without preparation (45%), forgetting things already mastered (39%), and feeling self-conscious in front of other students (39%).

Whether FLA was experienced in the classroom or not was significantly correlated with factors such as age, prior language learning, and personality (all p.<.05). Older students were less worried about making mistakes, but more frightened when they did not understand the teacher. Those with no previous language learning experience were more anxious about being laughed at by other students, but somewhat counter-intuitively, were more willing to speak to native speakers (NS). Interestingly, those with more outgoing personalities are more anxious about being laughed at by classmates.

FLA in the virtual environment

Overall, levels of FLA appeared lower in the virtual environment, with students' level of uncertainty about communicating in Chinese online slightly lower than in f2f, and a much lower level of anxiety about making mistakes in the virtual environment, with only 6% of students disagreeing with the statement "I didn't worry about making mistakes in Chinese in the online 3D environment"2[12]. In terms of knowing that they were going to have to use Chinese in the online environment, only 16% of students "trembled" and only 13% were anxious about not understanding what an NPC said to them. Just 15% felt panicked when they had to communicate with the NPCs without preparation, 9% forgot things they had already mastered, 12.7% experienced their heart pounding when starting a conversation, and 7% felt self-

[12] The figures presented are a combination of "agree" and "strongly agree" or "disagree" and "strongly disagree" from each side of the five-point Likert scale.

conscious about typing a conversation in Chinese with other students around them in the lab, much lower rates than the counterpart questions asking about the class environment.

Factors that correlated with FLA in the virtual environment were similar to f2f. According to the correlations analysis, female students were more confident communicating with NPCs in chat, but males felt they would be more confident communicating with live NSs. Older students were more worried about getting left behind in the lesson due to taking longer to read the responses and were more nervous when communicating with the NPCs. Students with no prior language learning experience felt anxiety from a number of sources in the virtual environment, and interestingly, students with more outgoing personalities appeared less sure of themselves when communicating in the virtual environment. Students with more computer/Internet time were more confident about speaking Chinese using voice in the virtual environment, but more anxious about the lesson in the virtual environment, even when well prepared.

Technical anxiety in the virtual environment

Levels of anxiety related to the UI, keyboard and mouse appeared relatively low, reflected in responses to statements such as "I found the Second Life viewer easy to use" (64% agreed) and "Using the keyboard and mouse to move around made me feel quite stressed" (53% disagreed). However, while 36% found the Second Life UI to be well laid out, 49% were non-committal and 14% disagreed. In terms of reading the dialogues with the NPCs, 53% of respondents disagreed with the statement "Reading Chinese characters in the instant messages and general chat was stressful", with 35% were non-committal and 13% agreeing.

With regard to the virtual city itself, there were clearly some issues related to students finding their way around, with 36% of students finding it confusing (38% noncommittal, 26% disagreeing). On reflection, this is a source of anxiety that students would not normally experience in the classroom. In counterpoise, 56% disagreed with the statement "I felt anxious looking around the visual environment because there were too many things to look at and take in" and 62% finding "lots of things in the virtual environment that helped me understand what was being said to me by the NPCs, other students and teachers in Chinese". Students also felt safe in the virtual city/environment (82%) and comfortable communicating via their avatar (78%).

Factors that correlated with technical anxiety in the virtual environment were fairly sparse, but included gender, age, previous learning experience, and personality (all $p.<.05$). Students with previous language learning experience found many things in the virtual environment that helped them understand what was being said by the NPCs, other students and the teachers. Counter intuitively, students with a calmer disposition were more stressed by having to read Chinese characters. Unsurprisingly, those of a more naturally tense disposition found using the mouse and keyboard to move around quite stressful.

Conclusion and future directions

Preliminary analysis indicates that there are multiple sources of FLA in both classroom and virtual environments. Initial indications are that overall, students found the virtual environment less stressful in terms of language use. It would also appear that there was not a significant inherent level of technical related anxiety, nor did the technical aspects of interacting in the virtual environment present significant additional levels of technical anxiety. This does not necessarily mean that students found the virtual environment more useful or enjoyable. The qualitative analysis of open ended comments from the survey currently being carried out and further quantitative analysis (e.g. through factor analysis) will provide a clearer picture about these aspects of student experience, and stage two of the study will add valuable data to that discussed above.

Stage two of the study will add valuable data to that discussed above. All the students in stage one were present in the same physical computer laboratory during the virtual world lesson. Students in stage two will be participating in a number of lessons in the virtual environment (two warmup and one actual lesson) in distance mode. While their own teachers may be present, the lessons will mainly be conducted by an instructor who is in another location, so all communication will be via the virtual environment. The second part of the study will attempt to clarify whether this factor will itself become an additional source of anxiety for learners in the virtual environment. Moreover, while students from University B will be doing lessons in the same location as the University A students (and indeed will cover the same tasks and content) students from the

University C will be engaging in Spanish lessons at another Spanish-themed location in Second Life and will carry out language learning tasks of a different nature to those of the Chinese language cohorts.

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Technology Integration and Gamification in University Courses

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Gamification in education involves applying some of the elements used in game design to educational content and information problem solving in order to increase student involvement with course concepts and enhance learning and retention. Four essential elements and four skill areas inherent in computer games were mapped to the content in eight courses that were taught in hybrid and online modes, and activities were designed to interest students in tapping these skills. Analysis of structured self-reports, lab reports, chat logs, and threaded discussions generated illustrations from various assignments addressing game aspects. Selected gamification strategies evolved over a four-year period in response to student reactions, and continue to be developed, incorporated, and evaluated for their potential to influence learning.

Introduction

Today college students are digitally literate and increasingly engaged with the online world. However, research shows they lack vital critical thinking abilities to evaluate and apply online information (**Dahlstrom, de Boor, Grunwald, & Vockley**, 2011; Head & Eisenberg, 2010). Concurrently there is an increase in online asynchronous courses and hybrid face-to-face and online courses where students must independently acquire and apply online skills to successfully complete coursework. Since future careers and personal lives require great facility with lifelong distance learning, online transactions, managing one's online identity, online conferencing and virtual team collaboration, higher education must equip students with needed online communication, research, production and presentation skills. As the demand for virtual work skills continues to rise (Blascovich & Bailenson, 2011) one principle pedagogical aim has been to develop viable online skills to process course content through technology integration, project-based learning, and teamwork (Boss, 2012; Boss, Krauss, & Conery, 2008).

Innovative teaching methods that utilize online immersive environments afford education opportunities for expanding and personalizing delivery of content and building virtual abilities. A key component in virtual instructional environments is integrating social networking for communication, interaction, and collaboration among learners. Students who have agreed to meet online synchronously to carry out collaborative tasks assigned in a particular course make use of a variety of free interactive technologies. For example, the use of Second Life as an immersive platform for student engagement provides a special opportunity for implementing synchronous role-play that can effectively integrate content with informative, educational, immersive and engaging drama. In this modality, creativity becomes a resource because students use their imagination to address course content and issues, building models, creating narratives and enacting scenarios of actual situations for analysis and interpretation (Thomas & Brown, 2011).

While our pedagogy based in classroom and computer lab contexts focused on active learning and constructivist approaches, students needed to become more independent learners. Lecture, demonstration, and classroom activities were staples before 2008 when we decided to examine virtual world platforms for education after reading of the increased student involvement in game-like virtual learning environments (Wheeler, 2009). Ludic methods applied to course content promised to enliven and animate concepts within an environment that could be created to appear and function according to any specification. Upon entering Second Life there already existed professional associations, businesses, universities, schools, libraries, cultural institutions and government agencies that had been there for a couple of years, experimenting to determine the uses and value of a virtual environment. People from around the world populate the virtual spaces created by individuals and groups. Professionals extend Web 2.0 style networking into virtual worlds through formal and casual groups that organize, manage and produce professional events, conferences, meetings, and social events.

The virtual world is a laboratory that can be used as a virtual classroom, online workspace, communication medium, presentation venue, role-play medium, simulation

Table 1. Instructional Gamification Architecture

I. Social Immersion Affordances to provide a game environment to stimulate urgent optimism	
Affordances	Functions
Adobe Connect	For synchronous online class meetings and conferences.
Second Life	For synchronous team explorations of specified areas and locations.
Second Life	For avatar-mediated role play events (e.g., wedding, road rage court case, exhibits and conferences).
Second Life	For avatar-mediated research and building activities.
Second Life	For avatar-mediated conference chat for communication and problem solving.
Instagram, Flickr, PicPlz	For seeking and allocating social recognition in a worldwide photo-sharing community.
II. Task Collaboration Affordances to encourage perseverance and blissful productivity.	
Affordances	Functions
Google Documents	For submitting multi-authored student reports of team projects.
Joomag and Keepsy	For team produced online magazine issues to communicate with the next generation of students.
Google Presentations	For team produced online and oral presentations.
III. Group Chat Interaction Affordances to foster social fabric and solidarity.	
Affordances	Functions
Google Groups	For sharing their profiles, weekly chapter reviews and weekly lab reports of their online activities.
Google+ Hangout	For holding office hours and consultations with instructor.
Skype	For holding office hours and consultations with instructor.
IV. Evidence-based Affordances to support a sense of epic meaning by turning assignments into evidence	
Affordances	Functions
Jing	For capturing and annotating images that show online evidence of progress in research activities.
PollEverywhere	For establishing ranges for social comparison through anonymous formative problem-solving quizzes and fact checking.
Google Forms	a. For individual assessment with online quizzes for grading.
You Tube Channels	For instructor curated interactive content students use to analyze training videos, e.g., in reference and user instruction.
SlideShare	For instructor curated online course content including assignment and exercise instructions.

tool, creativity machine, and more, depending on the ideas and flexibility of instructors. Employing a virtual world platform in education has advantages and limitations. Barriers to use have been widely reported in terms of technical issues and learning curve issues. Despite these problems, benefits to instructors and students lie at the center of cultural and behavioral shifts brought about by technology. Demand for virtual abilities continues to spread into all domains including education, nursing, medicine, aerospace, genetics, aquaculture (See Figure 1), business, etc., (Thomas & Brown, 2011).

Figure 1: Aquaculture Education in Second Life

Methodology

We applied gamification strategies derived from the literature in eight courses over four years from 2008 – 2012 with over 600 students. Each course was taught at least twice in different semesters, and four of the courses were offered every semester.

Undergraduate courses:

1. Cyberpsychology
2. Driving Psychology
3. Marriage and Relationships

Graduate courses:

1. Intro. to Reference and Information Services
2. Teaching Information Technology Literacy
3. Human Dimension in Information Systems
4. Information Behavior in Virtual Environments
5. Virtual World Librarianship

The Web and the virtual world platform Second Life were used in all courses for the purposes of attending pre-announced events or class sessions, making observations of some inworld or online activity, working in project teams, finding objects and information for assignments, designing and building interactive exhibits, and presenting results to the class and to specific audiences.

The methodology emphasizes learning new online skills for productivity and collaboration. We introduced new types of student interactions including a venue for each student to express an opinion that is reacted to by class members. Their interactions convey a distinct identity and authorship via assigned online discussion of class topics. Over a given term each student contributes a prescribed minimum of 80 individual interaction units ranging from 100-300 words.

Students used their own mobile, laptop and netbook wireless technologies as well as campus lab computers and a variety of free software, to participate in and produce assignments. Technology integration included all of the software in Table 1 above. Free software was used instead of the institutional course management system because students did not enjoy the CMS, and because it does not model what they will use in their careers where both proprietary and free systems are frequently applied. There were no additional costs to integrate these technologies. This uncommon historical moment is characterized by the fact that people at every age and educational level are learning the same technologies, therefore our designs incorporate these publicly available systems.

Figure 2: Student Research Presentation in Second Life

Each course included several assignments that incorporated teamwork, choice of activity and team members, role-play, threaded discussion, and live presentations (See Figure 2). Undergraduate courses required five types of weekly posts of minimum length including lab reports, replies to lab reports, chapter reviews, replies to chapter reviews, and social networking activity updates. Graduate courses required students to post and reply to chapter reviews, and summarize replies to chapter reviews for synthesis. Many options for voluntary participation are built into instructions to foster autonomy and creativity. Students in all courses produced and presented informative interactive virtual exhibits.

Generational Curriculum Model

Students can benefit in online courses when classes are managed as learning communities. In this model each semester is designated a "generation" in time. The entire series of semesters for a given course is designated a "generational curriculum" because it consists of the work of students of each generation being read by subsequent generations (James, 2009). In their assignments students write for the future generations of students who will take

the same course, citing research, explaining, advising and recommending. In this way, students see themselves as autonomous authors through processing the reports of prior generations, collected in a Web archive to which they also contribute and become a part. By processing generational work students can foresee what they are expected to accomplish in a course. This also models the academic practice of quoting and citing the work of others. When students realize their reports are to be read and commented on by future generations they experience a connection to the future and cease writing for the instructor.

The Four Game Powers

Game designer Jane McGonigal makes the provocative claim that by playing games we can save the world. She identifies "four powers or skills" inherent in computer and video games (McNally, 2012). The first is "urgent optimism" or the ability to continuously scan the environment to discover the next quest to engage. The second is "blissful productivity" or the ability to persevere in the face of challenge by using feedback to check progress. The third is "social fabric" or the ability to feel one belongs to a community where each shares in the work and contributes to progress of the group. Fourth is "a sense of epic meaning" or the ability to consider and work toward purposes larger than the self because big picture narratives facilitate commitment and cooperation.

These four skills represent orientations that tap a personal drive to mastery and to voluntarily accomplish goals with others. While educators strive to spark intrinsic motivation in students with compelling content and active learning methods, engagement remains elusive and inconsistent. By contrast in gaming contexts, intrinsic motivation is both primary and continuous. Therefore in recent years elements of gaming have been introduced into college curricula because of their promise of enabling continuous engagement to enhance learning (Collins & Halverson, 2009; Gee, 2007; Kapp, 2012; Kapp & O'Driscoll, 2010; McGonigal, 2011; Squire, 2011; Thomas & Brown, 2011).

The gamification strategies we embedded into these courses are discussed below in terms of the four orientations identified by Jane McGonigal (2011). These "powers" or abilities are orientations because they embody persistent states that serve to spur motivation during short-term tasks and long term projects. An *urgent optimism* orientation activates vigilant environmental scanning for something to work on or accomplish within a larger goal. Students experienced urgent optimism during team tasks where they must cooperate to build or put together an object, exhibit or activity. For instance, the Boolean Pool on Know How Island in Second Life is an interactive search strategy game requiring avatars to physically drag appropriate objects into a defined circle according to the search parameters, e.g., "red OR orange" requires dragging red and orange color objects floating in the pool into the circle at the opposite end of the pool (See Figure 3).

Figure 3: Boolean Game in Second Life

The students in the course are expert at creating and solving Boolean search strategies and expected it to be easy to accomplish, however it turned out to be impossible to get the pool to solve the query. Urgent optimism in the face of several failed attempts was expressed as another strategy to try.

> "It looks like there are four items that match the OR query and there are four of us, so if we each hold one item in the circle it should work."

This strategy also failed because the interactive animation script failed, nevertheless before quitting, urgent optimism persisted through nine attempts to find a way to solve the query.

During a virtual driving exhibit created by students in Second Life, a student's urgent optimism was activated at an exhibit offering free clothes for avatars.

> "I got caught up in trying to find some clothes and ended up being forced into a weird elf character."

Scanning the exhibit with camera and avatar movement, looking for something to appropriate, immerses students in learning online skills by choice. In this case it had unexpected consequences and generated an urgent information need (Nahl, 2010).

In a *blissful productivity* orientation learners continue working through difficulties, utilizing bits of feedback to feed perseverance, and accepting as natural the process of overcoming obstacles to accomplish goals. For instance, in an assignment to enter and examine several different virtual world platforms, students reported a variety of difficulties they faced during their explorations including inability to move, change the avatar, and communicate. Virtual world platforms are known for instability due to network issues, software issues, machine speed, graphics and capacity that demands a continuous problem-solving orientation. Blissful

productivity after several routine failures with different virtual worlds was expressed in terms of taking things in stride as a professional skill.

> "While I probably won't be in this world much, figuring out how to do things is common in many, if not most, jobs."

Professional work requires continuous learning and a blissful productivity orientation eases the stress of resisting change (See Figure 4).

Figure 4: Professional Development in Second Life

In a role-play team assignment to research a road rage case and put on a mock trial students persevered through complex intervening steps by negotiating in team meetings making progress toward winning the case.

Figure 5: Road Rage Case Role Play in Second Life

> "This weeks lab was a very challenging one because of the pressures we have on us to do our very best and win the trial case we have coming up. We have spent a few weeks preparing for this and I can't fail. My part was very challenging because I had the attorney and I had to be very flexible. I have to work with my clients and use their stories to make the best argument that I have. But trying something like this I thought it was very fun because when in life do I ever get to play lawyer?"

Providing an opportunity to make the lesson into a game activates persistent motivational forces and intentions, thus enlivening the learning process (See Figure 5).

The sense of belonging represented by a *social fabric* orientation can be achieved in online communities. Having students work online in teams and project groups encourages individuals to work together to accomplish larger tasks, to feel responsible for doing a share of the work, and to develop colleague relationships within teams. For instance, students in a professional master's degree program were assigned to explore in Second Life sims related to libraries. A sense of being part of the social fabric was expressed when two librarians found each other online and spontaneously began to explore library sims together.

> "Certainly the fact that we are both librarians influenced our decision on where to explore in SL. Even with my newbie knowledge I was also able to assist when she was updating her primitive avatar and it was nice to be knowledgeable enough to pass along some advice."

Professionals in Second Life have groups and estates devoted to their disciplines where they can easily meet others in the same or related careers at events, programs and other scheduled professional development activities. For instance, library sims such as Info Island enjoy active international online communities where librarians network and learn about developments in the profession, and provide instruction and information services. The American Library Association (ALA) and the Association of College and Research Libraries (ACRL) hold programs on their Info Island parcels (Bell & Trueman, 2008; Mon, 2009; Webber & Nahl, 2011). Libraries were among the first educational institutions to incorporate game principles into programs and services (Nicholson, 2010; Waelchli, 2009).

In online courses putting people together in working teams is critical because it facilitates cohesion, cooperation, commitment and the intense desire to avoid letting the group down, and camaraderie arises to establish a positive context for learning.

> "I will definitely miss meeting up with my group mates every week on SL, the challenging tasks the course offered, the adrenaline rush of doing the posts due to time constraints and reading through the posts on the Google group page. It's unfortunate that we have to close the doors and end this course, especially now that I'm getting the hang of it. I'm still at awe at how far we've come in this class. Mahalo to everyone for sharing their views and opinions, I feel like everyone on here poured out their selves in each post. I basically got to learn each and everyone through their posts."

Team projects in online courses also help to establish early colleague networks that begin and grow in cohort programs and persist into graduates' career paths.

To encourage a *sense of epic meaning* students must see themselves as helping or contributing to others, to causes, to shared goals. In this mode students are oriented to work for others, for the greater good, for the sake of a higher purpose. For instance, in the marriage and relationships course students examine self-centered and other-centered relationship approaches and practice these views via role-play scenarios in Second Life. Role-playing enables students to adopt different relationship strategies and to see themselves as becoming better partners, better people, and better role models for their children. A sense of epic meaning was expressed in terms of the insights gained in role-play assignments.

> "Writing the dialogs according to the other-centered and the self-centered models was enlightening. I never realized how negative I am whenever my partner asks a question. How could I not see that? Makes me wonder what else I am not aware of that I would change?"

Students highly recommend this course because they say it is life changing. Role-playing in immersive environments enhances the sense of reality due to the setting or backdrop and dramatic characters.

In the virtual driving class students have the opportunity to see themselves as heroes by overcoming natural tendencies to think terrible thoughts about other drivers and drive aggressively.

> "I know for me personally, before I took this class I would get very emotionally charged when I got behind the wheel. Although after having taken this class and having read the two books I feel like I'm more emotionally intelligent when it comes to driving. I feel like this class has helped me immensely to develop that. It was very interesting because most of the people in our group said that they felt the same way. I thought that was really neat."

Providing opportunities to drive virtual vehicles in virtual traffic engages real emotions that surprise students and make them aware of unsafe driving habits in their daily lives. As Blascovich & Bailenson point out "Students can be immersed in virtual environments that can be perceived as dangerous but without the actual physical danger." (2011, p. 246) so that lessons learned virtually safely generalize to natural environments.

The Four Game Elements

In addition to the four "powers" discussed above in terms of a set of game orientations, McGonigal identifies four minimal elements that define a game (2011):

1. The goal or outcome
2. Rules with limitations on how the outcome can be achieved
3. Feedback on how close players are to the goal
4. Voluntary participation

We wanted to understand to what extent game elements could be applied to enhance learning in the instructional context of undergraduate and graduate courses. According to Kapp "Games give experiences meaning …" (2012), thus game elements can be repurposed to give meaning to educational experiences and thereby enhance learning. Students actively engaging their imagination and problem-solving abilities by playing games to understand and incorporate knowledge, retain it and apply it in other contexts. In this view "The addition of game elements on top of traditional learning environments is a way of leveraging the power of engagement and imagination." (Kapp, 2012) enabling instructors to shift roles to see students as creative agents. The following are examples of the four essential game elements translated into course activities.

Games always have a *goal* or series of outcomes, and courses have goals embedded within assignments and due dates. There are several goals to accomplish for an entire course and within a given assignment there are sub-goals that represent component parts of the whole. Group assignments can have points for component parts, for the parts written jointly, and for the parts written individually, however, winning points alone is not sufficient to gamify assignments. To encourage cooperation, creativity and commitment we developed team project assignments extending over several weeks that included merging and vetting joint research, planning for a deadline, and active and written production to an audience. Teams kept records of their progress with collaborative Google Spreadsheets and Documents, and instructors used the comment function to answer questions, provide information, and give suggestions and corrections.

The *rules* in a course exist at the macro and micro levels. For the purposes of gamification, micro rules and limitations on methods were developed for particular assignments. For instance, students form their own teams using a collaborative spreadsheet with the names and profile of all registered students, and the times they are available to meet online in two-hour periods. Each team consists of four students, and students are responsible for setting up and scheduling four different teams over the semester.

Teams perform prescribed weekly activities such as joint research, immersive environment activity, or role-play. After the activity each student posts an individual lab report describing the activity in detail, including time of meeting and who was present. Students are required to read and reply to each other's lab reports, and cite each other in their responses. These detailed procedures have been in

development over several terms to allow students to take responsibility for their learning, to be innovative and responsive to each other, to actively join the community, and to build the community by choosing and negotiating teams and times on their own.

Feedback in courses often corresponds to grading done after the fact. In these courses the point systems are cumulative over the term and students keep track of their own records online and shared with instructors. Points are gained by completing specific activities according to specifications. Points are lost by failing to meet posting deadlines and length requirements, and for missing assignments. When students keep records of their accomplishments they are involved in monitoring cumulative performance so that they try to improve their record as the term proceeds. Instructor comments in collaborative documents also serve as formative feedback on progress and guidance on what needs to be done. Students reply to instructors within the documents and ask questions. Instead of being passive recipients of grades students become active managers of their performances. This approach affords students a "formative" perspective on their learning over time, as well as a "summative" at the end. Their grades thus become self-directed achievements.

Voluntary participation occurs in a variety of ways and at different levels in these courses. Building in autonomy can activate intrinsic motivation where the work itself becomes the reward. Each week teams negotiate among the choices of activities. Choices are also built into each component of an activity, including selecting topics, role characters, content from research and readings, and other aspects.

Figure 6: Accident Reconstruction in Second Life

Choice is built into subject matter, methods, and measures or assessments where students design, implement, and report data from pilot studies in research assignments. Creativity is encouraged through autonomy and students often comment that the work was fun, enlightening, and confidence building (See Figure 6).

Future of Gamification

Hundreds of millions of tweens between 8-15 years old represent the largest online age group, spending hours weekly in hundreds of immersive animated virtual worlds, playing with near and distant friends and family (KZERO, 2011), acquiring virtual skills. Within three years 15 year olds will begin to enter college and will expect learning to be digital, virtual, and immersive (deFreitas, 2008). Some scholars refer to the dawn of immersive learning methods as a "virtual revolution" affecting every area of society and every discipline in education (Blascovich & Bailenson, 2011).

Figure 7: Student-run Professional Panel in Second Life

Since learning requires adequate extrinsic and intrinsic motivation, gamification of online courses can be a workable instructional strategy for tapping into available social and personal motivational resources. A key feature is treating a class as a community, where members form voluntary teams and utilize course constructs to produce and perform role-play activities, write collaborative reports and make presentations for specific audiences (See Figure 7).

Because course evaluations, assignment quality and feedback from students has been positive, and because student interactions have increased significantly with gamification, we intend to continue to develop gamification strategies in these courses to increase engagement. In the works are plans for adding inter-team meetings and meetings with teams in related courses with related projects. This approach was tried in one of the spring 2012 courses, and students unanimously agreed they gained valuable perspective by meeting with other teams and with teams from other courses. Because technology integration helps students develop the necessary skills to become effective digital citizens, also planned is more technology integration, including shared white boards, shared interest boards, podcasts to satisfy online oral presentation

requirements, and students producing short videos and e-books, among others.

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The MICA Experiment: Astrophysics in Virtual Worlds

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We describe the work of the Meta-Institute for Computational Astrophysics (MICA), the first professional scientific organization based in virtual worlds. MICA was an experiment in the use of this technology for science and scholarship, lasting from the early 2008 to June 2012, mainly using the Second LIfeTM and OpenSimulator as platforms. We describe its goals and activities, and our future plans. We conducted scientific collaboration meetings, professional seminars, a workshop, classroom instruction, public lectures, informal discussions and gatherings, and experiments in immersive, interactive visualization of high-dimensional scientific data. Perhaps the most successful of these was our program of popular science lectures, illustrating yet again the great potential of immersive VR as an educational and outreach platform. While the members of our research groups and some collaborators found the use of immersive VR as a professional telepresence tool to be very effective, we did not convince a broader astrophysics community to adopt it at this time, despite some efforts; we discuss some possible reasons for this non-uptake. On the whole, we conclude that immersive VR has a great potential as a scientific and educational platform, as the technology matures and becomes more broadly available and accepted.

Introduction

Virtual Worlds (VWs) and immersive Virtual Reality (VR) technologies are still in their infancy, and yet they hold a huge transformative potential. They may presage the emerging "3D Web", that may be as transformative as the WWW itself, if not more. This includes their possible uses in science, scholarship, and education.

We face a dual problem of engaging the broad academic to Second Life (SL) and, more recently, to community in their use and exploration for scientific and scholarly research in general, and at the same time taping into its innovation potential to help shape and develop the VWs and enhance their utility and functionality. It would be healthy to have the intellectual leadership and rigor in this arena come form the academia, rather than from the games industry alone. Yet, the scientific community at large seems to be largely unaware of this technological emergence or its potential.

While there has been a slowly growing interest in VWs and engagement of the academic community in the humanities and social sciences (e.g., Bainbridge 2007, 2010), with a few exceptions (e.g., Lang & Bradley 2009) OpenSimulator (OpenSim) platforms. SL provided a convenient, well established virtual environment, and the ready audiences for our outreach activities.

Astronomy has been at a leading edge of the e-Science and Cyber-Infrastructure developments, e.g., with the Virtual Observatory framework: a Web-based, distributed research environment for astronomy with massive and complex data sets (see, e.g., Brunner et al. 2001, or Djorgovski & Williams 2005); however that "virtual" is not yet related in any way to the immersive VR or VWs, and is today mainly providing a global data grid of astronomy, with some data services. We also have many on-line forums for research collaborations, such as MODEST (http://www.manybody.org/modest), in which the "hard sciences" community has yet to engage meaningfully in these interesting, possibly transformative developments. Aside from being insufficiently informed, and the natural inertia in adopting radically new things, one reason for this negligence may be a lack of the real- life examples of the scientific utility of VWs.

With this in mind, we formed the Meta-Institute for Computational Astrophysics (MICA; http://mica-vw.org), to the best of our knowledge the first professional scientific organization based exclusively in virtual worlds (VWs). Our goals were to explore the utility of the emerging VR and VWs technologies for scientific and scholarly work in general, and to facilitate and accelerate their adoption by the scientific research community.

The charter goals of MICA were:

- Exploration, development and promotion of VWs and VR technologies for professional research in astrophysics and related fields.
- To provide and develop novel social networking venues and mechanisms for scientific collaboration and communications, including professional meetings, effective telepresence, etc.
- Use of VWs and VR technologies for education and public outreach.
- To act as a forum for exchange of ideas and joint efforts with other scientific disciplines in promoting these goals for science and scholarship in general.

MICA was formed in the early 2008, following the early explorations by Hut (2006, 2008), and lasted until June 2012. Its work continues under the auspices of the Caltech Astroinformatics group. Some of our work to date has been described in McMillan et al. (2009), Knop et al. (2010), and Djorgovski et al. (2010a,b), and in a number of other conference presentations.

While our initial activities were conducted in the VW of Qwaq (renamed since to TelePlace), we quickly migrated a number of the founding members of MICA were engaged. An emerging discipline of Astroinformatics aims to develop deeper and broader connections between

astronomy and applied computer science and information technology (see, e.g., http://astroinformatics2010.org).

MICA was an experiment in academic and scientific practices enabled by the immersive VR technologies, an example of the e-Science, or the "Fourth Paradigm" (Hey et al. 2009; the first three being experiment, analytical theory, and numerical simulations) - a segment in the evolving landscape of computationally enabled science in the 21st century

VWs as a Scientific/Scholarly Platform

As most people who have seriously tried them know, VWs are clearly a powerful scientific communication and collaboration platform. In addition to the traditional uses, such as the discussion, conference, or collaboration group discussion venues, there is another important aspect where VWs can play an essential facilitating role:

Genuine interdisciplinary cross-fertilization is a much-neglected path to scientific progress. Given that many of the most important challenges facing us (e.g., the global climate change, energy, sustainability, etc.) are fundamentally interdisciplinary in nature, and not reducible to any given scientific discipline (physics, biology, etc.),

the lack of effective and pervasive mechanisms for establishment of inter-, multi-, or cross- disciplinary interactions is a serious problem which affects us all. Engaging in effective interdisciplinary activities requires easy and effective communication venues, intellectual melting pots where such encounters can occur and flourish. VWs as scientific interaction environments offer a great new opportunity to foster interdisciplinary meetings of the minds. They are easy, free, do not require travel, and the social barriers are very low and easily overcome (the ease and the speed of striking conversations and friendships is one of the more striking features of VWs).

Another interesting question is how immersive VR can be used as a part of novel forms of scientific publishing, either as an equivalent of the current practice of supplementing traditional papers with on-line material on the Web, or even as a primary publishing medium. Just as the Web offers new possibilities and modalities for scholarly publishing which do not simply mimic the age- old printed-paper media publishing, so we may find qualitatively novel uses of VWs as a publishing venue in their own right.

Immersive VR environments open some intriguing novel possibilities in the ways in which scientists can set up, perform, modify, and examine the output of numerical simulations. In MICA, we used as our primary science environment the gravitational N-body problem, since that is where our professional expertise is concentrated, but we expect that most of the features we developed will find much broader applicability in the visualization of more general scientific or abstract data sets in arbitrary VW environments.

In a more general context, VWs offer intriguing new possibilities for scientific visualization or "visual analytics". As the size, and especially the complexity of scientific data sets increase, effective visualization becomes a key need for data analysis: it is a bridge between the quantitative information contained in complex scientific measurements, and the human intuition which is necessary for a true understanding of the phenomena that are being studied.

Moreover, the human visual perception system is naturally optimized for 3D: we are meant to interact with each other, with objects, and with informational constructs in 3D; the traditional 2D paper or screen paradigm is simply a historical and technological artifact. Perhaps this is the main reason for the "unreasonable effectiveness" of VWs (given the technology's nascent sta) in creating a subjective feeling of a real presence.

VWs provide an easy, portable and inexpensive (or free) venue for a multi-dimensional data visualization, but with an added benefit of being able to interact with the data and with your colleagues, in a truly explorative and collaborative manner.

One increasingly plausible vision of the future is that there will be a synthesis of the Web, with its all-encompassing informational content, and the immersive VR as an interface to it, since it is so well suited to the to the human sensory input mechanisms. We can think of immersive VR as the next generation browser technology, which will be as qualitatively different from the current, flat desktop and web page paradigm, as it was different from the older, terminal screen and file directory paradigm for information display and access. A question then naturally arises: what will be the newly enabled ways of interacting with the informational content of the 3D Web, and how should we structure and architect the information so that it is optimally displayed and searched under the new paradigm?

Figure 1: MICA members conducting scientific and collaborative discussions in an immersive environment in SL. Graphics (diagrams, slides, etc.) are imported as textures and displayed on suitable prims

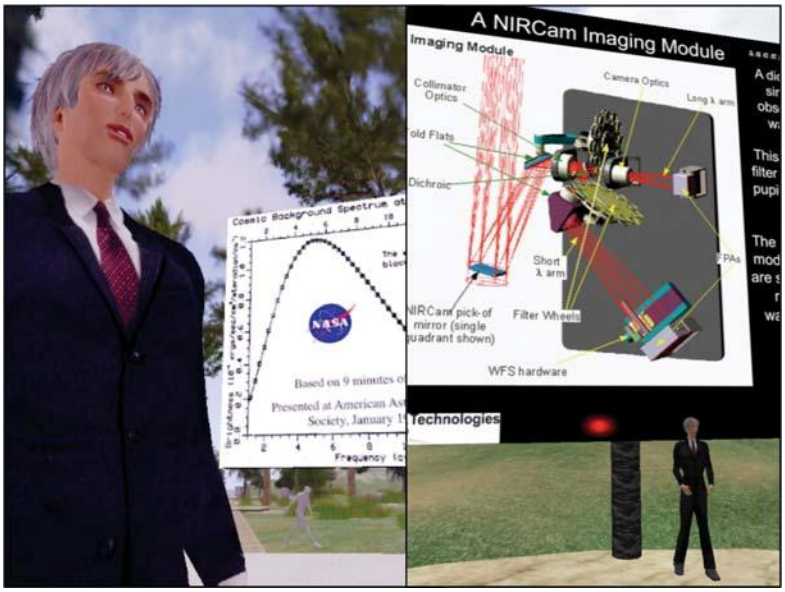

Figure 2: Nobel laureate John Mather (now the Project Scientist for the James Webb Space Telescope) giving one of the MICA technical seminars

Immersive VR as a Scientific Collaboration and Telepresence Platform

We have been using SL extensively as a venue for research group and collaboration discussions, including collaborators worldwide (Fig. 1). Many of us prefer this mode of interaction to Skype or telecon meetings, including the standard videoconferencing. Several research papers have been conceived at these meetings.

Much of our early effort was focused on the visualization and exploration of numerical stellar dynamics simulations in VWs. Throughout 2009, we organized weekly meetings in the MICA building, on our StellaNova island, in order to discuss the use of N-body simulations in SL and in OpenSim. The meetings were highly successful, and we had a steady audience of ten to twenty participants, partly professional astrophysicists, partly amateur astronomers and others interested in learning more about the gravitational N-body problem and its applications in stellar dynamics simulations of star clusters and galaxies.

Throughout 2009, we organized weekly meetings in the MICA building on our StellaNova island in SL, in order to discuss the use of N-body simulations in SL and in OpenSim. The meetings were highly successful, and we had a steady audience of ten to twenty participants, partly professional astrophysicists, partly amateur astronomers and others interested in learning more about the gravitational N-body problem and its applications in stellar dynamics simulations of star clusters and galaxies.

In the first year, we used SL as a platform for our weekly professional seminar series, with a typical attendance of ~ 30 avatars. These seminars served as a device to introduce our colleagues to VWs: we invite them to give a talk as an introductory experience with this medium. One of our speakers (both for a professional seminar, and for a public lecture) was John Mather, a Nobel laureate in physics, and currently the Project Scientist for the James Webb Space Telescope (Fig. 2). This indicates the level of seriousness and the perceptions of at least some members of the professional astrophysics community.

The great majority of those who accept our invitation to speak at the MICA seminars in SL found the experience to be interesting and rewarding. However, while some of the colleagues we attracted in this way remained active in exploring the scientific uses of VWs, the majority did not. We have thus stopped this seminar series, and had seminars on an ad hoc basis, when an appropriate speaker was available.

The lesson learned from this experiment is that the great majority of our colleagues are still leery and reluctant to embrace VWs as a scholarly platform. We consider below some possible reasons for this slow uptake of a highly promising technology. Unfortunately, this is not an unusual situation with the process of the academic community adoptions of any new technology, especially in the internet era, and given the endemic inertia of the academic institutions in adopting new ways of doing business. Some persistence is needed, as well as tangible demonstrations of the utility of these technologies for the scholarly work.

We also conducted a 1-day international workshop on the scientific uses of VWs within SL. This confirmed our expectations that immersive environments represent an effective, easy, inexpensive, and environment-friendly (due to the absence of a physical travel) venue for professional meetings. This was of course already realized by many other groups in the business world and by some government agencies, but it has not yet registered effectively in the academic community at large.

By eliminating the necessity of a physical travel, virtual meetings represent a very "green" technology. While in the early days of the internet there were high expectations for telecommuting, they were dashed by the lack of immediate and subjectively personal interactions (the "watercooler effect"). VWs solve this problem, and we expect that they will have a major impact in this arena, once this technology becomes more broadly accepted.

Education and Public Outreach

There is of course an extensive literature on the education in VWs, the review of which is beyond the scope of this paper. Gauthier (2007) describes some early astronomy outreach efforts in SL.

We have experimented with a normal classroom instruction in a VW environment (Fig. 3). We plan a more extensive use of VWs for both classroom-style lectures and informal student-faculty discussions.

We have established a strong and successful program of public lectures (Fig. 4), initially on a bi-weekly, but then on a weekly basis, during the academic terms. These included external speakers, as well as the members of our team. They were very popular, with a typical attendance of ~ 50 – 70 avatars. The slides shown, and in most cases also the audio and/or video (machinima) recordings are posted on the MICA website, and are freely available.

During the first few months, we have also held weekly informal "Ask an Astronomer" sessions, where anyone could ask astronomy or general science questions from one of our professional members. These sessions were very popular with science enthusiasts.

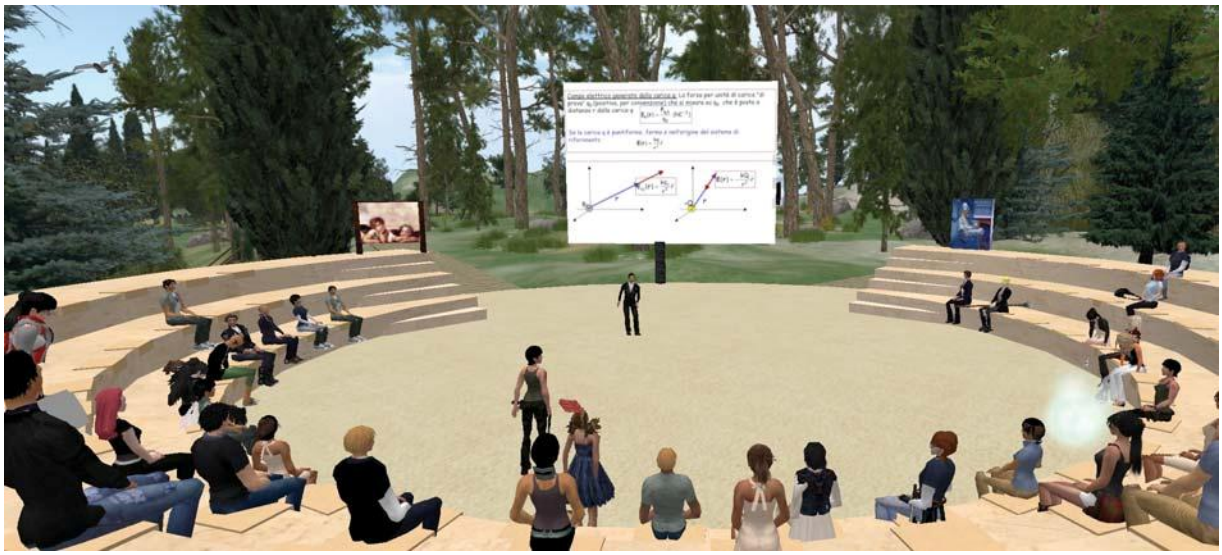

Figure 3: A lecture in an introductory physics class conducted in SL, while the instructor (Prof. G. Longo) was on one continent, and the students on another. The students' reaction to this novel approach was largely very favorable

Figure 4: One of the MICA popular lectures: Dr. Sean Carroll from Caltech is explaining the material from his book, From Eternity to Here

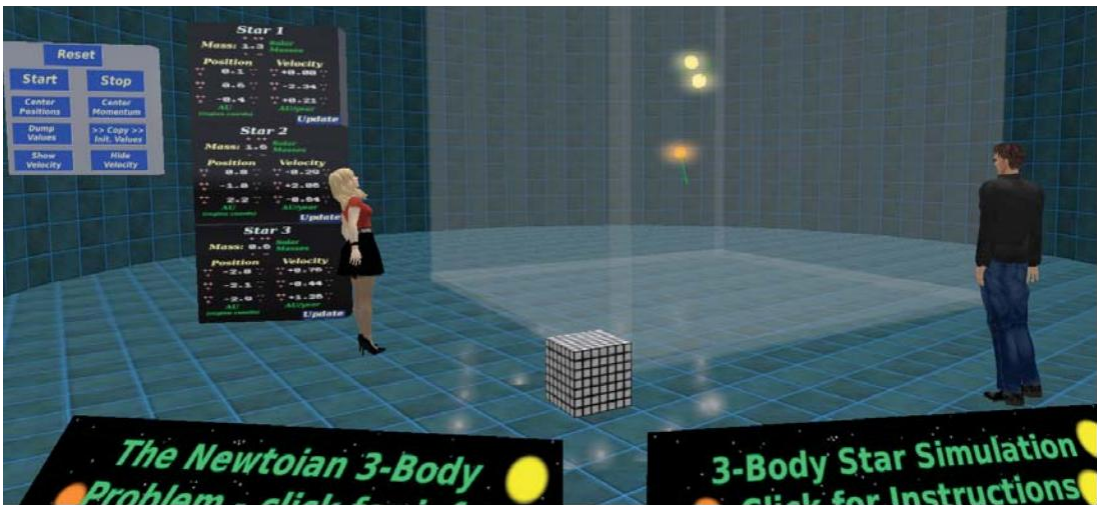

Figure 5: A working demo of a gravitational 3-body problem, deployed at the MICA sim in SL, and developed by Prof. Rob Knop, one of our core team members. This is an example of an interactive, hands-on experiment that a virtual teaching laboratory might contain

We have started to develop a virtual educational laboratory content, starting with a simple physics experiment, a 3-body gravitational interaction (Fig. 5). Students can modify the initial condition and observe the changes in the outcome, computed in real time. We envision such virtual teaching laboratories as a great potential resource for the schools who cannot afford actual real-life laboratories. Moreover, some experiments simply cannot be done in a real lab context – dynamical evolution of stellar systems being an example. We can develop a virtual lab exercise where one can change the actual physics (e.g., "what if the gravitational force was inversely proportional to the cube of the distance?"), and see the difference in the outcomes.

One important feature of VWs is that they lower the social barriers in most human interactions, and education is no exception. People who attended our popular lectures and informal discussions would generally not attempt (or not even have an opportunity) to make comparable contacts in real life. This leveling of an educational playing field may have a huge, beneficial social impact.

Scientific Data Visualization

Immersive visualization of complex data spaces is now the main research direction we are pursuing. VWs offer intriguing new possibilities for scientific visualization or "visual analytics". As the size, and especially the complexity of scientific data sets increase, effective visualization becomes a key need for data analysis: it is a bridge between the quantitative information contained in complex scientific measurements, and the human intuition which is necessary for a true understanding of the phenomena in question. The advantages of VWs in this arena are that the visual exploration can be collaborative, as researchers interact with each other at the same time as they interact with the data. It is also a low-cost, highly portable alternative to many other methods of 3D data visualization (e.g., caves, use of special theaters, helmets, or goggles, etc.).

Our initial experiments with immersive visualization of stellar dynamics simulation (Fig. 6) have been described by Farr et al. (2009) and Nakasone et al. (2009). In addition to visualization of pre-made, stationary data sets, we think of visualizing output of numerical simulations or data streams in real time, allowing scientists to interact with their experiment itself as it is ongoing.

In collaboration with Desdemona Enfield (her SL nom de pixel), we have developed universal scripts for immersive visualization of highly dimensional data sets. We are using data object shapes, textures, orientations, transparency, rotation, pulsation, etc., to encode additional data dimensions beyond the obvious spatial XYZ coordinates, color, and size of data objects (Fig. 7). This was expanded by us to include the transparency (the alpha layer) as the means of encoding an additional dimension. We can add additional dimensions through the use of object shapes, orientations (for the non- spherical data points), textures, and glyphs. In all, we expect that about a dozen parameter space dimensions can be encoded in these immersive, peudo-3D displays.

An additional functionality we added is the ability to link data objects with the external catalog or database information, e.g., using a simple point-and-click. This information can be displayed using a Web browser window, either external or internal to the VW browser.

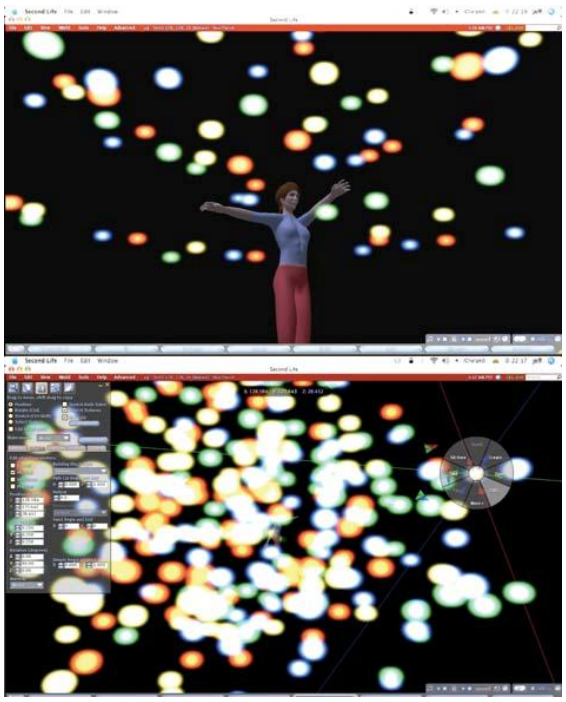

Figure 6: An early example of an immersive visualization of an output of a dynamical simulation of a star cluster, with the scientist interacting with the simulation from within the VW

We have ported these scripts into the OpenSim worlds, initially Intel's ScienceSim, and now the Virtual Caltech (vCaltech), where the experiments continue. This enabled us to overcome a major obstacl, the limited prim quotas in SL. In our OpenSim experiments, we can easily visualize ~ 100,000 data points. Beyond that, individual data point representations are better replaced by isodensity surfaces, at least for the majority of the data; outliers are still best represented as individual data points.

We are now also developing data visualization using the Unity 3D platform, and experimenting with Microsoft's Kinect device as a haptic interface.

Concluding Comments

MICA was a new type of scientific institution, dedicated to an exploration of immersive VR and VWs technologies for science, scholarship, and education, aimed primarily at physical and other natural sciences. It was an experiment in the new ways of conducting scholarly work, as well as a testbed for new ideas and research modalities.

The central idea here is that immersive VR and VWs are potentially transformative technologies on a par with the Web itself, which can and should be used for serious purposes, including science and scholarship; they are not just a form of games, and that message has to be absorbed by the academic community at large.

Our goal was to engage a much broader segment of the academic community in utilizing, and developing further these technologies. This, in turn, would bring in the new creative potential of the community in developing further the VR and VW technologies themselves.

MICA was intended to be a gateway for other scholars, new to VWs, to start to explore their potential and the practical uses in an easy, welcoming, and collegial environment. However, we did not succeed in engaging a broader segment of the astrophysics community in the adoption (let alone development) of these technologies; the same applies in most other sciences or academic domains. Why are academics so slow to recognize the utility and the potential of VWs and immersive VR?

We have polled our professional members (about 50) who have not continued to use VWs beyond their initial visit as to why. The majority answer was that they do fid the technology interesting, but simply do not have the time to invest in exploring it now.

A part of the answer is that many people (in particular those older than the growing generations of "digital natives") are not used to (and some are simply repelled by) the avatar representations of themselves and their colleagues – it looks like a video game, and not a serious professional activity. An additional factor is the (well deserved) iffy reputation of VWs such as SL and what goes on in them. This stigma must be overcome, if we are to attract a broader community of academic professionals to these technologies, both as users and as developers.

One possible approach is to introduce our skeptical colleagues to VWs through dedicated academic VWs with controlled access. OpenSim worlds are currently perhaps the best option in this regard. The SL/OpenSim will most likely not be the architecture of the future "3D Web". However, it is a good interim platform to get used to the immersive VR experience and start developing the novel tools for science, scholarship, and education.

Another factor in the slow uptake may be the quality of the user experience in VWs such as SL. Pure commercial games, for example, have vastly better graphics, although they are more rigid, and mostly not user-programmable. Yet there is no obvious alternative to SL and OpenSim at this time as scholarly VR experimentation platforms.

We are currently witnessing a dramatic growth in 3D display technologies, largely driven by the entertainment industry. These commercial interests are funding the technology developments in a way that the academic community could not, and that gives us a powerful leverage – just as it happened in the past with computing and information technology.

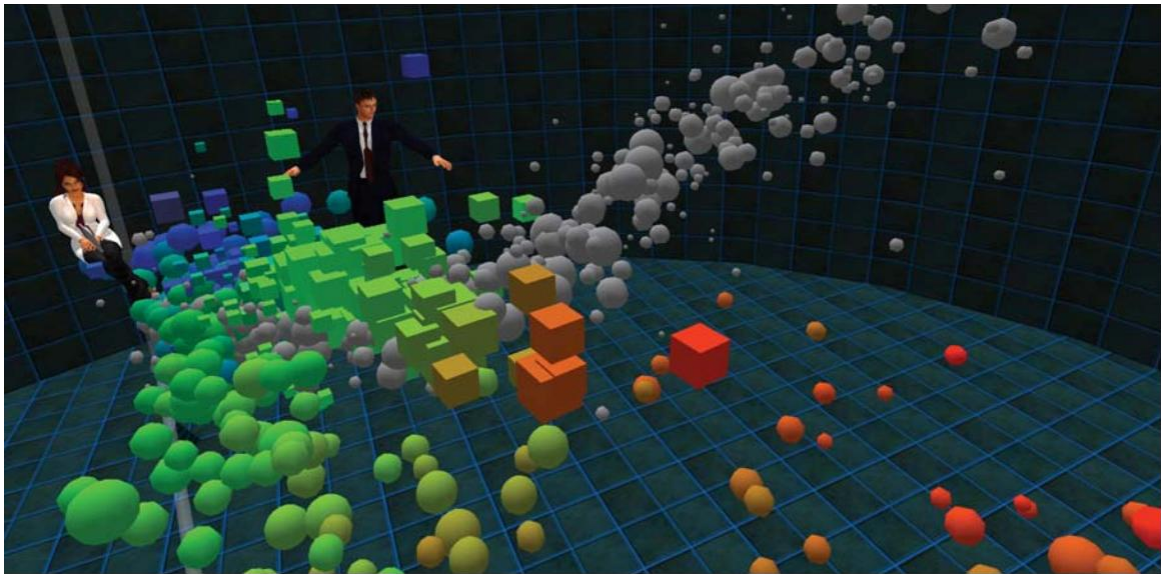

Figure 7: An example of an immersive, collaborative data visualization in SL. The data represent properties of stars, galaxies and quasars from the SDSS sky survey. The XYZ positions, point shapes, sizes, and colors encode different observed parameters

Figure 8: A Caltech student (F. Sauer) experimenting with data visualization scripts in an OpenSim world

The lack of an effective uptake of VWs in the academic community is symptomatic of a broader problem: while the information technology evolves on a Moore's law time scale (i.e., a couple of years at most), humans learn new skills and change their behavior on much longer time scales; they simply cannot keep up with the pace of the technology. An even more insidious problem is that academia as an institution evolves even slower, on time scales of decades or centuries. While the new generations of digital natives may find these technologies to be perfectly natural and a standard part of their lives, both personal and professional, we have to accelerate their adoption in the academic and research contexts.

This evolutionary process may have an impact well beyond academia, as these technologies will change the ways we interact, both with each other and with the informational content in the cyberspace. Engaging the

academic community in the extensive use of VR and VWs may also lead to novel practical and commercial applications and development directions which we cannot even anticipate today. If immersive VR becomes a major feature of modern society, in commerce, entertainment, etc., the potential impact will be very significant.

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Virtual Archaeology in Second Life and OpenSimulator

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Traditional approaches to virtual archaeology include dealing with researching methods to capture information from heritage sites, creating models out of that information, and how to present them to the public; these historically needed intense technical procedures which might be too costly for some types of projects. Virtual worlds allowed new types of models of heritage sites to be produced and disseminated at a fraction of the cost.

Second Life®, and its open source counterpart, OpenSimulator, are virtual world platforms with user-generated content. 3D models are created in real time and instantly rendered for all visitors. This allowed amateurs and researchers to create their own virtual archaeology projects easily and with few costs, and to have the resulting models immediately available to a vast community of millions of users. This article presents an overview of four different approaches to virtual archaeology projects that are present in Second Life and that have been publicly discussed and analysed; in particular, the last type shows a novel approach to virtual archaeology which is not found on other platforms, and how researchers have managed to extend the concept to new areas and developed methodologies to incorporate the validation of historical accuracy to encompass these areas.

Keywords: Virtual archaeology, Second Life, Virtual Worlds, OpenSimulator, heritage

Introduction

Virtual archaeology is a blend of techniques and methods employed by historians and archaeologists using computer models for visualising cultural artefacts and heritage sites. Traditional models emphasised the focus on realism and accuracy, as well as on haptic interfaces or complex "virtual rooms" to fully immerse a visitor into a 3D reconstruction of a historical site (Frisher et al., 2002). The advance in photo-realism techniques also allowed the movie industry to rely more and more on computer-generated models instead of building costly scenarios. However, first-generation virtual archaeology projects tended to give more importance to the technical solution than to the historical accuracy of the virtual reconstruction. Methodologies like the London Charter (Beacham, 2006) proposed to create a set of rules and definitions to allow historians and archaeologists to lead the virtual archaeology projects, validate their decisions with adequate documentation, and delegate the technical aspects to a team of developers (modellers and programmers), while keeping the lead of the project. Validating the accuracy of archaeological reconstructions became a fundamental aspect of virtual archaeology projects, more even than the focus on realism or immersion using haptic devices (Nick, 2001). Frisher (2010) extensively uses this kind of methodology for the *Rome Reborn* project, which used distribution of a low-polygon model through the popular Google Earth service, and which is considered to be historically very accurate.

With this change, new questions were raised about the use of such virtual archaeology projects and how they could be disseminated to a wider audience. Again, traditionally, they were used either for special installations in museums (which, due to the technology involved, could become very expensive) or to film documentaries. While static pictures could certainly convey the findings of a virtual archaeology project — published via the Web or on journals — the element of immersion and interaction with the historical site was not so successfully captured that way.

At the same time, as the capabilities of personal computers continued to advance, putting high-end graphic cards in the hands of everyday users, 3D virtual worlds started to become common, and quickly put to educational use. Virtual worlds, where users are represented by avatars, allow interaction between users and the environment, and are thus appropriate for simulating environments in real time, and their use in virtual archaeology soon became apparent.

Among the many virtual world platforms, a new class has emerged by the turn of the millennium: virtual worlds with user-generated content. In these environments, there is no separation between the design/modelling/programming stages and the visualisation itself. 3D models are created in real time and immediately available to all users in the same location. There is no need for rendering scenes in advance — a process that might take a long time with several iterations until historians and archaeologists agree with the results produced by the technical teams. Instead, the historian or archeologist can, by themselves, instantly create the models, and present them to an audience, or discuss it with colleagues by logging in to the same area in a virtual world where the virtual site is being built.

Second Life® (SL), a virtual world created and maintained by the Californian company Linden Lab, opened to the public in June 2003 with this new paradigm in mind. It is a virtual world platform with user-generated content, where content is persistently stored at Linden Lab's servers, which features visual contiguity (there is just "one" world, shared by millions of users, in a single landscape) and a very complex system of permissions, allowing content to be shared or sold (which, in turn, led to a very rich economy of digital content sales). Its open-source counterpart, OpenSimulator, is based on the reverse-engineering efforts of a team of independent developers who have documented the communications protocol between the Second Life Viewer (which was released by Linden Lab as a free and open source application, thus allowed several independent developers to contribute code to it and spawn their own variants with extra features) and the simulator servers running the virtual world. Both technologies use exactly the same viewer and present 3D content in precisely the same way. The difference is that OpenSimulator is a free and open source server-side application which can be installed on any computer to run a personal virtual world; Linden Lab's simulation software is proprietary and is used to run the Second Life Grid®, where, for a monthly fee, users can lease simulators for their personal use to store persistent content (access to the Second Life Grid is free). OpenSimulator-based grids are run by independent commercial operators, campus networks, or individuals, and are not interconnected with the Second Life Grid.

Since the Second Life Viewer includes building and programming tools, designed with amateurs in mind (and not professional 3D modellers or application developers), it is considerably easier to create content on the Second Life Grid than on professional 3D modelling tools (like Blender, Maya, 3Ds Max, among others), even for a non-expert. Additional content can obviously be outsourced to professional modellers or, even better, can be bought from other users, in what amounts to one of the world's largest marketplace for 3D digital content, worth about half a billion Euros annually of sales of digital content. For the researcher, this means that a lot of content is already available; additional content can be either created by themselves or cheaply outsourced to any of the vast amount of content creators in Second Life; and that content is immediately deployed and available in real-time. Researchers can meet in the virtual world to critically analyse the historical accuracy of the models thus created and immediately make the appropriate changes. And, of course, historical sites created in Second Life are instantly available to several millions of potential visitors, thus becoming a very powerful distribution method.

In the published literature that was reviewed, four distinct models of virtual archaeology in Second Life have emerged, of which the latter two will be more thoroughly reviewed. The first two are interesting for further study outside the fields of archaeology, history, and computer science, but they are nevertheless included for the sake of completeness.

Second Life "cyber-archaeology"

Harrison (2009) discusses how communities in virtual worlds create their own myths, and, based on those, virtual architecture, as being part of the "creation myth", become heritage sites, visited and preserved by the user community as a reference of their commonly held past. The approach is very interesting and follows Boellstorff's seminal work on ethnography in Second Life (Boellstorff, 2008), a book written as a result of several years of studying the Second Life communities from the perspective of an anthropologist. While Boellstorff is more interested in describing aspects of how the communities in Second Life are born, evolve, are tied to a certain virtual location, and create their own myths, Harrison discusses one of the embodiments of those myths — the virtual architecture of "past ages" that remains in the virtual world for several years because they are reference points for the community. Harrison concludes that the models for selecting and preserving certain virtual buildings in Second Life closely mirror the same process that happens in real life. Thus, certain buildings like the Governor Mansion in the Clementina region, allegedly the oldest building in Second Life, was ported over from the early alpha testing days of the virtual world platform, when it was built by its oldest user, Steller Sunshine, in July 2002. Like real archaeological sites, the building includes subsequent plaques of information telling the history of the building, showing the extension of the virtual world at the time it was built, and explaining why it was felt to be important to preserve it. Other locations in Second Life, instead of preserving actual buildings or other types of content, are set up as virtual museums, where visitors can see pictures of earlier versions of Second Life, like the "Unauthorized history of Second Life museum"; societies for the historical preservation of content and history of communities are popular, and these produce websites, blogs, or wikis to

document the "historical past" of Second Life and its communities.

Harrison argues about this type of virtual archaeology: "[...] that the role of cyber-archaeology is not only to study the 'actual' technologies employed by virtual communities, but also the virtual objects they create within cyber-space [...]"

This leads to a very specific type of virtual archaeology where there is no reconstruction of the historical past using virtual world technologies; instead, virtual buildings, with no physical counterpart, which have been used by an online community in their past, are preserved by the community as part of its own myths.

Amateur virtual archaeology

While Second Life includes several academic projects in the area of virtual archaeology, which follow methodologies employed by historians and archaeologists to establish historical accuracy, Second Life users have been very prolific in creating their own models of the historical past without any method or structure and caring little about historical accuracy. They are "amateur virtual archaeologists", getting inspiration from either real heritage sites, or images popularised by the entertainment industry, namely from movies, TV series, or computer games. (Graham, 2007) documents some of those sites in Second Life. At the time of publication, Graham (2007) found that the amount of amateur virtual archaeology sites in Second Life were by far more dominant than sites created by historians, archaeologists, or academic researchers; this might still be the case, in spite of the reasonably large amount of new academic projects created in Second Life since 2007. Victorian scenarios (with its popular "steampunk" counterpart), medieval reconstructions, or recreating the environment of the Roman Republic and Empire are popular. Most have a specific goal beyond merely visually depicting 3D models of a past (which might just be an imagined past and not a historically accurate one): in many cases, the environment leads to a community interested in a certain aspect of the past depicted by the buildings, and they adopt — using role-playing mechanisms — the costumes, mannerisms, and even the types of events typical of the period. One of the best examples is possibly Caledon, which is set in a mythical Victorian age where steam-based technology has evolved far more than in our own real historical past, and where the cities are laid out according to Victorian preferences and exhibit the kind of buildings typically found in Britain during the late 19th century (The Caledon Wiki, n.d.). Second Life users inhabiting the region of Caledon lease land for their own leisure, and are expected to behave according a certain etiquette loosely inspired in Victorian morality and code of conduct. Additional buildings have to be "in theme", meaning that no buildings can be added which not conform to a Victorian look and feel.

Not all areas depicting buildings of the past are role-playing areas. The Confederation of Democratic Simulators (CDS), for example, aggregates two different themes — Bavarian/Alpine Medieval, and Ancient Rome/Greece — but does not mandate any code of conduct or ethical behaviour related to the "theme" (CDS portal, n.d.). Instead, the themes have been selected using a democratic process, and teams of volunteers have done their best to reproduce imagined cities using Bavarian/Alpine medieval architecture or ancient Roman/Greek (depending on the location). While the scenarios are inspired by existing archaeological sites, they are not faithful reproductions and do not pretend to be faithful. Nevertheless, it is interesting to mention that in this case, some users with a background in architecture and history have given classes to the volunteers about specific aspects of Roman architecture, thus ensuring a minimal amount of historical accuracy. New projects to be implemented in the CDS require some background research by the teams proposing the project before putting the project to vote by the community; the CDS raises funding for additional projects by leasing parcels of terrain to its users, and, not unlike real grant projects, a certain amount of work is required until a new project (or even a completely new theme) is approved. An elected committee also validates the accuracy of the buildings created by volunteers (or subsequent users who lease terrain and contribute with more buildings) to make sure they keep "in theme", but this validation does not follow any academic methodology.

These and similar projects should be considered, at best, as hard-working amateur attempts at recreating historical sites, or at least sites inspired by real architecture of the historical past. The interesting aspect is that in these cases the purpose of building the reconstructions is to allow a community to "live" in them. Unlike a museum exhibit, or a 3D reconstruction created specifically for a documentary, these amateur virtual archaeology sites, in spite of its flaws and limited accuracy, have the purpose of encouraging interaction between users and letting them participate in the process of creative depiction of historical sites. This, as we will see, is not the case with most academic projects that have been found so far in Second Life.

The virtual museum of archaeology

Exhibits of heritage sites are costly to create and maintain, either on the heritage sites themselves or in real museums. Very early uses of the World-Wide Web included "online catalogues" of museums, where images of real museums were posted on the Web (the Louvre was a pioneer in this area) and visitors could easily "visit" an exhibition, comfortably sitting behind their computers at home, and not requiring anything more than a computer connection. Images, however, just convey one kind of visual experience; and the experience is solitary, without interaction. It is equivalent to buying a paper catalogue of a museum's exhibit and going through its pages at home; the

difference being that far more images can be added for comparatively very low distribution costs, and these can be updated dynamically from a central database, unlike a paper catalogue, which has to be published and shipped to each interested party every time an exhibition is changed. Multimedia elements like movies, sounds, or slideshow presentations can also be part of the experience, which would be impossible to replicate on a book; hypertext also allows references and additional information to be presented in a format impossible to replicate on a conventional book. Thus, "digital museums" have some advantages over the traditional paper catalogue, but visitors miss the rich experience of interacting with guides and other visitors.

Virtual worlds like Second Life extend the concept of remotely visiting a museum by allowing both guides and visitors to interact with each other; also, all media available on Web pages can be included in the virtual museum. Additionally, exhibitions can also include 3D replicas of real artefacts, and not merely 2D images (or movies) of them. They can be made to scale, allowing visitors to have an idea on how they looked in reality; real museums, by contrast, are limited to the building dimensions to fit those artefacts inside. Thus, while a vase or some Roman coins can be exhibited in most museums, a full replica of the Parthenon (or even of the Giza pyramids!) is not so easy — museums will need to scale down the replica in order to allow visitors to experience 3D models of them. Second Life has no such restrictions; replicas can be made at any scale.

On top of that, Second Life can be fully programmed by the curator of a virtual museum; this allows the exhibit to be highly interactive. For example, the *Portus II* project has established a small museum area in Second Life showing the results of the project (Keay et al., 2009). This follows a common layout for a museum, but with a twist: a 3D "miniature model" is reproduced interactively, and visitors can click on buttons to change the era to be displayed, and the 3D model will be created for that specific era. While a similar approach could be used in a real museum with, for example, a computer running a Flash application uncovering image layers depending on the visitor's selection, in Second Life the user gets the impression that the whole 3D model is being specially created in thin air for them.

Virtual museums are relatively easy to set up in Second Life and new ones are constantly springing into existence and are often short-lived (Urban et al., 2007). Urban, writing in 2007, summarises that most still follow a 19th century approach for museums, being basically images hung on walls and defining a path for visitors to follow; a short visit to a few museums (a few of which are still in existence) showed that, in general, the approach is still the same. Kuhr, writing on her blog (Kuhr, 2010), reports her impressions about a series of museums and similar exhibition places that she found in Second Life:

- *Sims[13] that were almost entirely empty. When I went to Non Profit Commons, there were a couple of greeters[14] there — really nice friendly people, ready to help with answering any questions. But few or no visitors.*
- *The usual sort of visual communication techniques and design choices that make most SL exhibits and museums so terribly ineffective —panels and text on walls, objects to click on to get notecards, etc.*
- *Environments that did little more than replicate real life educational spaces and exhibits.*

Some museums are not merely static displays of artefacts and architecture. The International Spaceflight Museum in Second Life, for instance, routinely hosted events discussing spaceflight, astronomy, astrophysics, or cosmology, usually by inviting researchers in the field to create an avatar and present lectures, which used to be well-attended (International Spaceflight Museum, 2007). The remaining exhibits, besides displaying models of several spaceships over the decades, also include visual and interactive displays of technological artefacts, like the Hubble Telescope.

Some attempts have been made to extend the concept of the virtual museum; for example, González-Tennant reports his experiences with the Rosewood, Florida museum in Second Life (González-Tennant, 2010), where he also encountered the limitations of merely replicating the "museum experience" in Second Life. To make the exhibit more interesting, he suggests, as an example, that the virtual museum curators engage in "digital storytelling": using digital media to tell personal and/or group stories. These can be presented to audiences in Second Life itself; the "museum" acts both as a provider of digital content and as an audience room where lectures, using digital material from the virtual museum itself, can be made in front of an audience of visitors. Other museums follow similar approaches, not unlike real museums, where special events attract visitors to an exhibition (Gaitanou & Tsoubrakakou, 2008).

While no solid conclusions can be made from individual opinions, and some searches did not uncover any published report on the success of museum exhibits in Second Life, informal conversations tend to convey the same impression: virtual museums, like their real counterparts, may not be particularly appealing (Styliani et al., 2009).

[13]Abbreviation of *simulators*, which is popularly used in colloquial writing, and refers to a region in Second Life. All regions have the same size, 256 x 256m.

[14]Users that spend their time (normally as volunteers) to aid other users. In this context, "greeters" are human guides to a museum or exhibit.

Nevertheless, a few polls showed that in the past users were more willing to visit museums in virtual environments than in real life (Loomis & Elias, 2003; Rothfarb & Doherty, 2007) or that visiting the virtual museum lead them to be more willing to visit their real counterpart (Marty, 2007); several anecdotal stories relate similar experiences, and they conclude that the anonymity/pseudonymity of Second Life tends to facilitate certain immersive experiences that users would otherwise never engage in real life; a discussion of the reasons for that behaviour is beyond the scope of this article (but can be found on (Boellstorff, 2008)).

Interactive virtual archaeology

The last type of virtual archaeology in Second Life is considerably more elaborate and generally more interesting. Instead of replicating the "museum experience", researchers have tried to reconstruct historical sites in Second Life, and take advantage of its unique medium. In contrast to reconstructions using 3D models, as said, users in Second Life can interact with the environment and with each other. Project members can directly talk to their visit while the exhibit is being built; researchers can be simultaneously present in the same virtual environment and discuss with their colleagues the accuracy of the model and change it in real time.

One well-researched project is the replica of Çatalhöyük, a Neolithic tell site located in Turkey, which was first modelled using traditional 3D tools and later created from scratch in Second Life (Morgan, 2009). Morgan describes in detail the experience of leading a virtual reconstruction project where archaeologists — not professional 3D modellers and computer engineers — do all the building tasks. She praises Second Life's relative ease of use for amateur modellers (even though she points out the many limitations of the technology) and how archaeologists, used to de-construct historical sites in its component parts, have now the opportunity to put the pieces together again inside the virtual environment of Second Life, and do that interactively, piece by piece, like assembling a giant puzzle. This process led to asking a lot of questions about the actual concepts that historians and archaeologists have always assumed about Çatalhöyük since the first excavations started in the 1960s. New hypothesis, formulated during the modelling phase, were quickly put to the test and rejected or confirmed; even small details, like the way the Second Life sun moved across the reconstruction and illuminated certain areas or put them into deep shadow revealed new concepts about how the historical site must have looked like, or what uses certain areas would need to have to make sense in the overall complex. Morgan's work, full of enthusiasm, pretty much describes a new tool for archaeologists and historians: a laboratory, where hypothesis can be put to test and visually confirmed by having avatars interacting with the reconstructed space. A lot of information can thus by validated or rejected that way, very quickly. Frisher reports similar experiences (Frisher, 2010) even though, in the *Rome Reborn* project, historians and archaeologists had to formulate the questions first, ask the modellers and technicians to implement them, and visualise the final rendering to evaluate the correctness of the hypothesis. Thus the need for historians and archaeologists to experiment with 3D models in order to visually validate their hypothesis is very valuable. The difference is that, in Second Life, there is no "delay" — researchers can immediately put their hypothesis to the test by shuffling buildings around in real time.

This was certainly also the case with the *City and Spectacle: A Vision of Pre-Earthquake Lisbon* project (Câmara et al., 2009). Developed by the Portuguese Centre for Art History and Artistic research (CHAIA, U. Évora), this is an ambitious project, originally developed in Second Life but now running on a private OpenSimulator grid, which aims to recreate most of the city of Lisbon just before the earthquake of November 1, 1755. The Baroque Lisbon of the 1750s completely disappeared during the earthquake and the following tsunamis and fires, and there is a certain lack of documentation (or even images and engravings) about the period. Landmarks like the Opera House, which only existed for about six months, were never captured in any painting — just engravings from the ruins exist, as well as scattered letters describing the magnificent building. Other documentation has unknown accuracy; some images from the early 1750s, for instance, are generally accepted as being faithful representations of Lisbon at the time, but there is no simple way to validate them, except by correlation with other documents. Textual descriptions of historical spaces can often be very inaccurate due to lack of context and subjective experience (Baker, 2010).

From all the existing data, CHAIA researchers attempted to build a 3D representation of Lisbon. Due to the ease of navigation in Second Life, it would be possible to match the model to existing images, and see if these were correct. Or, to take another example, using as background a description made by a traveller across the streets and the landmarks of 18th century Lisbon, would that description make sense, if an avatar followed the same path? Would they see the same scenes described on those letters? And if the model is changed to accommodate a certain description or a particular image, would it still be consistent with other images? Current historical research in pre-earthquake Lisbon just posed those questions and tried to answer them by comparing documents. As the researchers found out, it was only with a 3D model of the historical city that it was finally possible to validate some of the documents and images, and utterly reject others. Long-admired paintings were found to be completely inaccurate by introducing wrong perspectives and showing details that would be impossible for a viewer of the scene; a lot of

"embellishment" was thus uncovered, as well as concluding that in many cases, certain images and engravings must have been created from the artists' memory of the place and not in physical presence of the city buildings.

Accomplishing the same kind of "history laboratory" would have been very expensive using any other technology, mostly because of the iterative approach of 3D model building using traditional approaches. Similar to Morgan's case, "puzzle pieces" were assembled from documentation, quickly figured out that they would not match, and a different attempt modelled in Second Life, until it looked "right". This was relatively inexpensive and produced rather good results, which were also validated by following a methodology similar to the one described by the London Charter.

The *City and Spectacle: A Vision of Pre-Earthquake Lisbo*n project is not limited to be a "history laboratory". Its purpose is to also address educational uses and leisure. Further stages of the project will re-enact public spectacles typical of Lisbon in the 1750s, by using avatar actors, and allowing visitors to attend, optionally dressing up their avatars in costumes. In a sense, these events are like theatrical representations that, however, fully allow visitors to interact with the "actors" and participate in the event along the same lines that 18th century Lisbon dwellers would have done.

The possibility of using historical reconstructions in Second Life for further purposes beyond merely a display of architecture is very strongly present in the *Theatron 3* project. The Theatron 1 and 2 projects by the Kings' Visualisation Lab aimed to produce historically accurate 3D models of about 20 European theatres of all epochs, from ancient Greece to the 20th century. The third iteration of the project was concerned about recreating the same theatres (which had to be rebuilt in Second Life based on the original 3Ds Max models) with a specific purpose in mind: allow students of drama to rehearse historical plays in the environment they were originally written for. Tools were developed in Second Life for researchers to schedule a slot for using the models, and, on the appointed date, the selected theatre would automatically be generated inside a region; visitors, outside of the scheduled events, could browse through the collection of theatres and visualise them one by one, and visit them in turn.

Another set of tools was developed to implement choreographies, according to the students' interpretations of scene movements in historical plays. Thus, the students would act as directors, feeding simple commands to manipulate avatars across the stage, animate them with gestures, have them recite the appropriate lines, and synchronise the whole ensemble according to a "master plan" closely tied to the actual play. Visitors could enter the region and watch an "automated play", and, since everything happened in real time, it was possible for teachers to be simultaneously online while their students marked scene positions and configured the choreography device, and offer instant advice. This use of virtual archaeology as an educational setting has been peer-reviewed and a suggestion for evaluating similar projects has been presented (Childs, 2008).

The Sydenham Crystal Palace in Second Life developed by the University of Bristol is a similar project involving interaction in the virtual world with the goal of providing a more fuller educational experience (Earle & Shelley, 2009). In this project, a replica of the Pompeian House, as built inside the Crystal Palace during the London Exhibition of 1854, was replicated in Second Life, mostly based on existing 3D models. But the aim of the research was not to merely show the architecture; the historians wanted to expose their students to the actual experience of Victorian visitors experiencing a replica of an ancient Greek historical site. Due to the historical context and different moral values, Victorians evaluated what they saw based on their own set of perceptions and prejudice of the epoch, thus reacting quite differently than modern visitors to the same environment. To simulate the contrast, the project plans to introduce intelligent agents to "role-play" the Victorian mentality when confronted with the exhibit; in this case, the research was aided by actual reports made in the location and recorded for posterity — the reactions were recorded in many cases and can be simulated. Thus, on this particular virtual architecture project, not only the buildings and environment are replicated, but even the human interaction is reconstructed based on documentation, following established guidelines for validation of historical documentation. Historical sites are thus exhibited in Second Life with models of human behaviour as well.

Conclusions

The early attempts of virtual archaeology tended to focus on two aspects: how to best replicate 3D models of historical sites, and how to let the public visit them. As computer graphics evolved, the first projects put an emphasis on technology — both in terms of powerful scene rendering in real time, with as much realism as possible, but also in complex haptic interfaces, or "virtual room" exhibits, where the visitor would be fully immersed in the reconstructed historical site. This produced expensive solutions — expensive in development but also in presentation — which were appropriate for laboratory experiments and later for deployment as part of an exhibit of a real museum. The technology for capturing 3D information from historical sites and to render a replica as faithfully as possible was profusely used in the movie and game industry; besides documentaries, popular entertainment used 3D models inspired on historical sites. The accuracy of those models was however disputed, and initiatives like the London Charter established methods for

validating models where the role of the historian or archaeologist was the leader of the project, delegating the actual modelling to teams of technicians.

The resulting models were naturally much more historically accurate, sometimes at the cost of less photo-realism; these were not very popular with the entertainment industry, which departed from historical accuracy in favour of more eye-catching solutions for their audience.

With the advent of virtual worlds, historians and archeologists gained a new medium for disseminating their projects. Virtual worlds with user-generated content, where there are no intermediate steps between "modelling" and "visualising", like Second Life and OpenSimulator, opened new avenues of exploring the whole concept of virtual archaeology. Beyond the original goals of faithfully rendering heritage sites and presenting highly realistic scenes for visitors, current projects focus on the new possibilities that virtual worlds can bring to researchers: using the environment as a laboratory to test hypothesis in real time; allowing historians and archaeologists to do the modelling themselves without needing to hire technical teams; allowing visitors to interact with the virtual reconstruction of the heritage site and become participants; exploring new ways of disseminating information; and even replicating human behaviour in virtual environments.

Second Life (and its open source equivalent, OpenSimulator) has been a test bed for different approaches to presenting historical reconstructions in virtual worlds. Even amateurs have explored the possibilities of interacting with historical buildings and creating communities around them. Virtual museums, closely following their real counterparts, are relatively easy to establish in Second Life, and can attract visitors using technique similar to the ones employed in real life — real life curators have successfully run events in Second Life to bring visitors to their virtual museums.

But the latest generation of virtual archaeology projects show completely new uses for virtual archaeology projects, and they have no physical counterpart. These explore not only the 3D aspect of virtual worlds and the easy way content can be distributed, but they start to incorporate characteristics uniquely found in Second Life to make the experience of visiting a model of a heritage site much more enriching and immersive. These can be explored as new "laboratories" for the purpose of further research, using tools never before available to historians and archaeologists, but the same content can be immediately deployed for educational and leisure use, at a fraction of the cost of more traditional methods. The success of those new approaches to virtual archaeology is still being evaluated, but the evaluation procedures follow well-established guidelines in the history and archaeology research communities which are being extended to incorporate the unique and novel uses given to replicas of historical sites created in Second Life.

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Virtual worlds as a tool to facilitate weight management for young people

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Objectives: Childhood obesity is a serious problem in the UK, with around 20% of children aged 10-11 being overweight or obese. Lifestyle interventions can be effective, but do not always result in sustained weight-loss. This project explored the potential of web-based, 3-dimensional virtual worlds (VWs) for facilitating weight-management, well-being and patient and public involvement for young people.

Methods: Participants of a weight management camp learned how to use the VW of Second Life and took part in collaborative activities.

Results: All were able to use Second Life to navigate the environment and interact with one another. Participant appraisals of Second Life were mixed. Some found it complicated and difficult to use, and some found it fun, with 14 of 22 stating that they would choose to use VW again.

Conclusion: There is considerable potential for use of virtual worlds in promoting weight management, and Second Life or a similar VW could be used for this. Potential barriers include members of the target sample having limited access to necessary computer requirements, and that some may find VW-based educational experiences unappealing or challenging to navigate. For some however, VWs may provide a useful mode for provision of education and engagement in health.

Key words: Obesity; Childhood Obesity; Virtual Worlds; Second Life

Introduction

A considerable proportion of UK (United Kingdom) children are severely overweight. The scale of the current problem is such that experts are referring to it as a 'childhood obesity crisis' (Ben-Sefer, Ben-Natan, & Ehrenfeld, 2009). Approximately 10% of reception class children (aged 4-5 years) are obese, and this proportion rises to 20% of children in year 6 (aged 10-11) (National Statistics, 2012). In the UK, 17.1% boys and 14.8% of girls aged between 2 and 15 years of age are obese, and 3 out of 10 are overweight (National statistics, 2012). Although there is evidence that the previously steady increase of childhood obesity prevalence is now leveling out (National statistics, 2012), the extent of the problem remains a major concern, not least because obese children are likely to become obese adults (Serdula, et al., 1993). This contributes to the obesity epidemic being currently experienced, which is taking an enormous toll on the National Health Service (NHS) budget and the wider economy (obesity is estimated to cost $2 billion per year in sickness absence in the UK – National Audit Office, 2001) not to mention the health and wellbeing of many thousands of individuals affected. Obesity is a global problem that is well established in America and increasing in severity in

India and China, as high calorie foods become more readily available to these populations (Friedman, 2009). Obesity presents a health risk to the individual through associated co-morbidities such as type-II diabetes (Sugerman, Wolfe, Sica, & Clore, 2003). There are two causes; an unhealthy diet (usually one high in fats and sugar and low in fiber) and lack of physical activity to burn off the calories consumed. There are numerous contributors to obesity including, but not limited to, genetics, environment, metabolic, biochemical, psychological, and physiological factors (Epstein, et al., 1995). The complexity of contributors to obesity mean that chance of intervention success is highest when treatments are complex and multi-faceted, so that a multitude of possible causes are addressed (McGovern, et al., 2008).

Lifestyle interventions for children have been attempted that focus on administering healthy diets and increasing activity levels, but there is mixed evidence for the effectiveness of such interventions. A systematic review of non-surgical treatment options for pediatric obesity (McGovern, et al., 2008) identified some limited evidence for short-term efficacy of lifestyle interventions. Systematic reviews have also revealed a lack of robust empirical evidence for effectiveness of school-based diet interventions (T. Brown & Summerbell, 2009; Collins, Warren, Neve, McCoy, & Stokes, 2006). Results of two literature reviews demonstrate effectiveness of interventions that administer compulsory physical activity, but put into question extent that outcomes of such treatments can be sustained (T. Brown & Summerbell, 2009; Connelly, Duaso, & Butler, 2007).

Overall, the current evidence base for childhood obesity treatment is relatively weak (Paul J. Gately, et al., 2005). Lifestyle interventions appear to be effective within controlled environments, but beyond this, deliverable incentives and support for individuals can be more challenging to administer and effects of individual variables harder to measure. Weight management camps have been used in the United States of America and UK for administration of healthy diet and activity levels for overweight children in a controlled setting. The efficacy of weight management camps has been empirically demonstrated in terms of quantitative physiological, measures (Paul J. Gately, et al., 2005) as well as subjective, experience-focused perspectives (Hester, McKenna, & Gately, 2010). These camps have also been found to be effective in inducing healthier lifestyles and physiological benefits up to 10 months after the intervention, although there is still potential in improving longevity of sustained gains made by camp-based lifestyle interventions (P. J. Gately, Cooke, Butterly, Mackreth, & Carroll, 2000). The present article suggests information and communication technology facilities may be used to help to sustain gains made from successful lifestyle interventions such as weight-management camps.

Advances in information and communication technologies, along with the increased availability of more powerful computers and increasing ubiquity of broadband internet access mean that there are now new ways to implement and deliver sustainable internet-based interventions to large numbers of people. Internet-based facilities could be provided for attendees of weight management camp interventions. These facilities could be used to motivate participants to sustain their achievements in weight loss through continued education, and could also allow users to meet with one another online after the end of the intervention. A virtual world (VW) could be used as a platform for provision of online education and social meetings. VWs are computer-generated environments that are accessed by multiple users. The environment is accessed using digital self-representations known as 'avatars'. The benefits of VW for education have been demonstrated (Hall, Conboy-Hill, & Taylor, 2011; Patel, et al., 2012; Wiecha, Heyden, Sternthal, & Merialdi, 2010) and future potential for its use for health related benefits have also been articulated (Boulos, Hetherington, & Wheeler, 2007; Gorini, Gaggioli, Vigna, & Riva, 2008).

VWs also have a great deal of potential for aiding Patient and Public Involvement (PPI) as they provide a medium for people to feed back about their experience of receiving care, hold group engagement sessions or conduct meetings. The Collaboration for Leadership in Applied Health Research and Care (CLAHRC) for North West London have their own space on the 3-dimensional virtual world of Second Life (http://slurl.com/secondlife/HealthLands/93/137/131), which contains meeting rooms and a conference centre available for patients and the public to use as they wish.

An exclusive 3-dimensional VW for weight management camp attendees could be created, which could convey educational information regarding weight management whilst being fun to use. This could be made available for camp attendees to use during their period of attendance at the camp, as well as after they depart. The environment could contain educational materials that convey information about diet and activity recommendations and also provide a space for users to be able to socialize with one another. Attendees would be able to use such a tool to stay in contact with people who have met at the camp after they leave. Interventions could be delivered in the virtual environment using Behavior Change principles, such as Cognitive Behavioral Therapy to help people reduce unwanted behaviors (such as unhealthy eating habits) and motivational interviews could be carried out. The environment could be manipulated with the aim of inducing implicit learning and goal-directed behaviors. Users could be primed with imagery relating to healthy behaviors and could take part in simulated experiences that provide weight management education such as a tour of a

virtual restaurant with information on how to choose a balanced, healthy meal when eating out.

The cost of maintaining a virtual space to be used in this way would be minimal, especially in comparison to alternative 'real world' lifestyle interventions. It could also be used as a mode through which PPI could occur, where previous camp attendees could feed back about their experiences of attending the weight management camp and about any health-related concerns or issues they may have, which could be used to improve related services. Dissemination of other PPI-related findings may lead to improvements in other healthcare sectors.

There is a wealth of evidence in the field of Social Psychology that suggests we judge our actions and perceptions by comparing them to those around us, (G. D. A. Brown, Gardner, Oswald, & Qian, 2008) especially those who are similar to us (Goldstein, Cialdini, & Griskevicius, 2008). A group of people who had all previously attended the same summer weight management camp may be more likely to continue the healthy lifestyle they had learned to lead, by continuing to meet one another in a virtual environment after their time at the camp has ended, and encourage one another to maintain their achievements in weight loss and quality of health. Peer support groups could be set up for people who encounter barriers with maintaining the health gains they had achieved, and health experts could even meet people online in a virtual environment for targeted follow-up support (Gorini, et al., 2008).

This project aimed to investigate the potential of web-based, interactive 3-dimensional virtual environments for facilitating weight management, well-being and PPI for young people as part of a weight-loss lifestyle intervention. The objective of the present study was to introducing a group of weight management camp attendees to the web-based 3-dimensional virtual world of 'Second Life' and assess their initial perceptions of the VW, and the idea of using it in future for educational or recreational means. The present study did not aim to directly improve the weight loss or health behaviors of the sample, but to investigate participants' views of using VWs, so that VWs could be built which could aim to facilitate health behavior change in the future.

Participants were attendees of the Carnegie Weight Management (CWM) Summer camp. CWM is recognized by the UK Department of Health and is the only academic institution in the UK that provides weight management services for children. A group of young people in attendance of this camp learned how to Second Life, took part in in-world collaborative activities and reported their quality of experience. The authors predicted that most of the young people in this sample would not have used 3-dimensional web-based VWs before, and these introductory sessions aimed to gauge initial feedback from participants.

Methods

The present study aimed to measure participants' initial reactions to use of virtual worlds. All participants took part in a session where they navigated a 3-dimensional virtual world. They then completed questionnaires and took part in a group discussion regarding their experiences.

Materials

Second Life: The virtual world used in this study was Second Life (http://secondlife.com/). Second Life is internet-based, publically accessible and provides a virtual environment that adheres to real-world 3-dimensional topography. Users of Second Life can communicate with one another verbally using computer-connected microphones or by typing written messages. It is possible to restrict access to particular regions to specific groups of users, which can be useful for the provision of exclusive, controlled environments. Second Life has been used by several organizations for a variety of communication-related purposes (Leong, Kinross, Taylor, & Purkayastha, 2008).

Use of Second Life is generally only permitted for adults, but people 13 years of age or older are permitted to use Second Life thorough an affiliated organization, and controls are in place to ensure that they stay within the restricted confines of virtual space owned by that organization.

An area of virtual land within part of Second Life that is owned by CLAHRC for North West London in affiliation with Imperial College London was made private for the introduction sessions for the camp attendees.

This space contained a virtual ice-rink, where users could make their avatars skate. There was a 'magic carpet' and a hot air balloon set up in the area, both of which were available for users to ride and control together. A 'snowball machine' made it possible for users to have a virtual snowball fight and there was a virtual house that the participants could explore.

Figure 1: Participants could make their avatars ice skate together in Second Life

Presence: The level of presence refers to the effect that is experienced when interacting with a computer-mediated or computer-generated environment and refers to the extent to which people experience an artificial environment as being real (Sheridan, 1994).

Participants in the present study completed a scale designed to measure the presence they experienced whilst using Second Life, taken from (Fox, Bailenson, & Binney, 2009) (See Appendix A for a list of the presence questionnaire items).

Presence influences perceptions and behaviour induced by virtual environments. (Fox et al, 2009). It was measured in this study to gauge an understanding of the extent to which participants felt immersed in the environment when using Second Life and to investigate whether it would correlate with other outcomes.

Participants

Twenty-two young people participated in this study. All participants were between 13 and 17 years of age (M = 14.6, SD = 1.3). Six were male and 16 were female. All were attendees of the Carnegie Weight Management camp in Leeds.

Procedure

Three Second Life introduction sessions were run with 7-8 participants in 3 separate groups. Each of these sessions lasted approximately 90 minutes.

At the start of the session, each participant sat at a desk where a laptop was set up, upon which Second Life installed and a headset was connected. Two members of the research team were present.

At the start of the session, a presentation was given by one of the researchers to introduce Virtual Worlds in general, and Second Life in particular. The researchers then guided the participants through the steps of setting up an account on Second Life and creating an avatar after which the participants then logged in to Second Life

The participants were then taught how to alter the appearance of their avatar and how to move their avatar around the virtual environment and communicate with one another.

After this, participants used Second Life as they wished, and could focus on communicating with one another, continuing to adjust the appearance of their avatars or taking part in collaborative activities such as riding a hot air balloon and ice-skating.

Results

All 22 of the participants were able to create an account on Second Life and were able to move their avatar around the virtual environment, alter their avatar's appearance and communicate with one another using voice and written messages.

General feedback regarding use of virtual worlds

Twenty-one participants completed a questionnaire where they reported general feedback on the introduction session that they experienced.

Table 2. Table captions should be placed above the table

Question	**Yes**	**No**
Do you have access to a computer at home?	19	2
Do you have internet access at home?	20	1
Do you use computers to word process?	17	4
Do you use computers to send and receive emails?	18	3
Do you use computers for social networking? (e.g. using Facebook)	19	2
Do you use computers for voice conferencing? (e.g. Skype)	11	10
Do you use computers to play online games?	18	3

Table 2. Answers to questions regarding previous experience of using virtual worlds

Question	**Yes**	**No**
Had you heard of virtual worlds before taking part in this study?	16	5
Do any of your friends use virtual worlds	13	8
Had you heard of Second Life before taking part in this study?	4	7
Had you used virtual worlds before taking part in this study?	9	2
Had you ever used Second Life before taking part in this study?	1	0

Table 3. Answers to questions regarding future use of virtual worlds (DNA = did not answer)

Question	Yes	No	DNA
Would you communicate with one of your friends using virtual worlds?	8	9	4
Would you communicate with a group of your friends using virtual worlds?	8	9	4
Would you be interested in using virtual worlds again?	14	7	0

Answers to the question 'Would you communicate with a group of friends using virtual worlds?'

Of the 8 participants who answered 'yes', 5 cited reasons relating to Second Life being interesting or fun.

"Yes, because it's fun"

"Yes, because you could do an activity together"

Of the 9 who said no, 5 cited reasons relating to MSN or Facebook being preferable. Three left feedback that stated that they found Second Life complicated or difficult to use.

"Not really, because I use MSN or Facebook"

"No, Skype/MSN is much easier to you & doesn't need full attention"

Presence scores

Twenty-two participants completed a questionnaire where they reported the level of 'presence' that they experienced whilst using Second Life. The presence scale consisted of 10 items. Each item was scored from 1 (strongly disagree, indicating low presence experienced on the relevant dimension)-7 (strongly agree- high level of presence experienced). The presence scores present the sum of these items divided by the number of items (10).

The Mean presence score was 2.69 (SD = 1.76). The presence scores were positive predictors of whether or not participants expressed interest in using virtual worlds again ($p = .003$, $X2 = 8.811$), with those reporting they would use Second Life again having a higher presence score ($M = 3.48$, $SD = 1.66$, $n = 14$) than those who reported they would not use Second Life again ($M=1.17$, $SD = .0237$, $n = 7$).

Discussion

The aim of this project was to explore the potential of web-based, interactive 3-dimensional VWs for facilitating weight management, wellbeing and PPI for young people as part of a weight-loss lifestyle intervention. This was explored by introducing young people who were attending a UK weight management camp to the virtual world of Second Life and documenting their initial reactions to using this virtual world. Participants' previous experience of using virtual worlds and access to computer- and internet-facilities at home was also recorded.

Accessibility

Twenty of the 22 participants reported having computer and internet access at home, which means that it is likely that the majority of these individuals would be able to access a virtual world of some kind from their homes without any additional equipment. Nine of the participants reported having used VWs before, though only 1 had used Second Life.

Evaluations of the young people who took part in the introduction sessions were mixed in terms of their quality of experience of using the virtual world. Fourteen participants said they would be happy to use virtual worlds again and 7 said they would not (1 did not answer this question).

It would appear, therefore, that most participants in this sample do have both the access to necessary system requirements and the desire to use virtual worlds, which indicates that a web-based virtual environment for weight management camp attendees may be used by a substantial proportion of individuals in this population. It also appears, however that use of VWs would not appeal to everyone in this sample, so it is important to continue to consider any possible facility that gets created and used as an adjunct to other possible sustainability tools. It is important that those who do not have the desire or equipment to use VWs still have access to the same high quality, reliable and accessible health education and PPI resources.

Social networking in a virtual world

Of the reasons that participants cited as to why they would not use virtual worlds to meet with their friends, the most common was that Facebook and MSN are easier to use. An equal number of participants, however, reported that they found the virtual environment to be interesting or fun and that they would use it again and to meet friends for this reason. All participants were able to use their avatars to interact with each other and the environment within 20 minutes of creating an account, though 3 participants reported finding Second Life challenging to use. If any VW-based tool were to be made available to CWM camp attendees, training and support would need to be made ensured for users to help those who find VWs challenging to use.

Age restrictions of Second Life

At present, Second Life is the most accessible, user-friendly VW available, but its use is generally restricted for under-18s. New, similar virtual worlds could be created that would not have user restrictions and could be made available only to users that had taken part in the particular lifestyle intervention under question, such as a weight-management camp.

Presence

The minimum possible presence score was 1 and the maximum was 7. Individuals with an average score of 2 or less would have strongly disagreed or disagreed to most of the questions (see Appendix A), so those who reported that they would not use virtual worlds again appear to have experience almost no immersion in the virtual environment at all during the session. The overall average of the group was also relatively low, so it is reasonable to infer that the majority of participants were not heavily immersed in the virtual environment. This is, perhaps, unsurprising considering that participants were all in the same room in real life while using Second Life, and were often interacting with the session facilitators face-to-face. If each of the participants were in a different room with their

computer and in communication with each other through Second Life simultaneously, then perhaps presence scores would have been higher. Nevertheless, there is evidence that presence can increase efficacy of VWs in facilitating beneficial health behaviors (Fox, et al., 2009) so it may be worth considering how a web-based VW could be built with the aim of it creating a high degree of user immersion than Second Life.

Further work could possibly look into investigating cause-and-effect between presence and positive views of using virtual worlds. It may be, of course, that people who were positively disposed to using virtual worlds became more immersed in the experience as a result of this and thus reported greater presence scores. It may also be the case, however, that a more immersive virtual environment significantly increases quality of experience for all. If this is the case, then it is worth keeping in mind when designing a virtual facility.

Virtual worlds to aid health behavior change

Potential of specifically tailored virtual environments for inducement of positive mood, behavior change and wellbeing is well established (R. Baños, et al., 2012; R. M. Baños, et al., 2012; Fox, et al., 2009) and VWs such as Second Life have previously been found to be a highly effective environment for the improvement of health and weight-management related behaviors (Johnston, Massey, DeVaneaux, & CEO, 2012). Online weight managment peer support communities have been demonstrated to play a prominent and positive role in individuals' weight loss efforts (Hwang, et al., 2010), suggesting that if this aspect was built in to a virtual world which aimed to facilitate weight management, then this could lead to a strengthening of the positive effects on health behaviors that may result from the intervention.

The present study did not aim to improve the weight loss or health behaviors of the sample and the collaborative activities that the participants conducted in the virtual world were not designed to be educationally beneficial or to induce behavior change. Such activities could be created and tested in future studies. There are indications as to how such activities could have a positive effect on health behavior change that can be gained from previous research. Virtual world experiences have been effectively used for education, through simulation of real experiences (Patel, et al., 2012). Educational experiences relating to diet and exercise could also be created in a virtual world. Users could make their avatars exercise on a virtual treadmill for a given time to learn how much work they would have to do to use a certain amount of calories. Health behavior change through the 'Proteus effect' (conforming behavior towards that of a digital self-representation) has been demonstrated (Fox & Bailenson, 2009), and this effect has been found to be potentially mediated by presence (Fox, et al., 2009). This suggests that a person who watches their avatar conducting exercise may become more likely to conduct exercise themselves. A virtual environment with fun activities for users that involve their avatars being active, such as sports games, may lead to these users becoming more physically active. Efficacy of group lifestyle coaching sessions in VWs has also been demonstrated (Johnston, et al., 2012). Lifestyle coaching sessions that advice people who previously attended a weight-management camp on how to sustain their improved weight and health behaviors may also lead to sustained weight loss.

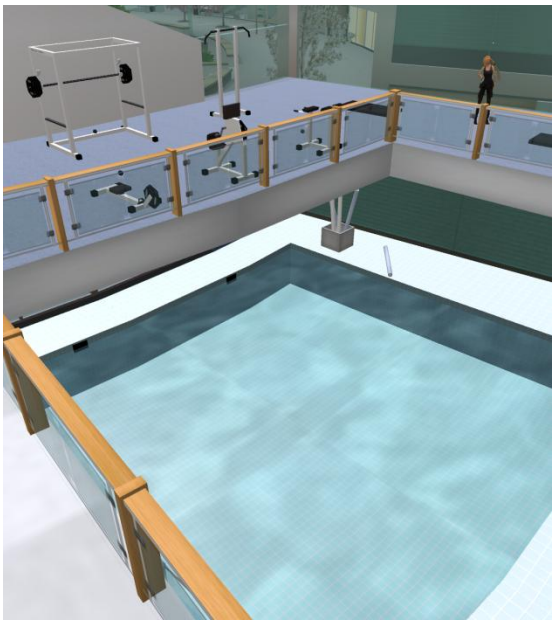

Figure 2: The Imperial College wellbeing centre in Second Life

Conclusions

There is a huge amount of potential for use of virtual worlds to facilitate weight management for young people. This study provides information regarding the initial reactions from a sample that may benefit from this intervention. The specificity of the sample (young people attending a weight management camp in the UK between the ages of 13 and 17) necessarily meant that the sample size was relatively small, but the feedback from this sample will be useful in consideration for further plans to use VWs in facilitating lifestyle interventions that target weight loss and related health innovations.

The above-described findings suggest that if a web-based VW facility was created for attendees of a weight management camp, or similar weight management intervention for young people, then this facility may be used by a substantial proportion of those involved in the intervention. This indicates that the provision of a virtual environment aiming to facilitate sustainability of healthy lifestyle interventions may be considerably beneficial.

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Appendix A Presence questionnaire

Please follow the key given below and circle the number corresponding to your views

1 Strongly disagree	2	3	4	5	6	7 Strongly agree

1.	To what extent do you feel the avatar is an extension of yourself?	1	2	3	4	5	6	7
2.	To what extent do you feel that if something happens to the avatar, it feels like it is happening to you?	1	2	3	4	5	6	7
3.	To what extent do you feel you embodied the avatar?	1	2	3	4	5	6	7
4.	To what extent do you feel you were in the same room with the avatar?	1	2	3	4	5	6	7
5.	To what extent did the avatar seem real?	1	2	3	4	5	6	7
6.	To what extent were you involved with the virtual world?	1	2	3	4	5	6	7
7.	To what extent did you feel surrounded by the virtual world?	1	2	3	4	5	6	7
8.	To what extent did you feel like you were inside the virtual world?	1	2	3	4	5	6	7
9.	To what extent did it feel like you visited another place?	1	2	3	4	5	6	7
10.	How much did the virtual world seem like the real world?	1	2	3	4	5	6	7

'Virtual' Morality: The Un/Acceptability of Hypothetical Scenarios in Second Life

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As part of a larger study on the basis and meanings of moral values and practices in 3D social virtual worlds, we conduct in-depth face-to-face interviews with experienced Second Life (SL) residents to reflect on in-world morally charged scenarios. Our research goal is to gain understanding in how residents make sense of virtual moral practices and what they believe is un/acceptable in-world moral behaviour. To this aim, research participants are asked to rank twenty-eight hypothetical SL-scenarios in a classification from '(most) unacceptable' to '(most) acceptable' and, while doing so, to reason out loud about their ranking. In our analysis, we focus on research participants' converging and diverging arguments on the un/acceptability of the scenarios. Regarding converging arguments, there is consensus on the unacceptability of six scenarios. Research participants believe these scenarios are equally problematic in virtuality and in actuality. Furthermore, they agree on seven scenarios as acceptable. These scenarios are not considered as morally charged because they are typical features of SL and hence rooted in technology. Regarding other scenarios, no general consensus was reached. Our findings have ethical implications, especially with regard to moral responsibility.

Keywords: Moral Imagination, Moral Reasoning, Applied Philosophy, Virtual Morality, Social Virtual Worlds, Second Life.

Introduction

As the roots of 'virtual' are in 'virtue', both virtuality and morality are etymologically united (Wilbur, 1997, p. 9). Yet, morality is nowadays problematized by virtuality, since virtual space and its technological features, such as pseudonymity, anonymity, and creating distance, raise compelling questions with regard to virtual encounters and the meaning of moral duties and responsibility. Many authors fear transformations, namely that the augmented virtualization of intersubjectivity and alterity reduces moral responsibility and awareness, or even worse, that it exterminates morality (a.o. Slouka, 1995). Communication in virtual surroundings is believed to make people less humane as the physical face, a precondition for moral responsibility, is missing (Heim, 1993, p. 102). Others, however, believe virtuality opens enriching possibilities and that, for instance, anonymity can overcome distance, hierarchies, and physical appearance (a.o. Johnson, 1997; Tuszynski, 2006).

Our research focus lies on the grounds and meanings of moral values and practices in three-dimensional social virtual worlds. We attempt to conjoin a strong grounding in moral philosophy with empirical research on how people actually deal with media. To this aim, we focus on Second Life (SL), a virtual world in which residents are free to choose how to spend their time in-world and how they assign meaning and purpose to their in-world activities. Exactly this freedom to act and to experiment in a world that is often conceived of as a separate realm (a.o. Jordan, 2000, p. 2) is the starting point of our study, in which we aim to gain more insight in the in-world daily moral order, the everyday existing in-world moral practices, and in residents' views concerning the problematized relation between virtuality and morality. We explore by means of in-depth face-to-face interviews how experienced residents, who have been frequently in-world since several years and who invest many personal resources (time, energy, skills, emotions, money) there, reflect on, imagine, judge, and evaluate in-world moral scenarios. To this aim, we ask research participants to imagine and rank twenty-eight scenarios that take place in SL in a classification from '(most) unacceptable' to '(most) acceptable'.

In what follows, we will first expand on the theoretical underpinnings of our study. Then, we elaborate on our research design. Third, we extensively report on our findings. We end with a discussion on the ethical implications of our findings.

Theoretical Underpinnings

Morality, Moral Reasoning, and Moral Imagination

There is no clear-cut answer to the question how to define morality. Johnson (1993) states that, at its minimum, "morality concerns the kind of lives we ought to lead, given the fact that our actions can help or harm people. However we define 'help' and 'harm', we notice at once that most of what we do in our lives affects the well-being of both other

people and ourselves" (pp. 251-252). Morality hence comes about whenever a subject is conscious of his or her conduct, namely when personal behaviour is reflected in an awareness that is not determined by a supra-personal external normative source like law and religion. As social animals, morality ties us all to each other and makes it possible to fulfil our strong need to be part of a group (Haidt, 2003). As morality has evolved and as its importance has been "its contribution to survival" (Allott, 1991, p. 2), it is inherently part of human nature and human evolution. Yet, morality goes further than our innate moral sense.

To be able to live and work together in harmony, public space and communities have created a consistent set of rules and norms. As a consequence, we are confronted on a daily basis with this set and have to make moral decisions day by day. Moral persons reflect on and evaluate their behaviour, principles, judgments, norms, and values (that are given within a specific cultural context, i.e. morals) on an individual level and extrapolate them to personal codes of conduct. Moral reflection or reasoning is essential, as it raises our awareness for the reach, implications, and consequences of our actions (Johnson, 1993, p. 253). However, although we desire moral order and control, we are constantly reminded of moral chaos in ourselves and in other people (Johnson, 1993, p. 30). As human beings, we are also fallible, vulnerable, and morally ambiguous (Gert, 1998). We always have the freedom to do harm and choose for an immoral option, thereby taking the risk of being sanctioned.

Johnson states human beings are fundamentally imaginative moral animals (1993, p. ix). Moral imagination forms an essential part of moral decision-making as it helps individuals to understand "the moral quality of a situation" (Roca, 2010, p. 137). It can be characterized as "the ability in particular circumstances to discover and evaluate possibilities not merely determined by that circumstance, or limited by its operative mental models, or merely framed by a set of rules or rule-governed concerns" (Werhane, 2002, p. 33). Moral imagination influences the reasoning process as it helps us to untie ourselves to evaluate and to think in a more creative way within the restrictions of what is morally possible (Werhane, 2002, p. 34). Consequently, moral reasoning is "an imaginative activity", since it "requires imagination to discern what is morally relevant in situations, to understand empathetically how others experience things, and to envision the full range of possibilities open to us in a particular case" (Johnson, 1993, pp. ix-x). Our moral capacity for empathy is the most essential act of imaginative experience we can perform and can be defined as "an imaginative rationality" as we participate empathetically in another person's experience (Johnson, 1993, p. 200, italics in original).

Virtual Worlds

Since the 2000s, the development and rapid growth of online three-dimensional virtual worlds is one of the most remarkable tendencies in the new media landscape. Boellstorff et al. (2012, p. 7) characterize virtual worlds as multi-user, persistent, and synchronous places that have a sense of worldness, and which allow residents to embody themselves, mostly by means of an avatar. On the whole, the lack of a common definition of 'virtual world' in academic literature often leads to confusion. (Social) virtual worlds have their origin in both virtual reality and video games, which might explain why virtual games and worlds are often treated as synonyms (Boellstorff, 2008, p. 42). Bell (2008) elaborates on this complexity and tries to converge diverse definitions. As a result, he provides the following definition: "a synchronous, persistent network of people, represented as avatars, facilitated by networked computers" (2008, p. 2). His wide view differs from stricter definitions that explicitly reconcile virtual worlds with the lack of a game element; Ryan (2009, p. 23), amongst others, has a more restricted view: "virtual worlds are immersive online environments in which people interact for non-goal-oriented entertainment purposes". The most significant difference is thus that virtual worlds do not impose a goal on residents. They lack strictly controlled scenarios that have been designed to develop specific competencies, making residents of virtual worlds free to choose how they spend their time in-world and how they assign meaning and purpose to their in-world activities (Aldrich, 2009, p. 1). As a consequence, motivations to engage in social virtual worlds differ from social reasons (network, friendship, love) to creative and business incentives.

Nevertheless, despite their differences, social virtual worlds and multi-user games share significant similarities. Both games and worlds can be comparable concerning investment of personal resources, social motivations, avatar identification and attachment, and socialization processes (a.o. Jakobsson & Taylor, 2003; Yee, 2006; Reynolds, 2007). While social virtual worlds contain elements of (role-)play, socialization is also an important part of multi-user games. In the game, players go further than passively applying a predetermined objective, as their behaviour is not strictly controlled by the rules of the game.

Second Life

One of the most widely known social virtual worlds is Second Life, which was created by Philip Rosedale in 2003, who also founded Linden Lab, Second Life's development company. Second Life is freely accessible via the Internet. Users of SL, the so-called residents, interact with each other through three-dimensional avatars. We characterize Second Life as a three-dimensional, persistent, multi-user, computer-generated social and cultural space, inhabited by humans and their representational avatars. We furthermore define SL as a moral space; notwithstanding

that it is virtual avatars that are interacting, they represent moral agents. Other important features are a first-person perspective, real-time interaction between actual people, a shared virtual reality, the lack of a general game-oriented goal, and an open-end purpose. Also, SL is "an immersive, user-created online world" (Au, 2008, p. x). The 'user-created' factor means that Linden Lab confines itself to the production of software and infrastructure and that residents are allowed to design the virtual world by making virtual objects. Residents are permitted to make actual profit by selling these objects. Although SL is not a game, it has an open ethical game design, as the values of the resident and the resident community can be implemented in the world or are reflected by it (Sicart, 2009, pp. 213-214). Residents can use their moral reasoning and values in their relation to the virtual world, which is open to the results of that moral reflection (Sicart, 2009, p. 214). A closed ethical game design, on the contrary, "is designed to create a set of possible actions with different moral weights, and the player will create her values as a player according to the game's values, without the possibility of contributing her values to the game itself" (Sicart, 2009, p. 214) .

Virtuality and Morality

Virtual spaces are often conceived of as separate spaces that have a different ontological status than actual natural bodily space (Heim, 1993, p. 133). Due to this ontological shift, many believe that the rules and principles of actual life are not applicable there, as the virtual and the actual become mutually exclusive domains (Powers, 2003, p. 192). Others believe that, although virtuality is an inferior representation of actuality, it can transform us in a harmful manner (a.o. Slouka, 1995). These authors express concerns about the problematic relation between morality and virtuality. Their anxieties are directly related to the fact that, within virtual space, people have total freedom to act and to experiment as they appear anonymous before virtual others. The lack of consequences and physical vulnerability raise concerns about accountability (moral responsibility), as one can always hide safely behind the computer screen, which might encourage the idea that one has nothing to lose. Moreover, one can always log out or start over by creating an alt (alternative avatar) or one can take an alt for experimentation, exploration, or even exploitation of others. Furthermore, technological features make it possible to mute and ban virtual others, or to remove them in one mouse click from one's friend list. Botterbusch & Talab (2009), who focus specifically on "user-initiated actions" (p. 9), distinguish the following ethical issues in SL: copyright infringement, spamming, multiple identities, identity deception, breach in privacy (e.g. monitoring and eavesdropping), and crimes as harassment, vandalism, and unauthorized use of computer information.

Several scholars have addressed the tension between morality and virtuality, both from a conceptual and empirical point of view. A well-known example is the often-cited essay 'A rape in cyberspace' (1993) in which Julian Dibbell chronologically reports on how a resident raped two other residents in the text-based social MUD LambdaMOO. Much ink has flowed in response to the essay's content, as it was the first text that dealt with moral transgression in the "virtual garden of good and evil" (Dibbell, 1999). Academic scholars and non-academic authors intensively elaborated on the incident, drawing most attention to the status of virtual rape, virtual harm, and performative language (see amongst many others Rheingold, 2000; Powers, 2003; Huff, Johnson, & Miller, 2003; Boellstorff, 2008). Jeff Dunn (2012) and Ren Reynolds (2007) amongst others address in particular questions about the moral status and moral evaluation of breaking moral boundaries in worlds like Second Life. Dunn (2012) for instance compares and evaluates the Asymmetry Thesis (virtual immoral actions can never be wrong), the Symmetry Thesis (virtual immoral actions are always wrong), and the denial of both Asymmetry and Symmetry theses, which claims that virtual immoral actions are sometimes wrong.

In current empirical literature on social virtual worlds, the issue of morality has only received scant attention, as most scholars focus on game-oriented worlds. A noteworthy empirical study completed by Jackson et al. (2008) discusses cultural differences concerning morality in the virtual and actual world. The researchers questioned 600 American and 600 Chinese teenagers on moral behaviour in the actual and virtual world. Their findings indicate, amongst other things, that Chinese youth thinks morally dubious online behaviour is more tolerable, except videogame violence, which is considered more tolerable by American male teenagers. Another study done by Jackson et al. (2009) is on children's opinions on morality in the virtual and actual world. They noticed differences concerning gender and race in the tolerability of morally problematic behaviour in the virtual world. Also, both morality in the actual world and the frequency of IT use seem to predict the tolerability of morally dubious behaviour in the virtual world. Also Segovia, Bailenson, & Monin (2010) researched morality in virtual reality, and focused on the self-importance of online moral identity and its flexibility. Participants had to watch a virtual scene that either involved their own virtual self or another participant that was acting either morally or immorally. Participants who experienced immoral behaviour had the tendency to compensate for their behaviour. Also, participants with morally questionable behaviour online rated themselves less moral than other participants.

Research Design

Objectives and Questions

We explore by means of in-depth interviews how experienced SL-residents reflect on and evaluate in-world

Table 3.

		R1	R2	R3
General	Age category	1940-1945	1970-1975	1940-1945
	Gender	F	F	M
	Education	Secondary school	Secondary school	Secondary school
	Job	Retired	Full time employed	Retired
	Marital status	Widow	Married	Married
	Children/grandchildren	Both	Both	Both
SL-information	Start	°2007	°2007	°2007
	Primary motivation	Curiosity	Social contacts, play, music	Wife was active in SL
	Secondary motivation	Loneliness	/	/
	Hours/day (now/past)	2h/day (now) 11h/day (past)	3h/day (now) 8h/day (past)	2h/day (now) 8h/day (past)
	SL-profile	Social	Social	Social & creative
	Number avatars	5 / 3 regular	1	6 / 2 regular
	Gender avatars	F	F	M & F

		R4	R5	R6
General	Age category	1955-1960	1985-1990	1985-1990
	Gender	F	M	M
	Education	University	Secondary school	College
	Job	Full time employed	Full time employed	Full time employed
	Marital status	Divorced	Single	Single
	Children/grandchildren	Children	/	/
SL-information	Start	°2006	°2007	°2007
	Primary motivation	Curiosity	Curiosity	Relaxation
	Secondary motivation	Interest in ICT and 3D	/	Curiosity
	Hours/day (now/past)	1/4h/day (now) 2h/day (past)	2h/day (now) 6h/day (past)	0h/day (not daily) 3h/day (past)
	SL-profile	Social, professional & creative	Social & creative	Social
	Number avatars	1	1	1
	Gender avatars	F	M	M

		R7	R8	R9
General	Age category	1945-1950	1965-1970	1950-1955
	Gender	M	M	F
	Education	College	Secondary school	University
	Job	Retired	Full time employed	Housewife
	Marital status	Married	Divorced	Divorced
	Children/grandchildren	Both	/	Children
SL-information	Start	°2007	°2005	°2007
	Primary motivation	Leisure	Curiosity	Curiosity
	Secondary motivation	SL real estate	/	Interest in social networks
	Hours/day (now/past)	12h/day (now) 12h/day (past)	0h/day (not daily) 3h/day (past)	0h/day (not daily) 3h/day (past)
	SL-profile	Social	Social & creative	Social
	Number avatars	11 / 3 regular	2 / 1 regular	1
	Gender avatars	M & F	M	F

		R10	R11	R12
General	Age category	1975-1980	1980-1985	1965-1970
	Gender	M	F	M
	Education	College	Secondary school	College
	Job	Full time employed	Full time employed	Full time employed
	Marital status	Single	Has a partner	Married
	Children/grandchildren	/	/	Children
SL-information	Start	°2006	°2006	°2007
	Primary motivation	Professional	Curiosity	SL real estate
	Secondary motivation	/	/	/
	Hours/day (now/past)	1h/**week** (now) 4h/day (past)	0h/day (not daily) 6h/day (past)	2h/day (now) 2h/day (past)
	SL-profile	Professional, social & creative	Professional, social & creative	Social
	Number avatars	1	1	1
	Gender avatars	M	F	M

		R13	R14	R15
General	Age category	1970-1975	1965-1970	1960-1965
	Gender	M	M	F
	Education	College	Secondary school	Secondary school
	Job	Full time employed	Full time employed	Housewife
	Marital status	Cohabitating	Has a partner	Widow
	Children/grandchildren	Children	Both	Both
SL-information	Start	°2005	°2008	°2007
	Primary motivation	Professional	Son was active in SL	Curiosity
	Secondary motivation	Fun	/	/
	Hours/day (now/past)	2h/day (now) 8-10h/day (past)	2-3h/day (now) 4h/day (past)	5h/day (now) 5h/day (past)
	SL-profile	Professional, social & creative	Social	Social & creative
	Number avatars	4 / 1 regular	1	1 (+ some alts)
	Gender avatars	M & F	M	F

moral scenarios. To this aim, we ask research participants to imagine and rank twenty-eight scenarios. Our objectives are, first, to let residents reflect loudly on moral practices by means of these scenario studies in order to gain insight in their moral principles, values, norms, and so further. Second, to ask residents which of these scenarios they have already encountered, either as a victim, or as the one causing the situation (the harm-doer), or as the one witnessing the situation. Third, to let residents imagine in-world moral scenarios which they have not yet encountered and evaluate their moral intensity. Fourth, to gain more insight in 'virtual' moral practices and what is believed to be un/acceptable 'virtual' moral behaviour.

Our research questions are, first, how do experienced residents reflect on, imagine, and evaluate 'virtual' moral scenarios? Second, to what extent do experienced residents evaluate these scenarios as virtual and thus not rooted in actuality? Third, when does one cross moral boundaries in a virtual setting? Fourth, what do experienced residents believe are the most un/acceptable scenarios in a virtual setting?

Methodology

We conducted semi-structured face-to-face in-depth interviews with fifteen experienced SL-residents . All interviews are conducted in Dutch, as our research participants are either Belgian (Flemish) or Dutch. The interviews were audio-recorded and we guaranteed confidentiality and anonymity. The total length of audio recordings of these fifteen interviews (introductory and closing chat not included) is 34 hours. Our small sample size and the intensity (duration) of the interviews reflect our methodological aim to collect detailed data. All research participants received a compensation for their participation.

Description Research Participants

We used purposive sampling strategy to select our research participants and aimed for a heterogeneous sample. Dimensions of variety in the sample were socio-demographics (gender, age, education, SES), and the kind of investments, expectations, and gratifications people show in their SL-visits (see table 1 for overview, also with regard to SL-information). They logged in for the first time between 2005 and 2007. Five of them currently have an actual relationship with someone they have met in SL; five of them had an actual relationship with an SL-resident in the past.

Scenarios

Our scenarios were adopted from our earlier findings, both in SL (we are active as a researcher there since 2009) and in the actual world (focus groups and in-depth interviews), in which informants identified moral issues to which they were exposed in SL. We aimed for diversity in moral intensity in our scenarios and three of them also refer explicitly to actual life (see table 2 for an overview of the scenarios).

Every scenario is written on a small card; every research participant receives the cards in a random and shuffled order. We will illustrate this with an example: one of the scenarios is 'to have sex with a child avatar in SL'. The research participants have to rank this scenario, while reflecting loudly about it. They are asked if they ever had sex as or with a child avatar (if they did not mention this spontaneously). If not, they are asked if they have ever seen it happening, what they thought about it, and how they responded to it. If they never encountered it, they have to imagine the scenario, morally judge, and evaluate it.

Table 2.

to have sex with a child avatar in SL
to hack an SL-account and to steal money from it
to not have time for your family because a friend in SL has problems
to play with an SL-resident's feelings
to not console a friend in SL
to not help a newbie in SL
to not respect the rules of Linden Lab
to spread racist ideas in SL
to humiliate an SL-resident in public
to spread the secret of an SL-resident in SL
to create an alt after having cheated in SL
to walk around naked in SL
to spy with an alt in SL
to have multiple partners in SL without them knowing
to copy the creative work of a resident in SL and to pretend that you have created it yourself
to have a different gender in SL
to lie about an actual life situation in SL
to have sex with an animal avatar in SL
to rape a resident in SL
to not tell your actual life partner that you have a partner in SL
to walk without permission into SL-houses and on sims
to not show up for an appointment in SL
to fake a computer crash to get rid of someone in SL
to make screenshots of a resident without asking him / her
to save chat logs in SL
to pretend to be younger in SL
to have more than one avatar in SL
to have nicer looks in SL

Exploration of the Findings

Remarks on Approach and Analysis

We have to acknowledge the difficulty of our ranking exercise, as we demand from our informants to reason loudly about issues they have often not thought about in a conscious way. Because they struggle with these moral issues and dilemmas, they find it difficult to rank them. The

majority of informants (ten in total) subsequently orders the scenarios in clusters instead. R10, for instance, ranks 'to have sex with a child avatar in SL' on the first place. On the second place, however, he clusters a number of scenarios under the heading 'common sense', that is, related to the norms and values he has been raised with. On the third place he solely ranks 'to have sex with an animal avatar in SL'. The fourth and final place consists of a cluster of scenarios he characterizes as 'banalities'.

Our research participants reflect on and evaluate the given scenarios in often diverging ways, resulting in fifteen different rankings (or clusters). Certainly, this may not surprise, as every human being has a different moral logic. Also, moral dilemmas arise specifically from the complexity to balance and harmonize competing moral logics and values that lie at the roots of the complex moral understanding of every single person (Johnson, 1993, p. 118). It is important to emphasize that, although all rankings are different, every research participant makes a clear division between acceptable and unacceptable in-world behaviour. No research participant ranked all scenarios as 'acceptable', even those who stated at the beginning of the exercise that they are very tolerant and that SL must be as open, free, and libertarian as possible (e.g. R9). Also R7, who makes a clear boundary in his moral behaviour and principles between virtual and actual life, denounces strongly of certain forms of behaviour in SL.

The most problematic scenario and thus the most morally charged one was 'to have sex with a child avatar in SL' (seven research participants ranked this on the first place), whereas the least problematic scenario was 'to have nicer looks in SL' (ten research participants ranked this on the final place). However, in this paper, we will not focus on the ranking as such (that is, which scenarios have been ranked higher or lower per individual); instead, we focus on their reasoning and judgments on the un/acceptability of the scenarios. We take into consideration the arguments of all research participants per scenario. We focus on where their arguments meet and where they diverge.

We present the findings in the following way: we first expand on the similarities, that is, where the arguments converge. Then, we focus on the dissimilarities, namely where the arguments strongly vary (in a binary way). Because of the limited length of this paper, it is not possible to discuss every scenario at length.

Similarities: Acceptable Scenarios

The following seven scenarios were agreed upon as acceptable, and hence ranked low: 'to have nicer looks in SL'; 'to have more than one avatar in SL'; 'to pretend to be younger in SL'; 'to save chat logs in SL'; 'to make screenshots of a resident without asking him / her'; 'to fake a computer crash to get rid of someone'; and 'to have a different gender in SL'. Regarding 'to rape a resident in SL', this is not defined as acceptable but as 'impossible' in SL, and therefore it is not morally problematic and hence ranked low.

In what follows, we will summarize the arguments. **First**, all research participants agree that 'to have nicer looks in SL' is totally accepted and, moreover, that it is a typical feature of SL. There is general consensus that your avatar does not have to look like your actual self. R13, for example, believes this is not only 'evident', as looks are also important in SL, but he relates this to how serious you take SL, i.e. the more time and energy you invest in your avatar, the more serious you are believed to take SL an sich. **Second**, all agree that 'to have more than one avatar in SL' is accepted, but four informants note that it is no longer acceptable if you use your alt to purposively lie and cheat in-world. Accepted uses of alts are amongst others: to have a back-up for your money (Linden dollars, i.e. SL's currency) and inventory; to not mingle reputations (e.g. avatars for 'fun' (e.g. role-play) and avatars for 'work'); to create more traffic on your sim; and to use alts for the creation of poses (SL-creation) and pictures (SL-art). **Third**, there is general consensus that the relation you have with someone is more important than his or her actual age, so 'to pretend to be younger in SL' is accepted. Two research participants (R1, R9) lied about their age in the beginning, but stopped lying, as it turned out extremely difficult to manage lies. R3 also lied about his age (as he was afraid of being turned down because of his higher age) and he even took notes during conversations to be able to manage his lies. He refrained from lying after he was caught. R7 states he has to lie about his actual age in SL, because he will be excluded if he is open about it. **Fourth**, they consent that 'to save chat logs in SL' is accepted, although it becomes problematic if one would disclose the chat logs in public, which is looked upon as privacy infringement. However, four research participants acknowledge that they save logs as a form of self-protection, in case they need evidence in situations of disagreement with others. **Fifth**, the argumentation about 'to make screenshots of a resident without asking him / her' is similar to saving chat logs, that is, not problematic in itself (they often do it themselves) unless you disclose them (breach in privacy). Also, there is a difference between making a screenshot on a public sim versus on a private sim. Nevertheless, this is accepted behaviour. **Sixth**, everyone has faked a computer crash to get rid of someone (or they just log out). There is general agreement that, although it is not a nice thing to do an sich, it is friendlier than telling the other person you find him / her boring. They do not feel guilty; everyone does it and others will also have done it to them. Also, it is conceived of as understandable behaviour. R4 explicitly says that this is a typical feature of SL, so why not make use of it. **Seventh**, 'to have a different gender in SL' is accepted, although, analogous to 'to have more than one avatar in SL', it can become morally problematic if one purposively lies about it

to mislead others. Also, similar to 'to pretend to be younger', the relation you have with someone in SL is more important than gender. R3, R7, and R13 all have female alts, although their actual gender is male. R4 shortly experimented with gender swapping in the beginning. R13 finds this an evident thing to do in SL and also R8, who does not do it himself, believes this is one of the typical features of SL. **Finally**, as they deny that virtual rape is possible in SL, 'to rape a resident in SL' is not morally problematized. All research participants refer to the possibility to escape by logging out. Only R4 strongly condemned virtual rape in the sense of 'misleading', i.e. to mislead a newbie and tell him or her to press on the pose-ball to have sex in SL, but even then she believes one always has the possibility to log out and escape. R5, R12, R13, and R14 also say that this is acceptable behaviour in role-play, if there is mutual consent. Informants also refer to actual life, where raping is an immoral act and they strongly condemn it. In SL, on the contrary, one cannot only escape; there is also a lack of physical consequences. Residents, who declare to have been raped, are judged to be too fragile and are believed to identify too much with their avatar.

Similarities: Unacceptable Scenarios

The following six scenarios were agreed upon as unacceptable: 'to have sex with a child avatar in SL'; 'to not console a friend in SL'; 'to not help a newbie in SL'; 'to spread racist ideas in SL'; 'to humiliate an SL-resident in public'; and 'to spread the secret of an SL-resident in SL'.

First, none of the research participants ever had sex with or as a child avatar in SL and the majority reacts strongly against it, by linking it explicitly to actual paedophilia. The image of an adult avatar having sex with a child avatar is wrong and harmful, even if an adult is controlling the child avatar. People who have these sexual fantasies are judged to be mentally ill. Children are the image of innocence; it is believed immoral to portray them in the context of adult and sexual practices. R10 once saw it in SL and immediately filed an abuse report. Although they morally denounce of this scenario, some informants remark that these adults might refrain from doing it in actual life, thereby preventing an actual child from being hurt. Some informants do not problematize the scenario strongly. R2, for instance, stresses that there are two consenting adults involved. R8, who struggles with this scenario and who thinks child avatars are always disturbing in SL, also states that in SL it concerns consenting adults. Interestingly, the scenario 'to have sex with an animal avatar in SL' was not conceived of as that problematic. Instead, it was often evaluated as 'fun', 'fantasy', 'role-play', and 'merely a cartoon on a screen' (these terms were not used with regard to the child avatar scenario). R5 has done it often in the context of role-play. This scenario is also evaluated as less realistic than sex with a child avatar. However, six informants also morally disapprove of it, especially if it is meant to be serious. **Second**, 'to spread racist ideas in SL' is evaluated as unacceptable behaviour. No one reports to have done this. Four informants witnessed it in SL; R6 filed an abuse report, while the others banned or muted the harm-doer. There is general consensus that SL has to be a positive and fun environment and that one has to be tolerant. Exploration in SL is accepted, but not if one wants to explore this kind of ideas, although the informants believe freedom of speech is important in SL. **Third**, 'to humiliate an SL-resident in public' is only acceptable if the resident deserves it or if it takes place within a BDSM context. In other cases it is not acceptable. The scenario is rated worse if the humiliation takes place on the basis of actual life information. R10 once filed an abuse report when he witnessed public humiliation. Interestingly, R13 explicitly states that he would defend the victim, which he would not dare in actual life (in SL there is less distance in his opinion). **Fourth**, all informants console friends in SL, stating that this is the human side of SL. No one reports that it merely concerns a virtual friend. To not console a friend is thus not acceptable, although R10 and R12 state it is dependent on the closeness of friendship and R11 believes it is dependent on the problem (an SL-related problem is considered as less grave than an actual life related one). R5 once did not console an SL-friend and felt very guilty about it. He apologized, but eventually lost his friend. **Fifth**, they all help newbies or have done it, and it is deemed bad if one explicitly refuses to do it. They often give (or have given) money to newbies and remember that they were also helped when they were new in SL. R9 and R10 also volunteered as a newbie assistant (newbie care). However, they believe it is not bad if one does not have time, and one cannot help every possible newbie. **Finally**, concerning 'to spread the secret of an SL-resident in SL', there is general agreement on its unacceptability; it is about trust and keeping a promise. Most research participants know secrets of other residents and some also revealed personal secrets to others. If someone asks you to keep a secret, you do this as a moral obligation, even when you have never met the particular resident face-to-face. R1 once revealed another resident's secret to a common SL-friend. The resident discovered it and socially sanctioned R1 as a consequence. She still feels guilty and ashamed about what she has done.

Dissimilarities

Regarding other scenarios, arguments were diverse. Some informants ranked particular scenarios as unacceptable, whereas others evaluated the same scenarios as acceptable. In what follows, we will focus on the most interesting examples.

Concerning 'to hack an SL-account and to steal money from it', the majority of research participants (eleven) believes this is actual theft and they strongly condemn it. R12's account was once hacked and he states it had nothing

to do with SL anymore, as it concerned actual money. These informants believe residents who hack and steal must be punished and banned from SL. However, others doubt whether it is possible and R7 would dare to do it to SL-residents he hates. R13 evaluates this as acceptable behaviour, as he has no problem with hacking in general. He further argues that if someone succeeds in hacking an account, Linden Lab simply has to protect it better. R10 and R11 believe that in the case of SL, hackers can always be traced and as long as you have a strong password, your account will not get hacked. If it does occur to you, you can only blame yourself. So, whereas some immediately condemn it, thereby referring to stealing actual money, others are looking primarily at the technology (password; Linden Lab design; technological possibility).

Regarding 'to copy the creative work of a resident in SL and to pretend that you have created it yourself', arguments vary from 'most unacceptable' (ranked on the first place by R11, who says that many have copied her SL-art) to 'funny' and 'most acceptable' (R14). R9 believes it is acceptable as it merely concerns virtual art, which does not have to be taken seriously. R7 states that he would dare doing it. Others believe it is impossible to do this in SL (e.g. R10, R15) while still others stress that you have to be honest and they link it to actual life plagiarism (R2, R3, R6, R8, R11, R12).

Although many agree that 'to walk around naked in SL' is not harmful, seven informants would refrain from doing it on sims where it is not allowed. R1 would never do this with her main avatar: "it is me". R2 on the contrary would not have a problem doing it: "it is my avatar, it is not me". The evaluation here thus also seems to be dependent on avatar identification. Others (e.g. R15) believe the rules of decency are the same as in actual life and therefore it is not acceptable behaviour.

The following three scenarios are evaluated in diverging ways, as they are dependent on personal definitions of cheating (in SL). Concerning 'to create an alt after having cheated in SL', arguments vary strongly. Some believe this is unacceptable and state these cheaters should be banned on the basis of their IP-address (e.g. R2). R3 believes you are stupid not to create an alt in this case, as the technology makes it possible; he and R7 both have done it. The arguments concerning 'to have multiple partners in SL without them knowing' also vary strongly. Eight informants believe this is unacceptable and define it as cheating, whereas others (e.g. R3) believe that it is not harmful if the other partners do not know it. Some have also done it themselves (R2, R13). Other informants explicitly state that one does not have to take virtual relationships that seriously (e.g. R9). The arguments regarding 'to not tell your actual life partner that you have a partner in SL' also diverged between acceptable and unacceptable. Ten informants evaluate this as a form of cheating; others, however, deny that this is cheating, as it merely is a virtual relationship (e.g. R1). R2 has done it herself; she would not do it with her current husband (whom she has met in SL), but her relation with her ex-husband was very troubled and hence she did not feel guilty towards him.

Discussion: Ethical Implications

With regard to acceptable in-world behaviour, we found consensus on seven scenarios. The reasoning and argumentation is rooted in the technological features of SL. Also, regarding the scenario 'to rape a resident in SL', most research participants refer to the log out button in their argumentation.

With regard to unacceptable in-world behaviour, they agreed on six morally charged scenarios. The reasoning and argumentation is rooted in actuality. Informants believe these scenarios transcend the merely virtual. These scenarios are always problematic, virtual or actual. When discussing these scenarios, research participants emphasize the human side of SL, e.g. R8: "residents are humans, not toys". They also often explicitly refer to the golden rule, that one should not treat others in ways one would not like to be treated oneself. During our interviews, we also asked our informants to give examples of unacceptable SL-behaviour: griefing; pretending to be a celebrity; limiting another resident's freedom; content theft; manipulating and intentionally misleading newbies; bullying other residents; and hitting on the partner of an SL-friend. Furthermore, we asked for situations for which they filed an abuse report: public humiliation (cf. supra); racism (cf. supra); content theft; sex with a child avatar (cf. supra); griefing; and the presence of a minor. The agreement on the unacceptable scenarios and these examples and cases show that there are ethical limits in virtual space. In our definition of Second Life (cf. supra), we characterized SL as a moral space, because, based on our definition of morality, every avatar represents a moral being. Our findings support this insight. In Hamelink's phrase, "features and qualities of people do not dissolve as they enter the virtual world" (2000, p. 10). People thus do not suddenly become immoral as soon as they enter virtual space and their moral intuition does not abruptly disappear from the moment they log on. However, we must acknowledge that various concepts and problems have taken on a new meaning regarding virtual space because of technological features.

To discuss the ethical implications of our findings in a more fundamental way, we have divided our sample in three groups, based on how they conceptualize virtual others (e.g. as human beings, residents, avatars…) and how they express the difference between their virtual and actual selves and behaviour (and related to this, if they have alts in SL).

We characterize our first group as the 'extension' group in terms of behaviour in virtual and actual settings. The majority of our sample belongs to it (R2, R4, R5, R6, R8,

R9, R10, R11, R12, R14, R15). They explicitly state to be aware of the human being who is operating the avatar. These informants in general only have one avatar and if they do have alts, these do not have a social SL-life and are used solely for SL-creation or to generate more traffic on sims. Apart from rather harmless experimentation (e.g. flirting with boundaries) in their early days in SL and apart from small differences that they relate to the lack of consequences, less restraints, and anonymity (e.g. to be more open), they explicitly state to represent themselves in SL, i.e. their virtual and actual selves converge.

Our second group deliberately creates alts for fun, play, and experimentation (including gender swapping). R1 and R3 belong to this group. They are aware of the human being who is operating the avatar and they strongly identify with their main avatar. Nevertheless, they have alts for play; for instance, they both have a child avatar to 'tease' adult avatars. R3 also has a female alt to seduce male avatars.

The two research participants (R7, R13) belonging to our third group make a clear rupture between virtual and actual practices. To them, avatars are respectively fantasy characters (R7) and in-world characters (R13). They are both not particularly interested in actual life information of virtual others. The fact that they are not openly attentive to the human being, who is operating the avatar, problematizes their position as actual moral agents. Furthermore, they have several alts (R7 has eleven avatars in total), both male and female. Despite the similarities, there are important differences between R7 and R13. In his early SL-days, some SL-residents emotionally harmed R7. He subsequently decided to become less moral and to take revenge on innocent residents, to show them how harsh a virtual place can be. However, on the other hand, he acknowledges positive things in SL in which he is emotionally involved and he also evaluates a number of scenarios as unacceptable. For instance, he morally disapproves of not helping newbies, hereby referring to the old days when he was a boy scout. To R13, SL is an exploratory world. The only thing he ever 'lied' about is his gender. However, he will not define this as lying, as in his opinion it is merely making use of the technological features of SL, it is thus an 'evident' thing to do. We must also note that all research participants of the second and third group (R1, R3, R7, R13) have spied on others with an alt. This practice is not considered as privacy infringement by them, but as merely making use of what the technology has to offer.

The fact that experienced residents reflect on and evaluate 'virtual' moral scenarios in diverging ways can be, as stated before, related to their differential moral logic and their complex moral identity. However, specifically with regard to the relation between virtuality and morality, it seems also related to their conceptualization of the 'boundary' between actuality and virtuality. Although they all extend certain moral principles to the virtual setting, they do not always do so. For instance, 'to fake a computer crash to get rid of someone' is not problematized and here they do not refer to the golden rule. The already discussed discrepancy between 'sex with a child avatar' and 'sex with an animal avatar' makes this clear as well: when it concerned an animal avatar, it was more often conceived of as fun and play. An ethical challenge this brings about is the difficulty to identify when it is serious matter and when it is conceived of as 'merely' a game, fun, fantasy, role-play, an exploratory world, or even a virtual playground. Residents, for whom having sex with an animal avatar is merely role-play, can harm others who morally disgust of this depiction and practice. Another ethical implication is the often-diverging way in which the moral content of a particular scenario is evaluated. An interesting illustration is the hacking of an SL-account. R13 looks upon it as a technological challenge whereas others primarily focus on the act of stealing actual money. A further ethical implication is related to what we would define as the (relation between) ontological status and moral evaluation. If one does not characterize a virtual relationship as real (or meaningful), one will not see moral content in virtual cheating. Or in the case of virtual art and plagiarism: if virtual art is not conceived of as real (meaningful), copying is not deemed bad, as became clear in our findings. And clearly, a fundamental ethical challenge lies in the fact that residents belonging to the second and third group (R1, R3, R7, R13) often refrain from moral responsibility by positioning their argumentation in the technology. Spying on others is, as mentioned before, conceived of as 'fun' and not as privacy infringement, and they do not problematize having alts in terms of multiple identities and identity deception.

Conclusion

Our objective was to gain more understanding in how residents make sense of virtual moral practices and what they believe is un/acceptable in-world moral behaviour. We asked experienced SL-residents to rank hypothetical SL-scenarios and, while doing so, to reason out loud about their ranking. Regarding converging arguments, we found consensus on the unacceptability of six scenarios. Research participants believe these scenarios are equally problematic in virtuality and in actuality (rooted in actual principles). Furthermore, they agree on seven scenarios as acceptable. These scenarios are not morally problematized as they are part of the technological specificities and possibilities of SL. Regarding other scenarios, no general consensus was reached. Our findings have several ethical implications concerning moral evaluation, moral responsibility, and (the acknowledgement) of moral agency. We distinguished the following ethical challenges: first, the discrepancy between those who identify certain virtual practices merely as fun or role-play and those who look upon them as moral transgression; second, related to that, refraining from moral

agency because one was merely role-playing or making use of the technological possibilities; third, the relation between ontological status (or its denial) and moral evaluation; and fourth, the ambiguous difference between rootedness in actuality versus in technology.

As this study focused on experienced residents, it might be interesting for future research endeavours to focus on less experienced SL-residents (for instance newbies) to explore if they reason differently on the scenarios. Also, as we focused on moral reasoning, we did not explore how these residents would actually behave in (and react to) a morally charged situation in SL; therefore, more experimental research is required as well.

On the whole, little systematic evidence-based research has been done regarding the question of morality in social virtual worlds, which makes the need for profound research urgent. Although many academics have shown an increased interest in the topic, it is still an emerging and hence underexplored field of study.

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Poster Session

AVES EXOTICAS: Using Virtual Worlds to Create Awareness about Wild Birds

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The project

avesdeportugal.info is a web-based nonprofit project designed for those who want to learn about wild birds and where to watch them. Its main purpose is to promote awareness about Portuguese wild birds by creating and publishing relevant content online, and by organizing free e-learning initiatives.

The project's website was launched in January 2008, comprises several micro-sites, and has more than 1000 web pages where users can find information about all species of birds that occur in mainland Portugal, and the best places to watch them. Thus far, this website has registered an excess of 5 million page views. The project has an online community of over 1300 members (Forum Aves), and almost 50000 messages have been published by its members since July 2007. The project also includes two blogs, a Facebook page, and a Twitter account.

In October 2011 avesdeportugal.info started a free e-learning program for Portuguese speaking people interested in developing their bird identification skills. As of June 2012, 19 e-learning classes have already taken place, with a total of 600 attendants.

The exhibition

In early 2012 avesdeportugal.info project managers began to explore the possibility of using virtual worlds to create alternative environments for the project's e-learning program.

To assess the adherence of avesdeportugal.info users and the Forum Aves online community to virtual worlds it was decided to organize an exhibition in Second Life® focusing on the 8 species of Non-Native Breeding Birds of Portugal (Aves Exóticas): 19 Real Life Portuguese wildlife photographers contributed with more than 20 photographs and 1/16 of an island was rented for the venue.

The exhibition was open to the public from April 15th through May 15th and had over 100 visitors (tracked using a script). Several of those visitors were new to Second Life®, and many of those joined in order to visit the exhibition, including almost all Real Life photographers that had contributed with pictures, but also website users and forum members who had no stake in the content exhibited there. Common feedback received by project managers included compliments on the environment created and content exhibited, but a few Forum Aves members complained about having to download a special software (viewer) and reported having graphics card issues that prevented them from having a good experience in Second Life®.

Future work

Developing e-learning environments using OAR files (Open Sim technology) and Kitely, and organizing birdlife awareness initiatives in Cloud Party.

avesdeportugal.info

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C. Maria Elias , Project Manager for Web and E-learning
Gonçalo Elias, Project General Manager

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Kromosomer – an experience in shared creative work and expression

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Kromosomer is a storytelling performance that interacted with digital, virtual and social media, using characters from Norwegian legends as a motto to raise questions on alterety: the "other, the not normal, the one that looks "different", which we want to distance ourselves from. The abject, something outside the subject and object, prior to the subconscious, something primitive that has not yet manifested itself symbolically.

Introduction

In the project and performance several artists participated in a "distributed" dramaturgy where contributed equally, but creatively independent. Avatars were created, based on characters from Norwegian legends; they formed the basis for new stories, mainly mediated through pictures which were used on a blog, where readers were challenged to create new stories. There stories were then passed on, either through social media or orally narrated in the performance. Participants were also instigated to record pictures and machinimas. Many of the participants/produsers' interpretations were later used in the physical performance, some assembled into a video that was projected on the walls, others printed to form part of an installation.

Background

The background material for the project was collected from traditional oral Norwegian legends (sagn). Folklorist Linda Dégh states that "legend contextualizes" and interprets belief' (Dégh, 1996). Belief is the core of the legend, and not only that - the science (knowledge) is a necessary counterweight when the legend occurs. It is as if life stumbles along the way, discover something and moves on. In legends there is a clash between reason and faith.

The logic, the meaning is broken down because we lose distinction between subject and object, "I" and "the others". Abject, as Julia Kristeva describes it, is prior to the subconscious, it is an encounter with something primitive that has not yet manifested itself symbolically (Kristeva, 1982). Legends are already a way of trying to assimilate and give symbolic value to the meaningless. Often the legends portray the meeting with "the other" as a physical one, but by using avatars in the metaverse one can experience the embodiment of "the others", thus creating a process of actually inhabiting alterity, possibly providing new tools to extend the language that can handle the feeling of meaninglessness.

The avatars

Jacquelyn Ford Morie notes that in virtual environments "our experience is very much influenced by how we perceive our self, and yet, within most immersive environments, as they exist today, this choice is still made by the VE designer" (Morie, 2007). Second Life avatars are unprecedentedly customizable, giving its residents the ability to design themselves, making embodiment not only an aesthetic experience but also a creative one.

Legends added a pretext for the exploration of a different kind of body. Through avatar manipulation in virtual environments, one can actually experience the embodiment of "the other". Yee and Bailenson, who studies this process of inhabiting alterity, argue that "immersive virtual environments provide the unique opportunity to allow individuals to directly take the perspective of another" (Yee et al., 2009), and even suggest the possibility of this embodied perspective taking having an impact on the reduction of negative stereotyping (Yee et al., 2009). With the free distribution of the Kromosomer modifiable avatars we aimed to promote residents' disposition to have an active and creative part in the process of their own avatars design, as well as in the embodiment of the story itself as a character.

Creative collaboration

The free distribution of the Kromosomer modifiable avatars promoted a different kind of relation between artists and public, in this project, that might stride against traditional roles. Instead of expecting a solely contemplative audience to an artistic performance, we proposed a shared creative process. Once the avatars were distributed they became avatars of others, inhabited by different identities that could take them literally as the legends' avatars or radically transform them and use them

to perform entirely new stories. This process relates to Axel Bruns' concept of produsage, as a conventional sense of production no longer applies to "massively distributed collaborations [...] constantly changing, permanently mutable bodies of work which are owned at once by everyone and no-one" and in which the participants easily shift users to producers and vice-versa, originating a hybrid role in between (Bruns, 2010).

Metaphores

We call our work process a metaphorical way of working because in new connections and meetings, we seek to articulate and give meaning to issues that concern us (Ricoeur, 2004). A metaphor is not a substitute but an interaction between two concepts: in their juxtaposition, the metaphors creates something new.

The virtual body is then a metaphorical one and therefore a body of expression and language, open to experimentation and possibility. By offering the avatars copy enable, transferable, and most importantly, transformable, we became more than authors, creators or artists: we were partners in a shared creative flux.

Conclusions

In this project we freed ourselves from space and time, working with what arises in creative meetings between concepts such as legends and metaverse, professional artists and amateurs, different disciplines, different interpretations, ultimately achieving a poetic function. Kromosomer generated a completely different way of working within artistic production, one in which the frontiers between artist and public are blurred, thus revealing new parameters and consequently new possibilities.

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Abstract

Kromosomer is a storytelling performance that interacted with digital, virtual and social media, using characters from Norwegian legends as a motto to raise questions on alterety:
the "other", the not normal, the one that looks "different", which we want to distance ourselves from. The abject, something outside the subject and object, prior to the subconscious, something primitive that has not yet manifested itself symbolically.

Introduction

In the project and performance several artists participated in a "distributed" dramaturgy where they contributed equally, but creatively independent.
Avatars were created, based on characters from Norwegian legends; they formed the basis for new stories, mainly mediated through pictures which were used on a blog, where readers were challenged to create new stories. These stories were then passed on, either through social media or orally narrated in the performance. Participants were also instigated to record pictures and machinimas. Many of the participants/produsers' interpretations were later used in the physical performance, some assembled into a video that was projected on the walls, others printed to form part of an installation.

Background

The background material for the project was collected from traditional oral Norwegian legends (Sagn). Folklorist Linda Dégh states that "legend contextualizes and interprets belief"[1]. Belief is the core of the legend, and not only that – the science (knowledge) is a necessary counterweight when the legend occurs. It is as if life stumbles along the way, discover something and moves on. In legends there is a clash between reason and faith.

The logic, the meaning is broken down because we lose distinction between subject and object, "I" and "the others". Abject, as Julia Kristeva discribes it, is prior to the subconscious, it is an encounter with something primitive that has not yet manifested itself symbolically [2]. Legends are already a way of trying to assimilate and give symbolic value to the meaningless. Often the legends portray the meeting with "the other" as a physical one, but by using avatars in the metaverse one can experience the embodiment of "the other", thus creating a process of actually inhabiting alterity, possibly providing new tools to extend the language that can handle the feeling of meaninglessness.

The avatars

Jacquelyn Ford Morie notes that in virtual environments "our experience is very much influenced by how we perceive our self, and yet, within most immersive environments, as they exist today, this choice is still made by the VE designer" [3] Second Life avatars are unprecedentedly customizable, giving its residents the ability to design themselves, making embodiment not only an aesthetic experience but also a creative one.
Legends added a pretext for the exploration of a different kind of body. Through avatar manipulation in virtual environments, one can actually experience the embodiment of "the other". Yee and Bailenson, who studied this process of inhabiting alterity, argue that "immersive virtual environments provide the unique opportunity to allow individuals to directly take the perspective of another" [4], and even suggest the possibility of this embodied perspective-taking having an impact on the reduction of negative stereotyping [4]. With the free distribution of the Kromosomer modifiable avatars we aimed to promote residents' disposition to have an active and creative part in the process of their own avatar design, as well as in the embodiment of the story itself as a character.

Fig.1. Deborah Lombardo aka Harbor Galaxy, *Paid*, 2012.

Fig. 2. Sameiro Oliveira Martins aka Meilo Minotaur, *Sea Serpent*, 2012.

Fig.3. Catarina Carneiro de Sousa aka CapCat ragu, *Peasant becoming Skurekallen*, 2012

Creative collaboration

The free distribution of the Kromosomer modifiable avatars promoted a different kind of relation between artists and public, in this project, that might stride against traditional roles. Instead of expecting a solely contemplative audience to an artistic performance, we proposed a shared creative process. Once the avatars were distributed they became avatars of others, inhabited by different identities that could take them literally as the legends' avatars or radically transform them and use them to perform entirely new stories. This process relates to Axel Bruns' concept of produsage, as a conventional sense of production no longer applies to "massively distributed collaborations [...] constantly changing, permanently mutable bodies of work which are owned at once by everyone and no-one" and in which the participants easily shift users to producers and vice versa, originating a hybrid role in between [6].

Metaphores

We call our work process a metaphorical way of working because in new connections and meetings, we seek to articulate and give meaning to issues that concern us [7]. A metaphor is not a substitute but an interaction between two concepts: in their juxtaposition, the metaphor creates something new.

The virtual body is then a metaphorical one and therefore a body of expression and language, open to experimentation and possibility. By offering the avatars copy enabled, transferable, and most importantly, transformable, we became more than authors, creators or artists: we were partners in a shared creative flux.

Conclusions

In this project we freed ourselves from space and time, working with what arises in creative meetings between concepts such as legends and metaverse, professional artists and amateurs, different disciplines, different interpretations, ultimately achieving a poetic function. Kromosomer generated a completely different way of working within artistic production, one in which the frontiers between artist and public are blurred, thus revealing new parameters and consequently new possibilities.

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Fig.4. Eupalinos Ugajin, *Untitled*, 2012

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