

LEARNING IN VIRTUAL WORLDS

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LEARNING IN VIRTUAL WORLDS

RESEARCH AND APPLICATIONS

Edited by

Sue Gregory, Mark J.W. Lee, Barney Dalgarno,
and Belinda Tynan



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CONTENTS

List of Abbreviations	vii
List of Tables and Figures	ix
Acknowledgements	xiii
Foreword	xv
Introduction	xix

PART ONE • HUMAN–COMPUTER INTERACTION

- 1 Navigation and Wayfinding in Learning Spaces in 3D Virtual Worlds 3
Shailey Minocha and Christopher Hardy
- 2 Communication Modality, Learning, and Second Life 43
Stephany F. Wilkes
- 3 Virtual Body: Implications for Identity, Interaction, and Didactics 67
Laura Fedeli
- 4 (In)Accessible Learning in Virtual Worlds 87
Robert L. Todd, Jessica Pater, and Paul M. A. Baker
- 5 Benefits of Second Life in the Ageing Population 117
Ann Smith
- 6 The Reality of Authentic Learning in Virtual Worlds 129
Helen S. Farley

PART TWO • ADVANCED TECHNOLOGY

- 7 Conversational Agents in Second Life: Freudbot 153
Bob Heller, Mike Procter, and Corbin Rose
- 8 Virtual Bots: Their Influence on Virtual Worlds, and How They Can Increase Interactivity and Immersion through VirtualPREX 167
Torsten Reiners, Sue Gregory, and Vicki Knox

PART THREE • LEARNING DESIGN AND IMPLEMENTATION

- 9 Analyzing Teaching Practices in Second Life: A Design Taxonomy
for the Implementation of Workshops in Virtual Worlds 193
Steven Warburton and Margarita Pérez García
 - 10 Netconnect Virtual Worlds: Results of a Learning Experience 227
Francesca Bertacchini and Assunta Tavernise
 - 11 Scaffolding Learning Through the Use of Virtual Worlds 241
Chris Campbell and Leanne Cameron
 - 12 Challenges and Strategies in Designing Cross-national Learning:
Team Projects in Virtual Worlds 261
Paul Resta and Miri Shonfeld
 - 13 Introduction to Laws Relevant to Virtual Worlds in Higher
Education 275
Layla F. Tabatabaie
- Conclusion 295
- List of Contributors 307
- Index 315

ABBREVIATIONS

ACU	Australian Catholic University
AI	Artificial Intelligence
AIML	Artificial Intelligence Markup Language
ALICE	Artificial Linguistic Internet Computer Entity
ALTC	Australian Learning and Teaching Council
ANOVA	Analysis of Variance
ASD	Autism Spectrum Disorder
ASL	American Sign Language
AT	Assistive Technology
CA	Conversational Agent
COLMSCT	Centre for Open Learning of Mathematics, Science, Computing and Technology
CoP	Community of Practice
CSS	Cascading Style Sheets
CSU	Charles Sturt University
DCT	Dual-Coding Theory
DGs	Design Guidelines
EULA	End-User License Agreement
HCI	Human-Computer Interaction
HCS	Heuristic Categories
HUD	Heads-Up Display
ICT	Information and Communication Technology
IM	Instant Messaging
IRB	Institutional Review Board
ISTE	International Society for Technology in Education
LAMS	Learning Activity Management System
LIBOPENMV	Library OpenMetaverse
LSL	Linden Scripting Language
MELCOE	Macquarie University's E-Learning Centre of Excellence
MMORPG	Massively Multiplayer Online Role-Playing Game
MPML _{3D}	Multimodal Presentation Markup Language 3D
MUD	Multi-User Dungeon

MUVE	Multi-User Virtual Environment
NAV	Navigational Aid
NPC	Non-Player Character
NSF	National Science Foundation (US)
OLT	Office for Learning and Teaching (Australia)
OpenSim	OpenSimulator
PIE	Psychology of Immersive Environments
POV	Point of View
PQ	Presence Questionnaire
RL	Real Life
RV	Real Voice
SL	Second Life
SLURL	Second Life Uniform Resource Locator
SPIN	Sponsored Program Information Network
STEM	Science, Technology, Engineering, and Mathematics
TPCK	Technological Pedagogical Content Knowledge
TOS	Terms of Service
UD	Universal Design
UNE	University of New England
UniSA	University of South Australia
URL	Uniform Resource Locator
V2T	Voice-to-Text
VF	Voice Font
VirtualPREX	Virtual Professional Experience
VLE	Virtual Learning Environment
VoIP	Voice Over Internet Protocol
VW	Virtual World
WAI	Web Accessibility Initiative
XML	Extensible Markup Language
ZPD	Zone of Proximal Development

TABLES AND FIGURES

TABLES

<i>Table 1.1</i>	Summary of NAVY's Methodology	11
<i>Table 1.2</i>	Structure of the Evaluation Worksheet	13
<i>Table 1.3</i>	Second Life Navigational Aids	16
<i>Table 1.4</i>	Examples of Learning Activities for the Abyss Observatory and the Associated Navigational Aids	17
<i>Table 1.5</i>	Guidelines Based on Positive Design Aspects that Aid Navigation and Wayfinding	21
<i>Table 1.6</i>	A Subset of Design Guidelines	25
<i>Table 1.7</i>	Navigational Aids and Design Considerations	33
<i>Table 2.1</i>	Reasons for Elimination of Prospective Study Participants and Final Sample Size (N = 60)	49
<i>Table 2.2</i>	Frequencies of Primary Interest in Second Life (N = 60)	50
<i>Table 2.3</i>	Chi-square Scores for Assignment to Test Condition Based on Age, Gender, and Race	51
<i>Table 2.4</i>	Cronbach's Alphas for Presence, Cognitive Load, and Retention Scales	53
<i>Table 2.5</i>	Correlation Matrix for Independent, Dependent, and Demographic Variables (N = 60)	55
<i>Table 2.6</i>	Means and Standard Deviations for Cognitive Load, Retention, and Presence by Communication Modality	55
<i>Table 2.7</i>	Post-hoc Differences in Means of Cognitive Load, Retention and, Presence by Condition	56
<i>Table 7.1</i>	Summary of Coding Categories for Freudbot Conversations in Two Settings	160
<i>Table 7.2</i>	Distribution of Social Presence Measures	161
<i>Table 8.1</i>	Various Projects Incorporating Bot Activities	174
<i>Table 9.1</i>	Complete Listing of the 27 Criteria That Comprise the Analysis Grid Organized into Four Main Themes	200
<i>Table 10.1</i>	Knowledge Questionnaire: Students' Mean Scores and Standard Deviation	235
<i>Table 12.1</i>	Pearson Correlation Between Main Variables: Social Presence, Engagement, and Satisfaction	268

FIGURES

- Figure 1.1* The problem of navigation and wayfinding 5
- Figure 1.2* A map of the deep|think Island in Second Life, showing its division into five sections 9
- Figure 1.3* Finding the way to the library 10
- Figure 1.4* A user observation session with the researcher following the participant as the latter went about conducting activities on the island 17
- Figure 1.5* A post-observation session 18
- Figure 1.6* An interview with the designer of Genome Island 19
- Figure 1.7* Flow diagram of NAVY's methodology 23
- Figure 1.8* Library in the deep|think Island 28
- Figure 1.9* The transition point in the paths from grass to the wooden surface includes a ramp which can be useful for wheelchair users 28
- Figure 1.10a* Addition of directional signs at a decision point on an intersection 29
- Figure 1.10b* Re-designed entry point of The Abyss Observatory 30
- Figure 1.11a* The seven pillars of wisdom outside The Open University's library on the main campus 32
- Figure 1.11b* The seven pillars of wisdom outside The Open University's library on the virtual campus 32
- Figure 3.1* Research participants: registration in Second Life 69
- Figure 3.2* Interface of the NVivo 8 software: Organization of the data in documents and sections 73
- Figure 3.3* Interface of the NVivo 8 software: Category tree 73
- Figure 4.1* Moonworld: a Second Life learning tool for space exploration. Copyright 2011–2012 by NASA-sponsored Classroom of the Future, Center for Educational Technologies, Wheeling Jesuit University. Reprinted with permission 92
- Figure 4.2* Xplanet Globe tests in OpenSim platform 98
- Figure 4.3* Max, the Virtual Guide Dog from Virtual Helping Hands 103
- Figure 5.1* The real and virtual participants using Second Life 120
- Figure 5.2* Exploring the historical islands in Second Life 125
- Figure 7.1* Web-based interface to Freudbot in Heller et al. (2005) 155
- Figure 7.2* Second Life interface to Freudbot on Athabasca University Island. 157

- Figure 8.1* Information being provided to a newbie 173
- Figure 8.2* Bots interacting with one another while a human avatar looks on 177
- Figure 8.3* Schematic framework of inworld and external components of bot creation 180
- Figure 8.4* Example of an event the student bot triggers based on the teacher avatar's behaviour 181
- Figure 8.5* Bot schematic 183
- Figure 8.6* Bot schematic with step-by-step procedures 184
- Figure 9.1* A classroom space that emulates a real-life traditional spatial design and layout 203
- Figure 9.2* The participants learn how to build a street lamp while working within an enclosed individual area, allowing for comfortable camera movement in a virtual space that simulates a street corner 203
- Figure 9.3* A workshop setting where the avatars can freely move around the teaching space. The chat range is demarcated by the boundary of the red platform 205
- Figure 9.4* At the beginning of the workshop "Creating a teleport hub and using the Flight Feather," the tutor presents the learning objectives on a whiteboard 205
- Figure 9.5* For the workshop "Building a holodeck with the Builder's Buddy script," the tutors prepared the materials within a hierarchical structure where basic materials and materials for each scene are clearly indicated 206
- Figure 9.6* A Q&A session after a workshop using the "CloseText rezzer" on channel 99 to drop participant questions 210
- Figure 9.7* Avatars freely occupy a workshop space as they build their own projects 211
- Figure 9.8* During the "Bracelets, bracelets, bracelets!" workshop, the participant sits on a chair and builds her project on a desk 212
- Figure 9.9* While avatars are constrained to their allotted space, the tutor circulates freely among them 212
- Figure 9.10* During the "Bracelets, bracelets, bracelets!" workshop, the tutor displays the three bracelets on a gigantic scale in the sky overhead 214

- Figure 9.11* While the participants work on their own projects, progressive stages of development remain visible in the sky to serve as a reference 214
- Figure 9.12* Mapping of all the analysis grid criteria is grouped according to theme and relationship to pedagogical or technical expertise. The criteria with the most impact are highlighted in red 220
- Figure 9.13* Pedagogical approach versus structure of the environment: moving toward good teaching practices (quadrant 4) in a virtual world setting 222
- Figure 10.1* The list of the historical sites in NetConnect virtual worlds: Lokroi, Biskupin, and Glauberg 229
- Figure 10.2* The temple in Lokroi, the houses in Biskupin and Glauberg 230
- Figure 10.3* Screenshots of the multimedia sections in the Lokroi virtual world: Videos, Pictures, Extra 231
- Figure 10.4* Objects that the user can manipulate in the NetConnect virtual worlds of Lokroi, Biskupin, and Glauberg 231
- Figure 10.5* A pinake, courtesy of the *Sistema Museale Virtuale della Magna Graecia* (Virtual Museum System of Ancient Greece) project at <http://www.virtualmg.net>, and an avatar in Lokroi 232
- Figure 11.1* An example of a LAMS sequence 254
- Figure 11.2* An example of an Edmodo site page 255
- Figure 12.1* Classroom and meeting space 266
- Figure 12.2* Outdoor team meeting space 266
- Figure 12.3* Students' avatars dressed like Mayans in Chichen Itza, Mexico 267
- Figure 12.4* Relationships between Teaching, Cognitive, and Social Presence and Tools, Tasks, and Group Cohesion 272
- Figure 13.1* Example of how text may appear in a virtual world (virtual classroom at Freie Universität Berlin, Germany) 286

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Sue Gregory, Mark J. W. Lee, Barney Dalgarno, and Belinda Tynan

FOREWORD

This important book provides both a synthesis of current research on virtual worlds as media for engagement and learning as well as an implicit research agenda for the future. As the authors note, at this point in the evolution of immersive interfaces, those making claims about their value should support them with both theoretical and evidence-based justifications. We know that learning technologies are not innovations that intrinsically generate learning; rather they are catalysts that, when used well, can enable high engagement, active learning, authentic assessment, and links between schooling and life (Dawley & Dede, 2014). Virtual worlds have many affordances that provide potential for these dimensions of effective learning, and this book describes to what extent these capabilities are currently realized and where improvements in design, implementation, and research are needed.

As the authors discuss, part of the difficulty lies in designing an interface that scaffolds the motivational and learning goals of a specific virtual world. Simplistic authoring shells have the virtue of easy usage, but this comes at the cost of having features beyond basic chat and graphics. To develop richly detailed simulated real-world situations with challenges that can be resolved through applying academic knowledge and skills, more sophisticated features are necessary, such as simulating data collection or enabling shared representations among team members (Kafai & Dede, 2014). Our work with immersive digital ecosystems demonstrates that such authenticity sometimes requires custom programming beyond what even a high-end gaming shell like Unity provides (Metcalf, Kamarainen, Tutwiler, Grotzer, & Dede, 2011). These advanced affordances also enable individual learners to customize (Dede, 2012a; Warschauer & Matuchniak, 2010). This anthology notes how important this personalization is in providing access to the broadest possible range of learners.

Virtual worlds have many capabilities (e.g., navigation, communication, embodiment) that not only aid motivation and learning when used well but also provide rich data for diagnostic, formative assessment. The unobtrusive, real-time assessments used to provide formative feedback include (Dede, 2012b, pp. 3–4):

- *Capturing exploratory paths.* The paths that a student takes in exploring a virtual world to determine the contextual situation, identify anomalies, and collect data related to a hypothesis are an important predictor of the student’s understandings about scientific inquiry.
- *Analyzing usage of guidance systems.* Gathering data on when students first choose to use an interwoven individualized guidance system, which messages they viewed, where they were in the immersive simulation when they viewed them, and what actions they took subsequent to viewing a given guidance message provides diagnostic insights that can aid instruction.
- *Interacting with animated pedagogical agents (APAs).* APAs are “lifelike autonomous characters [that] co-habit learning environments with students to create rich, face-to-face learning interactions” (Johnson, Rickel, & Lester, 2000, p. 47). The trajectory over time of questions students ask of an APA is diagnostic—typically learners will ask for information they do not know but see as valuable. This can help us comprehend a student’s thought processes and methods of knowledge acquisition. Also, APAs scattered through an immersive authentic simulation can collect diagnostic information in various ways, such as the APA requesting a student to summarize what he or she has found so far.
- *Documenting progress and transfer in similar settings.* Shifting a student to a similar, but not identical environment in which he or she must identify a problem (earlier in the curriculum) or resolve a problem (later in the curriculum) can provide insights into a student’s progress and aid transfer. Further, centring these assessments on learners’ common misconceptions and then immediately conveying the results to them can prompt “aha” moments that help synthesize new levels of understanding.
- *Attaining “powers” through accomplishments.* Like levelling up in games, students can attain new powers by reaching a threshold of experiences and accomplishments. These new capabilities document team achievements, promote engagement, facilitate learning, and offer additional opportunities for interwoven assessment.

Several chapters describe the potentially valuable contributions APAS can make to engagement, learning, and assessment in virtual worlds.

The material in this book about implementation of virtual worlds for learning and assessment of their strengths and limitations adds an important real-life dimension to this emphasis on effective design. Research and development on immersive interfaces must necessarily take into account the many challenges of real-world contexts, including professional development, cross-cultural understanding, and legal issues. Overall, this book is a very important, timely contribution to the ongoing dialogue about reaching the full potential of educational virtual worlds.

Chris Dede

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INTRODUCTION

*Mark J. W. Lee, Barney Dalgarno, Sue Gregory,
and Belinda Tynan*

Three-dimensional (3D) immersive virtual worlds have been touted as being capable of facilitating highly interactive, engaging, multimodal learning experiences; as a result, they have enjoyed considerable interest and uptake in education over the past several years. Educators and institutions worldwide have invested heavily in virtual worlds, with some making use of commercially hosted platforms like Second Life and ActiveWorlds, and others extending and adapting open-source products such as OpenSimulator (OpenSim), Open Wonderland, and Open Cobalt to create worlds hosted on internal servers and networks. Still others have built their own bespoke platforms and systems using a variety of programming languages and game engines to accommodate specific needs and goals.

Many of these efforts have been fuelled and driven by beliefs that virtual worlds, with their powerful affordances and rich, immersive properties can be used to achieve higher levels of student engagement and make enhanced educational outcomes more attainable. In the field of online and distance education in particular, there has been much optimism about the promise of virtual worlds to solve traditional problems such as learner isolation, bridging the gap between on- and off-campus cohorts by engendering collaboration and participation, and enabling a greater sense of immediacy, co-presence, and feeling of belonging to a community. Yet much of what has been published in the area has tended to be descriptive, centring almost exclusively around students' and teachers' impressions of the technology and offering only limited research-based evidence attesting to the real educational benefits. Now that the initial novelty of virtual worlds has worn off and the hype surrounding them has

begun to subside, educators are faced with an imperative to look beyond the rhetoric for proof about what actually works and what does not. As the technology gradually approaches maturity (see LeHong & Fenn, 2012; Gartner, 2012), virtual world proponents are being forced to confront the reality of rising hosting and maintenance costs, and must build stronger, more defensible business cases grounded in research to justify continued investment within their institutions and organizations.

This book has been created with the mission of advancing scholarly inquiry and developing and sharing best practices in the use of virtual worlds for learning in formal, non-formal, and informal education settings. Its objectives are threefold. First, the chapters supply readers new to the field with an introduction to the current knowledge base in the domain of virtual worlds for learning. Second, they present leading-edge research that will be of interest to experts and novices alike. Third, the editors hope that the coverage of emerging trends and developments will identify areas in need of further investigation, including opportunities for future theoretical and empirical research.

Overall, the editors and contributors seek to provide a forum for research-informed, evidence-based perspectives on the educational uses of virtual worlds. It is intended to serve as a one-stop resource that is relevant and useful to a wide audience including teachers, students, and researchers, as well as administrators and policy-makers.

How the Book is Organized

This book consists of three sections, each comprising a number of chapters that consider current research topics and challenges relating to learning in virtual worlds. Each one of the thirteen chapters deal with an aspect of the interactions between the learner and the virtual world, technological innovations that hold particular promise for the enhancement of the virtual world learner experience, or the design and implementation of virtual world-based learning interventions. What follows is a brief descriptive overview of the sections and chapters. At the end of the book is an Epilogue where we review the key findings from the chapters, identifying and discussing prominent issues and themes that emerge. We also contemplate possible future research directions.

Section 1: Human–Computer Interaction

The first section of this book is devoted to examination of some of the human factors pertaining to learning in virtual worlds. In the opening chapter, “Navigation and Wayfinding in Learning Spaces in 3D Virtual Worlds,” Shailey

Minocha and Christopher Hardy report on research carried out at The Open University in the UK aimed at achieving a better understanding of how users navigate and find their way around learning spaces in Second Life, and what can be done to improve the usability of spaces. This research is important because navigation and wayfinding can have a profound influence on the effectiveness and efficiency of learning activities undertaken in avatar-based 3D virtual environments. Through student-user observation, interviews, and heuristic evaluations conducted using predefined criteria, the authors were able to derive a set of evidence-based guidelines for the design of virtual world-based learning spaces and tasks. Minocha and Hardy proffer those guidelines to help designers and educators minimize learners' frustration and confusion and discourage time-wasting activities that distract them from core tasks and objectives.

The second chapter, "Communication Modality, Learning, and Second Life" by Stephany Wilkes explores a key issue for educators considering the use of virtual worlds for learning and teaching: that of communication modality. Specifically, Wilkes is concerned with the question of whether text communication, voice communication, or a combination of both should be used. Wilkes employed a quantitative study that looked at the impact of communication modality on cognitive load, short-term retention, and perception of presence in an inworld course on building in Second Life completed by 60 students. She found that the choice of communication modality had an effect on cognitive load and retention levels, but not on the perceived sense of presence. Wilkes discusses the implications and recommendations for practitioners in light of the findings, and cautions readers against making assumptions about the appropriateness or superiority of one communication modality over another in the absence of information about learners' backgrounds and prior experience, or without taking into account the context and nature of the learning tasks.

Chapter 3 by Laura Fedeli, "Virtual Body: Implications for Identity, Interaction, and Didactics," is about embodiment in a virtual world—in particular, how the ability to assume an avatar and carry out actions and interactions with it can give rise to active, social, and experiential learning not possible through the use of other technologies and media forms. While it is known that virtual worlds have a number of unique distinguishing characteristics that lend themselves to learning and teaching applications, including the facilitation of embodied actions and verbal and non-verbal communication, empirical evidence connecting these characteristics to the learner's construction of an inworld identity and his or her experience of a sense of presence and co-presence within the virtual world is sparse (see also Mikropoulos & Bellou, 2006; Mikropoulos & Natsis,

2011). Similarly, while a number of virtual world learning affordances have been identified by various authors (see, for example, Dalgarno & Lee, 2010; Hollins & Robbins, 2008; Warburton, 2009), there is a paucity of knowledge about the precise relationships that exist between the aforementioned characteristics of a virtual world and the pedagogical benefits arising from the performance of learning tasks that the technology affords. Fedeli's chapter addresses these gaps in the literature by reporting on a study that involved 21 educators as research participants and focused on their use of Second Life in their teaching practice. The researchers analyzed open-ended questionnaire responses and transcripts of inworld interviews and focus group sessions to obtain deep insight into the participants' experiences.

The next two chapters have a strong social justice theme in that they are concerned with promoting equity for particular groups of learners—namely, learners with disabilities or elderly learners—and ensuring these groups are able to successfully partake in virtual world-based learning activities. The first of these, Chapter 4, “(In)Accessible Learning in Virtual Worlds” by Robert Todd, Jessica Pater, and Paul Baker, tackles the problem of accessibility as it applies to educational applications of virtual worlds. It highlights critical issues that act as barriers keeping disabled learners from participating and makes recommendations for mitigating those issues that include both technical solutions (i.e., involving the use of assistive technologies) as well as those that relate to the way in which the environment, resources, and learning tasks are designed and implemented. The authors concentrate on Second Life and OpenSim, with a detailed treatment of the accessibility-related challenges and affordances of the former.

In Chapter 5, “Benefits of Second Life in the Ageing Population,” Ann Smith describes pilot studies examining the use of virtual worlds for learning by older people. This work points to the numerous potential benefits that stand to accrue from senior citizens' participation in virtual worlds, which include a range of social, psychological/emotional, and developmental benefits. At the same time, however, Smith also calls attention to the need for careful consideration of various aspects of interface and task design as well as the need to provide dedicated training and support for these learners. Smith examines usability and other problems that may be encountered by elderly users in a virtual world, as observed in the pilot studies, and she offers some suggestions for practice, further research, and development.

The first section concludes with a position piece by Helen Farley: Chapter 6, “The Reality of Authentic Learning in Virtual Worlds,” which questions common assumptions held and claims made with regard to the capacity of virtual worlds

for enabling so-called authentic learning. Farley contends that although virtual worlds may seem, at face value, to be the ideal environment to have students engage in learning that prepares them for the tasks, problems, and challenges they will face in the real world—arguably a primary goal of all formal education in the twenty-first century—certain subject areas and knowledge domains do not lend themselves to simulated learning in virtual worlds, at least in their current form. Farley examines some of the factors influencing the success of attempts to facilitate authentic learning in virtual worlds and some of the limitations of technology currently available in the mainstream.

Section 2: Advanced Technology

Many of the basic, underlying technologies seen in virtual worlds are not new but have existed for some time, and have been used in education in some form for well over two decades (Mikropoulos & Natsis, 2011). That said, at the turn of the millennium there was a sort of renaissance, a renewal of interest and activity in the area of desktop and networked virtual reality environments. A new generation of massively multi-user virtual world platforms was born with the mainstreaming of high-speed, broadband Internet connectivity, which is now commonly available in homes and workplaces in addition to schools, colleges, and universities. These platforms are highly extensible, lending themselves to tailoring and modification even by novice users who have no knowledge of programming. More technically savvy users can create powerful scripts that allow the virtual environment and objects within it to exhibit sophisticated custom behaviours, relying on simple rule-based systems or complex artificial intelligence techniques.

The second section of the book comprises two chapters focusing on advanced technologies that can be embedded into virtual worlds to support and augment the learner experience, with an emphasis on the possibilities offered by software-based agents in the form of “bots,” or non-player characters (NPCs). The section begins with Chapter 7, “Conversational Agents in Second Life: Freudbot” by Robert Heller, Mike Procter, and Corbin Rose, which looks at the potential of conversational agents, in particular those representing historical figures, used inworld in an online and distance education context. The case study they report on focuses on the use of Freudbot, an agent based, as its name suggests, on the nineteenth-century psychologist Sigmund Freud. The study analyzed transcripts from 39 conversations between learners and the Freudbot agent within Second Life along with transcripts from 25 conversations between learners and a similar text-based agent outside of a virtual world in order to

compare the levels of social presence and learner engagement evident in each. There were no significant differences in measures of social presence and engagement, although variations were discovered in the characteristics of the conversations. The authors make some preliminary observations regarding conversational agents in virtual worlds that may help guide and inform subsequent work in the area.

Chapter 8, “Virtual Bots, Their Influence on Virtual Worlds, and How They Can Increase Interactivity and Immersion through VirtualPREX” by Torsten Reiners, Sue Gregory, and Vicki Knox, provides a different perspective on bots, describing their use as part of a project called VirtualPREX (Virtual PProfessional EXperience), aimed at enabling pre-service teachers to practise their lesson delivery and classroom management skills in a virtual world environment to prepare for their school-based professional experience placements (more information about the VirtualPREX project can be found in Masters, Gregory, Dalgarno, Reiners, & Knox, 2015). They focus on how these bots can be used in place of human-controlled avatars to increase interactivity and immersion for learners in a virtual world, the rationale being that it is often not feasible to have real actors role-playing characters, especially in scenarios involving large numbers of “people.” The authors introduce four platforms and script libraries that can be used to develop bots in Second Life—Pikkubots, Pandorabots, Logic System, and LIBOPENMV—before explaining how bots were designed and scripted to act as virtual children (primary school students) in the VirtualPREX simulated classroom environment.

Section 3: Learning Design and Implementation

In the third and final section of the book, the authors turn their attention to topics that have to do with the design of virtual world-based learning tasks and interventions, and with the implementation of those designs in various educational settings. In Chapter 9, “Analyzing Teaching Practices in Second Life: A Design Taxonomy for the Implementation of Workshops in Virtual Worlds,” Steven Warburton and Margarita Pérez García propose a taxonomy suitable for the design of hands-on workshops to be conducted in a virtual world, drawing on studies of 177 such workshops. Warburton and Pérez García examined the workshops using an “analysis grid” that yielded a set of 27 descriptors, grouped under the four headings of “planning and preparation of the instruction,” “delivery of the instruction,” “follow up and evaluation,” and “activities for recalling and transferring learning.” The grid was then repurposed as a design scaffold and they evaluated its use in this way in a further 52 inworld workshops.

Next, in Chapter 10, “NetConnect Virtual Worlds: Results of a Learning Experience,” Francesca Bertacchini and Assunta Tavernise report on the design and use of three virtual world environments devoted to cultural heritage learning. Students between the ages of 15 and 18 were able to “visit” and explore virtual archaeological sites in the form of inworld reconstructions of historical settlements in Poland, Germany, and Italy that have been ruined or no longer exist. This case study demonstrates a clear need for groups to come together when using pedagogical approaches that draw upon student contributions, and for development and research that goes beyond simulation and the mere provision of information. The co-construction of knowledge among the groups is an important outcome, and opens the door for moving toward deep learning for individuals in collaboration with their peers.

Chris Campbell and Leanne Cameron wrote Chapter 11, titled “Scaffolding Learning Through the Use of Virtual Worlds,” which relays the findings of two projects: the first involving fourth-year undergraduate student teachers learning with and about Second Life, and the second involving secondary school students using OpenSim for what they described as “construction activities.” Support provided to students consisted of familiarization exercises they took prior to commencing the main part of the activity, just-in-time support delivered within the face-to-face classroom during the course of the activity, and technology-mediated support, also during the activity, through various Web 2.0 tools as well as supplementary image and video resources. Campbell and Cameron evaluated the activities, and in particular the scaffolding methods and approaches employed through questionnaires, focus group interviews, and student reflective journals.

Chapter 12 by Paul Resta and Miri Shonfeld, “Challenges and Strategies in Designing Cross-national Learning: Team Projects in Virtual Worlds,” is an account of a series of studies in which graduate education students from Israel and the United States worked in teams consisting of a mix of students from each country. The teams were tasked with developing virtual world-based learning activities such as Virtual WorldQuests (similar to WebQuests, but undertaken inworld), field trips, and role plays using a combination of asynchronous and synchronous communication mechanisms to discuss their ideas and produce and share project deliverables that were subjected to both instructor and peer assessment. The researchers conducted surveys and interviews with student participants to identify the perceived strengths and weaknesses of the approach, particularly in terms of social presence, group cohesion, engagement, and satisfaction, and to develop advice for other educators wishing to organize similar

cross-national, cross-cultural project-based learning experiences for their students that capitalize on the collaborative capabilities of virtual worlds.

Lastly, the closing chapter in the book, Chapter 13, “Introduction to Laws Relevant to Virtual Worlds in Higher Education,” is a contribution by Layla Tabatabaie, who provides an analysis of the key legal considerations in the use of virtual worlds in higher education. She surveys the legal and public policy landscape of this area and makes comparisons between countries that are representative of each of the three major legal systems of the world: the American system (represented by the US), the English system (represented by England), and the Far East system (represented by China). University and college teachers, students, and administrators from across the globe will find this international comparative analysis invaluable as it provides practical insight and guidance for navigating the pitfalls within their relevant jurisdictions.

This anthology provides the reader with an overview of how virtual worlds can and are being used for online, face-to-face, and blended learning, focusing on three sections: technology, usability, and design. An international lineup of authors provide chapters outlining research that readers can consider when using virtual worlds in their own teaching and scholarship.

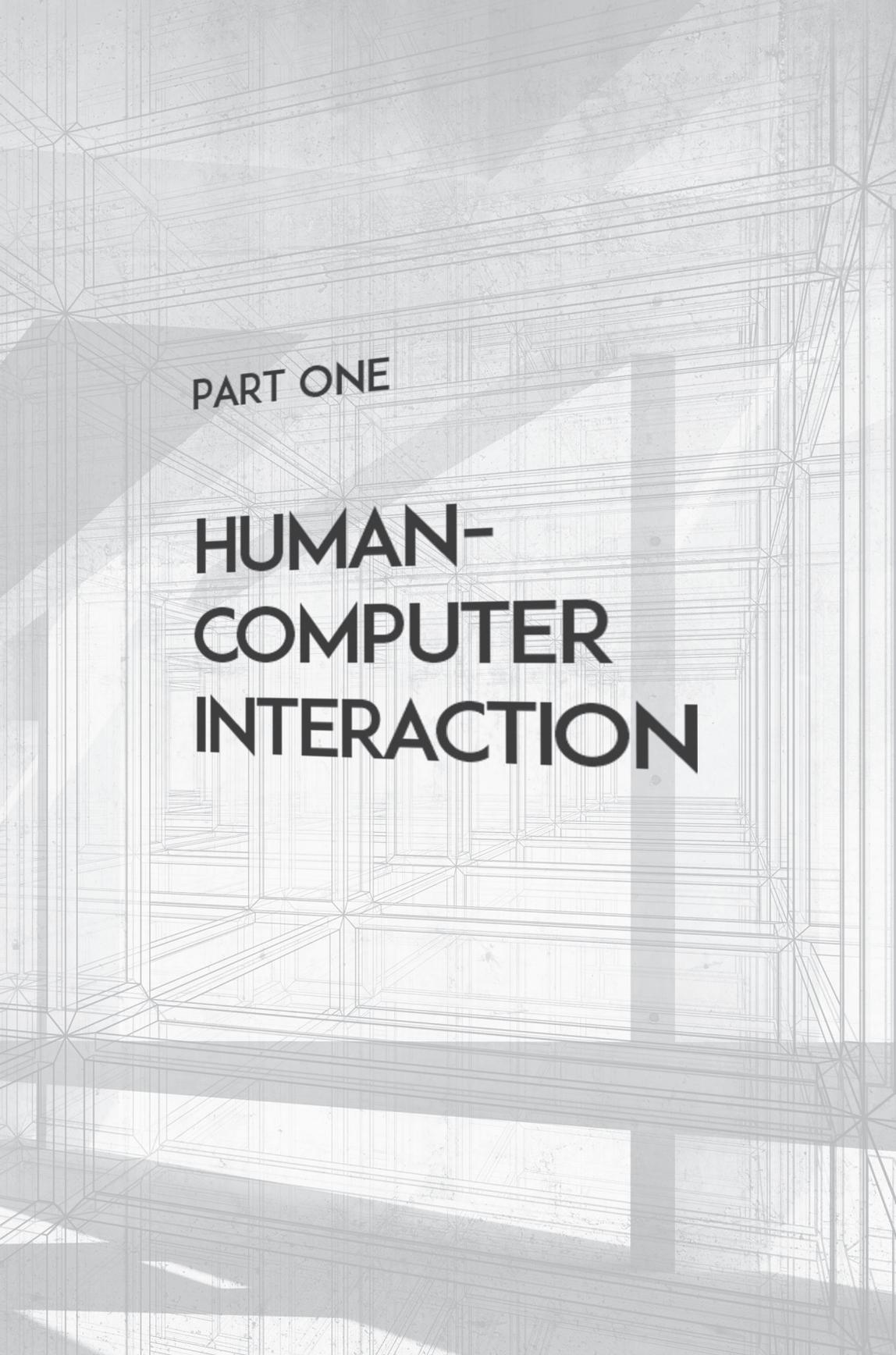
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PART ONE

**HUMAN-
COMPUTER
INTERACTION**

1

NAVIGATION AND WAYFINDING IN LEARNING SPACES IN 3D VIRTUAL WORLDS

Shailey Minocha and Christopher Hardy

Three-dimensional (3D) virtual worlds are simulated environments, often managed over the Web and facilitated by networked computers, which users can “inhabit” and interact in via their graphical self-representations known as “avatars.” In a 3D virtual world, the users experience others as being present in the same environment even though they may be geographically distributed. Users converse in real time through gestures, audio, text-based chat, and instant messaging (Meadows, 2008). Three-dimensional virtual worlds support synchronous communication and collaboration more effectively than 2D web-based environments by extending the user’s ability to employ traditional communication cues of face-to-face interactions, such as gestures and voice, and having a better sense of presence and place (Bronack, Cheney, Riedl, & Tashner, 2008). Virtual worlds, therefore, offer an awareness of space, distance, and coexistence of other participants similar to real life spaces giving a sense of environment, geography, and terrain (Bell, 2008).

There are several 3D virtual worlds that are being employed for gaming, organizing meetings and events, marketing, e-commerce, training through role-playing and games, in education, and for conducting research on crowd behaviour or social science experiments. Examples of 3D virtual worlds include games such as World of Warcraft (<http://eu.battle.net/wow/en>), Runescape (<http://www.runescape.com>), and Entropia Universe (<http://www.entropiauniverse.com>) as well as other multi-user virtual environments such as Second Life (<http://www.secondlife.com>) and those based on open-source software

like OpenSim (<http://www.opensimulator.org>)¹ or web browser-based platforms such as AvayaLive Engage (<http://engage.avayalive.com/Engage>) and Jibe (<http://www.reactiongrid.com>). In this chapter, our focus is on Second Life and the design of learning spaces within it. Unlike massively multiplayer online role-playing games (MMORPGs) like World of Warcraft that have a scripted plot or storyline, Second Life is not a “game” per se. The content and narrative in Second Life are created and owned by the users.

Virtual worlds such as Second Life offer new opportunities for teaching in immersive and creative spaces. In distance education and online learning courses, Second Life can facilitate socialization and collaborative activities, or in blended learning environments it can complement face-to-face teaching; for example, activities that may not be feasible or are too difficult to carry out in real-life settings such as training students on warehouse management can be done within the virtual world (see “A Day in the Life of a 3D Warehouse” at <http://www.ciltglobal.org/sl>).

However, learning and teaching in virtual worlds poses a number of challenges for educators and designers. In terms of pedagogical theories, moving from established transmissive theories of learning such as behaviourism and cognitivism (Felix, 2005) to participatory ones such as social constructivism in virtual worlds can be challenging (Reeves & Minocha, 2011). Further, the design of 3D learning spaces to match with pedagogical activities, the extent of the designs’ realism, and the influence of the design of learning spaces on student learning and engagement also raises interesting issues.

There is a lack of published research on the design guidelines of learning spaces in virtual worlds. Therefore, when institutions aspire to create learning spaces in Second Life, there are few studies or guidelines to inform them except for individual case studies such as in Lucia, Francesse, Passero, and Tortora (2008), or in Rapanotti, Minocha, Barroca, Boulos, and Morse (2011). The Design of Learning Spaces in 3D Virtual Environments (DELVE) project (<http://webarchive.nationalarchives.gov.uk/20140702233839/http://www.jisc.au.uk/whatwedo/programmes/elearning/ltig/delve.aspx>), funded by the Joint Information Systems Committee in the UK, was one of the first initiatives that identified through empirical investigations the usability problems associated with learning spaces in virtual worlds and the potential impact on student experience. The findings of the DELVE project (e.g., Minocha & Reeves, 2010a,

¹ Examples of OpenSim-based worlds can be found at http://www.opensimulator.org/wiki/Grid_List

2010b) revealed that applying architectural principles of real-world designs to virtual worlds as discussed by Charitos (1997) and Dickey (2004) may not be sufficient. In fact, design principles from urban planning (e.g., Lynch, 1960), Human-Computer Interaction (HCI), web usability, geography, and psychology influence the design of learning spaces in virtual worlds.

In DELVE, Minocha and Reeves (2010a) derived several usability guidelines: form should follow function, that is, that the shape of a building or object should be primarily based upon its intended function or purpose; use real-world metaphors such as mailboxes for students to leave messages, or search pods similar to real-world information kiosks; consider realism for familiarity and comfort; design for storytelling; or design to orient the user at the landing point, et cetera. However, the investigations in DELVE identified that the key usability problems experienced by users in 3D learning spaces are related to navigation and wayfinding. For example, in Figure 1.1, there are no directional signs at an intersection in a 3D learning space related to genetics in Second Life.

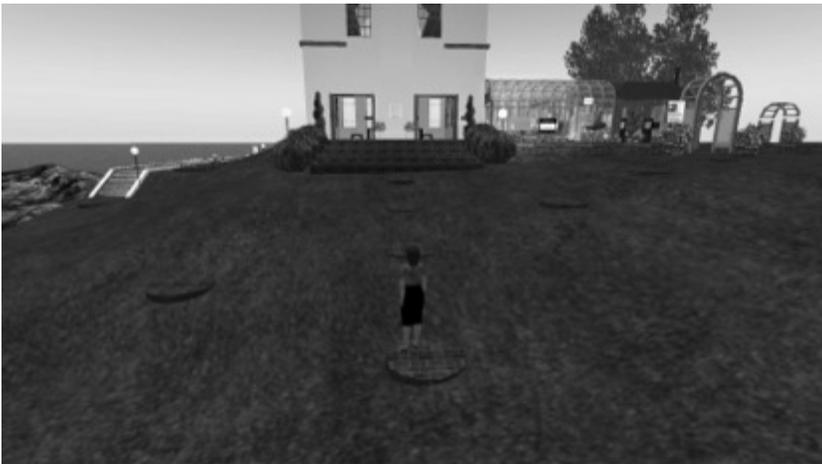


Figure 1.1 The problem of navigation and wayfinding. Picture courtesy of the Genome Island in Second Life.

In this chapter, we report on the Navigation and Wayfinding (NAVY) project which builds on the findings of the DELVE project. As the most commonly used virtual world for education, Second Life was the logical choice for conducting the NAVY project research. Based upon empirical investigations of a number of islands in Second Life (an island is a space which is analogous to a website

in a 2D environment) involving user-based studies, heuristic evaluations, and iterative reviews of the heuristics by usability experts, we have derived over 200 guidelines for the design of learning spaces in virtual worlds.

Background

Based on their interviews with educators, Reeves and Minocha (2011) reported several interpretations of a learning space in a virtual world: (a) a space where an educator-led learning activity occurs; (b) open spaces such as a sandbox within an island in *Second Life*; (c) an entire island where learning can take place through socialization, in formal learning activities, and also while networking; and (d) the whole of *Second Life*. In the research we report on in this chapter, a learning space is defined as an island in *Second Life* designed to facilitate learning activities, and support self-paced, collaborative, informal, and formal learning. An educational institution's island in *Second Life* can provide a dedicated environment for learning, which helps to ensure a sense of belonging and purpose for students. This sense of belonging is particularly significant for distance education students whomay have not visited a physical campus of their institution in real life.

Navigation and Wayfinding

Volbracht (1999) defined navigation as the process by which people control their movement using environmental cues and aids such as maps so that they can achieve their goals without being lost, and wayfinding as the process of determining the strategy, direction, and course needed to reach a desired destination. Wayfinding doesn't involve movement; it is the cognitive element of navigation and the process of determining and following a path or route between an origin and a destination (Golledge, 1999). Darken and Peterson (2001) defined navigation as the aggregate task of wayfinding and motion, where wayfinding is the cognitive element of navigation, and motion or travel is the motoric element.

Navigation and Wayfinding in Real-World Environments

Arthur and Passini (1992) described three stages of wayfinding in real-world contexts: decision-making, executing decisions, and information processing. In unfamiliar settings, people need information at every stage:

- For decision-making, that is how the setting is organized, where they are in it, and where their destination is.
- To execute decisions, such as, information directing them to their destination.

- To conclude the decision-execution process: identifying that they have reached their destination.

Arthur and Passini (1992) identified two major components of wayfinding design: spatial planning and environmental communication. Spatial planning determines the location of entrances, exits, and major destinations. From a wayfinding perspective, spatial planning comprises three stages:

- Identifying the constituent spatial units
- Grouping spatial units into destinations
- Organizing and linking the units and zones.

Arthur and Passini (1992) introduced the second component of wayfinding design as environmental communication. Achieving an accurate cognitive map of the spaces in an environment and the routes for navigating is essential for effective orientation and movement. Spatial knowledge helps a user to construct a cognitive map (internal representation) of the environment. For example, landmarks give a place identity and also help people to provide directions (e.g., the Eiffel Tower in Paris, or Big Ben in London). Landmarks are salient cues providing information on a person's location during wayfinding. Paths, maps, and signage such as directional signs, identifications, and signs at the decision points along the paths also enhance wayfinding performance (Arthur & Passini, 1992). However, information required to solve a wayfinding problem isn't determined by the environmental setting alone. It is also influenced by a person's preference for a certain type of information—whether it is linear and sequential, as one might find on signs, or whether it is spatial and global, such as information emanating from the setting itself. These two wayfinding styles are not exclusive, as most people use both. Therefore, it is important that spatial and linear information coexist to allow for both wayfinding styles.

Navigation and Wayfinding in Virtual Worlds

Charitos (1997) focused on the design of virtual worlds from an architectural perspective. He considered the significance of spatial elements in virtual environments to inform human wayfinding and suggested an architectural way of thinking may prove useful for developing novel ways of designing virtual environments. He discussed two types of components that can aid navigation in virtual worlds: objects and elements of space. Landmarks, signs, boundaries, and thresholds are referred to as objects, whereas places, paths, intersections, and domains (districts) are elements of space. Charitos made no attempt to test

the effectiveness of these components on wayfinding performance, and Conroy-Dalton (2002) critiqued his approach, stating that it remains conceptual.

Dickey (2004) applied Charitos' (1997) architectural perspective of virtual world design in her investigation into the design of educational virtual environments. She discovered that the inclusion and careful placement of architectural objects and elements aided student navigation and wayfinding through both the virtual environment and the materials. Therefore, the use of architectural objects and elements holds much relevance for the design of virtual worlds. Dickey acknowledged the limitations of her approach to the design of virtual environments, stating that real-world environmental issues such as the weather and erosion are not applicable to virtual worlds, so there may be occasions when an architectural perspective will not suffice. However, she proposed that an architectural model using the components (landmarks, signs, etc.) identified by Charitos could be an effective model for the design of educational virtual worlds.

Steck and Mallot (2000) provided explicit evidence about landmarks when discussing the role of local and global landmarks in the navigation of virtual environments. They performed an experiment in "Hexatown," a virtual environment comprising a hexagonal grid of streets and junctions, where each junction was identified by the presence of a local landmark such as a telephone box. They also used global landmarks in the form of a television tower, skyline, and hilltop. Their research showed that different participants adopt different wayfinding strategies. Some used only local landmarks for decision-making, some solely global landmarks, while others used a combination of the two, and still others alternated between them. Vinson (1999) concluded that landmarks indicate position and orientation, and contribute to the development of spatial knowledge. Using distinctive landmarks facilitates users' abilities to acquire and apply spatial knowledge, enabling them to navigate virtual environments.

Darken and Sibert (1996) concluded that large-scale virtual environments require structure in order for users to effectively navigate in them. The real-world principles of organizational and environmental design identified by Darken (1995) can provide such a structure: for example, by dividing large-scale worlds into smaller distinct parts, organizing these parts under a simple organizational principle, and providing frequent directional clues.

Figure 1.2 provides an example of structure: an area is divided into smaller sections (districts) and augmentation using directional indicators and maps is provided; something commonly implemented within Second Life islands.

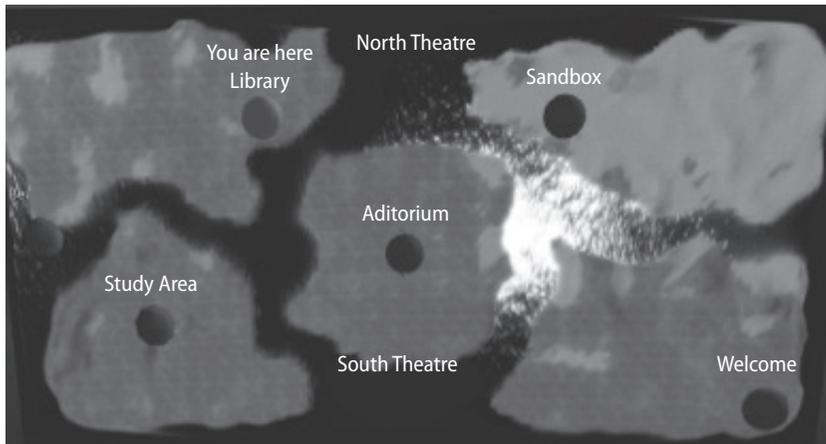


Figure 1.2 A map of the deep|think Island in Second Life, showing its division into five sections. Picture courtesy of the deep|think Island, Department of Computing, The Open University, UK.

Efficient navigation is a problem (Sadeghian, Kantardzic, Lozitskiy, & Sheta, 2006), especially in large-scale virtual worlds where a navigator's viewpoint cannot encompass the entire environment (Vinson, 1999). If navigation is difficult, users will have a bad perception of the virtual world's usability (Sebok, Nystad, & Helgar, 2004). Navigational difficulties in virtual worlds originate from various factors. A general lack of familiarity is one factor (Burigat & Chittaro, 2007) that is not surprising, given a user will always be unfamiliar when first encountering a particular space (Vinson, 1999). Sayers (2004) stated that a user's lack of familiarity with the environment can result in disorientation, which can cause anxiety and discomfort (Darken & Peterson, 2001). Wayfinding problems may occur in virtual worlds because they generally have less sensory (visual, auditory, or motoric) detail than real-world environments (van Dijk, op den Akker, Nijholt, & Zwiers, 2003). Heino, Cliburn, Rilea, Cooper, and Tachkov (2010) state the key issue relating to navigation and wayfinding: if users cannot find their way to a destination, they cannot use the virtual world for its desired purpose.

Darken and Sibert (1996) found that augmentations provided by directional indicators, for example, landmarks, maps, and paths can enhance wayfinding performance. Wayfinding tasks generally require the navigator to be able to conceptualize an entire space. Task performance improves with an increased spatial knowledge of the environment. In summarizing their research they stated that, despite the importance of navigation in virtual worlds, support

for effective navigation is often overlooked in the design process. They attributed this shortcoming to the lack of guidance. Thus providing guidance for designers of virtual worlds to aid navigation and wayfinding has been the focus of our research.

Impact on Student Engagement

We define student engagement as the time, energy, and resources students devote to activities designed to enhance learning within an educational context. Navigation and wayfinding problems in learning spaces can adversely influence student engagement and learning because they hinder a student's ability to locate study resources. In Figure 1.3, the student teleports to the Library area on the deep|think Island and finds a board stating "Library Welcome Area." When trying to find the library, the student will most likely decide to make a right turn into the Library Welcome Area. This decision is incorrect; the library areas are the distant cone-roofed buildings on the left.

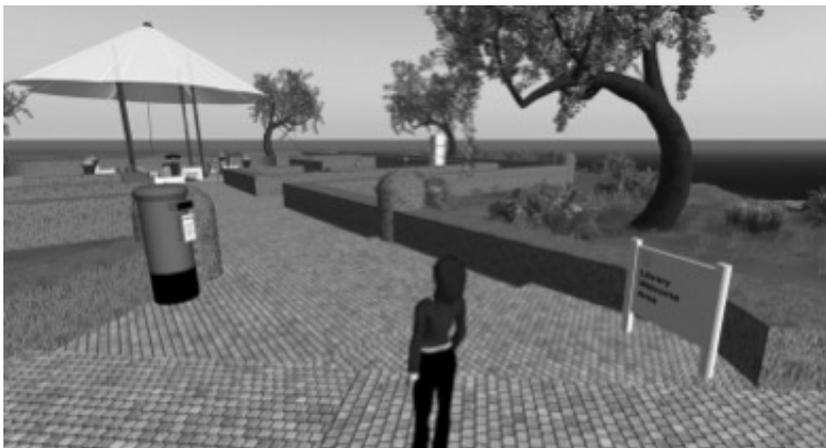


Figure 1.3 Finding the way to the library. Picture courtesy of the deep|think Island, Department of Computing, The Open University, UK.

The research in the DELVE project showed that users come to a 3D virtual world with mental models based on their real-life experiences and interactions with websites. In the NAVY project, our aim was to investigate the impact of obstacles in navigation and wayfinding on student experience and how the design aspects related to website navigation (e.g., design of the home page, organization of links, and so on) can complement real-world navigation (e.g.,

maps, paths, landmarks, etc.) to influence the design of learning spaces in virtual worlds.

Research Methodology

Our empirical investigations involved the following (Table 1.1):

- Heuristic evaluations: a usability inspection technique which involves a usability or an HCI expert evaluating a user interface design of a computer system (e.g., website, mobile phone) with respect to usability guidelines to determine the aspects of the user interface that do not adhere to the guidelines and could potentially cause obstacles or usability problems in user–system interaction (Stone, Jarrett, Woodroffe, & Minocha, 2005);
- Structured or semi-structured interviews;
- User observations with think-aloud protocols and post-observation discussions (Stone et al., 2005);
- Document analysis.

Three types of participants were involved in the research: designers of learning spaces in Second Life, Second Life educators, and students who were experienced users of Second Life.

Table 1.1 Summary of NAVY’s Methodology

Technique	Who was involved?	What did it involve?
Heuristic evaluations	two usability experts conducted the evaluations; a guidelines expert from the industry assessed the heuristics as they were being iteratively developed and consolidated	evaluating 11 islands in Second Life with respect to heuristics to check the adherence or non-adherence to the designs with respect to the heuristics
Structured or semi-structured interviews	Second Life educators and designers of learning spaces; a tour guide in Second Life	conducting interviews within Second Life (inworld interviews) similar to the way one would done in a face-to-face setting; one of the educators chose to send us the inputs by email; 3 designers, 3 educators, and 1 tour guide participated

Technique	Who was involved?	What did it involve?
User observations	students familiar with Second Life and who had carried out learning activities in Second Life	10 students were observed conducting learning activities on 4 islands; post-observation discussions were carried out to enable the participants to reflect on their experiences and to share navigation strategies with the researcher (observer)
Document analysis	papers related to the design of islands that we were evaluating, any associated blogs, wikis, videos (transcripts)	analyzing the documents and related multimedia resources to determine the background of the island, purpose of the island and the audience; which kinds of learning activities it supports

Developing the Heuristics and Evaluation Worksheet

First, we compiled an initial set of heuristics from the literature, for example:

- Architectural principles of real-world designs (Arthur & Passini, 1992);
- System checklists (e.g., Pierotti, 1995);
- Participatory heuristic evaluations (Muller, Matheson, Page, & Gallup, 1998);
- Heuristic evaluations of computer games (e.g., Isbister & Schaffer, 2008; Sutcliffe & Gault, 2004);
- Web usability (e.g., Nielsen, 2000).

We identified ten usability heuristic categories (HCs): eight from Nielsen (2000), one from Sutcliffe and Gault (2004), and one from Muller et al. (1998). These HCs included visibility of system status, match between the system and the real world, user control and freedom, consistency and standards, recognition rather than recall, aesthetic and minimalist design, help and documentation, pleasurable and respectful interaction with the user, navigation and orientation support, and error prevention. By adapting the original descriptions, the definitions of the individual HCs were developed in order to align the “new” definitions to the context of 3D learning spaces. Then we assigned relevant heuristics to the most appropriate HC and compiled in a spreadsheet (we called it an “evaluation worksheet”).

We reviewed and refined the evaluation worksheet of heuristics iteratively throughout the project. Enhancements to the evaluation worksheet included:

- New columns, added for the rationale for inclusion and the source (source implies a reference to the heuristic, a published paper or book).
- A practitioner guidelines expert assessed the heuristics in the early stages of development. After their feedback we added new columns: implicit knowledge of an evaluator and design resource (e.g., where a designer could find out about colours or information on design of maps).
- Within the ten heuristic categories, we ordered the heuristics so that designers could prioritize their evaluations if they did not have the resources to evaluate every heuristic.
- Two usability experts iteratively evaluated the heuristics and we incorporated their feedback into the improvement (e.g., clarity, re-wording) of the individual heuristics.
- We added additional heuristics to cater to usability defects arising from heuristic evaluations, and which weren't in the existing heuristics.
- We removed heuristics if deemed inappropriate; for example, if they duplicated existing heuristics, weren't relevant, or couldn't be evaluated without quantitative analysis such as measuring student immersion or satisfaction.
- The heuristic category HC9, "Navigation and orientation support" which was the focus of the NAVY project, was enhanced by literature review (e.g., Arthur & Passini, 1992; Darken, 1995; Dondlinger & Lunce, 2009; Steck & Mallot, 2000). We ordered the heuristics in this category as per the three stages of the wayfinding process.

The final structure of the evaluation worksheet is shown in Table 1.2.

Table 1.2 Structure of the Evaluation Worksheet

Column heading	Column content
Identifier	A unique identifier for the heuristic with two parts: e.g., HC1 to HC10 for the 10 categories (1 to 10).
Heuristic category name	A category name in which related heuristics are grouped together, e.g., the "Navigation and orientation support" category contains heuristics relating to architectural landmarks maps, paths, and signs. A category can be considered a general principle for usability design.

Column heading	Column content
Heuristic	A sub-division or low-level rule of a heuristic category. For example, heuristic HC9.5 states, "Is the text on maps easy to read?"
Rationale for inclusion	This provides the logic for including the heuristic. For example for HC9.5, the rationale was that if text on maps is not easy to read, it may be misunderstood or not read at all.
Implicit knowledge of the evaluator	This identifies the knowledge the evaluator required to assess the heuristic. For example, in order to evaluate the design of a map in terms of HC9.5, an evaluator was expected to be aware of how text can be formatted to aid readability; one guideline is that UPPER CASE text is slower and hence more difficult to read compared to Proper Case text.
Example	Two examples are provided for each heuristic: (a) An example in which a heuristic is violated, i.e., a usability defect; (b) An example that demonstrates positive adherence to the heuristic, i.e., a positive aspect.
Figure	Two figures are provided for each heuristic to demonstrate: (a) a usability defect, and (b) a positive aspect.
Source	This is the origin of the heuristic, e.g., a literature source, a user observation session, a heuristic evaluation, or through general exploration of Second Life islands.
Design resource	This is a URL (web resource) where a designer can find more detailed guidance for evaluating a heuristic in order to supplement their implicit knowledge required for the heuristic (e.g., a resource related to wayfinding signage).

Heuristic Evaluations

We conducted heuristic evaluations of 11 islands in Second Life. These spaces were selected to:

- cover a range of disciplines, such as, computing, genetics, and marine science;
- support a range of learning activities; and
- provide variety in approaches to aiding navigation and wayfinding, for example, landmarks, maps, paths, signs, camera controls, and teleportation.

There was also a logistical constraint; we chose those islands where we felt there was a potential to carry out interviews with the designers and educators, and/or to seek permissions from the island owners for pictures and to visit their islands with the participants (students) for user observations. The primary focus of the NAVY project was navigation and wayfinding, therefore, seven of the eleven islands were evaluated specifically in relation to navigation and orientation support (HC9). We also wanted to know how designers of commercial Second Life islands guide a visitor to shopping locations. We evaluated LE LOOK, a non-educational Second Life island selling avatar accessories, for its navigational and wayfinding characteristics.

We, the two researchers on NAVY, performed the role of “expert evaluators” and conducted independent heuristic evaluations. We conducted two types of heuristic evaluation: exploratory walkthrough and task-based walkthrough. An exploratory walkthrough involved a usability evaluation without any specific tasks to guide the evaluation process. In conducting the exploratory walkthroughs, we used a variant of heuristic evaluation. As well as identifying usability defects, we also noted positive adherence to the heuristics, as our aim was to identify examples of good design practice. A task-based walkthrough involved an evaluator identifying usability defects whilst conducting learning activities that a student/visitor would be expected to perform.

User Observations

In approaching navigation and wayfinding issues, designers need to pay attention to how people perceive and understand an environment, how they situate themselves in spaces, and how they use information about the environment in the decision-making and decision-execution processes (Arthur & Passini, 1992). Therefore, conducting user observations alongside heuristic evaluations in NAVY was the optimal way for us to balance expert-based reviews by eliciting end-user navigational experiences and wayfinding strategies.

For each of the islands that investigated, we designed a set of learning activities for user observations. These were a subset of the activities that the designers and educators of that island were expecting the visitors or students to perform. Further, the learning activities encompassed one or more of the Second Life navigational aids (NAV) listed in Table 1.3. The list of NAVs was compiled from the literature review and the results of conducting exploratory walkthroughs in Second Life.

Table 1.3 Second Life Navigational Aids

Navigational aid	Description
NAV1	<i>Architectural landmarks:</i> A significant physical feature of the environment which is memorable.
NAV2	<i>Camera control:</i> A tool with which an avatar can view parts of an island in Second Life from a variety of angles without having to move.
NAV3	<i>Directional signs:</i> Signs with or without arrows that specify the direction of a location, object, or event.
NAV4	<i>Flying:</i> In an island of Second Life, moving through the sky like a bird without the need for wings.
NAV5	<i>Identification signs:</i> Signs in verbal and/or non-verbal forms that identify a place or object. Unlike directional signs, identification signs mark destinations rather than directions.
NAV6	<i>Maps:</i> A visual representation of an area showing the relationships between elements of that space, such as objects and regions.
NAV7	<i>Notecards:</i> An item of text and/or embedded images, textures etc., that can be stored, retrieved, and transferred between avatars.
NAV8	<i>Paths:</i> A channel movement such as a railroad, street, or walkway.
NAV9	<i>Second Life landmarks:</i> A Second Life precise location which can be stored and used to teleport from another location.
NAV10	<i>Sensors:</i> A device that can detect an avatar's movement in a given area of an island in Second Life.
NAV11	<i>Structure of the island:</i> The overall form or organization of an island in Second Life.
NAV12	<i>Teleporters:</i> A device used for teleportation.
NAV13	<i>Teleport maps:</i> A visual representation of an area that can also be used as a device for teleportation.

As an illustration, in Table 1.4, we have listed some of the learning activities in The Abyss Observatory, a marine science museum in Second Life.

Table 1.4 Examples of Learning Activities for the Abyss Observatory and the Associated Navigational Aids

Learning activity	Associated navigational aids (NAVs)
Identify the purpose of the island: is it apparent how to find your way around? Is help available?	identification signs, maps, structure of the island, teleport maps
Discover what marine creatures and marine life exists at different depths of the ocean: e.g., in the area of “Journey into the Deep” find your way to the Microorganism Lab and observe the black smokers.	camera control, directional signs, identification signs, maps, paths, notecards
Find your way to the Research Ship “Okeanos Explorer” and collect a notecard describing its history.	architectural landmarks, camera control, flying, directional signs, notecards, identification signs, maps, paths, Second Life landmarks, structure of the island, teleporters, teleport maps

During user observations, we encouraged participants to think aloud (as if talking through their experiences to themselves). This enabled the researcher, who followed the participant as they went about conducting the learning activities (see Figure 1.4), to know if they were struggling to find a location/resource, or if certain navigational aids were well-designed and enabled the participants to find their way easily.



Figure 1.4 A user observation session with the researcher following the participant as the participant went about conducting activities on the island. Picture courtesy of the Vassar Island.

Following user observations, we held post-observation discussions (see Figure 1.5). During the post-observation session, the participants reflected on their experiences and we sought clarification for issues arising during the session. We encouraged the participants to share their other wayfinding experiences in Second Life to elicit examples of good and bad instances of navigational aids from other islands, and to also determine the navigational strategies that the participants prefer (for example, flying vs. teleporting or walking, use of maps vs. use of signs, and so on).



Figure 1.5 A post-observation session. Picture courtesy of the Vassar Island.

Each user observation session lasted approximately 45 minutes. The post-observation discussion with each participant took around 10–20 minutes. We audio-recorded the user observations and post-observation discussions.

Structured or Semi-Structured Interviews

We conducted inworld structured or semi-structured interviews with designers and educators. The questions enquired about the rationale for the design decisions of existing 3D learning spaces and sought their perceptions and examples of what contributes to usable designs. All the interviews, except for one where the educator chose to send us their response by email, were conducted inworld and on the island of the educator/designer who was being interviewed. This allowed interviewees to supplement the discussion by demonstrating pertinent features of the learning space (see Figure 1.6). We also conducted an interview with an educator who oversees the International Society for Technology

in Education (ISTE) Second Life group tours. The rationale for this interview was to investigate how navigational assistance can be provided for groups of avatars, and identify difficulties with navigating as a group.

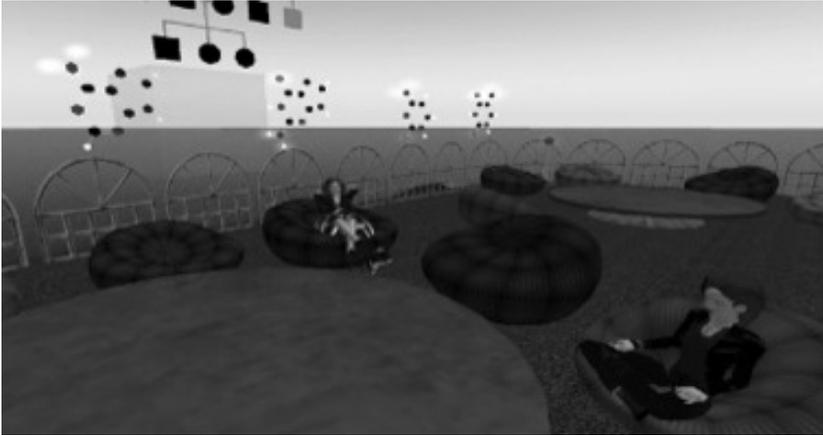


Figure 1.6 An interview with the designer of Genome Island. Picture courtesy of Genome Island.

We conducted inworld interviews in audio using Second Life voice chat, though in one case we used Skype since the participant had a low-bandwidth connection. One interview was conducted using Second Life's text chat as we felt that the interviewee would be more comfortable in that medium because of a language barrier. The issues of conducting empirical research in virtual worlds such as communication modalities (using text chat vs. voice chat in inworld interviews, or comparison of inworld interviews with face-to-face interviews), recruitment strategies, and how the anonymity of the medium demands a greater investment of time to establish a mutually beneficial relationship based on trust with the participants, et cetera, are described in detail in Minocha, Tran, and Reeves (2010), and Wadley, Gibbs, and Ducheneaut (2009).

Document Analysis

Document analysis (Gardin, 1973) involves analyzing the motivation, intent, and purpose of a document within a particular historical context. We collated documents related to a particular island by searching for papers and other online resources such as websites of the island, blogs, wikis, and videos/transcripts. The analysis helped us to understand the purpose of the islands and the intended

audience, which in turn helped us to design learning activities for task-based walkthroughs and user observations.

Research Ethics

We followed the guidelines of the British Educational Research Association (British Educational Research Association, 2011). The ethical implications for involving human participants, conducting inworld observations, and taking snapshots (pictures) in Second Life were considered, for example, using Linden Labs' policy for snapshots (Linden Research, 2011). We sought and gained approval from the Human Research Ethics Committee of the university (The Open University, Human Research Ethics Committee, 2013).

Data Analysis

We analyzed heuristic evaluation data in terms of the definition of usability (ISO, 1998):

- Positive aspects of navigation and wayfinding that enhanced user experience or facilitated task completion.
- Usability defects: obstacles such as inefficient completion of a task (it takes longer than necessary to complete), breakdowns, ineffectiveness (failure to achieve the task, or finding a venue or resource), or user dissatisfaction.

We applied thematic analysis (Thomas, 2006; Braun & Clarke, 2006) to identify themes emerging from transcripts of user observations, post-observation discussions, and interviews with designers and educators. We also used the technique to analyze the usability defects and positive aspects arising from task-based and exploratory walkthrough heuristic evaluations. Thematic analysis was suitable for the NAVY project because it provides a way of structuring and summarizing the findings from a diverse range of research techniques. It involves reading the raw data while being guided by the research questions to derive concepts and report patterns (themes). The primary purpose of the technique is to allow research findings to emerge from the frequent, dominant, or significant themes without the restraints imposed by structured methodologies.

Results

In this section, we present a subset of the data to demonstrate the analysis of the data collected during user observations and heuristic evaluations.

Positive Design Aspects that Aid Navigation and Wayfinding

Analyzing the positive aspects from heuristic evaluations and user-based observations revealed several themes based on key HCI and the usability principles of visibility, affordance, feedback, use of real-world metaphors, consistency, and structure. The themes and the corresponding guidelines are shown in Table 1.5.

Table 1.5 Guidelines Based on Positive Design Aspects that Aid Navigation and Wayfinding

Theme	Guidelines
Objects that are similar to real-world objects are easy to recognize	<ul style="list-style-type: none">• Consider the use of real-world metaphors• Consider using design features so that an area resembles a real-world space
Information to aid navigation should be easy to find and understand	<ul style="list-style-type: none">• Place key information at, or close to, the entry point• Place a map at the entry point to the island• Show the user's location on every map• Maps should be visible at a distance and be readable without the use of camera controls• Provide identification signs outside major locations• Provide identification signs to orient the user• Place key information at, or close to, the entry point• Place a map at the entry point to the island• Show the user's location on every map• Maps should be visible at a distance and be readable without the use of camera controls• Provide identification signs outside major locations• Provide identification signs to orient the user
Colour and formatting is important in the design of objects	<ul style="list-style-type: none">• Consider using bright colours to get a user's attention• Use consistent colours and fonts for maps and teleport boards• Make information on directional signs as concise as possible• Consider formatting textual information on maps and schematic diagrams to signify its importance
Audio or visual feedback to user's actions should be easy to notice and appropriate to match with the context	<ul style="list-style-type: none">• Give immediate feedback for user actions• Consider using a combination of audio and visual feedback• Consider the use of animated objects to get user's attention

Theme	Guidelines
Pathways and entrances should be easy to understand	<ul style="list-style-type: none"> • Ensure that paths are legible • Ensure that the approaches and entrances to places are legible • Consider the use of transition points on paths • Consider the use of path-defining elements, for example, by using textures to indicate the entrances and make them look different from the main circulation route

Design Features that Negatively Impact on Navigation and Wayfinding in 3D Learning Spaces

The themes or design features that cause obstacles or breakdowns during navigation and wayfinding and representative quotes from student-participants are presented below. The name of the Second Life island that a student participant is referring to is in square brackets at the end of the quote.

Theme: Learning spaces don't resemble real-world physical spaces

"I was unsure when I had reached the Library as I was expecting to see collections of books and a building resembling a real-world Library, similar to that on the OU [university] campus." [deep|think] (see Figure 1.7)

Theme: It is not obvious how to interact with an object

"I see this 3D map down here that says library. I click, but it doesn't let me click. This board called Library. I touch . . . I'm not sure how to teleport using this." [deep|think]

Theme: Functional areas of an island can be difficult to find or get to

"I don't know where the Explorium is. I am lost, really, so I am just wandering around trying to figure out where I am supposed to go." [The Abyss Observatory]

Theme: Navigational aids can be difficult to locate

"There is a sign that says Study Island. If the signpost was put a bit earlier that would be better, because I don't know until I actually reach it." [deep|think]

Theme: Navigational aids can be difficult to understand and use

“The schematic diagram shows some of the places where you can go but it’s not very clear exactly how that relates to where I am.” [The Abyss Observatory]

Theme: Help is not always easy to find

“I don’t know how to ask for help as I can’t think of anything obvious.”
[The Abyss Observatory]



Figure 1.7 Flow diagram of NAVY’s methodology.

Effects on Student Experience

Examples of the effects on student’s ability to perform learning activities due to difficulties in navigation and wayfinding and quotes from the student-participants follow.

Effect: Students may abandon the learning activity

“It was really confusing as there were no signs and I could not find my way around for love nor money so I just gave up in the end.” [The Abyss Observatory]

Effect: Learning activities will take longer than necessary

“I remember when going back to the teleport map I really had to think hard about how I had got there . . . it was sort of like a maze for me to have to go back again.” [deep|think]

Effect: Students may return to the entry point to seek help

“Is there something in the deep|think Welcome area that tells me where the library is?” [deep|think]

Effect: Students may become frustrated or confused

“The notecard mentions Skypods and the link to Library Welcome Island . . . but if I select that I will end up back here (sighs) . . . oh.” [deep|think]

Effect: Students may wander aimlessly looking for their destination

“You just have to keep wandering around until you find what you’re looking for.” [Genome Island]

Effect: Students may make incorrect assumptions or may take a guess

“There’s a study area which is probably the Student Room, I’m assuming. I am going to go there and test.” [deep|think]

The impact on student experience and engagement in terms of the usability constituents of effectiveness, efficiency, and satisfaction (ISO, 1998) are many. For example, if students wander aimlessly looking for their destination, this will affect effectiveness and user satisfaction; if learning activities take longer than necessary, this will have a negative effect on efficiency; and if a student abandons the learning activity, this will result in a breakdown situation, or will affect efficiency, as the student expends additional cognitive and time resources.

The following design aspects resulted in breakdowns in the user-based observations:

- Locations did not resemble real-world physical spaces
- Key locations were not shown on maps or teleport maps
- Directional signs were missing or badly designed
- Identification signs were absent; it is not sufficient just to direct a user to a destination. A user must know when they have reached their destination by seeing identification signs
- Locations were not referred to consistently on information boards and in teleport maps

From each of the themes corresponding to positive aspects, usability defects, and breakdowns in the data, we have derived over 200 design guidelines (DGs). Each design guideline is supported by examples or user quotes from the data. A subset of guidelines is presented in Table 1.6.

Table 1.6 A Subset of Design Guidelines

ID	Design guideline
DG199	Locations of an island should be referred to consistently on information boards and teleport maps.
DG202	Provide maps of an island to orient the user.
DG203	Consider using help points to provide important navigational information.
DG204	Provide mechanisms for students to teleport within a learning space.
DG205	Consider incorporating Second Life landmarks in notecards to teleport within an island.
DG206	Incorporate visual aids in the form of signs and notices.
DG207	Consider that people use camera controls to look for things rather than walking around.
DG208	Replicate real-world objects for familiarity.
DG209	Consider that people tend to fly around in the absence of appropriate navigational aids.

A subset of the good practice design guidelines resulting from the thematic analysis of transcriptions from interviews with designers and educators is presented below with the identifying DG number followed by the design guideline. Quotes from the designers and educators follow the guideline.

DG183: Structure learning spaces by having different functional areas.

“Activities in Genome Island are organized into four main areas; The Abbey and Gardens, the Tower, the Gene Pool and the Cell Terrace.”
[designer, Genome Island]

DG184: Provide 3D models of an island to orient the user to the structure of the island.

“The 3D map is to help visitors to understand The Abyss Observatory and consists of 7 or 8 layers.” [educator, The Abyss Observatory]

DG185: Provide help by incorporating introductory tours, quests, tutorials, and scavenger hunts.

“The tour was intended to give a quick overview of Genome Island and a little bit about each area. You can get off at each point before continuing the tour.” [designer, Genome Island]

DG187: Provide help by incorporating information points, notecards, Second Life landmarks, and links to Web resources.

“We provide notecards with locations and Second Life landmarks you can use to teleport to places in deep|think. I don’t think anybody actually walks . . . it is such a big development that people just get a map out and use that to just teleport to each part of the island.” [designer, deep|think]

DG188: Provide support for group tours on an island.

“When conducting ISTE group tours, my favourite teleport device is a very clear board. One that’s large, with big squares on it that multiple people might be able to hit at the same time. I don’t mean they have to be able to teleport at the same time, but when there is a big crowd of people around the teleport board and it has a tiny ball to hit with your mouse clicker that’s hard to do in a crowd. But, if it’s a nice big board with a picture and multiple people can touch it and zap off . . . that’s great.” [educator, ISTE tour group]

DG189: Provide support for educators to design guidance notes, learning activities, plan lessons, and plan tours.

“When I designed the tour of The Abyss Observatory, I had several aspects/criteria in my mind: time duration of the tour; and how easy it would be to move from one place to another with minimum walking and following around but through teleporting.” [educator, The Abyss Observatory]

DG190: Provide a range of mechanisms to support navigation.

“The principle of redundancy has been used. There is the 3D map of deep|think, there is the flat teleport map and there is, to some extent, the same information in Mary’s quest. Other examples like from the underwater theatre where you use the lift, the little teleporter or swim.” [designer, deep|think]

DG192: Apply lessons learned from the 2D or 3D virtual environments such as the Web, computer games, or existing Second Life learning spaces.

“Teleporters are sort of like hyperlinks. So, I did think about web navigation when designing Genome Island. They serve the same purpose as websites as they take you from place to place. Unfortunately, there is no backspace to take you back to your previous location.” [designer, Genome Island]

DGI93: Incorporate design features with real-world similarities.

“We intend [for] The Abyss Observatory [to be] different from [a] real-life museum. And to make clear the difference, we arranged [the] usual museum and aquarium near the entry point. But about navigation, we should design [it] as [much as] possible [to be the] same [as a] real-life museum, because human behaviour is restricted by real life.” [designer, The Abyss Observatory]

DGI94: Design 3D learning spaces in an iterative process involving evaluations with users and re-design.

“The scavenger hunt in Genome Island was fine-tuned over different classes.” [educator, Genome Island]

We have also derived best practice guidelines for navigation and wayfinding for each of the navigational aids listed in Table 1.3. Each best practice guideline is accompanied by an image from an island in Second Life to demonstrate the guideline and aid the designer to understand and apply it. Figure 1.8 illustrates one of the best practice guidelines for paths (NAV8 in Table 1.3): “Paths are channels for movement such as walkways. Transition points in paths should clearly demarcate two different areas. There are several examples in the Virtual Ability Island which show transition points and some of these are also designed as ramps for accessibility purposes.”

Design Changes in Second Life Islands as a Result of the Research Findings

Following our investigations, we presented summaries of our findings to the designers of the islands involved in our research. The summaries helped to sensitize designers to the usability defects and inform them about good practice in their designs from an HCI perspective. The designers modified their designs based on our feedback. For example, new directional signs have been added to Genome Island. Following the guideline “DGI1: provide directional signs at decision points,” the usability defect of not having a directional sign at the intersection (see Figure 1.1) was removed by incorporating a signpost there (see Figure 1.9).



Figure 1.8 Library in the deep|think Island. Picture courtesy of the deep|think Island, Department of Computing, The Open University, UK.



Figure 1.9 The transition point in the paths from grass to the wooden surface includes a ramp which can be useful for wheelchair users. Picture courtesy of the Virtual Ability Island.

The paths in the maps of Vassar Island have been modified, and the designers of Vassar Island are considering modifying some of the island's directional signs based on our guidelines. The Abyss Observatory now features a revamped entry point, improved identification signs and teleportation devices, and the use of colour coding in directional signs and information boards (see Figures 1.10a and 1.10b). In the previous design (Figure 1.10a), there was no information at the entry point about the various displays in The Abyss Observatory, and only guided tours by the island owner (when he was around) could help uncover the possibilities. In Figure 1.10b, the entry point includes information for four guided tours showing different parts of Abyss. Now guided tours from the central hub help visitors explore the island on their own.

Discussion

In this section, we discuss some of the results of our research by contextualizing them within the literature related to the design of real-world navigational aids and web usability principles. The users' comments in this section are indicated in double quotes and the name of the island is in square brackets.



Figure 1.10a Addition of directional signs at a decision point on an intersection. Picture courtesy of the Genome Island.



Figure 1.10b Re-designed entry point of The Abyss Observatory. Picture courtesy of The Abyss Observatory.

Maps and Signs

In real-world interactions, some people prefer maps to signs, and vice versa. However, in our research, we could not draw conclusions where people used the maps in Second Life the same way as they do in the real world, as the design of maps or 3D models in virtual worlds are significantly different. However, there is compelling evidence in our data that shows users' reliance on signs while navigating 3D learning spaces: "there are no directional signs to guide me to the library" [deep|think], "I'll go to the auditorium . . . which is in front of me . . . I can see the sign" [deep|think], "there's a sign for the Cell Terrace . . . so that was easy" [Genome Island].

Providing environmental information such as maps and signs at the appropriate place is a key aspect of wayfinding design (Arthur & Passini, 1992). However, adherence to this principle was lacking on every island employed in the user observations. For example, there was no map at the entry point of Genome Island, an absence of directional signposts at intersections in deep|think, no identification sign for the Explorium in The Abyss Observatory, and inadequate directional signposts in Vassar Island. Further evidence regarding the incorrect design and placement of signs was gathered in a user observation of deep|think: "they should've put the notice so we could see it from where we're standing because you can only see it's the Breakout Area once you've reached it."

User's Position on the Map

Another principle discussed by Darken (1995) is to show a user's position on maps, which helps to orientate them; adherence to this principle was evident in deep|think, The Abyss Observatory, and Vassar Island. In contrast, this was not evident on the 3D model of Genome Island: "one thing I would have hoped for is a 'you are here.'"

Redundancy of Navigational Information

The principle of redundancy in navigational information implies the use of multiple means to communicate the same information (Arthur & Passini, 1992). For example, a directional sign for a safari park may incorporate an image of an elephant and the textual description "Safari park." In the welcome area of deep|think Island, there is a 3D model and a teleport map that provide similar information. However, the 3D model may cause confusion because users expect to interact with it and use it for teleportation, but it is just a representation and is not interactive.

However, it helps to bear in mind that although redundancy is an important principle and can support diverse navigational styles or strategies that different users employ depending on their choices and skills, using several navigational mechanisms (e.g., signs, landmarks, maps, etc., listed in Table 1.3) can clutter the space and cause information overload. We have noted in our empirical investigations that designers and educators are increasingly adopting a user-centred design approach: trying out designs, evaluating them with students, and then re-designing and improving them based on the feedback. A user-centred design will help ensure that learning spaces are optimized in terms of navigational and wayfinding support to suit the interaction preferences of users, and enable users to effectively process the information presented and to find their way around.

Navigational Strategies

We observed that while navigating to a location, teleportation was the logical first choice of all participants: "I am always looking for a teleport map" [The Abyss Observatory], "I prefer things that take you there straight away . . . teleport things" [The Abyss Observatory], "my preference is to use teleports if I know where they are" [Genome Island], "teleporting makes life a lot easier" [Genome Island]. We noted that if users couldn't easily access a teleport device or Second Life landmark, their wayfinding strategy was to either fly or wander around.



Figure 1.11a The seven pillars of wisdom outside The Open University's library on the virtual campus. Picture courtesy of the Media Relations Office, The Open University, UK.



Figure 1.11b The seven pillars of wisdom outside The Open University's library on the virtual campus. Picture courtesy of the deep|think Island, Department of Computing, The Open University, UK.

Architectural Landmarks

Genome Island provides fine examples of architectural landmarks (the ethos and significance of architectural landmarks in 3D spaces is discussed in Charitos, 1997), such as the Abbey and Tower, which are effectively used to direct students to activities and resources in the instructions. On the deep|think Island of The Open University, UK, the real-world architectural landmarks have been replicated in Second Life (see Figures 1.11a and 1.11b). On the island, there are seven pillars of wisdom that serve as architectural landmarks for locating the library. On the real-world campus of the university, these seven pillars are situated outside the library, and students, even though they study at a distance, may have come across pictures of the library in university communications—replicating them in the virtual space adds to its familiarity and comfort.

Suitability of Navigational Aids

Second Life navigational aids were introduced in Table 1.3. Following analysis of the data in NAVY, Table 1.7 provides a summary of related design considerations for navigational aids.

Table 1.7 Navigational Aids and Design Considerations

Navigational aid	Design consideration
NAV1: Architectural landmarks	Architectural landmarks such as a tower or auditorium can easily be located by users and serve as reference points.
NAV2: Camera control	Controlling the Second Life camera is a skill that users find difficult to master, but it provides a valuable navigational aid. The zoom function allows users to view parts of an island without having to walk. The camera's view can also be rotated, allowing users a 360-degree view of parts of an island without moving.
NAV3: Directional signs	Directional signs at intersections provide navigational assistance where walking is required, or preferred, by visitors. The design, number, and placement of directional signs should be considered to aid legibility, readability, and decision-making.
NAV4: Flying	If insufficient navigational aids are available, the most common wayfinding strategy adopted by users was to fly. This was particularly true of experienced users of Second Life. Therefore, consider including architectural landmarks (see NAV1) to orient users, and make buildings open and easily accessible.

Navigational aid	Design consideration
NAV5: Identification signs	Identification signs should be given for key locations or buildings as they inform users they have reached their destination. If a location is not identified, users can become disoriented and make incorrect assumptions. Identifications signs should be visually accessible and consistently designed.
NAV6: Maps	Maps play an important role in showing how users can identify and move between their current location and a destination. They should be easy to read and include architectural landmarks, paths, and key locations. Not all users understand or like to use maps. Maps should be placed close to the island's entry point. On complex islands, consider the use of additional maps at landing points for sub-sections of the island.
NAV7: Notecards	Give consideration to information included in notecards. Second Life landmarks embedded in notecards are frequently overlooked or become lost within a user's inventory. This is particularly true of inexperienced Second Life users. Label the notecard so that it is obvious what it contains and make the content easy to follow.
NAV8: Paths	Some users of Second Life like to walk and use paths. Paths should be designed so they are legible and articulated. Winding pathways and narrow corridors should be avoided as this can restrict avatar manoeuvrability.
NAV9: Second Life landmarks (similar to bookmarks in websites)	The use of landmarks varies considerably based on users' experience and personal preference; do not automatically consider them the preferred method for teleportation.
NAV10: Sensors	Sensors: A device that can detect an avatar's movement in a given area of an island in Second Life.
NAV11: Structure of the island	Structure of the island: The overall form or organization of an island in Second Life.
NAV12: Teleporters	Teleporters: A device used for teleportation.
NAV13: Teleport maps	Teleport maps: A visual representation of an area that can also be used as a device for teleportation.

Designing Entry Points of Islands in Second Life

Users' first impressions of real-world or virtual environments greatly influences their perceptions and attitudes. An impression is largely formed at the entry

point, that is, a point of intentional entry into a space. Also, the user observations in NAVY have shown that visitors often return to the entry point of an island when they encounter wayfinding difficulties; they expect the entry point to be a source of help, just as website users return to the home page if they are unable to find their way around the website.

The principles of design of home pages on the Web can be applied to the design of entry points in 3D virtual worlds, for example (based on Lidwell, Holdern, & Butler, 2003):

- *Minimal barriers*: remove barriers by ensuring it is clear how a visitor can interact with objects; do not use unfamiliar terminology; incorporate features that are similar to real-world physical spaces.
- *Points of prospect*: use points of prospect to orient the user and provide options for navigation. For example, make it obvious what the learning space is about, use directional signs, maps, meaningful graphics, teleporters, and notecards containing Second Life landmarks.
- *Progressive lures*: incorporate progressive lures such as the tours on Genome Island and Vassar Island, or the introductory video given on deep|think. Other types of progressive lures are the use of entry-point greeters, or a visual display of popular destinations such as a teleport map just beyond the entry point.

Research Outcomes

The empirical research in the NAVY project has demonstrated that while navigating and wayfinding in 3D virtual learning spaces, users employ a combination of real-world navigational and wayfinding mechanisms (e.g., walking, using signs, and maps), and those of 3D virtual environments (e.g., teleporting, flying). Their choices and decisions are also influenced by real-world experiences of navigating and wayfinding, and also depend on interactions with websites. Teleportation was the most commonly used method to move around in Second Life. However, having found a teleport device, users were not always sure how to interact with it for a variety of reasons, for instance, due to lack of visual feedback. If teleportation wasn't possible or teleporters couldn't be found, a user resorted to flying or walking. Although the usage of real-world navigational aids such as maps, paths, and signs is evident in the designs of learning spaces, we have noted that designers have incorporated elements of web design, particularly in the design of entry points and navigational mechanisms from the entry point.

The key research outcomes of the NAVY project include: (a) 104 heuristics for the design of 3D learning spaces, 43 of which are specifically related to navigation and wayfinding; (b) over 200 design guidelines yielded by thematic data analysis; (c) exemplars for the 20 best practice guidelines for the design of 3D learning spaces; (d) the identification of 13 Second Life navigational aids, their suitability for use in 3D learning spaces analyzed and contextualized in the literature related to HCI, web usability, and real-world navigation; and (e) how the principles of entry-point design for a website could be applied to the design of entry points in 3D learning spaces.

Although the NAVY project was carried out in Second Life, it is hoped that the findings from our research will be applicable to other avatar-based virtual worlds. We are in the process of setting up a website to disseminate the design guidelines and heuristics, and to obtain feedback on the usability, comprehensibility, and usefulness of our research outputs from educators and designers.

The research findings from the NAVY project have implications for several audiences:

- Designers of 3D learning spaces
- Educators using learning spaces for teaching
- Students interacting with learning spaces
- Researchers of virtual worlds.

Designers of 3D learning spaces: A key contribution of this research project has been to develop a toolbox of heuristics and guidelines for designers.

Educators and students: The design guidelines for improving the usability of learning spaces will benefit educators and students through enhanced engagement, for example, reducing obstacles to learning by making resources more accessible.

Researchers: The methodology in NAVY involved the use of pre-interview information sheets, user observations, think-aloud protocols, and retrospective protocols. Overarching this methodology were the ethical implications of conducting research in virtual worlds. Previous empirical research in Second Life by Minocha et al. (2010) involved interviews and focus groups. The methodology in this project extended their methodological approach and toolbox of techniques by utilizing heuristic evaluations and user observations. Further, we have shown how a combination of research techniques can provide insights from different perspectives. Although designers and educators provided the basis and rationale

for their designs in our interviews with them, user observations with students and heuristic evaluations were used to assess the actual design.

Future Directions and Conclusion

Navigational strategies and how they may change over time: Although we elicited the navigational strategies and preferences of the participants, we did not delve deeper into how these navigational preferences were developed and how the preferences and strategies may have changed over time. It is quite possible that as users' skills with the Second Life interface develop, or they became more familiar with the 3D virtual environments, they employ different navigation strategies. It would be worth investigating how these user-navigational strategies develop and change over time. Such an investigation will help inform educators and designers about the design of activities and learning spaces, respectively, to support a variety of navigational strategies and preferences of their students and to cater for, in their designs, the possible changes that may occur over a period of time.

Quantitative data analysis: One limitation of our research is that although we gathered qualitative data of NAVY problems and their possible aspects on usability and user experience, we did not gather quantitative data such as, "it took X minutes of time to reach a location because of the absence of signage. When directional or reassurance signs were positioned at the correct places, for example, at decision points or to reassure, it took Y minutes. Task performance was therefore improved as $Y < X$." In Second Life or other 3D virtual environments, it is generally straightforward to perform such comparison studies as one can add or remove objects without much effort, for example, by dragging and dropping from the designer's inventory.

Developing usability metrics to study wayfinding performance: Ruddle and Lessels' (2006) study of wayfinding in virtual environments identified three levels of metric: users' task performance, physical behaviour, and decision-making rationale. Within the users' task performance category they identified three metrics: time taken; distance travelled and the number of rooms entered; and number of errors or correct turns. One consideration for future research could be to apply and extend Ruddle and Lessels' set of usability metrics for wayfinding performance in 3D learning spaces.

Evaluating wayfinding strategies in real-world simulations of architectural structures: A virtual world can provide a cost-effective environment to develop models

or simulations of physical learning spaces and to observe the stakeholders' interactions with these simulations and elicit their experiences (e.g., Pathmeswaran, Ahmad, Rooke, & Abbott, 2010). These evaluations could provide insights to the architects and designers about how the spaces being designed will be used in real life and changes that are required to improve them. Thus, it would be worth investigating the effectiveness and efficiency of 3D virtual worlds such as Second Life and our set of guidelines and heuristics for designing and evaluating architectural designs before they are built in real life.

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COMMUNICATION MODALITY, LEARNING, AND SECOND LIFE

Stephany F. Wilkes

Preparing to teach in a social virtual world can raise many questions for instructors. One of these questions is deceptively simple: “When delivering instruction, should I talk, type, or do a little of both?” It is difficult to answer this question with confidence because there is little empirical evidence about the effects of different communication modalities on learning in virtual worlds, and on the specific aspects of virtual worlds that enhance or detract from learning. Virtual worlds raise issues of immersion (how lifelike a virtual environment is), presence (the learner’s sense of “being there”) and co-presence (the learner’s sense of being in the virtual world with others) (Heeter, 1992; Schroeder, 2006).

The question of which communication modality to use in virtual world instruction is influenced by the generally accepted belief that the more lifelike (immersive) a virtual environment is, the more successful it is assumed to be. In instructional design, dual-coding theory (DCT) has shown that lessons containing concrete information, vivid images, and sound are easier to comprehend and better remembered than abstract lessons (Paivio, 1975; Clark & Paivio, 1991). Similarly, because the human voice is natural and deeply familiar, it is a cue that may increase the likelihood of retaining information (Sallnas, 2004). In addition, speaking rather than typing during a lesson containing concrete, how-to information with vivid images may create a more immersive experience and thus contribute to improved learning outcomes (Moreno & Mayer, 2002; Mousavi, Low, & Sweller, 1995). Because social virtual worlds are actively used for distance education and other forms of training, educators have an interest in improving the understanding of immersion, presence, co-presence, and any relationship between these and learning.

This study, though limited in scope and conducted with a small sample, explored the relationship between communication modality, presence and co-presence, and learning in a social virtual world commonly used for education. To this end, I measured learning (short-term recall and retention), cognitive load, and perceptions of presence and co-presence from participants assigned to one of three communication modalities: voice only, text only, and voice and text together.

Key Terms

Working memory and cognitive load are two concepts key to my study. Working (short-term) memory is a three-part system of limited capacity (Sweller, van Merriënboer, & Paas, 1998). Because working memory is key to learning and yet so limited in its capacity, learners are automatically placed in a difficult position as they attempt to gather new knowledge. Long-term memory, in contrast, is permanent memory.

Cognitive load is defined as the amount of mental energy required to process a given amount of information. As the amount of information increases, so does the cognitive load on our mental resources (Feinberg, Murphy, & Duda, 2003). Cognitive load theory holds that learning will be inhibited when the amount of information and instruction exceed the capacity and limitations of our mental resources.

Theoretical Background and Research Questions

The study addressed four hypotheses, presented in Wilkes, 2009 with brief theoretical and empirical material from a more extensive literature review.

Does Communication Modality Affect Learning?

I expected retention scores in this study to be higher for voice participants (Group V) and voice-and-text participants (Group VT) than for text-only participants (Group T). I based this assumption, somewhat roughly, on Alan Baddeley's theory of working memory—different components of short-term memory retain certain kinds of information better over others, such as speech sounds as compared to visual information (1992, 2002). Baddeley's theory holds that the coding processes underlying working memory are neutral with respect to input modality, including the verbal-non-verbal dichotomy, which implies that we should expect no difference in retention based on the communication modality used in the study activity. Baddeley's theory, however, also emphasizes

the critical role of attention, in that anything that limits attention capacity will impair performance (learning).

Penney's hypothesis departs from Baddeley's in regard to modality. She proposed a model of the structure of short-term memory called the separate streams hypothesis, describing that the processing of auditorily and visually presented verbal items is carried out *separately*. Other researchers' findings support the idea that more memory capacity is available when dual modalities are used (Clark & Paivio, 1991; Mayer & Moreno, 1998; Penney, 1989; Sweller, 1994).

Moreno and Mayer (2002) found that receiving information as on-screen text rather than narration significantly hindered learning, groups presented with verbal information as speech recalled significantly more information than those presented with verbal information in the form of text, and presentation of information as on-screen text hindered learning in all groups.

Does Communication Modality Affect Cognitive Load?

I expected cognitive load to be lower for voice participants (Group V) and higher for voice-and-text participants (Group VT) and text-only participants (Group T), because of subjective reports of mental strain and effort.

The modality principle (Moreno & Mayer 2002) states that when presenting a multimedia explanation (visual and verbal information), words should be presented auditorily rather than visually. The rationale for this is that, by using the auditory channel to process the words, effective working memory capacity is expanded since students are not forced to split their limited visual working memories between the on-screen text and the pictorial information. Pictures are processed through the visual information channel, while spoken words are processed through the auditory channel. Processing of words is off-loaded onto the auditory channel, which is otherwise underused (Moreno, 2006).

The work of Mousavi et al. (1995) provided an important empirical foundation for that of Moreno and Mayer. These researchers found,

1. The presentation of information in mixed auditory and visual mode, rather than a single mode, had beneficial effects on learning, presumably expanding effective working memory capacity by not overloading a single working memory channel.
2. A significant modality effect between two visual-visual and two visual-auditory groups. The two visual-auditory groups required less time to solve two repeat problems.

3. Auditory solution statements to be superior over written solution statements, regardless of the way in which problem information was presented.

In summary, research on modality, working memory, and cognitive load is complex, but some researchers suggest that more items will be recalled in a memory test if some are presented in a visual modality and some in an auditory modality, rather than all in a single modality (Mousavi et al., 1995; Penney, 1989). As Penney (1989) and Baddeley (2002) point out, however, if the auditory component is too long or highly complex, it will create an excessive strain on attention and working memory, increase cognitive load, and ultimately decrease recall and retention.

Does Voice Communication Increase Perceptions of Presence in a Virtual World?

Presence (one's sense of "being there" in a virtual world) and co-presence (one's sense of "being there with others") are considered two major factors that differentiate virtual worlds from other online and multimedia applications. According to Mikropoulos and Strouboulis "Presence is the main attribute of virtual reality (VR) that differentiates it from other information technologies, giving learners an active role," which instructors hope will increase recall and retention of material (2004, 582–591). "Active learning" takes place when participants themselves carry out an action or series of activities (as in the how-to style instruction conducted as part of this study), rather than watch someone else perform them. Slater, Sadagic, Usoh, and Schroeder (2000) point out that if humans are required to perform tasks within virtual environments, then surely it is beneficial for them to feel present in that environment.

Some researchers (Sallnas, 2004) have indicated that modality (specifically voice) can impact perceptions of presence. Others (Moreno & Mayer, 2002) found that modality did *not* impact perceptions of presence, while the level of immersion made possible with the media environment (a desktop vs. head-mounted display) did affect presence. Based on prior findings by Sallnas (2004) that voice contributed to co-presence, and that co-presence was a factor of presence, I thought that Group V would experience greater perceptions of presence.

Do Perceptions of Presence Affect Learning?

Some of the more compelling reasons for developing highly immersive environments that create stronger perceptions of presence are based on theories of

limited working memory; making interactions with technology more immersive involves adding more lifelike and natural “cues” to the environment (visual, audible, contextual, textual, and so on) that might combine to trigger recollection later, easing and enhancing the recollection of course material. More immersive environments will supposedly attract students’ limited attention to learning content rather than to the interface (Moreno & Mayer, 2002).

In regard to virtual environments specifically, some researchers have claimed that presence is causally related to task performance and learning (Schuemie, van der Straaten, Krijn, & van der Mast, 2001) and many of the factors that appear to affect presence, such as vividness, are known to enhance learning and performance (Witmer & Singer, 1998). Biocca, Harms, and Burgoon (2003) note that communication and Human–Computer Interaction (HCI) researchers are typically interested in social presence because it may mediate the effects of other variables of central concern to the researcher, including interface features, learning, and memory. There is, however, no conclusive empirical evidence to support these claims. Whether or not presence contributes to better task performance remains controversial based on reported findings (Schuemie et al., 2001).

In research conducted by Moreno and Mayer (2002), groups presented with a higher level of immersion did not differ in the number of items they recalled from groups presented with a lower level of immersion. Immersion (media environment) did not affect responses to cognitive assessment questions. Participants in more immersive conditions reported higher levels of presence, but groups did not differ in their learning outcomes.

Study Methodology and Procedures

This study took place between January and July 2009 and was conducted entirely online and anonymously.

In the interest of full disclosure, I managed the implementation of voice chat in Second Life and was a full-time employee at Linden Lab, creators of Second Life, from February 2007 to August 2009. Though I was obviously close to the voice project as a result of this, it is worth noting that no internal or known external voice research with Second Life residents had been designed or conducted prior to this study, and that no comprehensive voice user data had been collected or disseminated. That said, I believe I had no prior knowledge that might have skewed or otherwise positioned me to expect or look for certain types of findings over others. In addition, research has indicated that researchers of games should play the games they are studying. If they do not, they cannot

know what questions to ask, decipher the local language, understand the game mechanics, or have any sense of the social context of play (Williams, 2004). Finally, Linden Lab provided no financial or other support of this work, which was completed entirely in my own personal time. Study sessions, for example, were conducted exclusively during evenings and weekends.

Recruitment and Screening for Study Participation

First, study participants were recruited offline (through flyers posted at libraries, for example) and online (through various websites and email lists). All recruiting materials and study communication informed participants that they would receive \$10 USD (or equivalent currency) as compensation following study completion. Prospective study participants were referred to a study information web page and required to submit consent forms. After submitting the consent form, potential subjects were directed to and completed a screening questionnaire.

Both new and existing Second Life users, known as Residents, were recruited for study participation. In order to account for the factor of Second Life experience, the screening questionnaire included three questions about experience, which asked if the participant had ever logged in to Second Life before, how long ago their account had been created, and how many total hours they had spent in the virtual world. These questions were taken into account during the intercorrelations phase of data analysis.

In order to qualify for study participation, prospective participants had to meet three conditions:

1. They had to agree to accept the test condition (communication modality) they were assigned to, and specifically to use spoken voice communication if assigned to it.
2. They had to meet the minimum system requirements (asked across two questions about Internet connection speeds and RAM). Otherwise, Second Life may not have been able to run on their computers, and it was easier to disqualify these participants at the outset.
3. They had to have a high degree of availability (i.e., be available at several dates and times listed in the screening questionnaire).

Next, qualified subjects were notified by email as to whether or not they had been selected for study participation and, later, randomly assigned to study conditions. Table 2.1 presents the total number of participants recruited and

the number of participants who did not qualify or who were eliminated for other reasons.

Table 2.1 Reasons for Elimination of Prospective Study Participants and Final Sample Size ($N = 60$)

Reason for elimination	Number of participants
Total recruited	149
Did not agree to accept assigned condition	24
Did not meet minimum system requirements	6
Did not attend scheduled study session (no-show)	46
Attempted to but could not attend or complete study session (technical difficulties)	10
Total study participants	63
Removed during analysis phase due to missing data or as outliers	3
Final study sample (N)	60^a

^a The sample size of 60 participants was the bare minimum required to achieve the desired power for statistical analysis (Cohen, 1998).

Sample Demographics

Of the 60 participants in the final sample, 37 (62%) were female and 23 (38%) were male. The ages of participants ranged from 18 to over 80 years of age: 23 (38%) were under age 35, 25 (42%) were under age 55, and 12 (20%) were age 55 or more. Most of the participants (51 or 85%) identified as White/Caucasian; of the remaining nine participants, two (3.2%) were African American, one (1.6%) was Hispanic, four (8.1%) were Asian, one (1.6%) was Native American, and one (1.6%) was a Pacific Islander.

Three aspects of prior Second Life use were considered: whether or not a participant had ever logged into Second Life before, the age of their account, and the total time spent in the virtual world. Forty-one (68%) participants had logged into Second Life at least once before the *Introduction to Building in Second Life* class, while nineteen (32%) had not. In regard to account age, 34 (57%) participants had created their Second Life account less than six months ago, while 26 (43%) had their Second Life account for more than six months. In response to the question: “How much time (total hours) have you spent in Second Life?” 28

(47%) reported that they had spent less than 2 hours total in Second Life, 9 (15%) had spent 2 to 20 hours total in Second Life, and 23 (38%) had spent 20 or more total hours in Second Life.

Introversion and extroversion, video game use, availability for study participation, and primary interest in Second Life (Table 2.2) were also recorded in the screening questionnaire. Typing proficiency was not self-reported, an omission that may have later influenced text chat outcomes in Groups T and VT. All participants were, however, asked to describe their computer experience through questions about their usual computer input device (mouse, keyboard, and so on): if they already used voice chat in Second Life, if they owned a headset with a microphone for speaking, what kind of computer they would use to participate in the study, the speed at which they usually connected to the Internet, and the amount of computer memory their machine had. Finally, at the beginning of each activity session for Groups V and VT, the instructor described how to use Second Life volume controls, how to mute one's own microphone and that of other participants, and how to use Talk controls.

Table 2.2 Frequencies of Primary Interest in Second Life (N = 60)

Topic of interest	Not at all	Somewhat	Fairly	Extremely
Socializing	9 (15%)	20 (33%)	20 (33%)	7 (12%)
Building/content creation	13 (22%)	11 (18%)	15 (25%)	16 (27%)
Virtual business	26 (43%)	13 (22%)	11 (18%)	6 (10%)
Providing education	22 (37%)	13 (22%)	9 (15%)	10 (17%)
Receiving education	11 (18%)	21 (35%)	11 (18%)	13 (22%)

Note: Responses on a 4-point, Likert-style scale.

Participant Assignment to Condition

For the study, I used a stratified random sample controlled for age and gender. The results of a Chi-squared test (Table 2.3) indicated that assignment to condition was random.

Each participant and study session had one of three randomly assigned communication conditions: either the Voice (V), Text (T), or Voice and Text (VT) communication modality. Everyone attending a particular study session was automatically “in” their test condition simply by using the communication modality provided and stated at the beginning of class. Group V had 18 participants while Groups T and VT had 21 participants each.

Table 2.3 Chi-square Scores for Assignment to Test Condition Based on Age, Gender, and Race

Participant attribute	χ^2	df	p
Age	1.34	4	.86
Gender	1.48	2	.48
Race	0.49	2	.78

Study Activity

Next, using a typical computer setup (i.e., either a desktop and mouse, or laptop and mouse) participants attended one learning activity, the *Introduction to Building in Second Life* class, for approximately 45 minutes. During the class, participants completed building exercises with an online instructor, a female avatar with female voice. Both avatar appearance and instructor were kept constant throughout the study.

Following the *Introduction to Building* class, subjects completed an online questionnaire with three sections on perceived mental strain (cognitive load), presence, and retention, comprised of questions about material covered during the *Introduction to Building* class. First, participants completed two 7-point Likert-scale format questions that asked them to report perceived mental strain. Reports of mental strain were followed by a Presence Questionnaire (PQ) (Witmer & Singer, 1998; Gerhard, Moore, & Hobbs, 2001), a 7-point Likert-scale format with 28 questions rating their experience in different areas of the 3D environment. After completing the online PQ, participants completed a learning (retention) assessment, a test of how well they remembered material from the learning activity. Only short-term retention was measured. Participants were compensated immediately after the online questionnaire was submitted.

Study Instrumentation and Reliability

All of the study instruments described in this section were part of a single, online post-activity questionnaire. Three dependent variables were measured: presence, retention, and cognitive load. Two of the instruments used in this study were the creation of the author (the cognitive load and retention instruments) while one instrument, the Presence Questionnaire (PQ), was created and is copyrighted by Witmer and Singer (1998) with permission to make copies of part or all of their work for personal, classroom, and commercial use.

Witmer and Singer's PQ is frequently employed in virtual reality research and cited in the literature on immersion and presence in virtual environments. I employed the PQ (version 3.0) in this study for many sound reasons: because Moreno (2006) used it in her work on modality and presence, and I aimed to expand on her work; it is complete in that it measures multiple aspects of presence; its validity and statistical reliability is well established and no serious shortcomings of the instrument have been detected in more than a decade; it measures presence data collected from participants immediately following exposure to a virtual environment, which also took place in this study; and because the items in the PQ applied neatly to Second Life without requiring alteration. Witmer and Singer have described their tests of reliability on the PQ at length in the literature (Witmer, Jerome, & Singer, 2005).

Though Second Life is not the same (or even the same kind of) virtual environment in which the PQ was originally applied, the relevance of PQ questions to Second Life inspired application to a social virtual world, just as Moreno (2006) applied the PQ to an environment different from those studied by Witmer and Singer (1998) and Witmer et al. (2005).

The 28-item Presence Questionnaire was measured on a 7-point Likert-type scale ranging from "No/None" to "High/Extremely" on presence variables. Example items included: "How well could you move or manipulate objects in the virtual environment?" and "Were you able to anticipate what would happen next in response to the actions that you performed?"

Reliability of All Presence Items

The PQ was supplemented with 11 post-experiment questions from Gerhard et al. (2001). These questions are more attitudinal in nature and measure immersion, communication, involvement, and awareness. I added these because they were considered highly salient based on the design of the study, and because they directly ask participants about social presence (co-presence) while the PQ does not. The 7-point Likert-style scale was applied to these questions in order to keep response format consistent. Example items included, "How responsive were the avatars of other participants to verbal communication that you initiated?" and "How compelling was your sense of other participants being present?"

The total presence score was a sum of all responses to all presence questions, beginning with the PQ items followed by Gerhard et al.'s items (2001). Gerhard et al.'s presence sub-scales were not included or evaluated as part of this study. Because the addition of Gerhard's questions could have compromised the

established reliability of Witmer and Singer’s PQ, reliability was tested for all presence items and was strong with Cronbach’s alpha .95.

Reliability of Cognitive Load Measures

The cognitive load measures were brief and typical of cognitive load evaluations, in which study participants are asked to report their perceived levels of mental effort and strain. The cognitive load assessment was comprised of two 7-point Likert-type scale options that ranged from “Not at all” to “Extremely.” They were, “How difficult was the Introduction to Building class?” and “How much mental strain did you experience during the Introduction to Building class?”

Reliability of Retention Measures

The retention instrument was originally comprised of nine, and later eight primarily multiple-choice style questions designed to measure different types of learning outcomes: declarative knowledge, concept learning, and procedural knowledge (Smith & Ragan, 2005). Example items included, “Which of the following shapes are ‘prims’ in Second Life? Please check all that apply” and “Below is the list of steps required to construct a table in Second Life. The steps are listed in the incorrect order. Please re-order the steps shown below to successfully build the table shown here (a table with an oval top and four cylindrical legs). Select the #1 button for the first step you should take, with #8 marking the last step in the procedure.” The total retention score was the sum of all correct answers.

To establish internal scale reliability for each of the three scales presented above, reliability was calculated using Cronbach’s alpha for the dependent variables (retention, presence, and cognitive load). All of the items that constituted a particular measure were entered and a Cronbach’s alpha was run for that measure, resulting in the internal consistency of that particular scale. The procedure and results of scale reliability for all items on the test instrument are presented in Table 2.4.

Table 2.4 Chi-square Scores for Assignment to Test Condition Based on Age, Gender, and Race

Reliability	Scale alpha
Retention	.51
Cognitive load	.94
Presence	.95

The original retention alpha was .495, too low to be considered reliable. Factor loadings indicated that one question reduced scale reliability when included. It was “Look at the image below. Three lines are shown: a red line, a green line, and a blue line. Each line represents one angle, or axis. Choose the colour of the line that represents the Z axis.” This question was not retained, bringing Cronbach’s alpha to .51, which still did not meet the standard of .07 desired reliability. Upon further examination, I noted that reliability was underestimated: The retention scale was not a continuous measure, but dichotomous, and another measure of reliability would be more appropriate. I also note this limitation in the Discussion section.

Results

Did Demographic Variables Influence Outcomes?

First, to determine if demographic variables might affect observed outcomes, I ran descriptive statistics and Pearson’s two-tail correlations for all variables (independent, dependent and demographic; see Table 2.5). As I noted previously, I used a stratified random sample controlled for age and gender, and a Chi-square test confirmed that the assignment to condition was indeed random and not significant for age ($p = .855$), gender ($p = .477$), or race ($p = .782$). Other demographic variables (time and experience) were not included in the stratified random control or Chi-square test, so I conducted analyses to investigate whether the independent variable and/or demographic variables (time, experience, age, race, or gender) impacted cognitive load, retention, or presence.

The results of the Pearson’s correlations (Table 2.5) were *negative* and *significant* for retention and presence ($r[54] = -.36, p = .01$), for cognitive load and retention ($r[54] = -.26, p = .05$), for experience and presence ($r[54] = -.31, p = .02$), for experience and retention ($r[54] = -.39, p = .001$), and for time and cognitive load ($r[54] = -.36, p = .01$). The results of the Pearson’s correlations were *positive* and *significant* for time and presence ($r[54] = .41, p = .001$) and for time and experience ($r[54] = .50, p = .001$).

Next, I calculated means and standard deviations for the independent variable of communication modality (Group V, Group T, and Group VT) on each of the three dependent measures (presence, retention, and cognitive load). These are shown in Table 2.6.

Then, I completed a one-way analysis of variance (ANOVA) for each dependent variable (cognitive load, retention, and presence). The results of the ANOVA between groups were significant for cognitive load ($F[2, 54] = 4.58, p = .01$) and

retention ($F[2, 54] = 3.53, p = .04$) but were not significant for presence ($F[2, 54] = .65, p = .53$).

Table 2.5 Correlation Matrix for Independent, Dependent, and Demographic Variables ($N = 60$)

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9
V/T/VT	2.05	0.81	1.00								
Presence	185.47	27.14	-.124	1.00							
Retention	.72	0.17	-.25	-.36**	1.00						
Cognitive load	2.14	1.22	-.22	-.24	-.26*	1.00					
Experience	3.80	1.54	.28**	-.31*	-.39**	.09	1.00				
Time	1.92	0.93	-.15	.41**	.48**	-.36**	.50**	1.00			
Age	3.25	1.54	.09	-.11	-.03	.02	.01	.00	1.00		
Gender	1.62	0.49	.13	.12	-.11	.04	-.17	.15	-.03	1.00	
Race	1.43	1.18	.08	-.02	.11	-.08	-.18	-.04	-.23	.12	1.00

* $p < .05$ (2-tailed).

** $p < .01$ level (2-tailed).

Table 2.6 Means and Standard Deviations for Cognitive Load, Retention, and Presence by Communication Modality

Condition	V			T			VT		
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>
Cognitive load	18	5.56	2.57	21	3.33	2.08	21	4.14	2.26
Retention	18	5.19	0.9	21	5.38	1.14	21	4.49	1.32
Presence	18	188.07	27.33	21	188.69	24.14	21	180	30.11

I hypothesized that retention scores would be higher for voice participants (Group V) and voice-and-text participants (Group VT) than for text-only (Group T) participants. The results of a one-way ANOVA to test this hypothesis were significant ($F[2, 54] = 3.53, p = .04$). Retention scores were highest for Group T ($M = 5.38, SD = 1.14$), lower for Group V ($M = 5.19, SD = 0.89$), and lowest for Group VT ($M = 4.49, SD = 1.32$).

Cognitive load was not lower for voice participants, as expected; in fact, cognitive load was *lowest* for text participants. The results of a one-way ANOVA to test this hypothesis were significant ($F[2, 54] = 4.58, p = .01$). Cognitive load was lowest for Group T ($M = 3.33, SD = 2.08$), higher for Group VT ($M = 4.14, SD = 2.26$), and significantly higher for Group V ($M = 5.56, SD = 2.57$).

I expected voice use to contribute to greater perceptions of presence but it did not. The results of a one-way ANOVA to test this hypothesis were not significant ($F[2, 54] = .65, p = .53$). Group T had the highest presence scores ($M = 188.70, SD = 24.14$), while Group V had just slightly lower presence scores ($M = 188.07, SD = 27.33$), and Group VT the lowest ($M = 180.00, SD = 30.11$).

Finally, I expected that perceptions of presence would not correlate with retention, but results indicated the opposite. The results of a Pearson's two-tail correlation to test this hypothesis were positive and significant ($r(60) = .36, p = .01$). Perceptions of presence *did* correlate with short-term retention.

To determine if the means were significantly different, I ran a post-hoc analysis (Tukey) for all dependent variables (cognitive load, retention, and presence) by condition (Group V, Group T, and Group VT). Post-hoc analysis showed mean differences were significant ($p < .05$) between groups V and VT on retention ($p = .03$), between groups T and VT on retention ($p = .04$), and between groups V and T on cognitive load ($p = .01$). See Table 2.7.

Table 2.7 Post-hoc Differences in Means of Cognitive Load, Retention, and Presence by Condition

Condition	Mean difference	SE	<i>p</i>
<i>Cognitive load</i>			
V and T	1.11*	0.37	.01
V and VT	0.11	0.37	.15
T and V	-1.11*	0.37	.01
T and VT	-0.40	0.35	.50
VT and V	-0.71	0.37	.15
VT and T	0.40	0.35	.50
<i>Retention</i>			
V and T	-0.03	0.05	.86

Condition	Mean difference	SE	<i>p</i>
V and VT	0.10	0.05	.15
T and V	0.03	0.05	.86
T and VT	0.13*	0.05	.04
VT and V	-0.10	0.05	.15
VT and T	-0.13*	0.05	.04
<i>Presence</i>			
V and T	0.63	8.77	1.00
V and VT	8.06	8.77	.63
T and V	0.63	8.77	1.00
T and VT	8.7	8.43	.56
VT and V	-8.06	8.77	.63
VT and T	-8.7	8.43	.56

**p* < .05.

Time and Experience

Finally, I conducted exploratory analysis for time and experience, as the correlation matrix (Table 2.5) showed a relationship between these two extraneous variables, the independent variable (communication modality), and the three dependent variables (cognitive load, retention, and presence). While not hypothesized, strong correlations (both positive and negative) indicated that time and experience should be treated as second independent variables in future analyses. I ran six 2-way ANOVAs with the independent variables of communication modality and either time or experience, and one of the dependent variables (cognitive load, retention, or presence).

Cognitive load was lowest for Group T ($M = 1.67$) regardless of experience. There was no significant difference between Group T participants who had created their Second Life accounts less than six months ago ($M = 1.82$) and more than six months ago ($M = 1.50$).

Cognitive load was higher for Group V ($M = 2.77$) than for Group T ($M = 1.67$) and Group VT ($M = 2.07$), without a significant difference between Group T and

Group VT. There was a significant between-groups effect for communication modality and time spent in Second Life ($p = .23$). The text condition (Group T) and time spent in Second Life (> 20 hours) correlated with a greater decrease in cognitive load.

Discussion

Experience and Time are Significant

In this study I sought to determine whether or not communication modality (assignment to Group V, T, or VT) had an impact on cognitive load, retention, and presence. The most significant finding is that experience and time had significant effects on measures of cognitive load, retention, and presence. Significant between-subjects effects were found for cognitive load and time ($p = .23$), for retention and time ($p = .21$), and for retention and experience ($p = .03$).

These findings are not surprising. According to Eyring, Johnson, and Francis (1993), task familiarity (an individual's possession of declarative knowledge and procedures relevant to performance of a given task) can be gained through prior experience with the task, or through experience with tasks similar in terms of declarative knowledge and procedures. Eyring et al. (1993) cite Ackerman (1989), who suggested that previous experience may allow an individual to pass more rapidly through early stages of skill acquisition and reduce cognitive demands. It is possible, based on my findings about the impact of time and experience, that more experienced Second Life users had learned how to better use the virtual world's interface (which was necessarily a strong component of the learning activity) and may have also known other content included in the learning activity script.

Retention scores were approximately the same for participants in the voice condition group (Group V), regardless of the time (either < 20 hours or > 20 hours) they had spent in Second Life. The text condition group (Group T) correlated with increased retention, but only for those participants who had spent more time in Second Life (i.e., > 20 hours, $M = .81$). Based on these results, it is impossible to determine whether time spent in Second Life, the communication modality, or both led to improvements in learning. For retention, between-groups effects were significant for communication modality and time spent in Second Life ($p = .21$).

Though retention increased slightly for Group T, it did not increase significantly for both experience levels. Retention scores were highest for Group VT participants who also had more than six months' experience ($M = .88$). The VT

condition had the opposite effect on less experienced participants, for whom retention dropped significantly ($M = .57$). For retention, the between-subjects effects for communication modality and experience were significant ($p = .03$).

For presence, between-subjects effects were significant for time ($p = .01$) but not for communication modality and time ($M = .975$). The text condition (Group T) correlated with increases in perceptions of presence for both experience levels in Second Life. For presence, between-groups effects were significant for experience ($p = .014$) but not for communication modality and experience in Second Life ($p = .938$).

Cognitive Load was Significantly Higher for Voice Conditions

Cognitive load was lowest for Group T ($M = 3.33$, $SD = 2.08$), higher for Group VT ($M = 4.14$, $SD = 2.26$), and significantly higher for Group V ($M = 5.56$, $SD = 2.57$). This is the opposite of the result I expected. As I reviewed earlier, using a visual modality to present both pictorial (in this case, the 3D objects in the *Introduction to Building* class) and verbal information (text-based instruction) can create an overload situation for the learner. More memory capacity is thought to be available when dual modalities are used (Penney, 1989).

It would be careless not to explore the most simple explanations first; the availability of chat log text transcripts for Groups T and VT. It is possible that cognitive load may have appeared higher for Group V because the text modality provides transcripts, and a text record would be very helpful in aiding recall and retention. Group V participants may have had to work harder to remember everything without a record to refer to. A chat window of text may also have reduced cognitive load not just after class, but during as well; Group T participants would have quickly realized that, if they missed a step, they could scroll back and catch up later by scrolling forward. This ability could have reduced perceptions of mental strain or a feeling of falling behind during instruction. Unfortunately, the nature of remote, online research makes it impossible for the instructor to see or control whether or not participants in Groups T and VT retained full or partial text transcripts of the material.

Another simple explanation is participant familiarity with the communication tools themselves and extraneous cognitive load. While text-based chat and email communication is common online, voice communication may be less so. At the time I conducted the study, Second Life had its own voice communication system; familiarity with generally available voice chat applications like Skype would not necessarily have applied or extended to the virtual world. The fact that participants had to learn how to use voice chat in Second Life (even

with instructor guidance) may have increased extraneous cognitive load during instruction.

Another possible interpretation is that auditory load may be intrinsically more demanding (Mousavi et al., 1995), or that voice communication in combination with social virtual worlds creates higher auditory load than might be expected for other multimedia learning contexts. The results seen here, of Group V experiencing the highest cognitive load, support those of Mousavi et al.'s (1995) experiment in which two groups, a visual-visual mode and an auditory-auditory mode, were studied to see if visual processes were inherently more demanding. Mousavi et al.'s (1995) results suggest that the auditory-auditory mode may have been more intrinsically demanding of cognitive load; a significant difference favoured the visual-visual group (which was most like Group T in this study).

Finally, in Group V, complementary rather than different simultaneous information was presented. According to Penney's (1989) separate streams hypothesis, different content coming in through two streams is expected to free up working memory. In Penney's (1989) work, lists of different items presented simultaneously to different sensory modalities improved short-term memory retention. The instructor's script for the *Introduction to Building* class was comprised of complementary information to the actions taking place in Second Life. The nature of the study activity, then, may have played a role in contributing to higher load for Group V.

Voice Use did not Contribute Significantly to Greater Perceptions of Presence

Group T had the highest presence scores ($M = 188.70$, $SD = 24.14$) while Group V had just slightly lower presence scores ($M = 188.07$, $SD = 27.33$) and Group VT the lowest ($M = 180.00$, $SD = 30.11$). Some research (Sallnas, 2004) indicated that modality (specifically voice) could impact perceptions of presence. Other research (Moreno & Mayer, 2002) found that modality did not impact perceptions of presence, while the level of immersion made possible with the media environment (a desktop vs. head-mounted display) did affect presence. The results of this study support the findings of Moreno and Mayer (2002) and do not extend those of Sallnas (2004).

One possible explanation for these results (though such data was not collected as part of this study) is that the combination of real-world voices with inworld avatars may have lessened the "fantasy impression" of avatars, reminding participants more of the real world than the virtual one. To address this, future research should evaluate perceptions of presence with real voices

and voice fonts, which are filters that make human voices sound different. Comparisons between two voice groups (Real Voice [RV] and Voice Font [VF]), studied along with Text Only, Real Voice and Text (concurrently) and Voice Font and Text (concurrently) groups could provide more substantive data on voice types and perceptions of presence in virtual worlds.

Finally, no or low levels of conversation may have contributed to a decrease in participants' sense of co-presence. A sense of being with others includes things like primitive responses to social cues, such as laughter, and these cues are thought to ultimately aid recall. Participants were not required to engage in any conversation, whether text or voice-based, while attending the *Introduction to Building* class. While data on non-instruction conversation was not recorded as part of this study, anecdotal recollection brings to mind only two livelier classes that evidenced these types of primitive responses. It is possible that little overall communication may have made the voice modality less salient to the study experience than it would have been in other contexts, such as a virtual support group for people recently diagnosed with a disease, in which human connection through speaking with others is of primary interest.

Related to this is the fact that participants were randomly assigned to their conditions and were unlikely to have prior acquaintance with one another; they simply may not have felt comfortable striking up a conversation with unfamiliar avatars. In addition, the *Introduction to Building* class was a one-time-only experience for study participants, perhaps giving little reason to engage in conversation since users could be quite confident of not encountering the person (or avatar) again. For these reasons, these results may not hold up in a context where students attend a class over a longer period of time, get to know one another better, attend a class both in real life and Second Life, and/or possibly engage in more voice communication. Conflicts in prior research on voice, immersion, and presence still exist and are worthy of further study.

Perceptions of Presence did Correlate with Retention

Perceptions of presence did correlate with retention. The results of a Pearson's two-tail correlation to test this hypothesis were positive and significant: ($r [60] = .36, p = .01$). These findings should be viewed with caution, however, because the data I collected as part of this study do not really tell us why. Unfortunately, this study does not shed much light on the specific aspects of presence (whether social cues, attributes of the virtual environment itself, and so on) that most influenced retention; how presence may have influenced attention, which Baddeley and others have shown is so important in retention, or generally how

the mechanisms between perceptions of presence, retention, and cognition function. As Miller (2011) points out, the field of memory research is complex and recommendations to instructors should not be overly simplified.

The retention measures I used in this study could have been, and should become, stronger. First, I only measured short-term retention. Results may differ if longer-term retention is measured. In addition, the retention instrument was brief in terms of the number of questions it contained and focused on Second Life-specific how-to content, which is unusual, not common in instruction, and difficult to judge for robustness. This study should be replicated with non-Second Life specific content (ideally multiple types of subject matter) to see if the results for retention and presence hold up across different types of subject matter. Varying subject matter, of course, introduces the possibility for high experience or existing knowledge on the part of participants, so those factors should be examined and, if necessary, controlled for.

Though limited, then, this finding does add some empirical evidence to the idea that greater perceptions of presence do contribute positively to the type of learning (active) studied here. The relationship between and cognitive mechanisms behind presence and retention is a rich area for future study by educational and cognitive psychologists.

Future Directions and Conclusion

It is important to remember that these study results are based on a very small sample ($N = 60$). Replicating this study with a larger sample may strengthen or change the results, especially if a larger sample size is used with stratified random assignment based on experience and time (suggested) instead of race, gender, and age (used here).

As Miller (2011) states, the memory theory literature suggests powerful linkages between attention and memory, and that what has been traditionally known as short-term memory may, in fact, be attentional focus. Miller also points out that information that is “vivid, emotionally arousing and meaningful” tends to win out in memory recollection and retention (2011, pp 11–122). Future work on virtual environments should investigate the role of and measure attention and whether the ability of a virtual environment to provide vivid, emotionally arousing information influences learning in both the short term and long term.

This study dealt only with short-term memory and retention, in that the post-activity assessment always took place immediately after the *Introduction*

to *Building* class. No participants, for example, attended the class and then returned to the post-activity assessment hours, days, or weeks later. Retention should be measured over a longer period to see if differences are found over time and improved long-term memory storage and retention is, most likely, the goal of most educators.

The prior spatial, Second Life interface, and other abilities of participants were not evaluated or taken into account but should be for similar studies. In addition, “real world” subjects that are commonly taught should be used in instruction rather than the Second Life-specific material taught here (useful as an equalizing factor across a small sample but uncommon and not highly relevant).

These results should not be generalized across virtual worlds; I confined this study to surveying, interviewing, and observing Residents within Second Life only. A study of additional social virtual worlds and the comparison of communication habits between users of each is an interesting direction for further research, especially to see how challenging it is to generalize findings across populations (and test how world-specific some findings may be).

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VIRTUAL BODY

Implications for Identity, Interaction, and Didactics

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This study is based on research developed in the theoretical framework of the cognitive sciences (Clancey, 1997; Damasio, 1995; Gallagher, 2005; Gallese, 2001; Lakoff & Johnson, 1980; Merleau-Ponty, 2009; Varela, 1990; Zlatev, 2009) and pedagogy (Gamelli, 2001; Kolb & Kolb, 2008; Manuzzi, 2002; Mendelson, 1998) that assign an essential value to the “body” for knowledge and comprehension. The relevance of the body and the concept of embodiment, or the act of “embodying,” is present in many theories in the field of pedagogical sciences.

Cicero proposed dramatization, for the acquisition of the rhetorical methods of controversy, in order to “transcend abstract principles and allow his students direct access to argument in action” (Mendelson, 1998, p. 29). In this way the student, through what is called a “discursive enactment,” is able to give “body” to the event. *Res* (“the thing”) and *verba* (“the words”) come to a synthesis, and through a “rhetoric of embodiment” prevent the student from becoming entrapped in theoretical abstraction. Instead, he succeeds in reaching full comprehension thanks to the performance that is “embodied” and “enacted,” as argued by Leff in his 1989 study (cited in Mendelson, 1998, p. 38).

If the environments and tools provided by the Internet are characterized by a synthesis between action and symbols in which representation has a primary value for the user because of the “disappearance” of the body in the communication flow, we can assume that virtual worlds are characterized by a new involvement of the body with an absence of mediation between the user and the medium. With the advent of virtual worlds, the body regains its status and

expresses its meanings/values in virtual interactions: the physicality of the body is substituted by the avatar.

This study addresses the multi-user virtual world Second Life (SL) and was conducted during the year 2010 with different groups of participants, drawn from educators and teachers.¹ Starting from the assumption that embodiment is a necessary condition for the development of cognitive processes, the aim of this study is to verify in what ways and with what value the concept of embodiment is present in Second Life and, specifically, how it may influence the learning/teaching process.

Taking into account the theoretical premises, the state-of-the-art literature, and the results of the analysis of two case studies related to the two consecutive editions (academic years 2008–2009, 2009–2010) of the post-laureate course “Teaching and Learning with MUVES” at the University of Macerata, Italy (Fedeli & Rossi, 2011), and developed within the initial framework of the European project MUVEnation (<http://www.muvenation.org>), I proposed the following hypotheses:

- The user “inhabits” the virtual world through his or her own body-avatar.
- The avatar has its own physical/aesthetic identity that affects “inworld” social relationships.
- The avatar has its own life story whose paths are marked on its body, on the space in which it lives, and on the artifacts it creates.
- Sensory motor skills, space management, and multi-sensorial involvement affect the didactic modalities in Second Life, opening new perspectives on the management of the teaching/learning process.

The Research Design: Paradigm and Approach

This research is based on a qualitative approach and the “philosophical world-view” (Creswell, 2009) or “paradigm” (Guba, 2000) takes a socio-constructivist perspective (Berger & Luckmann, 2008; Guba, 2000; Lincoln & Guba, 1985; Schwandt, 2007). Thus this study is mostly based on participants’ viewpoints and perceptions. For this reason, I used data-gathering techniques that offer open questions and opportunities for interactions among the participants in order to make participants socially negotiate their subjective meanings (Cicognani, 2002).

¹ The results of the research presented in this chapter are discussed in greater detail in a book by Laura Fedeli originally published in 2013 in Italian under the title *Embodiment e mondi virtuali: Implicazioni didattiche* [Embodiment and virtual worlds: Didactical implications] by FrancoAngeli.

I followed a phenomenological approach (Creswell, 2009) due to the specific nature of the study: it was relevant to determine the participants' experiences about their lives in the virtual world in order to be able to elaborate models connected to the concept of embodiment. The choice of a small group of participants (21 Italian teachers) with whom I had extensive and deep contact is consistent with the procedural parameters of a phenomenological approach and the study's objectives. As the study is aimed at eliciting data on perceptions of teachers/educators and trainers in relation to the value of the concept of "body" for the teaching/learning process in Second Life, the sample needed to be representative of the professional educational context in order to be "purposive" (Zammuner, 2003, p.110), that is, appropriate to the aim of the research.

Participants were recruited by phone calls and were not part of a common inworld community. The following criteria were identified to select the participants: he or she had to be a teacher or a trainer in real life who had didactic experiences in Second Life (either as a teacher or student, or both). The graph in Figure 3.1 shows the avatar age range of the participants recruited.

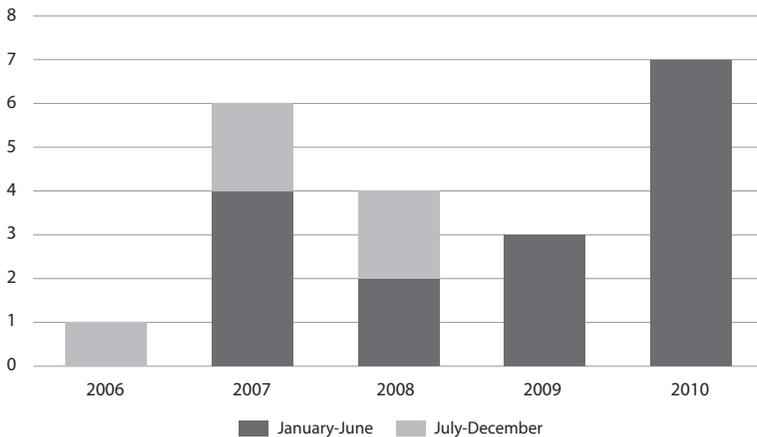


Figure 3.1 Research participants: registration in Second Life.

The research questions were designed to highlight the different dimensions of the user's presence and interaction in Second Life tied to the ownership of a "body."

Data Gathering

In qualitative research it is common to use different data-gathering methods in the same investigation (Creswell, 2009; Miles & Huberman, 1994). This allows

the researcher to deepen the non-exhaustive feedback collected through asynchronous tools such as the questionnaire and integrate those data with additional tools like individual interviews.

In the analysis of social reality, as underlined by Corbetta (2003), there are three basic actions: observing, asking, and reading. These are connected to three main categories of researching in the qualitative approach: “direct observation,” the “in-depth interview,” and the use of documents.

In the present study I collected data using three tools: a web-based open-ended questionnaire, focus groups, and in-depth interviews. Participants were first asked to complete a questionnaire, second I interviewed them individually in Second Life, and finally they were divided into three small focus groups that were also run in Second Life. That sequence allowed me to make a progressive analysis of the data with a different level of detail in the provided feedback.

The questionnaire had 53 questions divided into different sections and included closed patterns (checkbox questions, table questions) and open-ended questions (text fields, essay questions, multi-text questions). In some cases, I used images to facilitate the comprehension of the questions related to concepts specifically tied to the Second Life environment, and to foster reflection about typical aspects of the world’s interaction.

The topics covered by the items were divided into two general areas:

1. Avatar: aspects connected to the care of the avatar’s appearance; the value of the presence of elements in Second Life that recall the habits/norms of real life and professionalism (economical, cultural, social, and educational); aspects tied to sensations/emotions.
2. Interaction: use of sensory motor skills, building, scripting to acquire knowledge; aspects tied to communication (voice, gestures, use of accessories/tools, posture, space management); aspects related to the relationship of the user with the medium Second Life.

Questions in the macro topic “Avatar” were aimed to elicit the perspectives of the participants in relation to their graphical 3D representation, collecting their opinions, perceptions, and reflections which may contain references to biological, social, and cultural aspects of the virtual “body.” The macro topic “Interaction” addresses a wide landscape of dimensions of analysis mostly based on the use of the sensory motor skills of the avatar.

To avoid eliciting answers to the questionnaire that were too synthetic or inappropriate because participants didn’t comprehend the questions (Jonassen, Tessmer, & Hannum, 1999), I interviewed each participant in order to better

highlight the collected data and attribute the right meaning to the statements expressed in the questionnaire.

Conducting the interviews inworld allowed me, as the researcher, to focus on specific items and let the participants express themselves in a more open and involved way. Furthermore, the “face-to-face” interviews offered the opportunity for me to establish direct contact with the participant and infer useful information through dialogue and argumentation.

I negotiated the date, time, and location with each interviewee with the choice to meet at the avatar’s own place, if requested, or in his or her professional inworld context (school, association, etc.) in order to make the event comfortable for the participant and to give him or her the opportunity to show anything (objects, tools, scenarios, etc.) considered helpful to explain didactic activities or approach in Second Life.

The interviews were designed to be semi-structured and leave the necessary space for topics introduced autonomously by the interviewees during the meeting itself (Corbetta, 2003).

The questions explored three topics introduced in the questionnaire, which had first undergone a process of analysis:

- The modalities in which the sense of presence of oneself and others is felt by the avatar and their implications for mutual comprehension and learning.
- The transition and permeability between real life and “second” life.
- The different nuances of the perception of a life cycle of the avatar in Second Life.

As for the focus groups, we need to consider the literature relating to this method. Morgan distinguishes three scenarios:

First, they are used as a self-contained method in studies in which they serve as the principal source of data. Second, they are used as a supplementary source of data in studies that rely on some other primary method such as a survey. Third, they are used in multimethod studies that combine two or more means of gathering data in which no one primary method determines the use of the others. (1997, p. 2)

In this study the focus group, the last step of the data-gathering process, had a structure that was affected by the partial analysis of the feedback resulting from the questionnaire and the interviews, with the aim to clarify and complete the perspectives users provided (Zammuner, 2003).

The process of elaborating on the questions followed the “questioning route” (Krueger, 1994) method, which creates a structured path. According to Zammuner (2003), this approach best meets the requirements of studies in an academic context where the researcher has previous knowledge of the participants’ characteristics. As I stated above, the participants’ demographic information and qualitative data relating to their perceptions about the object of the study were well known to me when I was organizing the focus groups, so I employed a structured set of questions. I followed the prescriptive rule of the focus group methodology to keep the question format open and, when necessary, asked retrospective questions to encourage the participant to make reference to his or her own experience. In both interviews and focus groups I was the only actor involved in directing and moderating the events.

Coding Data

The qualitative research software QRS NVivo was used to organize and codify all the data gathered in written documents, images, and links to external resources.

As Figure 3.2 shows, the documents connected to the questionnaires, interviews, and focus groups (direct sources) were uploaded in the folder “Internals,” including images of the photographs in the avatars’ profiles in Second Life. The “External” folder was used to collect links to blogs or websites participants referred to during data collection. The interface screenshot showed an example of the interview document identifying the place in Second Life (SLURL) where the interview was conducted, the date and time, the name of the interviewer, and the identification code for the participant. Each document was also accompanied by a snapshot of the event.

All data were coded during the analysis process, which required several adjustments in the creation of categories (Figure 3.3). Three categories were identified: “Avatar,” “Interaction,” and “Didactics in Second Life.” Within the category “Avatar,” five subcategories were isolated:

- Identity value
- Alternate identity value
- Social value
- Emotional value
- Physiological value

The first two values, “Identity value” and “Alternate identity value,” refer to the concept of identity by Rosenberg (1990). The elements considered in the analysis were tied to “name,” “appearance” (personal identity), “gender,” “age,”

“profession” (social status), and labels, such as references to stereotyped attitudes and behaviours, for example, describing oneself as an “intellectual” or a “playboy” (social types). The only difference between the first two identity values was based on the type of avatar: “prime,” that is, the avatar most commonly used, and “alt,” an alternate/secondary avatar.



Figure 3.2 Interface of the NVivo 8 software: Organization of the data in documents and sections.

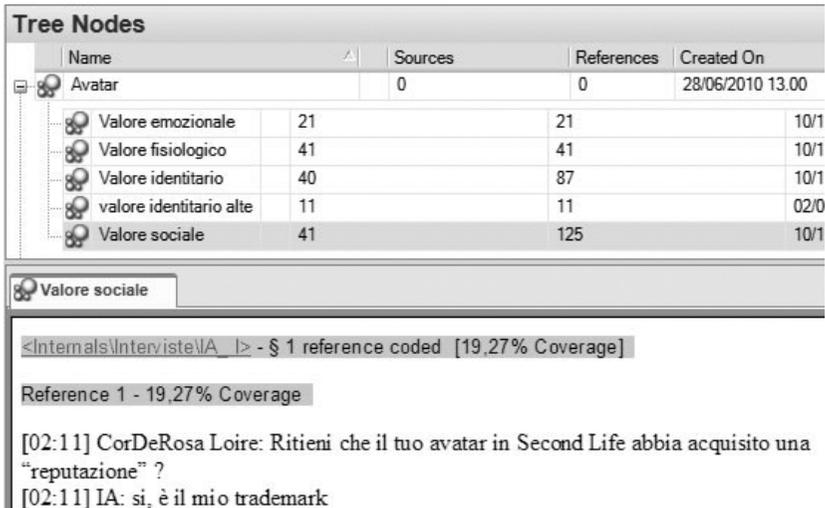


Figure 3.3 Interface of the NVivo 8 software: Category tree.

The subcategory “social value” is intended to gather all data related to the role played by the avatar in the community and social relationships in Second Life, the implications of the avatar’s personal and professional choices, and every piece of information that can be related to the avatar’s “life cycle.” Social value is also understood to be the source of reverse processes of influence: similar to the work done by Yee and Bailenson (2007), this study aimed to identify a connection between the avatar’s appearance and the phenomenon of social acceptance/refusal.

Emotional traits, feelings, and physical sensations have been coded in two different subcategories: “emotional value” and “physiological value,” to identify the connection with “body” in the frame of the avatars’ experiences. Second Life is a social environment, an aspect that was coded in the main category “Interaction” to analyze the role of the tools connected to the environment itself in relation to the dynamics of interaction and the implications for the development of didactic activity. Analysis of the communication and interaction dynamics was based on their effectiveness as perceived by the research participants, in relation to the technical characteristics of the virtual environment and the consequent didactic effect. By exploring synchronous interaction in a shared space, I hoped to discover data related to the concept of intersubjectivity and the role of sensory motor skills in the process of comprehension.

The data focused on the didactic activities were coded in the category “Didactics in Second Life” with the goal of highlighting the participants’ experiences, lived both as students and teachers, and to identify what value was attributed to the different educational modalities, strategies, and tools in relation to the perception of the teaching/learning process in the virtual world. Data from the questionnaire and the interview were triangulated with data gathered during the three focus groups run as the final stage of the study.

Data Analysis and Interpretation

One way communities build their members’ sense of identity is to locate their existence in a time trajectory or “life cycle.” Linde (1993) states that it is necessary to have a history to exist in a social environment, a history that is consistent, acceptable, and in a continuous process of development.

As human beings we are born, grow, and age. In Second Life those patterns can assume alternative forms, not tied to biological factors of course, but equally relevant from a sociocultural viewpoint. The moment of registration in the virtual world is considered by the community as the avatar’s date of birth, and for

this reason it is visible in the avatar's profile and defined as the "rez day"—in Second Life "to rez" means "to appear" on the screen—(Boellstorff, 2008), that is, the day on which the avatar took shape and substance in the world. Among the 21 participants, just 8 stated they remembered their rez day and, with one exception, they were all "midbie" (with some expertise) or "oldbie" (expert) avatars. The data suggests a connection between the avatar's experience in the virtual world and the perception of a "second life" and thus embodiment in the avatar.

Personal names are social labels, and birth is tied to the choice of a name. In Second Life the avatar has a name that marks him or her for the rest of his or her life. The research data shows that the choosing a name for the avatar is not a casual procedure, but involves a series of reflections that can be summarized:

- Connection with the real name (original name, initials of the original name, anagram of the original name, nickname used on the Web, assonance with the original name/last name, part of a relative's name, combined word created from the synthesis of the original name and last name)
- Elements tied to personality, tastes, and interests
- Aspects connected to one's professional life

The choice of the last name is simpler since Linden Lab, the proprietors of Second Life, until mid-2010 offered a list of last names the user had to choose from during the registration process. Since mid-2010, users have been able to register with a single-word username and can change their "display name" as often as once a week. This option may have changed user attitudes and the value of the "name" issue in terms of embodiment, but study participants all registered before the new Second Life rules were in place.

Study participants indicated their parameters of choice: language, assonance with the avatar's name, and connection with the user's origin (city, culture).

Isomorphism between the avatar's name and a unique identity not connected with other online environments is present for 17 participants, who stated that they did not use their avatar's name in their blogs, social networks, or Learning Management Systems unless it was an environment that had a connection with their activity in Second Life. This behaviour shows a tendency to attribute a unique identity value to their avatar which underlines a different perception of presence in the virtual world. The embodiment, as a process of attribution of identity value to the avatar thanks to its "growth" and development of a life cycle, is present in statements made by the participants in relation to the perception of a story about their second lives.

The “second life” is characterized, in fact, by frequent references to “development” in terms of the avatar’s improvement in appearance (gesture management), technical skills (being able to use the tools in the environment’s interface), social habits (communicating and interacting with other residents, making friendships, creating professional relationships), and professional activities (learning, knowledge sharing, and teaching). An interesting aspect is the participants’ perception of acting in a place that is felt to be customizable according to the user’s need. The avatar’s growth is also felt to be due to its capacity to modify his or her surroundings, create objects, and interact with them.

Actually the avatar’s growth seems to follow certain steps that, according to some participants, resembles the stages of development of an inductive learning process: a first phase of exploration, a second of reflection and systematization of knowledge, and a final verification. These different phases are also compared to the real life cycle of childhood, adolescence, and adult life, showing that life inworld is affected by time spent there, a time that is organized by the community and the avatar him- or herself.

I also analyzed the personal images uploaded in the profiles, taking into consideration shots and framing. Four different types of shots were used for the profile photo: “Close-up,” “Medium close-up,” “Mid shot,” and “Very wide shot” (where the subject is too far away to make out clearly). Different cases include the absence of a photograph in the profile and the presence of a photograph where the avatar appears with a companion.

Analysis of those photographs shows that most participants with a midbie/oldbie avatar have chosen to use a personal image in their Second Life profile—a close-up or a medium close-up, showing the details of the avatar’s face and thus consolidating his or her identity. Almost all participants who did not use any photograph in the profile were “newbie” (beginner) avatars.

This data indicates that the older the user, and consequently the more experienced in the virtual world, the more they seem to pay attention to their representation and public recognition as an avatar (Bodur & Bélisle, 2010).

I must point out that no participant uploaded a generic image to their profile, that is, images of cartoons, landscapes or logos, as often happens in online environments used for social interactions such as social networks and social media. In the Second Life profile’s features it is also possible, along with the avatar’s photograph, to upload a photograph of the user in real life, but almost all the participants chose not to do this. This could explain the peculiarity of an environment lived as an “alternate” world in which the resident’s presence is completely satisfied by a virtual body and identity.

Users dedicating such attention to appearance and avatar recognition are supported by data from the questionnaire and interviews. Elements of appearance such as body shape, skin tone, and eye colour seem to be rarely changed during the avatar's life cycle. It is necessary to point out that those aspects are the ones that most characterize the avatar, exactly as in real life—human beings are recognizable by their height, build, complexion, and other somatic characters. In Second Life it is very easy for users to change their avatar's build and somatic characters, but a high percentage of participants stated they had changed them just once or never, instead playing a great deal with clothes and accessories.

The avatar has not only a precise aesthetic identity but also a personality, as illustrated by the words of participants, who described their avatar using different kinds of adjectives and noun phrases which can be grouped into three dimensions of traits reinforcing the hypothesis that the avatar, in Second Life, embodies a complete identity:

- Physical appearance: slim, tall, beautiful, etc.
- Style: simple, fashionable, elegant, casual, classy, etc.
- Attitude: dynamic, independent, free, interesting, charming, hardworking, cautious, etc.

The social element of Second Life is fostered by different features of the medium which allow communication and interactions to take place in a variety of modalities and represents the unique aspect of this virtual world compared with other multi-user virtual environments.

The avatar seems to create a relationship space, as Weinstone states, “the idea of an avatar usually implies an embodiment that is intentionally crafted—the product of *techne*—and thus a ‘zone of relationality’ between persons” (2004, p. 40).

I also investigated the perception and value of the avatar's daily routine, life choices, and professional activities. Reputation, credibility, and professionalism were identified as social parameters. These three elements appear to be closely related and also connected to the avatar's appearance.

Reputation is the product of social relationships, activities developed within the community, and social and cultural initiatives that continue for an extended period. More than half of the participants stated that they felt they had a reputation in Second Life, and reported that, to obtain it, they had to live there socially and needed considerable time to create relationships in the group/community. Those who said they had no reputation inworld were newbie avatars who were still struggling to find their position within the community.

To have a reputation implies a series of duties, such as taking care of one's appearance to keep one's social position and credibility. A reputation is the result of commitment and proper relationships. Paradoxically, the reputation acquired in Second Life sometimes represents the "trademark" of the user as a professional in real life: one of the participants explained how, as a language teacher in real life, it was difficult to interact and be recognized by a community, but as an avatar her reputation affected her real-life professionalism.

According to the data, "professionalism" in Second Life for educators means being able to manage technical aspects inworld and be skilled at "building." The participants underlined the importance of showing their abilities as teachers to gain credibility.

The perception of different feelings and moods, such as feeling un/comfortable, frightened, or satisfied, are described as frequent in the avatar's life and these emotions are addressed in relation to social presence. All participants reported feeling at ease in the presence of friends, colleagues, and people who supported them in different ways. They often spoke about events when they were helped by mentors, especially in the first period of their new life.

As for experiences where participants experienced fear, discomfort, or discrimination, the data cover different scenarios:

- The use of stereotypes and unease at being judged for the role participants played.
- The presence of groups and the risk of being considered not appropriate and being excluded.
- The presence of a "griever" and the fear of being attacked or having one's avatar "invaded" by being engaged, hit, or shot.
- The sense of *dépaysement* when a place/land was felt to be unknown and risky.
- The sense of frustration when a participant was not able to follow an event/class.
- The discussions/fights that take place inworld and that can affect real life.

The aspect of satisfaction, instead, was strictly related to the possibility of creating, producing, and sharing a product or event. Satisfaction was tied to the development of activities that were immediately visible, concrete, and recognized by the community. These activities were, for example, the organization of exhibitions, cultural or didactic events, and participation in conferences.

The participants were asked if they ever felt a physical commitment to activities which normally involve the body, and there were 10 positive replies, almost

half of the sample. The fields they described being active in were the following: leisure/sport activities (horseback riding, cycling) and emotional/sexual activities (hugging, falling in love, having a baby, getting married, having sex).

Having romantic experiences that could result in relationships was an element strictly tied to the social aspect of the environment and the concept of embodiment. This aspect is also connected with the concept of life cycle I previously described; to be a couple and experiment with the emotional/sentimental and sexual components of a relationship is an extension of the potentialities of physicality in Second Life. Reification of the relationship may occur through the search for social formalization (wedding) and the creation of a child and/or a house to share with the loved avatar.

Some participants also indicated music, dance, and daily activities such as eating and drinking as sources of physical sensations. Participants reported being involved in different learning/teaching activities as examples of body involvement.

Conducting an analysis of the tools used in Second Life to foster and support interaction among residents and between avatar and the environment, I wished to identify how those tools can affect the value of embodiment. Within the dynamics of interaction, I focused on the opportunity to change point of view (POV) and be able to manage different perspectives.

All the participants, except one, used the four different options of POV, for reasons that can be summarized as management of the situation in its complexity, management of oneself, management of interaction with other avatars, and management of specific details in the situation. The POV options are:

- “Traditional view,” used to gain a general view of the surroundings and keep the situation under control.
- “Zoom,” lets the avatar orientate and identify elements or details.
- The pre-set “view of one’s avatar from the front,” used to observe oneself and imagine how one looks to other avatars.
- “Mouse look” view, a seldom-used option; it is important to remember that in Second Life the “first person perspective” is one in which, by default, the image of the avatar disappears.

Among the four available options, “mouse look” was the least used and it could be guessed that the user, using the “first person” view option, loses contact with his or her avatar who is no longer the protagonist of the scene. The phenomenon of *dépaysement* is clearly expressed by the user and some

participants' statements highlight its value, expressing the desire to see their presence embodied in the avatar.

The importance for the user to perceive the avatar as a body that occupies a physical space in the virtual world is strengthened by participant statements reporting the wish to observe and control the avatar, and observe and comprehend the avatars with whom they interact. The embodiment of the user in the avatar appears to be a primary aspect; to be able to look at oneself, to “physically” meet friends and colleagues becomes a need. The interactions that develop in Second Life are not comparable to what happens in a “blind” chat, according to one of the participants.

The wish to comprehend the other and be understood during a virtual interaction also explains the use of so-called gestures and animations to change the avatar's facial expressions, movements, and postures. The participants stated they used gestures and animations aimed at enhancing the effectiveness of interaction (expressing moods and sensations) both for their professional activities and daily routines to make their avatars act in a more natural way.

Since synchronous interaction in Second Life happens in a specific shared place, participants were asked how this could help/support a didactic event. The feedback received highlighted the following aspects:

- The chance to infer useful information from the position and movement of the avatars in space;
- The reproduction of dynamics similar to those developed in real life (but different from other online environments);
- The sensation of being part of a group or team.

These elements are connected to the concept of intersubjectivity and show how the shared space and meanings associated with the movements and postures of the avatars can have a relevant role in the process of mutual comprehension during an interaction that occurred inworld. The avatar represents what in real life is the face, a unique identification marker (Fedeli & Rossi, 2010) that, in “face-to-face” interactions, has an essential role for effective communication (Cole 1998). In Second Life, participants insisted on the relevance of being physically involved through affective/sensory-motor modalities, as reported by Zlatev. The process of sharing experiences also occurs on an “action oriented” participatory level and is based on bodily interaction represented by “empathic perception, imitation, gesture and practical collaboration” (2009, p. 14).

One of the most basic aspects of the research question that deals with the value of the embodiment concept to the teaching/learning process refers to the

participants' feedback about the different perceptions that occur in the virtual world compared to other online environments used for education/didactics. Due to the possibility of having a shared physical space perceived as "lived" and "alive," and because of the movements and actions of the avatars, we can say that the interactions that occur inworld are embodied in the consequences and effects they have on both the environment and avatars themselves. Such a situation resembles, according to many participants, one that can occur in real life in face-to-face classes, where teachers and students share either a classroom or a lab and their interactions are also affected by the spatial relations among them.

Sharing a space facilitates collaborative work by enhancing group cohesion; that sense is clearly expressed with the word "team" used by more than one of the participants. In the participants' words there are often expressions tied to the concreteness of the virtual space and avatar, such as the use of the verb "to rub oneself" which implies the physical presence of a body. A relevant aspect tied to the concept of embodiment is the use of "building" and "scripting" in Second Life to create educational content; the "prims," that is, the basic elements used to build inworld, offer the chance to "embody" disciplinary concepts. A 3D map built by a student that can be touched, manipulated, crossed, and visualized in different perspectives, transforms a mere representation (such as a 2D map developed by a graphics editor or a desktop/online application) to a bodily experience interpreting an enactive approach to cognition (Varela, 1990). The experience of building allows the avatar to be active and not just involved in a visual experience.

Data I gathered during the three focus groups show that the participants need to find new ways to contact with their students in order to make online educational practices more interactive. Participants who had previous experience in e-learning report the peculiarity of Second Life in relation to the dynamics of interaction and collaboration already described through data from the interviews.

For some participants, activities in Second Life seem to have developed interaction and group management skills that made relationships with students more productive. Both students and teacher perceived the educational process as a shared one; the teacher abandons a mainly directive role and is open to different modalities of interaction.

The process of design in Second Life seems to be greatly affected by the "learning by doing" approach. Creating and modifying objects makes it easier for the teacher to personalize and readjust his or her course based on the different learners' needs.

The example of the participant who reported using “prims” in Second Life to teach how to manage “blocks” in the Learning Management System Moodle demonstrates how the 3D building and direct manipulation of objects can be used to facilitate comprehension and memorization. The action of “building” becomes the foundation of the course’s design, and practical “hands-on” activities stimulate the development of cognitive skills.

Participants also underscored the relevance of designing activities that can take advantage of opportunities to act upon stimuli from multiple sensory channels or modalities. Multimedia becomes the tool by which it is possible to acquire a concept in a modality that can be defined as “synesthetic.” One of the participants, describing an activity about musical education, reported using physical involvement to help students comprehend a musical tone. He referred to an activity structured as a game, in which the students were required to guess the instrument related to the sound they could hear, and to stand on the image of the instruments to check the correctness of their guess. That game was part of an interdisciplinary activity based on the fairy tale “Peter and the Wolf” (set to music by Sergei Prokofiev) in which, thanks to a multimedia approach, the music becomes an “object” to walk on and acquires new sensory characteristics.

These aspects, along with the participatory and evocative ones, emerge as the main elements of the didactic experience in Second Life and the most productive for a successful teaching/learning process.

Future Directions and Conclusion

Study results indicate that immersion and interaction, addressed as the main affordances of Second Life can be ascribed to the involvement of the user avatar’s body in many directions.

The level of interaction is determined by the quality of the user’s participation in the “life” of the virtual world in terms of identity, management of social relationships, and power on the world itself, a world that is continuously under development.

A 3D avatar is an online presence that establishes itself in all its identity values, demonstrating that the choice and creation of an avatar with a specific appearance, is a sensitive procedure that intensifies the effects on communication and the development of social connections. The avatar can rely on sensory motor and kinaesthetic skills to enhance the concept of a living physical body that has feelings, sensations, and grasps the presence of other avatars.

The experiences and reports of the participants in this study amply demonstrate the effect of “presence” in a reality that does not suffer from the privation

of a physical and relational space but, conversely, can take advantage of a situation of augmented cognition thanks to the phenomenon of embodiment.

The immediacy and depth of perception of one's own presence in the virtual world creates situations that can reproduce out-of-world (real world as opposed to virtual world) social dynamics. This reasserts what Krueger (1992) stated in the mid-1970s with his experiments in artificial reality, but with the difference that today we no longer speak of "visual" experiences. Instead, we deal with "embodied" experiences.

Second Life allows a practice of body involvement that fosters, in the didactic application, new questions and inputs that satisfy a learning model based on dialectics between "action/reflection" and "experience/abstraction," opening the way to a pedagogy that succeeds in "giving body to the thoughts and forms of thoughts to the body" (Manuzzi, 2002, p. 64).

The body-avatar is a source of information that helps create that common ground of experiences and understanding that develops intersubjectivity: I observe, share the same space and touch my interlocutors; my cognition is launched even from their presence. Second Life is a world that is felt to be real when the body-avatar experiences physical sensations and emotions evoked by lived experiences; the avatar intensifies the effects on communication and the development of social relationships (Merola & Peña, 2010).

The data gathered supports the hypothesis that experiences gained in the virtual world cannot be interpreted as merely representational. It is a real life where the user is not just a "resident" but actually builds his or her own habitat in environmental, geographical, and human/social terms; he or she experiences pleasure and satisfaction such as apprehension or embarrassment in a life that is "real," even if "other."

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4

(IN)ACCESSIBLE LEARNING IN VIRTUAL WORLDS

Robert L. Todd, Jessica Pater, and Paul M. A. Baker

Virtual worlds, or simulated 2D and 3D online environments (e.g., Second Life), have become an increasingly common software platform for education and training applications during the last decade (cf., Brown & Bell, 2004; Chou & Hart, 2012; Cremorne, 2009; deNoyelles & Kyeong-Ju Seo, 2012; Gerald & Antonacci, 2009; Jones, 2007; Kingston, 2011; Taylor, 2002). They hold the promise of opening new horizons for students and educators, but can also present unexpected barriers to access, especially for students who have disabilities (Folmer, Yuan, Carr, & Sapre, 2009; Forman, Baker, Pater, & Smith, 2012; Mancuso, Chlup, & McWhorter, 2010; Stendal, Molka-Danielsen, Munkvold, & Balandin, 2011). For the purposes of this discussion, a “virtual world” is defined as “a synchronous, persistent network of people, represented as avatars, facilitated by networked computers” (Bell, 2008, p. 2). Applying the definition of online accessibility from the World Wide Web, Web Accessibility Initiative (WAI—<http://www.w3.org/WAI>), “accessibility” refers to the degree to which people with disabilities can use the virtual world. More specifically, accessibility means that people with disabilities can perceive, understand, navigate, and interact with the virtual world, and that they can contribute to it. “Disability” in this context can be defined as any functional limitation (physical, sensory, or cognitive) that impedes a student’s ability to fully engage in the educational process, as compared to similar-age norms.

One common assumption about the educational uses of virtual worlds is that “immersion or “the subjective impression that one is participating in a comprehensive, realistic experience” (Dede, 2009, p. 69) can enhance the

learning experience. Researchers have also observed that virtual worlds offer possibilities for experiential learning, encouraging students to engage in problem-solving activities within a flexible environment that facilitates collaborative and constructivist learning (Cremorne, 2009). Educators have also been drawn to the potential that virtual worlds offer for distance learning, social interaction, and learner engagement (Chou & Hart, 2012). In these applications, the presence of avatars can enhance “engagement and learning beyond computer-mediated communication without such agents” (Jarmon, 2009). Researchers have also noted the capacity of virtual worlds to facilitate experiential learning (Jarmon, Traphagan, Mayrath, & Trivedi, 2009) via simulations, role-playing, and group work (Duncan, Miller & Jiang, 2012; Inman, Wright, & Hartman, 2010). Outputs like user-created content are also of particular interest. In many virtual world environments, including the relatively popular Second Life, students themselves become the creators of content, and mediate their own interaction and learning (Jarmon, 2009; Kingston, 2011). Although more recently there has been some disenchantment with the complexities of using virtual world environments, (deNoyelles & Kyeong-Ju Seo, 2012; Young, 2010), they remain popular educational tools. In this chapter, we will investigate a specific domain of user difficulties in virtual worlds, namely, accessibility issues, especially for students with disabilities. We will present key accessibility issues involved in the deployment of virtual environments for educational uses, focusing on popular fee-based (Second Life) and open source (OpenSim) platforms. These platforms were chosen because of the number of their concurrent users, the ability to create within them, and their use within the educational community.

It is important to note that we, the authors, are not end-users of the assistive technologies included in the chapter, but have consulted with end-users throughout the writing process via the BreakThru project (<http://www.georgiabreakthru.org>) on virtual mentoring, funded by the US National Science Foundation’s (NSF) Research in Disabilities Education.

Accessibility issues can make the uptake and use of virtual worlds in education a challenging concern, especially for institutions that have adopted full inclusion in their policies. But developers of virtual platforms, third-party software developers, teachers, students, and organizations based in virtual worlds continue to respond to these challenges, providing tools, guidance, mentorship, and promising practices to overcome difficulties and allow the platforms to live up to their potential as learning environments.

Accessibility Barriers

While virtual worlds offer unexploited potential for innovative educational practices, at this stage in their development they also present a range of potential barriers common to all users, as well as accessibility related ones that impact people with disabilities. General barriers, those common to all users, include issues such as:

- Reluctance to accept virtual worlds as a serious educational tool rather than a “gaming” environment;
- Potential technical problems for hardware, software, and Internet connections;
- Potential for distraction;
- Privacy issues for students;
- Legal issues;
- Development and maintenance costs;
- Authentication of individuals using the platforms.

In addition to these issues, *accessibility* is often a greater concern for people with disabilities (White, Baker, Pater, & Todd, 2011). Accessibility barriers inherent in many virtual worlds violate global demands for total “e-inclusion” and “eAccessibility,” which call for full inclusion of all users in information and communication technology (ICT), including users with disabilities (European Commission, 2012). Accessibility has not typically been a primary concern for most developers of virtual world platforms. Created environments typically rely heavily on visual stimuli and graphical user interfaces that assume relatively “normal” vision, eye-hand control, and dexterity (Folmer et al., 2009; Forman et al., 2012). Platform developers have placed some useful settings in many of the common virtual environments, such as customizable fonts, high- and low-contrast options, keyboard navigation, and sensitivity controls (Trewin, Laff, Cavender, & Hanson, 2008). Unfortunately, these basic user interface options are all that most virtual environments include. Additional technologies and design approaches (such as universally designed processes and interfaces) are needed to fully enable users with disabilities to access the entirety of virtual world interfaces.

Regardless of the platform, the level of accessibility provided is more limited by the time and resources available for the development of the environment than by any barriers inherent within the technology (Trewin et al., 2008). Ironically, the very richness that affords so many possibilities for inclusion,

participation, and dynamic interaction complicates the implementation of accessibility features, especially for those with sensory, dexterity, communication, and cognitive disabilities (Cremorne, 2009; Ellis & Kent, 2008; Forman et al., 2012). In many cases, “digital design is triggering disability when it could be a solution” (Ellis & Kent, 2008, p. 1). Particularly within educational settings, barriers to the delivery of content and interaction with instructors can limit the educational experience for students (Stendal et al., 2011).

A typical barrier to accessibility for users with visual impairments, for example, is a lack of metadata, that is, embedded code such as names and descriptions of virtual objects. One study found that in the popular virtual platform of Second Life, at least 31% of objects lack a descriptive name (Folmer et al., 2009). Overall, users with low vision present a special challenge due to the highly visual nature of the medium. Audio cues are required to orient the user and to describe the environment. By supplementing visual effects with audio, the vision impaired user could potentially react with the same degree of precision as sighted users. Studies that presented the results of this approach suggest promising results for user navigation, but note that there is a significant learning curve for users who have not yet learned to associate objects with their sound cues (Trewin et al., 2008). Text cues and object labels can provide increased accessibility for both users with low vision and users who are deaf or hard of hearing. Provided that these labels are as meaningful as alternative text on a web browser, they are a valuable addition that increases accessibility for users with disabilities, while also increasing usability for all users. Taken together, these accommodations increase the flexibility of the software to provide access to both populations.

Researchers note a need for more creative solutions that can tackle challenges generated by highly graphical and multimedia rich environments (Cremorne, 2009; Stendal et al., 2011). Sophisticated interface elements, scripting, Cascading Style Sheets (CSS), dynamic updating (e.g., Ajax), embedded video and sound, Adobe Flash, and reliance on mouse interactions all push the limits of assistive technologies and existing accessibility guidelines (Gibson, 2007) in virtual worlds and kindred environments.

An alternative approach to generating “fixes” to accommodate users of these highly visual environments is that of Universal Design (UD). In the context of information, Universal Design, or as it is called in the European context “Design for All,” is aimed at ensuring that everyone can participate in the Knowledge-based Society. The European Union refers to this using the terms eInclusion and eAccessibility. A three-way approach is proposed: goods that

can be accessed by nearly all potential users without modification, or failing that, products that are easy to adapt according to different needs, or use standardized interfaces that can be accessed simply by using assistive technology. To this end, manufacturers and service providers, especially but not exclusively in the Information and Communication Technologies (ICT) domains, produce new technologies, products, services, and applications for everyone (Stephanidis & Akoumianakis, 2005).

The UD approach is slowly becoming integrated in virtual worlds and games designed for the general public, increasing accessibility for users with disabilities in the process. Various software platforms are at different stages of completion with regards to accessibility features, and the open source community has supplemented the software with alternative clients that provide expanded accessibility options, particularly for users with disabilities. Sections of the Second Life Wiki (<http://wiki.secondlife.com>), for example, are devoted to accessibility issues, tips, and resources (see Second Life Wiki, 2011a).

Examples of Disability Issues Evident in Two Virtual World Platforms used in Education

Virtual world platforms used in education share many accessibility issues common to multi-user virtual environments (MUVEs), although they also differ as to particulars. This section provides a summary of accessibility issues in two platforms currently used in educational settings: Second Life and OpenSim. Both platforms are built on similar foundations, but have different approaches to content development. While Second Life was developed by Linden Labs, who remain in control of a majority of the servers and environment, OpenSim is maintained and developed by the user community. Both virtual environments are designed for large groups of users, and content is typically developed using inworld tools. Second Life was chosen as an exemplum because it is the most commonly used virtual world platform internationally for online education (Dalgarno, Lee, Carlson, Gregory, & Tynan, 2011; Duncan et al., 2012) and is the most-cited platform in educational literature (deNoyelles & Kyeong-Ju Seo, 2012). OpenSim has been included in this review to provide an open-source option for readers, important for those users who cannot pay ongoing fees for proprietary platforms, and for those educators who want more complete control over the virtual environment. OpenSim was chosen among open source platforms because it maintains a high percentage of educational users (Dalgarno et al., 2011) and shares a high level of compatibility with the Second Life client

(Allison, Miller, Sturgeon, Nicole, & Perera, 2010), making it relatively easy to “port” virtual artifacts from one to the other.

Second Life

Second Life is currently the most popular virtual world platform used for education and entertainment (Dalgarno et al., 2011; Miesenberger, Ossmann, Archambault, Searle, & Holzinger, 2008; Warburton, 2009) in terms of number of users. It has been widely used by individuals with disabilities, who have given it mixed reviews. On the one hand, the platform has allowed some to be free of situations they cannot control in real life (Springer, 2009). For example, users can explore outer space with the NASA-sponsored MoonWorld (<http://moon-world.cet.edu>). Participation has also offered many benefits to users such as “[improving] spatial awareness, hand/eye coordination, and fine motor skills” (Springer, 2009, p. 42). On the other, the platform presents some accessibility issues that make it difficult for many users to participate.

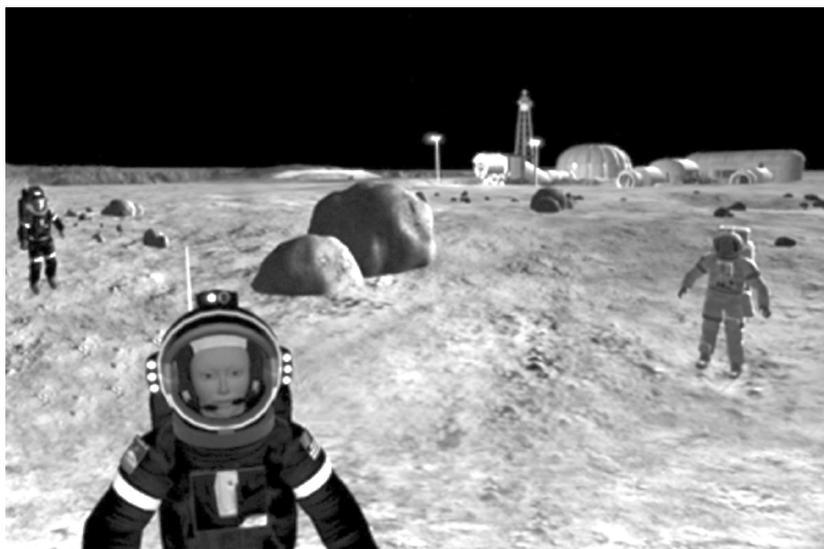


Figure 4.1 Moonworld: a Second Life learning tool for space exploration. Copyright 2011–2012 by NASA-sponsored Classroom of the Future, Center for Educational Technologies, Wheeling Jesuit University. Reprinted with permission.

Second Life has traditionally presented significant challenges to users with visual disabilities, especially blind users (Peters & Bell, 2007). Currently there is no set standard on providing metadata in virtual worlds, and therefore there is

little guidance for developers to address vision concerns. This can inhibit the interaction of users with low vision; they may not be able to perceive objects, relate to events, or even perform basic user functions without descriptive and informational tags. People using screen readers or other alternative methods to access Second Life often have difficulty moving about and interacting because objects in their virtual world are not defined. For this reason, many believe that virtual worlds, including Second Life, should be held to the same accessibility standards as the Web, including having alternative text for object and meta-information on behaviours (Miesenberger et al., 2008).

Moreover, the Second Life viewer was not designed to be compatible with any voice-output screen readers. These readers, such as JAWS (Freedom Scientific, 2012) or Window-Eyes (GW Micro, 2012) provide voice output for operating systems features, software applications, web browsers, and other normally visual elements of computer use. The lack of built-in compatibility with these readers means that they cannot effectively translate Second Life controls and environment objects into sound and speech. A few options exist to help minimize this problem. TextSL, created by the University of Nevada, is a text client that lets screen readers access Second Life. Unfortunately, at the time of writing JAWS was the only screen reader supported by TextSL. IBM has also developed a tool called the IBM Virtual Worlds Accessible User Interface (2011) to assist users with visual limitations. In addition to these, Virtual Helping Hands has developed the Virtual Guidedog (discussed later in this chapter), which uses an object to assist avatars of users with limited vision, hearing, or mobility. For users with low vision, Second Life also offers features to change the text size for the interface and chat.

In general, Second Life worked well for users who are deaf or hard of hearing, until voice features were introduced (Peters & Bell, 2007). Before 2007–2008, many users who were deaf or hard of hearing were pleased with Second Life because all conversations took place in text chat. Under these circumstances, people who were hard of hearing had the option to withhold information about their disability if they chose to do so. With the introduction of voice via microphone, if these individuals choose not to use the voice/listening features then they may feel forced to reveal the reason, therefore creating the potential for social and communication barriers (Carr, 2010). This presents a social/communication conundrum which these individuals claim mirrors real-life situations. Users who are deaf or hard of hearing and users with difficulty speaking have stated they sometimes claim that they lack the technical capacity to communicate in voice, as opposed to disclosing their disabilities.

Second Life also offers voice-recording capabilities to record inworld events, such as meetings and conferences. Voice chat is recorded to an audio file for later playback. While this feature helps users with low vision, it can create problems for users who are deaf or hard of hearing, as a growing number of Second Life events are now available only with voice recordings, not text. Second Life does not offer any transcription services. Users must provide transcriptions when preparing for events, or must outsource the service for a cost. For this purpose, Second Life recommends CastingWords (<http://www.castingwords.com>) or the Amazon Mechanical Turk (<http://www.mturk.com>).

Those who use sign language as a first language may face barriers to access similar to those with difficulty reading caused by slower written language skills. In effect, these individuals are forced to use a “second language” to communicate, since American Sign Language (ASL) is not supported by Second Life. These users often report a “lag” in textual communication, but few claim it is an insurmountable barrier (Carr, 2010). Frequent conversation partners tend to learn their reading/writing speed and accommodate them.

On the whole, users who are deaf or hard of hearing and users with difficulty speaking can generally participate in most activities in Second Life. Such users are distributed in skill level and engagement throughout the Second Life population, including some high-level builders and scriptwriters. Some engage with the Second Life disability community at large, while others choose not to. Despite these barriers, users who are hard of hearing still seem, as a whole, to be happy with the function and ability that Second Life offers (Carr, 2010).

Many Second Life users who have mobility limitations have expressed relative satisfaction with Second Life as well (Antonacci & Modaress, 2008). Some report that the platform opens doors, as those with limited mobility feel less constrained by functional limitations, since in Second Life, they can walk or even fly with ease. Some users with mobility impairments present themselves in Second Life using a wheelchair, while others do not. Other users switch back and forth between avatars using wheeled mobility aids and avatars that do not. Many users report the virtual world provides an opportunity to hide their mobility issues or present them to others in hopes of increasing disability awareness, with the power to choose which approach to take in specific situations. The reduced physical barriers are a positive point for those who have difficulty moving around in real life. Users can attend events or even travel to other countries that would have otherwise been difficult for them to reach (Antonacci & Modaress, 2008).

Even though Second Life is providing many opportunities for users with limited mobility, it is often difficult for those with severe dexterity limitations to manoeuvre their avatars. Simple functions such as walking or flying can be challenging. The viewer controls for camera and avatar motion in Second Life require precise, small click targets. However, using voice-to-text tools or alternative pointing devices, most users are able to participate to a certain degree in most functions in the world, and some are even able to participate in advanced functions like building or scripting. Second Life suggests many alternative input devices such as 3Dconnexion alternative mice, FrogPad (see <http://www.frogpad.com>), the Wacom tablet, the Kensington Expert Mouse, and so on (Second Life Wiki, 2011b) to assist users who have dexterity limitations.

Users with cognitive disabilities have not been addressed in literature to the same degree as other groups (Inman et al., 2010). However, in the limited research these users report increased feelings of inclusion since any delay due to cognitive issues could be perceived as multitasking between spatial, remote chat, and other activities in Second Life. Additionally, many users feel that the immersive qualities of virtual world environments allow them to focus their attention more effectively than they can on other computer tasks such as web browsing, which are discrete and asynchronous. Users with Asperger's Syndrome and autism often react positively to Second Life because it allows them to learn social skills that may otherwise be overwhelming or difficult to grasp in real life (Boulos, Heatherington, & Wheeler, 2007; Stendal et al., 2011).

Barriers for users with cognitive disabilities are typically a result of software complexity and difficulty learning virtual world skills. The learning curve for Second Life is already significant for users without cognitive disabilities, creating an even larger barrier for those with them. But experience has shown that these users can and do compensate, and given time they can become relatively proficient.

In addition to all of the populations we have described here, there are users who have perceptual difficulties in media-rich environments such as Second Life. These difficulties include vertigo from perception/movement in a virtual environment, seizures caused by flashing or moving objects, and migraines caused by moving or flashing objects, even the rate at which the monitor refreshes. In general, accessibility for these users has not been widely discussed. These conditions are often more incapacitating in the virtual world than in the physical one, and thus are not recognized as disabilities as easily as more common limitations. Because these issues can create adverse, difficult-to-tolerate symptoms, they often result in the recreational user abandoning

the virtual experience rather than seeking accommodations. Most users in this category who persist have an idiosyncratic way of adjusting viewer settings and their built environment that works for them specifically. An example is a user with perceptual limitations who creates default settings on Second Life so that visual images appear in a high-contrast colour scheme of black and yellow. This appears unattractive to most viewers, but allows this individual to navigate Second Life for hours at a time without headaches and related adverse symptoms.

Individuals with learning disabilities are another population that faces challenges in Second Life, but may also reap rewards. The platform's interface sometimes creates initial barriers to usage as it requires learning control and communication commands unique to Second Life. But given proper training and time to learn the system, students generally report success (Moon, Todd, Morton, & Ivey, 2012). Limited research has been conducted into the levels of impact these platforms have on the learning processes of those who do not fall into the normal student paradigm (Inman et al., 2010), but studies do indicate certain advantages. The dynamic nature of the platform allows for enrichment of the learning experience that is not possible with a traditional textbook or standard course management system. Because the artifacts created are most often persistent, students who need more time with learning objects have the ability to revisit them and take the time needed for mastery. Also, Second Life is a very collaborative and social tool, which lends itself to greater peer interaction and potential mentoring that can give students with learning disabilities another kind of assistance.

Despite numerous accessibility issues, Second Life remains a promising tool for users from various disability communities to interact in ways that would otherwise be impossible or very difficult. Second Life is also slowly adapting and providing alternative access tools as they are needed by the user community. The high number of active users with a range of specialized needs has raised some awareness of accessibility issues, both with the Linden developers and with users at large. The growing movement for usability and accessibility standards for virtual worlds within the World Wide Web Consortium and other bodies holds promise for improved experiences for users with disabilities (Moon et al., 2012). Once such standards are in place, it is hoped that virtual worlds like Second Life will become more accessible and follow more closely the precepts of Universal Design.

OpenSim

OpenSimulator (“OpenSim”) is an open source, community-developed virtual environment with basic features roughly equivalent to Second Life. However, the implementation of the software differs significantly. Second Life is a service; hosts purchase space from Linden Labs and sculpt a virtual world within the confines of the Second Life grid. OpenSim more closely resembles traditional software in that the goal is for individual users to create their own metaverse or shared virtual space where the end-user experiences a virtually enhanced physical reality and a physically persistent virtual space (Smart, Casico, & Paffendorf, 2007). The creators can choose to link these worlds to others or create a “walled garden” (Rogers, 2009) only invited participants can enter. World builders download the package from the OpenSim website and install it on private hardware.

Since OpenSim is based on the same protocol as Second Life, it suffers from many of the same accessibility limitations. The standard Second Life client does not become any more accessible when connecting to an OpenSim server than the Second Life grid. There are alternative browser clients for viewing both Second Life and OpenSim, such as Radegast (<http://www.radegast.org>) that make accessibility a higher priority. Unfortunately, OpenSim does not always mesh perfectly with these clients, and may require added effort on the part of developers if they are to be used. While largely similar to Second Life, the “plug-in” expandability of OpenSim and its community-driven development frequently makes compatibility an issue.

OpenSim’s largest drawback is not directly related to accessibility, but rather development. While an open source community potentially allows a very large pool of developers, the actual OpenSim community is relatively young, and thus small. The software is currently in alpha release, and not yet feature-complete. Community plugins have vastly expanded the project since its inception, but they almost universally focus on basic features rather than accessibility. In short, there is very little support for users with disabilities in the OpenSim community. This forces them to fall back on the same alternative clients and assistive technology that enable access to Second Life, while also requiring a far larger investment in time and code for those who choose to launch an OpenSim world.

Because of the strict controls within the Second Life platform, many have begun exploring how OpenSim could be used independently. Xplanet is an example of how independent researchers are making their findings more contextual and accessible (Dague, 2008).

Figure 4.2 is an example of how free and accessible content (xplanet.sourceforge.net) can be used to create an interactive 3-D learning tool inworld. Different layers can be used to analyze not only different attributes of the Earth but also other planetary bodies. These layers include historical, weather, and geological events (like volcano and earthquake activity) and other data.



Figure 4.2 Xplanet Globe tests in OpenSim platform.

OpenSim, because of the nature of the extensible platform, can be offered to individuals under the age of 18. The Teen Grid of Second Life was open only to individuals between the ages of 13 and 18, and was closed recently due to economic pressures within the company (Harrison, 2010). Because of the extensibility between objects created within these two platforms, many of these educators have moved to the OpenSim platform.

Assistive Technology Tools for Accessing Virtual Worlds

A number of assistive technologies can be utilized to make virtual worlds more accessible to users with disabilities. While most virtual world platforms are relatively inaccessible “out of the box,” third-party clients and standard assistive technology (AT) hardware can allow users to access many more features than would otherwise be possible.

Accessing a virtual world environment can be a difficult task for any new user, and a daunting or nearly impossible feat for users with functional limitations. A person with limited dexterity might have trouble just turning on a computer, and virtual world use can be a demanding endeavour. Users have to see the environment in which they are involved, chat privately or with a group at the same time, hear audio prompts/music/talks, get bearings for the lay of the land, be able to navigate to a specific destination, store and retrieve files for sharing, research objects for possible purchase, and many other tasks that for the most part require vision, hearing, cognitive, and dexterity functions. We have provided information on types of AT that can enhance computer usage and, by extension, virtual worlds in education. These examples must remain broad in order to cover the range of AT involved, but specific instances of this AT, along with purchase information, prices, and so on, can be found on the assistivetech.net website. The site is free to use and provides searchable indices of thousands of products that may be of assistance to virtual world students and educators.

A person with limited dexterity will have trouble using the full attributes and applications of a mouse and keyboard. He or she might have trouble gripping and moving a mouse, pushing the buttons, and rolling a small navigation wheel. He or she might also have difficulty in typing on, reaching for, and fully utilizing a standard keyboard. Many variations of mice and keyboards exist to accommodate a user's dexterity needs, along with certain accommodations that negate the need for a keyboard and mouse altogether. Such items include:

- Track and ball mouse
- Optical mouse
- Wireless mouse and keyboard
- Joystick
- Ergonomic mouse and keyboard
- Glove mouse or movement sensor
- Head pointer/mouse
- Adjustable keyboard/mouse tray
- Voice activation/prompt software

A person with low vision must be alerted when his or her environment changes, other users are trying to access them, events are starting, and when there are objects for possible retrieval and sampling. Users without disabilities rely heavily on their vision to navigate them through virtual environments. It is challenging to replicate all of the prompts, cues, and changes that a person with average eyesight will perceive so that a user with low vision can have comparable

functionality. However, AT attempts to deliver these prompts and cues through other sensory outlets. The visual accommodations for a virtual world experience include:

- “Thin” browser clients like Radekast and Metabolt
- Screen magnifiers
- Keyboard magnifiers
- Larger keyboard
- Text-to-speech software or screen readers
- Larger screen/display
- Low-glare screen filter
- Braille keyboard
- High contrast text displayer
- MaxVoice
- Virtual Guidedog (“Max”)

Virtual world users who are deaf or hard of hearing have less difficulty, as much of the virtual environments can be navigated with no audio. However, in educational environments, teacher’s lectures and class discussions are often provided via audio, a critical component of the user experience. Further, audio can provide interesting and informative cues, such as environmental noise, such as waves crashing when near a beach, music being played by a band, or an individual avatar broadcasting a playlist. A user might attend concerts, dances, lectures, and theatrics while in the virtual world. For these occasions, assistive technology might include:

- Sound amplifier
- Words-to-text software
- Environment sounds to text

The learning curve for virtual world navigation is relatively steep for all users. If users with learning or cognitive disabilities must access a virtual world, they might require further assistance and guidance. Such users might benefit from clear and comprehensive step-by-step instructions. The following outlets can provide support:

- Chat rooms, blogs, and technical support
- Easy and thorough instructions for accessing the virtual world

Overall, there are many accommodations that virtual world users might need in order to fully function and participate in a virtual learning environment.

Many users with disabilities will already have assistive technology that they use to effectively operate their own computer, while others will need more accommodations to utilize a virtual world setting. These needs tend to be very individual, and require specific tools and combinations of tools. See the “Examples of Virtual World Tools and Assistive Technologies in Practice” section later in this chapter, for examples of AT integration by users. In addition, there are two wikis that may be of assistance in helping students and teachers find the best combinations of AT and software tools to address educational needs. These are the ATWiki (<http://atwiki.assistivetech.net>) and the Second Life Wiki, especially the core article on Second Life Accessibility (Second Life Wiki, 2011a). In these, users share solutions to problems of interest, and since they are public wikis, all stakeholders may comment on and expand the articles. In general, reference to Universal Design for Learning (see the section on “Accessibility Barriers”) can help guide students and educators to make effective choices in AT and other tools.

Accessible Second Life and OpenSim Projects and Tools

The Second Life client provided by Linden Labs makes very little effort to provide accessible solutions to students. Likewise, OpenSim is based on the same basic software, and is in such an early phase of development that the volunteer developer community is more concerned with core functionality than accessibility. Luckily, there are a few projects in development that allow users to access these worlds using alternative clients with a stronger focus on accessibility for users with disabilities.

IBM AbilityLab Virtual Worlds Accessible User Interface

IBM is developing an alternative client for Second Life that is specifically tailored to users with blindness and low vision. Unlike the normal Second Life client, the IBM Virtual Worlds Accessible User Interface (IBM, 2011) de-emphasizes the visual nature of the world in favour of pure information. Sighted users may use the program, but the virtual world is not rendered pictorially. Instead, it is rendered in pure text that is accessible to industry standard screen readers such as JAWS. This is a major step forward compared to the base client, which is inaccessible to these software packages.

The interface is a Web 2.0 application run from within a web browser. It requires foreknowledge from sighted users with whom the interface user is interacting. Sighted users must equip an annotation item in the virtual world that allows them to select objects in the world to describe to non-sighted users.

The interface picks up cues from these objects that are then rendered as text descriptions within the browser window. It also allows users to record voice descriptions and transmit them to non-sighted users. These descriptions are contributed to a database of annotations that the interface user may access to learn about the world.

Accessible Online 3D Virtual Learning Platform

This is a collaborative project by the University of South Australia (UniSA), Flinders University, University of Sydney, Edith Cowan University, RMIT University, Monash University, and University of Sheffield (UK), conducted in consultation with accessibility specialists, legal advisors, and human rights representatives (<http://www.communitywebs.org/3dvle>). It builds upon multi-disciplinary approaches for the creation of an accessible 3D virtual world environment in Second Life and OpenSim to demonstrate the pedagogical benefits of an immersive, flexible, inquiry-based approach to online learning. The project focuses on 3D affordances to enhance experiential learning for undergraduate and graduate students. Simulation experiences are created that parallel problem solving in real-world environments. Developers employ techniques from simulation games to enhance learning and retention. Online teaching experiences seek to promote cooperation and knowledge sharing between students. The project's developers also hope to address the critical goal of assembling online learning and teaching standards for virtual worlds in education.

Radegast Metaverse Client

Radegast (<http://www.radegast.org>) is a lightweight, feature-rich non-graphical client, ideal for situations where a full 3D rendering client is not a feasible option, for instance while running the software on low-performance computers. It provides connection to Second Life and OpenSim-based virtual worlds.

Radegast supports a full array of Second Life communications features, including group and inventory management, friend lists, and many others. It includes a Bundled Speech plugin with text-to-speech and speech-to-text capabilities and adheres to standard accessibility APIs. Accessibility enhancements are currently only supported on Windows.

Virtual Guidedog

Max, the Virtual Guidedog (<http://www.virtualguidedog.com>) is popular among users with low vision. For those who are able to use graphical pointing devices, the Virtual Guidedog allows them to integrate this ability with some screen reading

capacity. The dog is a set of scripts that have a variety of functions, such as printing the names of nearby objects or avatars into chat, or going to objects and avatars on command. This functionality is limited to instances where Second Life builders have provided the necessary object information. The Guidedog screen reader is a plugin that runs on top of the standard Second Life viewer. Ordinary screen readers are unable to access Second Life chat windows, but the Guidedog's can. However, the screen reader does not know how to access many advanced features in the viewer, so the user needs to be able to use a mouse-like device to access full functionality. Some Second Life functions are accessible via keyboard shortcuts as well, but the number is by no means complete.

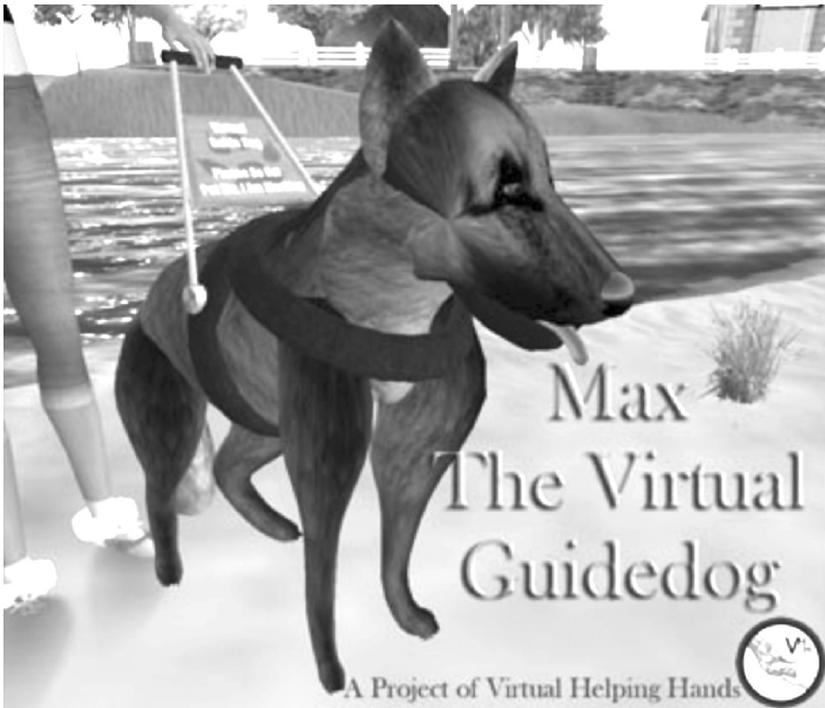


Figure 4.3 Max, the Virtual Guide Dog from Virtual Helping Hands. Reprinted with permission from Virtual Helping Hands.

Voice-to-Text Programs

Second Life is, at best, semi-accessible with voice-to-text programs (V2T) and there is a steep learning curve for learning how to use them because the user must have the ability to customize software. In addition, both Second Life and

V2T software tend to be memory-intensive, meaning that the user has to have a high-end computer. Overall, it is most useful for text chat and limited navigation, with an appropriate pointing device to augment navigation, building, and other 3D functions. Second Life is not compatible with “Say What You See” functions that allow advanced control of menus and other interface elements because the client does not have standard window classes. It would be possible to develop a client that does so, but one does not exist at this time.

Typical tools used for V2T in Second Life are Dragon NaturallySpeaking (Second Life Wiki, 2011b) and Dragon Dictate (2012). Many Dragon users have to rely on older versions of the software that have the Mouse Grid Command, and use the professional edition with extensive macro recordings. It may be possible for someone to record a package of Dragon macros for distribution, but this has also not been widely implemented. It is workable to both script and build in Second Life and OpenSim using V2T, although some functions require a pointing device. Many V2T Second Life users rely upon a “Dragon” guide published on the Second Life Wiki (2011b) and on mutual support to achieve their goals.

Space Navigator 3D Mouse and Other Control Devices

Some users with repetitive strain issues use the Space Navigator (3Dconnexion, 2011), a 3D mouse specifically designed for Second Life. This 3D device allows users with very limited dexterity to perform all essential control functions in many virtual world platforms, including Second Life. Other choices for those with severe dexterity limitations include “frogpads,” trackballs, head-mounted pointers, or a range of other common AT devices that act as mouse substitutes.

OpenSim Voice-to-Text

OpenSim allows the use of any Voice over IP (VoIP) system, and the integration of users who are on the VoIP system and not in the virtual world into conversations. This means that if a VoIP system were to have a usable voice-to-text transcription feature as an extension, it could be used with an OpenSim platform. However, as on the rest of the Web, automated voice-to-text is not particularly advanced in producing legible text, and more research is indicated for practical use.

Live Transcription Service

Most Second Life events held in voice use voice-to-text transcribers to provide a summary of what is being spoken. The service operates as it typically does in webinars and online conferences.

Examples of Virtual World Tools and Assistive Technologies in Practice

Combinations of assistive technology and promising practices are countless, but students and teachers within the BreakThru project have provided real-world examples of their use. Each of these students uses Second Life to communicate with his or her mentors and fellow students, forming virtual communities of support to help overcome challenges in science, technology, engineering, and mathematics (STEM) courses in secondary and post-secondary programs.

One student who is blind uses a text-to-speech software product (JAWS) in combination with the Radegast Metaverse Client to render Second Life visual data into an audible format. He employs a Braille keyboard to input data, along with speech recognition software. Within Second Life, he prefers to use a microphone for speaking and receiving information from other users, avoiding text chat whenever possible. Another student who has a dexterity limitation uses a joystick as an alternative “mouse” along with an ergonomic, large-key keyboard. She supplements these tools with voice recognition software as necessary. Within Second Life, she relies heavily on voice interaction, and asserts her preference to communicate with others via voice whenever she is expected to provide input. Unlike the blind student, she does not have a preference for voice over chat for receiving information, however. A third student, who has Asperger’s Syndrome and a medical condition that causes headaches from eyestrain, uses different accommodations. She alternates between using of the Second Life browser and the Radegast client. When using the Second Life browser, she uses its inherent tools to change the colour and contrast of her view to decrease eyestrain. Within the Radegast, she relies more heavily on text views with light graphical display. Unlike the students above, she does not use the microphone to speak and requests text chat only from users within the world. She explains that this accommodation allows her extra time to formulate appropriate responses, avoiding the awkward pauses and vocal mistakes that she tends to make in speech communication. Additionally, she uses a low-glare screen filter whenever she is online.

These are only three examples of the myriad accommodations possible for people with disabilities using virtual worlds. Each user is unique, and will require an individual solution. But understanding the breadth of possible resources and tools customizes solutions and therefore makes them more practical and effective in the educational environment.

Second Life Communities

With over 1 million monthly users (singularityu, 2011) on the Second Life platform, there are a variety of different communities that allow for greater collective sharing of best practices and solutions to give every user a way to maximize community connections. We have included several active communities that support people with disabilities. These often bridge the divide between the virtual and “real” worlds, and provide critical information and assistance to students with disabilities and teachers new to the platform.

Virtual Helping Hands

Virtual Helping Hands (<http://www.virtualhelpinghands.org>) is a non-profit organization that aids individuals with disabilities through coordination of virtual and non-virtual resources. Their primary goal is to make virtual worlds as accessible as possible to these users. They provide assistance and resources, and help to develop new technologies to remove barriers to accessibility. They manage four separate projects, including the Virtual Guidedog and SecondAbility Mentors.

Virtual Ability, Inc.

Virtual Ability, Inc. (<http://www.virtualability.org>) is a Second Life community with strong links to other virtual world non-profit organizations. They seek to “enable people with a wide range of disabilities by providing a supporting environment for them to enter and thrive in online virtual worlds” (Virtual Ability, Inc., 2014, para. 2). To that end, they have undertaken a project alongside ADL Company, an award-winning producer of education programs in leadership, management, and healthcare to develop AVESS: the Amputee Virtual Environment Support Space. Through AVESS, Virtual Ability, Inc. circulates best practices for delivering online services to military amputees and their families. The group has constructed demonstration environments in Second Life to test best practices, with the eventual product being controlled by the US Army on private servers.

Virtual Ability, Inc. also maintains close links to other Second Life resources and provides a list of their partnerships on their website. Affiliated projects include the Health Info Island in the Alliance Library System’s Information Archipelago, the Health Support Coalition, and the Accessibility Center.

Virtual Worlds and Learning Opportunities

Education via virtual worlds or other immersive 3D environments is not a new concept and has been explored since the early 1990s. Current platforms now provide for the ability to scale these types of educational projects from small pilots to larger initiatives. The declining cost of the enabling technologies, as well as a greater push for experiential and problem-based learning within educational practice contribute to the current environment that is favourable for these types of applications.

Assuming that adequate provisions are made for accommodating the needs of users with functional limitations, virtual worlds like Second Life and OpenSim offer a highly customizable platform for collaboration, simulation, and experimentation. Aside from documented benefits for students in certain disciplines—most notably languages, architecture, and traditional sciences (biology, chemistry, physics)—and for distance education students (Clarke, 2011), virtual worlds allow for the opportunity to manipulate the context and environment of an educational set of interactions.

From a curriculum-planning standpoint, virtual worlds can be deployed tactically in several different ways. From the perspective of the learner they offer a variety of methods to alter the context or presentation of the individual. For instance, in the case of individuals with communication limitations, the various communication modes available (text and voice), allow for the composition of a message in such a way that the hearer/observer, could be unaware of the disability of the “speaker.” This enables the communicator to focus on content and intent rather than being distracted due to concerns about what the “hearer” might map onto him or her based on instantaneous word-by-word communication. Several examples in application have been implemented, including many involving individuals with Asperger’s Syndrome or Autism Spectrum Disorder (ASD). Research indicates that virtual world text options provides many of these users with the opportunity to engage and participate with classmates in a relatively stress-free context (Gorini, Gaggioli, Vigna, & Riva, 2008; Parsons et al., 2000). In a very different example at Georgia College (Smith, 2012), Second Life has been used to supplement Spanish language classes by having English speakers interact with native Spanish speakers. Project personnel have noted that the virtual environment provides affordances for language learning that would not have been possible in person, eliminating geographical barriers between native speakers and allowing for voice and gestural nuances to enhance the learning process.

From the standpoint of the teacher or facilitators, these environments open up the opportunity to mentor students or learners in a manner that might be more cost-effective, convenient, or in some cases, practical. It allows for the opportunity to build teams of cross-cultural individuals or people with variable capabilities in non-geographically limited ways. For instance, while Second Life has been used to run model United Nations simulations (majenh, 2009), it would also be an ideal space to experiment with a similar venue focused on students with disabilities. Another recent initiative using Second Life for learning purposes is EmployAble (<http://www.cds.hawaii.edu/employable>), a model virtual reality employment orientation and support centre using Second Life as a platform to provide training, networking, mentoring, and employment resources for people with disabilities and connecting them with potential employers, developed by the Center on Disability Studies at the University of Hawaii.

Below we have listed some of the more important potential outcomes that educators could see from the use of virtual worlds in the learning process.

Individualization

Customizable user-generated content is one of the most critical functions offered through virtual worlds. On platforms like Second Life, relatively novice users have the ability to create unique and dynamic “inworld” artifacts. These virtual objects can be marked and tagged with metadata that allow for richer interactions and greater personalization. The creation and manipulation of these objects is something that is almost impossible in the real world. For people with disabilities, this could mean many different things. The primary benefit is that multiple learning styles can be accommodated and supported simultaneously. Objects can be made more prominent and certain data can be incorporated if attention needs to be called to a certain piece (Standen, Brown, & Cromby, 2001). Different pathways of knowledge acquisition can be represented in the same space so that the simulation or lesson supports individualized learning needs for unlimited numbers of students. This is important when taking into consideration the vast array of different learning and psychological disabilities, and how they have different impacts on the way students learn.

Mediated Consequences

The capability of creating user content as well as real-time collaboration with many different people and objects can be both challenging and exciting. Because of the dynamic environment, the learner has the ability to experiment with educational applications and objects, the presentation of self as a learner or member

of the community, and the construction of self-produced content. If the same kinds of experimentation were to take place in the “real” world, the learner could suffer potentially humiliating or dangerous consequences (Cromby, Standen, & Brown, 1996). These consequences can be mediated or negated through the use of virtual environments and, by doing so, can build confidence and self-empowerment within the learner. These types of mediated “playgrounds” are rare within the everyday space of the classroom and have potential for positive outcomes, especially for students with various types of psychological disabilities (Gorini et al., 2008).

Access to Mentors

Because of geographic distances or the lack of integration with formal disability-focused communities, many learners with disabilities do not have the opportunity to meet and form relationships with peers who share the same health or social experiences. Within the health field, virtual worlds and other online communities have been used successfully to create community within specific sectors of the population. “E-mentors” formed within these communities can play a significant role by providing a consistent presence online, acting as a catalyst for a majority of the communication and action within the environment, and promoting relationships between other participants (Cantrell, Fischer, Bouzaher, & Bers, 2011). Applications within the disability field have proven successful in programs like the BreakThru project that connect students with disabilities and mentors via a virtual world in an effort to increase student confidence and participation in science, technology, engineering, and mathematics (STEM) classes. While online communities have served these purposes for many years, virtual worlds allow for a more interactive, individualized, and immersive experience for both the learner and the mentor.

Future Directions and Conclusion

Virtual worlds hold the promise to be exciting and powerful tools for teachers and students, allowing modes of interaction, expression, and creation never before possible in the classroom. As a relatively new form of ICT, it is to be expected that available platforms and tools are subject to rapid change, and so generalizations can be difficult. But it is still fair to say that in their current incarnations, virtual worlds as a whole do not make the most effective use of potential affordances for all users, in keeping with global demands for e-inclusion and eAccessibility. There is still considerable work that must be done to popular platforms such as Second Life and OpenSim before they provide a fully

welcoming environment for all users, especially those with disabilities. In this chapter we have indicated many of those weaknesses, and it is hoped increased awareness of such barriers will lead to more inclusive tools in upcoming virtual world builds. Virtual world users and researchers can assist developers by providing ongoing feedback of their needs, illustrating accessibility problems, and suggesting solutions.

In the meantime, it is the responsibility of all stakeholders in virtual education to work toward more accessible virtual world environments. Third-party software developers have provided exciting and effective tools to help students accommodate their needs. Students themselves continue to discover ways to use the affordances of their platforms, such as peer support through the virtual world itself, to solve problems and achieve educational goals. Teachers have contributed markedly to the process by sharing their teaching techniques, promising practices, and published research on virtual world education. Parents and student associates continue to be advocates and provide peer support for students working to overcome obstacles.

Fortunately, the nature of virtual world platforms creates affordances for this intercommunication. Users are able to meet, communicate, and share promising practices and information on assistive technologies. This requires basic access to the platform in question, but once it has been achieved, the virtual world can be a source of assistance in improving accessibility.

Specific examples of empowering communities include Second Life's Virtual Ability, Inc. and Virtual Helping Hands, explored previously. Each functions as a node within the virtual world to share information on improved access for all users. Members and guests can interact freely within their island spaces on Second Life to help guide users throughout the process of accommodation, sharing online artifacts, and enabling scripts, such as the Virtual Guidedog, directly. In addition, they are typical of inclusive nodes within the platform in that they each have websites that provide guidance and communication portals to knowledgeable members. These websites can assist users who have not yet managed to gain sufficient access within the Second Life platform to seek solutions inworld. These communities, and many others like them, hold the promise of peer-generated solutions to many access issues and therefore more complete inclusion of students within virtual world educational settings.

Furthermore, many of the assistive technology tools discussed have user communities with a history of peer assistance, including website, email, discussion boards, and inworld guidance (see the BreakThru website, for example). Tool developers and users take advantage of common social media sites such

as Facebook and Twitter to reach potential users and communicate solutions. Examples include the developers of the Virtual Guidedog and the Radegast Metaverse Client. It is typical of users and developers to employ a range of “new media” tools to disseminate information, adding further access possibilities to users who have not yet achieved fluent communication within the platform.

The virtual world platforms themselves, depending on the underlying technical constraints, can handle a myriad of different (accessible) activities to support learning and encourage enhanced user engagement. The most popular additions include layering modelling, simulations, gaming, and real-time sensor integration into the learning construct developed inworld or within the platform. These “additions” allow for further social integration and educational immersion of the content. As we discussed throughout this chapter, the ability to further enhance the experience with user-generated content allows users to personalize the environment, and therefore can engender feelings of belonging and acceptance.

Accessible experiential learning encourages students to engage in problem-solving activities within a flexible environment that can facilitate collaborative and constructivist learning. Coupled with the potential virtual worlds capacity for distance learning, social interaction, and learner engagement, virtual worlds open entirely new approaches and possibilities for more inclusive communities of learning.

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BENEFITS OF SECOND LIFE IN THE AGEING POPULATION

Ann Smith

The Internet, now central to our economic, cultural, and political lives, is used to deliver public services, personal communication, and as a vast source of information and entertainment. The United Nations estimates that one-third of the population living in developed regions and one-fifth in developing areas will be aged 60 and over by 2050. The task of addressing the well-being of people in their old age is a massive one now faced by governments and local authorities.

In this chapter I discuss studies that were conducted with elderly participants from the Gaer and Stow Hill communities (Newport, UK), which has the largest proportion of seniors in Wales (Office for National Statistics, 2001). I also highlight the need for specialized training and continuous support for the elderly who must feel secure in using digital technologies. This study further illustrates that regardless of the individual being a novice or advanced internet user, training and support for digital technologies is an important factor and essential for them to continue to be regular users.

Background

The world's population is ageing drastically—every second, two people turn 60. By 2029, one-third of Europe's population will be over 60 years old, with Japan and North America following close behind (United Nations, 2008).

The ageing population presents major economic and social challenges to governments, such as the enormous demand it has on health and social care services, but these resources are essential as they help to provide the elderly with richer and more fulfilling lives.

The definition of what is considered a virtual world has long been discussed and argued within academic research. Most definitions of virtual worlds require that

1. virtual worlds should be persistent and shared by a large number of users;
2. interactions in virtual worlds are fed back in real time to users who are represented via avatars (Siriaraya & Ang, 2011, p. 2).

One such virtual world is Second Life, an avatar-based social network. Users in Second Life can not only socialize with other users but also participate in activities such as purchasing and creating virtual goods such as clothes. Most research conducted about virtual worlds focuses on mainstream users, who are usually teenagers or young adults (Yee, 2006).

Deep interpersonal relationships can be found inside virtual worlds—researchers have pointed to the existence of romance (Winder, 2008) and support groups (Norris, 2009) in these environments. Other studies have identified communication, cooperation, and collaboration as important determinants to user acceptance of virtual worlds (Siriaraya & Ang, 2011, p. 2).

Problems Supporting the Ageing Population

It has been forecast that the “50 and older” population will grow 68 times faster than the total population between 2000 and 2050 (Heet, 2003). In the UK alone, by 2020 over half of the population will be over 50 (BBC News, 2008). Thus there is a growing need to address how the ageing population interacts effectively with advancing technologies and its benefits. The world’s population is living longer, but disability, old age, and less available wealth create barriers that prevent access to further education, impede understanding of health issues, increase social isolation, and reduce well-being.

Advancing Technologies

The world’s population is living longer, which means an increasing proportion will have to remain in the workforce for longer as well. New digital technologies such as distance learning and the Internet have been widely used in order to make learning accessible to the public and the elderly, with different age groups using information and communications technology (ICT) in different ways. In the twenty-first century there are emerging and exciting new technologies that could help increase older people’s participation in daily life, such as high-speed broadband Internet access, social networks, and virtual worlds. If this demographic is shown how to use these technologies correctly, it would

improve their social interaction, lifelong learning opportunities and sense of control. For example,

- Social interaction: new ways to interact with family, friends, and communities. For instance, Cesta et al. (2010) used robotic platforms for tele-presence with features enabling social interaction.
- Learning and skills development: new lasting skillsets for motivation and personal development; these could include learning services, communities, or technologies tailored to older people. They could use technology to provide their experience and time to teach students of all ages, regardless of their location (Maurer, 2003).
- Increased personal control: enhances older people's participation in society, whether by learning new skills, engaging in hobbies, or using advanced digital technologies (Kostka & Jachimowicz, 2010).

Edutainment and Infotainment

Important educational tools for the future include games, virtual worlds, and entertainment that educates while being enjoyable, allowing people to learn through examples. Generally they combine experiences of entering a fantasy world and manipulating the features or characters in an animated environment in the form of a game or story. Typically, stories and gaming are central, with simulations creating a learning environment that is as entertaining as much as it is educational (Henry, Douglass, & Kostiwa, 2007).

Beyond gaming are the virtual worlds such as Second Life (Kumar et al., 2008) and unlike online games, these virtual worlds offer a faultless continual world where users can freely roam as avatars of themselves, without predefined objectives. Younger users find navigating and roaming through virtual worlds, engaging in new social interactions with strangers, and dynamically changing content unproblematic, but with the cognitive declines of older adults, this can make learning and use of such technologies very challenging. Older users also do not cope well with hidden functionality in interfaces (Sa-nga-ngam & Kurniawan, 2007).

Community-Based Training for the Elderly

Training sessions were conducted in the low-income communities of Newport (UK) with a group of 20 elderly individuals. They were introduced to Second Life and the benefits associated with this virtual world.¹ The success of the training led

¹ The name of the Second Life island used by the students is IDL Newport Hub.

us to implement and design a pilot study (Chilcott & Smith, 2011) for two women over seventy-five years old from the training group. It provided one-to-one training lasting for three weeks (Figure 5.1), meeting once a week for two hours, and thereafter meeting regularly in Second Life for island-hopping and chat. Twelve months after the first training session, we revisited the pilot study participants. We were interested to hear if they were still using Second Life (or other digital tools) as a tool for edutainment and its social aspects. Finally, with the two pilot study participants acting as mentors, we provided another training session for a group of eight elderly individuals. The average age of the participants was 64.5 years old, with the youngest participant being 50 and the oldest being 79.



Figure 5.1 The real and virtual participants using Second Life.

Objectives and Aims

The main objectives and aims for the community-based Second Life training sessions and pilot study were:

1. To provide effective training and support to the community using Second Life: We found engagement was one of the most crucial factors. Effective training provided the users and local communities with the appropriate start-up skills and initial confidence to use Second Life. Effective support requires an approach such that all questions are treated with respect and understanding. Without this, a firm foundation for ongoing learning would not have been created, affecting the success of the project.
2. Provide new learning and interface methodologies for the virtual worlds tailored to the ageing population: Older users often need more assurance,

and their anxieties and fears are often compounded by computer problems that may be mere annoyances to younger, more experienced users. The elderly typically require more time and coaching than younger users, and we discovered that it was very challenging for this group to use the mouse and look at the screen at the same time. Second Life has many interfaces, fast-moving graphics, and “real life” interactions (which the older users found terrifying initially) that would have resulted in disengagement if all of the above had not been planned for and catered to by the project (Fisk, Rogers, Charness, Czaja, & Sharit, 2009).

3. Determine if virtual worlds enhance well-being and reduce isolation in the ageing population: As well as the older population’s financial and health status, subjective measures of their well-being and quality of life can be sensitive to major life transitions such as retirement, and such subjective measures aid our comprehension of these issues. (RAND, 2001)
4. Determine if virtual worlds enhance appropriate lifelong learning for the ageing population: There are areas in SL for learning that could help improve the financial and social long-term needs of an ageing population.

Approaches

Training Methods

Group-based training provided the means to introduce the elderly individuals in the study to the benefits of Second Life in a secure environment where they felt comfortable. Those interested in exploring Second Life on their own were supported with one-to-one training, so that they could address any issues that may be affecting their performance without fear of being judged.

Interview Methods

In order to understand the engagement of older people in virtual worlds, we carried out qualitative semi-structured interviews with those who were using or interested in using Second Life.

Qualitative Research Methods

These methods allowed us to identify how users perceive and use a particular technology (Cairns & Cox, 2008). This was useful for us to achieve an in-depth understanding. Specifically, semi-structured interviews were appropriate

because their flexibility allowed us to formulate a generalized understanding of various issues related to elderly users in virtual worlds (i.e., Second Life).

Interview Structure

The structure of the interviews gave us a broad understanding of the factors perceived by older people to be important in their interaction within virtual worlds. We constructed our interview questions to cover a range of dimensions:

1. Elderly users: Their demographics, characteristics, interests, anxieties, and usage patterns of virtual worlds (if any).
2. Social interaction: Factors that affect the formation and maintenance of relationships for older people in virtual worlds and issues they perceive to be important in communication and socialization.
3. Education: Could they see the potential of using virtual worlds to gain knowledge, such as visiting heritage sites or exploring areas with information about health-related issues?
4. Benefits: What were the benefits perceived by older people in using virtual worlds?

Interface Learning and Design

Designing new interfaces for virtual environments would first require us to understand how elderly users perceive and prefer to interact and socialize in such environments. This knowledge could be used as a reference for further research and help designers create virtual environments that better match their preferences and requirements.

Findings and Discussion

Objective One: Training

In the first training session there were 20 elderly users who participated in the interview. Of the participants, 15 were female and 5 were male. Most of the users (75%) reported themselves as not being frequent users of Second Life or hadn't even heard of it. Of the elderly users who said they were comfortable with using computers and the Internet, most used Skype and email as communication tools.

When analyzing the results from the study of those using virtual worlds, we found a number of interesting themes. A large percentage of older people who have started using SL were in some way limited in mobility either due to a

physical disability, the effect of old age, or not being willing to go out at night. This was one of the reasons for them being interested in learning about and using virtual worlds. We discovered that participants in the interviews were willing to learn more about virtual worlds, which indicates that some older people are indeed interested to learn about a new technology (Czaja & Lee, 2007).

Objective Two: Interface Design

During the study, our analysis revealed that the keyboard and mouse navigation commands used to control avatars were mastered by most of the participants; but we also discovered that some navigation tools in Second Life may be unsuitable for exploration by older users. For example, some participants indicated that at times they felt confused and puzzled when attempting to fly around the virtual spaces, and on several occasions experienced an emotional upset similar to feeling lost in the real world. This requires additional investigation, as walking, rather than flying, was indeed deemed to be the favourite technique for manoeuvring around. Perhaps this may be because elderly users have a strong emotional connection to their avatars, regarding them as real entities rather than just virtual digital characters.

Since the pilot study, the interface of Second Life has changed dramatically (with no obvious feedback or informed consent of the users). Linden Labs significantly updated their software, and this has confused elderly participants. With the interface change and no re-training, they felt uneasy with the technology and too afraid to continue to use Second Life as they had before. They said that the interface was not familiar and the new design was directed toward the younger population of users. To support their conclusion, their grandchildren had no problem adjusting to the interface change, but for the elderly users it was too much and they lost interest.

Objective Three: Social Interaction

Ageing and mobility barriers continue to influence the elderly with how they maintain real-world social contact over time. For many, their social activities are increasingly restricted to daytime appointments due to growing levels of fear and apprehension attributed to leaving home after dark. From our analysis, we noticed that older people at first seemed embarrassed when interacting with other avatars, and had feelings of wariness about providing appropriate responses. After independent and regular usage of Second Life, having regular daytime meetings with their virtual friends and supporting one another in communication and navigation mechanisms, their confidence grew.

During the study we discovered that the elderly identified with their avatars as “themselves” (as real people) rather than digital beings, and they had strong bonds of embodiment and feelings about their digital characters. For example, when the participants were exploring the islands and meeting new and unfamiliar avatars, it was apparent that on occasion they experienced a sense of uneasiness because of unsolicited communications from others. This raises questions about whether there is a need to protect future study group participants from uncomfortable interactions and if a more secure and safe environment should be introduced.

The main disadvantage of using Second Life from an elderly point of view was the uncertainty of the virtual world. They did not like talking to or following an avatar they did not know. Instead, they preferred to know the avatar by his or her real name or be able to recognize him or her (e.g., facial features). Once again, this mirrors older users’ behaviour in the real world, where they would not approach a stranger and start talking to them.

Objective Four: Well-being

Second Life is a unique communication environment, where users who are actively absorbed in the virtual world can become emotionally involved with other avatars (Taylor, 2002). Although it is only digital interaction, the feelings created can be equal to those found in everyday existence. While real-world social interaction is available to seniors at the community centre (through attending clubs), it does not impact on the real life experiences of the majority of the community’s inhabitants. This is due to a lack of confidence and social barriers, with elderly residents becoming increasingly housebound in their later years.

We discovered after watching elderly users partaking in several digital trip experiences that they found many of the virtual places they visited exciting; however, the group also thought that the design and artistic experiences of these virtual islands were more often developed for a younger audience’s taste. Thus, perhaps there is a need for new design methodologies tailored to elderly subcultures (Boellstorff, 2008). This view is in conflict with elder users’ desire for youthful (younger-looking) avatars and indicates that virtual world design is a significant feature in ensuring well-being and continuing social interaction in virtual places for this age group. In summary, there is a need for additional studies to examine the reasons for (and the impact of) looking younger in Second Life, rather than simply using an avatar that more closely resembles a user’s own (actual) age.

Objective Five: Edutainment

The elderly community's learning experiences in the Newport area have taken a number of forms. For example, the local history clubs are well attended and there is a focus on lifelong learning. These learning experiences are driven by demand and are regarded as flexible and smooth. The ability to exploit the immersive medium of Second Life offers a novel prospect for improved lifelong learning opportunities customized to the elderly's cultural interests and well-being. Figure 5.2 shows avatars from the study exploring an island for educational purposes.



Figure 5.2 Exploring the historical islands in Second Life.

Feedback from this study and the community training provided a surprising finding. Social interaction was not a priority for the group. Instead, individuals were more interested in the educational aspects of the virtual world, such as visiting islands that had a historical point of interest. They wanted to explore areas of historical interest and gain knowledge about these sites, since in the real world visiting such places would be impractical due to costs and problems with mobility (e.g., wheelchair access).

Benefits

The elderly users viewed virtual worlds as a kind of enabling technology (Winder, 2008) that helped remove age-related limitations. Second Life allowed them to

enjoy activities that were no longer possible for them in physical life, such as visiting historical sites. SL models these sites in 3D (in present or simulated ancient times), which allows the elderly to visit them virtually.

Future Directions and Conclusion

We hope the findings from our study could be applied to develop better virtual worlds and web-based interfaces that are tailored to elderly users as well as to younger adults.

Lifelong learning goals should be individually relevant and significant to the user, conducted in environments that provide a cost-effective direct learning approach that allows the participant to manage and have control of the learning process. Many adults over the age of 50 have realized that the enjoyment of learning often allows them to enhance their spiritual and personal development, and also allows them to become more aware of worldwide issues. The study clearly shows that Second Life is a tool that could enhance learning and entertainment. Mature adults favour learning techniques that provide easy access to resources, require small investments of their own time and expense, and allows them to begin learning without any major delays once they have decided to start the process. Second Life is a freeware online application that incurs no direct cost to the user (unless he or she purchases an island), but it does require a small investment of time for hands-on training.

Our elderly adult learners (regardless of age, gender, income, and education differences) normally preferred group-based learning methods, which allowed them to become more involved in their communities. However, a few keener participants were still willing to take part in smaller groups in order to gain extra exposure to and experience of Second Life.

More research is required for comprehensive study into the factors causing the digital exclusion of older people, using surveys with larger sample sizes, qualitative research, and Internet usage. The aim should be to develop a more detailed understanding of the factors specifically influencing older people, and exploring the types of content likely to encourage them to interact via their usage of the Internet and virtual worlds.

There is proof that the elderly are less likely than their younger peers to be stimulated by or engaged in virtual worlds, but when they do they have the potential to reap considerable benefits, such as increased social interaction, well-being, and edutainment. There is also evidence that there are sizeable

numbers of older people who are perhaps not having the amount of fun or social participation that they desire or deserve.

It is evident that immersive virtual environments have also not been fully explored or used as a possible positive technology that can be utilized as a social tool in addressing remoteness and edutainment (for elderly participants) in the information and digital world. For additional research we propose a focusing on extending present real-world social activities for older people, and developing a customized virtual context to help determine their suitability for the elderly; and identifying effective methodologies to apply Second Life training in a home environment in order to meet the well-being and active living challenges faced by our ever-growing elderly population.

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THE REALITY OF AUTHENTIC LEARNING IN VIRTUAL WORLDS

Helen S. Farley

Authentic Learning

Virtual worlds can be used to replicate the sorts of pedagogical activities used in classrooms and lecture theatres in the real world. They also provide an environment in which to explore emerging pedagogies, or allow the investigation of issues that might be too arduous, dangerous, or expensive in real life. In addition, the social nature of virtual worlds represents a manifest progression from discussion boards, augmenting existing communication channels by including those social and cultural conventions operating in real life, and establishing new ones that are unique to the environment (Good, Howland, & Thackray, 2008). Given the obvious affordances of virtual worlds for learning, there has been a tendency for some educators to claim that virtual worlds will overcome many of the barriers encountered in the provision of authentic learning.

Authentic learning places the learner in the environment of the doer, assimilating the skills and beliefs about a particular discipline or profession (McClean, Saini-Eidukat, Schwert, Slator, & White, 2001). This approach typically focuses on real-life, multi-faceted problems with learners working toward their solution often by using role-playing, scenario-based activities, illustrative case studies, or through participating in virtual communities of practice. The learning environments are inherently multidisciplinary and generally not constructed in order to teach theoretical ideas. Instead, authentic learning utilizes activities in which learners grapple with tangible learning contexts rather than with abstracted knowledge (Pimentel, 1999). The learning environment resembles

some “real life” disciplinary context or activity (Lombardi, 2007). These might include flying an airplane, nursing an ill patient, detecting financial fraud, or participating in a religious ritual. Duffy and Jonassen (1991) recommend that learners should use tools to perform activities that resemble those found in the contexts they will work in in the future. Of paramount importance is the creation of situations that let learners practise the proficiencies essential in the specialist environments where they aspire to work (Savery & Duffy, 1995). The goal is to prepare learners to do the kinds of complex tasks that occur in life. As a result of bringing learners into more authentic learning environments, educators hope that they will evolve from novices to experts (Roussou, 1997). It is argued that skills developed in virtual worlds contribute to expertise development, innovativeness, creativity, and other skills needed for the jobs of the future (Mishra & Foster, 2007).

Brown, Collins, and Duguid were among the first to suggest that knowledge is not independent but instead, is “situated, being in part a product of the activity, context, and culture in which it is developed and used” (1989, p. 32). They also exposed the separation between knowing and doing as a myth and proposed the value of a “cognitive apprenticeship” (Brown et al., 1989). Since that time, a number of authors have distilled lists of characteristics from that literature around authentic learning and those modes of learning associated with it, such as situated learning. A meta-analysis of some 45 papers led Audrey C. Rule (2006) to the conclusion that there were four broad themes in authentic learning:

1. Real-world problems that engage learners in the work of professionals.
2. Inquiry activities that practise thinking skills and metacognition.
3. Discourse among a community of learners.
4. Student empowerment through choice.

Though these themes are undoubtedly found in authentic learning contexts, it is useful to seek further clarification into what characterizes authentic learning.

After analyzing an extensive body of literature, Herrington, Reeves, and Oliver found 10 characteristics that they believed contained the essence of authentic learning. They wrote that:

1. Authentic activities have real-world relevance . . .
2. Authentic activities are ill-defined, requiring students to define the tasks and subtasks needed to complete the activity . . .

3. Authentic activities comprise complex tasks to be investigated by students over a sustained period of time . . .
4. Authentic activities provide the opportunity for students to examine the task from different perspectives, using a variety of resources . . .
5. Authentic activities provide the opportunity to collaborate . . .
6. Authentic activities provide the opportunity to reflect . . .
7. Authentic activities can be integrated and applied across different subject areas and lead beyond domain-specific outcomes . . .
8. Authentic activities are seamlessly integrated with assessment . . .
9. Authentic activities create polished products valuable in their own right rather than as preparation for something else . . .
10. Authentic activities allow competing solutions and a diversity of outcomes (2007, pp. 86–87).

These characteristics have been widely cited in the literature exploring authentic learning and discussion around them will form the basis for this investigation.

Many educators claim that “authentic learning,” or learning-by-doing, is the most desirable way to educate students, leading to a deeper, more complex, and contextual understanding of a particular discipline area. Even so, the reality is that it is often too difficult, expensive, or dangerous to provide these opportunities in the classroom or lecture theatre (Lombardi, 2007); hence educators have turned to virtual-world environments to create simulations of disciplinary or professional contexts.

Authentic Learning in Virtual Worlds

Technology can be central for helping to foster those proficiencies that enable learners to thrive in an environment where technology is ubiquitous and for facilitating authentic learning experiences. In addition, technology can enable the creation of digital communities of practice and provide experience for many of the tools in use by current practitioners (Rosenbaum, Klopfer, & Perry, 2007). With the advent of virtual worlds, educators heralded the arrival of a technology that could facilitate authentic learning in a relatively inexpensive and safe way. There are a plethora of virtual worlds available to educators; the most popular is Second Life, as it enables users to create content, has its own economy, and is inexpensive to access. For tertiary educators, these features of virtual world environments enable them to provide their students with authentic learning experiences that resemble real-world activities and scenarios. A

budding architect can design a building on a grand scale, walk around inside it once it is complete and move walls and shift staircases to craft more useable spaces. A soon-to-be surgeon can practise unfamiliar procedures on a patient who will not sue him or her and cannot die if something goes wrong. And a student of history will more fully understand historical events when he or she takes on a role and wanders around a battleground or participates in a significant legal trial (Farley & Steel, 2009). Participation could also increase speed in reaction times, improve hand-eye coordination, and raise learners' self-esteem (Pearson & Baily, 2007, p. 1). For certain disciplines, the educational affordances of a virtual environment such as *Second Life* are obvious (Salmon, 2009, p. 529).

Virtual worlds can act as venues for authentic learning by providing simulations. These can model certain facets of systems that may be inherently complex and allow learners to manipulate different parameters to observe the consequences of their actions (Rosenbaum et al., 2007). Learners are within and part of a constructed environment. Each one is an active participant, not merely a viewer of a static scene. Instead, they are engaging with the simulated environment in a way that resembles real-life interactions, rather than in response to embedded prompts. Authentic tasks cannot be successfully completed by learners alone, but can be handled with the help of peers or educators who demonstrate effective strategies (Jones & Bronack, 2007, p. 96). In addition, environments such as those provided by virtual worlds are invaluable when guiding learners to perform tasks that are prohibitively expensive or too hazardous to perform in the real world (Adams, Klowden, & Hannaford, 2001; Dieterle & Clarke, 2007). Well-crafted simulations deployed in virtual worlds can deliver safe and economic opportunities to facilitate authentic learning in an optimal way (Mason, 2007; Cram, Hedberg, Gosper, & Dick, 2011).

Even though the potential seems great, authentic learning conditions can be very difficult—if not impossible—to recreate (Griffin, 1995). More recently, a number of authors, while acknowledging the claims made around the potential efficacy of *Second Life* as a location for education (and more specifically authentic learning), also point to the lack of empirical evidence to support those claims (Good, et al., 2008; Vrellis, Papachristos, Natsis, & Mikropoulos, 2010; Mahon, Bryant, Brown, & Miran, 2010). Even before the widespread adoption of virtual worlds, social scientist and commentator Sherry Turkle warned against claims about the efficacy of new technologies in this arena. She suggested that even though new technologies provide opportunities for learning, there is considerable risk that because the virtual is deliberately compelling, and since virtual technologies are usually primarily designed to provide entertainment,

educators believe that they are achieving more than they actually are (Turkle, 1995). Though experiences in virtual worlds can be immersive and engaging, they still may not be authentically educative for the user (Jackson & Laloti, 2000).

Some Factors Influencing the Success of Authentic Learning in Virtual Worlds

Virtual worlds are viewed as places where anything is possible; the most elaborate buildings can be constructed, and models of biological systems can be designed with impressive attention to detail. A simulation of a living cell can be crafted with intricate recreations of organelles, chemical messengers whirling around the cytoplasm, and receptors sitting on the cell membrane waiting for hormones that will switch it on, switch it off, or induce it to self-destruct (apoptosis). Biology students can push through the cell wall and watch these processes up close—maybe alter the parameters to check how that action changes the cell's responses. In another part of the virtual world, nursing students figure out how to treat a woman with a post-partum hemorrhage. Should she sit up or lie down? Is it too soon to call for a doctor, and how can her husband be calmed down (Honey, Connor, Veltman, Bodily, & Diener, 2012)?

Because such a large amount of detail can be incorporated into a virtual world build, it is tempting to believe that authenticity is embedded into the learning for which that build was designed. As I mentioned above, authentic learning is a multi-faceted process with many complex and interrelated characteristics. To truly ensure authentic learning is achieved in these environments—or any environment—it is necessary to fully consider all that authentic learning entails.

The Kinds of Knowledge Appropriate for Authentic Learning in Virtual Worlds

In discussing authentic learning in virtual worlds, we are talking about a wide range of professions, disciplines, and associated activities. A quick survey of the literature reveals examples of firefighting and evacuation training (Buono, Cortese, Lionetti, Minoia, & Simeone, 2008), commerce education (Schiller, 2009), community nursing (Schmidt & Stewart, 2010), and the acquisition of pre-clinical skills for dental students (Phillips & Berge, 2009) all happening in Second Life. Some disciplines such as psychological counselling are heavily reliant upon developing effective verbal communication skills. Yet others require the acquisition of practical, physical skills such as veterinary surgery or pipe laying for road construction. Given the diversity of skills that need to be acquired across all disciplines, it is not possible to say with any degree of

confidence that virtual worlds provide suitable environments for authentic learning across all disciplines or for all activities.

Some discipline areas are well suited to using virtual worlds for authentic learning. For example, a virtual world may offer support for languages other than English. In many virtual worlds, there are communities where English is rarely used. Indeed, Second Life has its own areas predominantly populated by native speakers of a variety of languages—and many groups exist inworld which take advantage of this opportunity for authentic language learning (Cooke-Plagwitz, 2008). Many of these language-based sims offer contextually rich environments reflective of various cultures and countries. These virtual spaces hold many possibilities for authentic communication between language learners and native speakers of a target language (Dickey, 1999). In Second Life, residents of virtual Paris and virtual Morocco primarily speak French, and native Italian speakers wander through the streets of a virtual Milan, pausing outside the famous Teatro della Scala.

Language learners can communicate about things in (and even outside of) the virtual environment (Dickey, 1999). The communication is real, and the situations are real (Deutschmann & Panichi, 2009, p. 38). These environments can therefore facilitate greater levels of experiential learning combined with language practice that may not always be possible in more traditional e-learning environments. Deutschmann and Panichi give examples of appropriate tasks in these environments (2009, p. 38):

1. asking and giving directions
2. touring SL and finding specific places
3. visits to a cultural location (i.e., a library or art gallery)
4. attending a conference or live performance
5. interviewing residents of Second Life
6. finding factual information from Second Life sources
7. using avatar movements to express emotions
8. participating in physical activities (playing [simulated] sports, etc.)
9. doing things (shopping, playing chess)

In a virtual world, if a learner asks another avatar for directions to a particular place, the communication is real. There are spaces in those environments that can be navigated to. By way of contrast, in the classroom a learner merely role-plays being lost and then goes through the motions of navigating the directions once they are offered (Deutschmann & Panichi, 2009; Jauregi, Canto, de Graff, & Koenraad, 2011). There is no opportunity to learn through

genuine misunderstanding as the learner is not required to follow those directions in any verifiable way. In the virtual world, users can interact using a diversity of norms of social interaction and experience real interpersonal communication while concurrently engaged in meaningful learning (Thorne, 2008). Communication exchanges in world are often contextual and follow the patterns of real-world communication (Jauregi, et al., 2011). Howard Vickers, who runs the online language school Avatar English, has used this capacity for contextual communication with his students. He has adapted Bernie Dodge's (1997, 2004) original WebQuest model (<http://www.webquest.org>) to the 3D virtual environment with his SurReal Quest (Vickers, 2007). By exploiting the communicative features specific to Second Life, Vickers sends his students on information quests throughout the virtual world that require them to interact with native speakers of the target language in addition to pursuing traditional Internet research. Students are ultimately required to present their information in an audio or video podcast. In this way, learners are able to practise their newfound language proficiencies through a blend of Internet research and social interaction in the virtual environment (Cook-Plagwitz, 2007). One of the greatest benefits of using virtual worlds as venues for language learning is their ability to facilitate authentic communication (Deutschmann & Panichi, 2009).

Even though the potential for foreign language learning in virtual worlds is promising, educators must remain cognizant of the fact that many non-verbal cues will be missing from interactions in these environments. Though as the client-side software is developed it is becoming progressively easier to move through and communicate both verbally and non-verbally in a virtual world, many cues are missing, including facial expressions, subtle body movements, and those culture-specific hand gestures that often accompany speech. Potentially, the variables needed for effective language learning could be lost (Jackson & Lalioti, 2000). Some of these issues will ultimately be overcome with the incorporation of motion capture technologies such as the Microsoft Kinect. Avatar Kinect is a multiplayer online game accessible via the Xbox 360 with the Microsoft Kinect sensor. The motion capture capabilities of the sensor enable the facial expressions and gestures of the user to be captured. Currently, a limited number of environments are available via Avatar Kinect, but it is conceivable that the Kinect technology could be adapted for use in other virtual environments such as Second Life. This seems especially likely given that a version of the Kinect sensor with the capability of integrating with a desktop or laptop PC was released in February 2012.

An early example of a build that embeds authentic learning would be the River City Multi-User Virtual Environment (MUVE), which was developed in 2000 to teach middle school students how to conduct a scientific investigation with topics relevant to biological and epidemiological inquiries. The students, posed as visitors to the fictional River City set in the nineteenth century. Working in small groups, they were tasked with discovering why the city was so afflicted by disease. They were required to construct an experiment to test a hypothesis they devised. They could interact with a variety of characters, such as a university professor who delivered pertinent lectures, and an investigative reporter who prompted them to reflect on their findings. As Agostinho (2006) reported, the use of characters to present significant data can be a useful strategy in virtual environments. The students learned how to use scientific instruments, and at the end of the process delivered their findings to their class in a simulated academic conference. The MUVE was connected to a database that collected information about the activities of individual students for formative assessment. During immersion in the MUVE, students became scientists: they learned the underlying principles of the subject, acquired the investigative skills and processes used by scientists, devised and carried out explorations to test their hypotheses, and understood why these investigations are so weighty (Dieterle & Clarke, 2007). In other words, students learned about science by being scientists. Rather than utilizing the usual didactic methods of knowledge transfer, the River City curriculum supported learners as they began talking within the community of scientists. In this way, newcomers became part of a community of practice through the configuration of the meaning of learning and by engaging their intent to learn (Dieterle & Clarke, 2007; Rosenbaum, et al., 2007). Immersion in a virtual environment can allow learners to acquire firsthand those skills, procedures, and facts that characterize their future professions. These include professional capabilities such as personal responsibility, the ability to work effectively in teams, professional ethics, client or patient care, and risk management (Barton, McKellar, & Maharg, 2007).

In contrast, some skills are very difficult to acquire in a virtual world. For example, it would be very difficult to learn physical or practical skills such as surgery without an appropriate user interface. In Second Life, there are many recreations of hospitals, including operating theatres (see Patel et al., 2012). The surgical instruments are laid out in them, apparently ready for use. What these environments generally lack, however, are natural user interfaces so that the actions of the user resemble those of his or her avatar. This degree of precision in movement would be necessary to enable the acquisition of surgical skills.

It would also be very difficult to teach surgery without replicating the feel of a scalpel meeting flesh, which remains prohibitively expensive and technically difficult (Farley & Steel, 2009; Hayward, Astley, Cruz-Hernandez, Grant, & Robles-De-La-Torre, 2004; Luursema, Verwey, Kommers, & Annema, 2006). The term “haptic” refers to the sense of touch; these clues provide information about weight, surface features, relative size, density, flexibility, and shape of a structure which can be felt with the hand or other part of the body (Luursema, Verwey, Kommers, & Annema, 2008). Even though there are considerable difficulties in bringing this degree of realism to a virtual world, there are examples of it being done successfully in single-user virtual reality environments (see Schreuder, Oei, Maas, Borleffs, & Schijven, 2011). The teaching of Minimally Invasive Surgery (MIS) is particularly suitable for this style of instruction, and though these simulations are not taking place in virtual worlds, it is not difficult to foresee this happening in the near future. A number of projects are already exploring the potential of haptic feedback in these environments (Warburton, 2009). Thus virtual worlds can act as authentic environments for problem-solving but are not necessarily authentic for developing practical skills (McClellan, Saini-Eidukat, Schwert, Slator, & White, 2001).

Authenticity of the Environment

Much ado is made about the physical beauty or the visual accuracy of many builds in virtual worlds. In any list of must-see destinations in Second Life, Vassar College’s Sistine Chapel ranks highly, with visitors marvelling at the level of accuracy in the virtual reproduction (for example, see Curtis, 2011). Michelangelo’s detailed paintings and Raphael’s tapestries can be viewed up close in a way that is not possible in the real-world Sistine Chapel. In fact, any visitor to the actual Sistine Chapel will relate how crowds of people jostle for position, or describe the feeling of awe that descends when entering that impressive space. Though the recreation of the Sistine Chapel in Second Life is as visually accurate as possible, several important cues that make the visit to Rome’s monument so compelling and memorable are missing in its Second Life counterpart.

In a similar way, the Virtual Hajj—maintained by Islam Online—impressively replicates all of the sites on that important pilgrimage route, yet fails to engender the heightened emotions that emerge when a large number of adherents bump against one another as they circle the Kaaba. When thinking of the Hajj, this mass of humanity is as characteristic as any other aspect (Radde-Antweiler, 2008). The Virtual Hajj takes just a couple of hours to complete,

whereas the real Hajj takes several days, in addition to the months of planning beforehand. It is possible that undertaking such a virtual pilgrimage might over-emphasize some aspects of this holy duty while underplaying others, giving an erroneous impression of what the Hajj actually entails. An authentic environment would ideally provide a social, emotional, and cultural context as well as replicating a physical environment, and these factors may be more significant than the backdrop. Authentic settings enable effective teaching and learning through collaboration (Lombardi, 2007). Recreations of real-life professional and disciplinary contexts are often missing those cues that would lend them authenticity and move them beyond a simple visual recreation.

Barton, McKellar, and Maharg (2007) concur, stating that any attempt to perfectly imitate reality in virtual worlds is sure to fall short. Their point is that reality is far too complex and unpredictable, and cannot be readily reconstructed. Authenticity does not arise from a simple mimesis. The authors illustrate their point using the example of a flute from the Baroque period. In the literature, there are many accounts of how instrument-makers crafted them. But no matter how closely these methods are followed, the modern copy, though resembling the original, will never be exactly the same (Barton, et al., 2007). However, if designers and educators identify and embed key cues in the virtual learning environment, authentic learning may still take place. It should be noted that these cues are not just visual, but may be social, emotional, or symbolic (Aldrich, 2009). Virtual world environments can provide a context in which knowledge is useful. Ideally, that context largely resembles the setting where learners will eventually be apply the knowledge. The context can be very specific or abstract, and beyond a physical recreation of a space (Aldrich, 2009). For example, in order to foster anti-bullying behaviour, it would be necessary to recreate a context that would engender high levels of stress and a feeling of being threatened in a person. These sorts of factors are conducive to the new content being absorbed. An emotional involvement in the content induces the brain to release the neurotransmitters necessary to encode memories and stimulate learning (Aldrich, 2009, p. 6).

In an attempt to recreate an authentic learning environment, Jackson and Lalioti (2000) imagine a build that would enable a young South African student to have a cultural experience in a virtual world environment. The student, of isiZulu cultural background, could experience what it is like to be a child, an adult male warrior in the army, and an adult woman in the *seraglio* (harem) established by Shaka Zulu during the early 19th century. The student could walk through recreations of the architecture and structures from that time

period. But the cultural aspects would not legitimately come into play unless certain rules were added to the simulation, such as those taboos defining where different members of society could go and what objects they were able to interact with (Jackson & Laloti, 2000). Experiencing culture is more complex than just walking through architecture and structures. A learner participating in such an environment is able to create one or more identities, allowing him or her to discover how a character is acknowledged or appreciated (Turkle, 1995; Butler & White, 2008). Here, being able to change the appearance of a learner's avatar to adapt to a specific role, and to recreate an environment which resembles the real world, will reinforce the apparent veracity of the simulation, and consequently enhance the student's willingness to suspend disbelief (Good et al., 2008).

The apparent physical reality of the learning environment is less important than the design of the task and learner engagement in the environment (Herrington et al., 2007). An authentic learning context is far more complex and unpredictable than a mere visual recreation of a physical space. Social, cultural, emotional, and symbolic factors also provide important information about the context in which skills are to be practised and where domain-specific knowledge is to be rehearsed. If these are missing, the virtual build may not be sufficiently similar to the real-life context in which the student will have to apply these skills for transfer to occur.

Availability of Information/Sufficient Complexity of the Environment

Authentic learning opportunities involve ill-defined problems and real-life contexts (Kluge & Riley, 2008). Life is not straightforward. The necessary clues to solve a problem are rarely laid out and signposted as such, yet in virtual world scenarios this is frequently the case. For example, an artificial intelligent (AI) agent or "bot" can only respond in limited ways to a nursing student taking a clinical history in a virtual world. If the student's questions fall outside those the bot recognizes, it will ask for the question to be repeated in another way (Amundsen, 2011). The range of responses from the bot is limited by the way it is programmed. In real life, a person questioned in the same way would most likely give some sort of response, however unhelpful it might be.

In this domain, the difference between those problems that are well-structured and those that are ill-structured becomes important. Usually in virtual worlds the former predominate, and these sorts of problems have absolutely correct and knowable solutions (Kitchener, 1983; Cram et al., 2011). Unfortunately, there is little indication that the ability to resolve well-structured problems

leads to the emergence of expertise in the learner (Schraw, Dunkle, & Bendixen, 1995). Consequently, those problems that are most useful for authentic learning in virtual worlds are ill-defined ones that may require contradictory assumptions, evidence, and beliefs that lead to different solutions (Kitchener, 1983). In other words, to teach learners how to solve ill-defined problems they must be engaged in solving complex problems requiring both deductive and inductive reasoning (Reeves & Reeves, 2008).

A law student may ask a client for documentation irrelevant to resolving a legal dispute, yet this skill of careful selection is learned only through experience. In a virtual world simulation of a legal dispute, it becomes exceedingly difficult to anticipate what students will ask for, making it necessary to incorporate a lot of extraneous information into an authentic learning environment (Barton et al., 2007). This is the best way for students to learn how to effectively filter out what is not necessary. Learning environments in virtual worlds often do not incorporate this extra information, challenging the assumptions made about authentic learning within them. What also needs to be considered is the development of appropriate outcomes for student actions such that they can identify gaps in their knowledge (Rosenbaum et al., 2007). For example, an AI bot patient needs to respond in a physiologically believable way to the administration of the wrong dose of a drug by a student nurse.

In contrast, business simulations are well suited to virtual worlds; in many ways they mimic the real world because of their capacity for collaboration, they have an indigenous currency, and they contain a population external to a particular course or program sufficient to sustain a business. It becomes possible and even desirable to design business simulations that incorporate a collaborative learning environment incorporating fun, play, and authenticity in its processes that mirrors real-world economic conditions (Mak & Palia, 2005). Because Second Life has its own currency, currency exchange, and a large population, it is possible to run a business in this environment. The population (as of January 30, 2012) was 27,759,350. At any one time, around 60,000 residents are online. In one 24-hour period, the value of transactions was \$1,402,509 USD (Shepherd, 2012). Inherently, the environment is sufficiently complex such that a business responds in an unpredictable way. The design of learning is not dependent on the forethought or imagination of the designer to the same extent as simulations in other disciplines. Business students are able to market and advertise their business to the Second Life community. They must think about the location of their enterprise and the range of products that they are selling or services they are offering. The large resident population can

access their goods and services. Solving the issues to run a successful Second Life business are in themselves the sorts of ill-defined problems that characterize authentic learning.

The Learner Experience

If the learner experience is compromised through lag due to insufficient bandwidth, poor technical skills, steep learning curve, and so on, then the learner's cognitive load will dramatically increase (Pollock, Chandler, & Sweller, 2002). These problems can be designed around, but usually they are not. For authentic learning to occur, the complexity in a scenario must be due to the ambiguous context inherent in the activity rather than because of the user interface or unreliability of the technology. When learners have to contend with extraneous information—for example having to learn how to use an unfamiliar user interface or navigate through an unfamiliar environment—their attention is pulled away from the objective of the learning exercise. This phenomenon is known as extraneous cognitive load and impacts negatively on learning (Pollock et al., 2002).

In order to promote student engagement with a program, course, or activity in a virtual environment, it is necessary to generate immersion. Immersion has been defined as the “the subjective impression that one is participating in a comprehensive, realistic experience” (Dede, 2009, p. 66), and is seen as a necessary condition for “presence the psychological sense of actually being located in the virtual environment (Franceschi, Lee, & Hinds, 2008, p. 5). Engagement refers to the focus of a learner's attention on the task at hand, and given sufficient involvement and mental clarity can lead to the optimal learning state of “flow.” This term was first coined by Mihaly Csikszentmihalyi (1990) and refers to a mental state that athletes equate with “being in the zone.”

A virtual environment that promotes a more intense experience of sensory immersion will engender a greater feeling of presence (Witmer & Singer, 1998, p. 228). Various technologies facilitate sensory immersion, thereby locating the experience in three-dimensional space. These technologies may provide visual stimulation. More complex virtual environments also provide stereoscopic sound and haptic feedback, applying vibrations and forces to the participant (Dede, 2009, p. 66). The more sensory data provided by the environment, the greater the sense of presence (Franceschi et al., 2008, p. 6) and as more senses are engaged, presence is likewise increased (Steuer, 1992). If a simulation is authentically realistic, more emotions are stimulated in the learner in response to tasks and events within that environment. Students are more likely to

experience tension, fear, or frustration, leading to a more authentic emotional environment. This has long been recognized as a factor facilitating authentic learning (Smith, 1987).

The novel user interfaces of the Nintendo Wii and Microsoft Kinect gaming systems are evidence of the innovation displayed by gaming developers catering to the lucrative console gaming market. These interfaces have radically altered the way that users interact with three-dimensional virtual environments. Existing user interfaces such as the QWERTY keyboard and mouse commonly do not facilitate speed, responsiveness, and dimensional motion, diminishing the user's experience (Champy, 2007). Haptic feedback further enhances immersion by facilitating the user's interaction with 3D objects (Butler & Neave, 2008). For university educators, being able to leverage these attributes for use in virtual worlds such as Second Life would enable them to provide learners with the opportunity for authentic learning experiences that more closely resemble real-life tasks and scenarios (Farley & Steel, 2009).

In addition to the more general factors in the learner's environment, there is the hardware user interface acting as an extension of the physical environment. For users of virtual worlds, these interfaces bridge the physical and the virtual. Most learners accessing a virtual world environment will do so with a keyboard and conventional mouse, better suited for navigating around a document than a virtual world. Consequently, learners accessing these environments encounter a range of physical challenges. Issues include:

- the functional isolation of users (Xin, Watts, & Sharlin, 2007);
- the fact that movement is not intuitive and in addition, there is limited freedom of movement (Fassbender & Richards, 2008);
- there are particular problems for children, the elderly or those with disabilities who are unable to coordinate keyboard strokes and precisely use a mouse (Cardoso, Melo, Gomes, Kehoe, & Morgado, 2007; Kim, Roh, & Kim, 2008); and
- the inability to leverage the common knowledge that users acquire from their ordinary physical interactions in their day-to-day living (Xin, et al., 2007).

These factors may create sufficient distraction in the physical environment to decrease the feeling of presence in the virtual world. User interfaces that facilitate more intuitive movement would help to overcome these sorts of issues, extending the affordances of these environments for more authentic education and training. Well-crafted simulations deployed in virtual world environments

are able to deliver safe and cost-effective recreations of authentic contexts that can enable optimum learning, particularly when enriched with the capacity for tactile precision and haptic feedback (Farley & Steel, 2009). An obvious example from the real world is training aircraft pilots to fly. Flight simulator training, when used in tandem with training in a plane or helicopter, has been discovered to be more effective than training with just an aircraft (Hays, Jacobs, Prince, & Salas, 1992).

Future Directions and Conclusion

Though at first glance, virtual worlds such as Second Life appear to be the ideal environment in which to embed authentic learning, in reality this would be difficult to achieve under normal circumstances. Even when only considering a few of the characteristics that Herrington and her colleagues (2007) identified as integral to the process, it becomes evident that in order to realize the enormous potential of virtual worlds for authentic learning, careful planning and design are necessary. It is also necessary to accept that the skills and knowledge associated with some disciplines, professions, and skills are simply not suited to virtual world learning.

Effective simulation to support authentic learning goes a long way beyond visually recreating an environment. Educators must work together with learning designers to ensure that authentic tasks align with the crucial components of the learning environment: goals and objectives, disciplinary content, technological affordances, and assessment (Herrington et al., 2007). Cognitive realism is more important in simulations. As far back as 1963, Bert Y. Kersh identified that realism was not important in classroom simulations (Kersh, cited in Smith, 1987). Though he was talking about simulations that involved film projection, the same principles hold true for virtual world environments. Much more essential are those factors that promote immersion and presence. There is fruitful research to be done in defining the minimum necessary conditions for promoting immersion, and hence, presence. Factors are likely to include interface design, the physical location of the learner, and the more obvious properties associated with the design of the environment and tasks learners will undertake.

Brown, Collins, and Duguid (1989) stated that knowledge and abstract ideas arise from the subtle complexity of the outside world. This knowledge cannot be distilled if the environment is not sufficiently complex, if markers and guideposts guide learners through activities with known outcomes. Authentic

learning is partially defined by the inclusion of ill-defined problems for which there are no straightforward answers and certainly not just one correct answer. Those skills that are learned are relevant to the environment. This is consistent with what happens outside of virtual environments and leads to “situated cognition” (Van Eck, 2006). Because these conditions are difficult to design for in virtual worlds, it will be necessary for educators to collaborate to design fewer but more complex and authentic simulations that can be replicated at little cost and evolve iteratively. Educators should collaboratively research those characteristics of a discipline-specific context that are necessary for a learner to experience in order to gain the knowledge necessary for the successful practice of that discipline, and then incorporate those characteristics into any simulation.

Simulation is potentially one of the most potent tools available to e-learning designers. Well-crafted simulations can engage and challenge the learner in a very direct and individual way. To maximize success in these situations, the learner must work at a higher cognitive level than required by the mere recall associated with traditional didactic methods. Instead, the learner must be immersed in the situation and apply both novel knowledge and extant skills to meet the challenges set before him or her. Though not all simulations are instructional, instruction that exploits the techniques of simulation are more likely to capture the learner’s attention for longer periods of time (Rude-Parkins, Miller, Ferguson, & Bauer, 2005), facilitating the emergence of presence and subsequently flow. In addition, by making the experience directly relevant, learners have an emotional stake in the content, making them more likely to learn (Aldrich, 2009, p. 6).

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PART TWO

**ADVANCED
TECHNOLOGY**



CONVERSATIONAL AGENTS IN SECOND LIFE

Freudbot

Bob Heller, Mike Procter, and Corbin Rose

Conversational agents (CAs), also known as chatbots, are computer programs that are designed to chat with users using the rules of conversation and turn-taking (see <http://www.chatbots.org> for examples). As noted by Kerly, Ellis, and Bull (2009), the use of CAs in education is growing significantly as conversational technologies mature, and can be seen in a wide variety of educational applications including tutoring, question-answering, second language learning, learning companions, and reflective dialogues. Although evidence for their value may be equivocal (see Clark & Choi, 2005; Dehn & van Mulken, 2000; Gulz, 2004; Gulz & Haake, 2006 for reviews of animated pedagogical agents, a closely related technology) the rationale for their use is sound. Conversational agents provide an engaging and intuitive interface to a body of knowledge that can be accessed in a personalized and adaptable format (Cassell, Sullivan, Prevost, & Churchill, 2000).

In our studies with conversational agents, we investigated a historical figure application on the assumption that distance education students would be highly motivated to chat with famous historical theorists in psychology. Subsequent research supported this assumption, as historical figures were rated as one of the best applications of conversational agents (Heller, Procter, Mah, Jewell, & Cheung, 2005) and other authors have suggested historical figures as a fertile application space for conversational agents and animated pedagogical agents (Payr, 2003; Veletsianos & Miller, 2008).

Our first historical agent was Freudbot (Heller et al., 2005), which was patterned after Sigmund Freud and created using Artificial Intelligence Markup Language (AIML), an XML-based programming language developed by Richard Wallace (see <http://www.alicebot.org>), one of the most widely used programming platforms for chatbot development, as reflected in the website Pandorabots (<http://www.pandorabots.com>), a hosting service for AIML-based chatbots, with over 1.3 billion responses served. Typically, users converse with AIML chatbots by typing their comment or question in a text window—the agent responds immediately after the user submits his or her input. At its core, AIML is a pattern-matching program and thus is similar to Eliza, the grandmother of all chatbots (Weizebaum, 1966). However, unlike Eliza, AIML enables a recursion property that reduces user input into different symbolic categories, thus enabling a chatbot response appropriate to the conversational context.

Freudbot’s “knowledge” is stored in the form of first-person narratives. The narratives are presented in chunks as long as the user types appropriate conversational prompts to advance the story either explicitly (“Tell me more”) or implicitly (“That’s interesting”). In some cases, Freudbot can answer questions that are anticipated from the narrative output. The importance of narratives as a vehicle for knowledge transmission has been recognized in intelligent tutoring systems (McQuiggan, Robinson, & Lester, 2010) and is well suited as a medium for CAs as historical figures. In total, Freudbot possessed close to 90 stories related to his theories and biography. In cases where the user input was not “recognized,” Freudbot would default to a conversationally appropriate request in order to “direct” the user to a relevant conversational narrative.

Heller et al. (2005) reported a proof of concept study in which Freudbot was evaluated by 53 students after a 10-minute conversation mediated by a standard web page interface as shown in Figure 7.1. Questionnaire data on Freudbot performance indicated that the potential of the application was widely recognized, but there was some criticism of the agent’s actual performance. When asked if they would chat again with Freudbot, over two-thirds of the participants indicated yes and, not surprisingly, the ratings of Freudbot provided by this subsample were significantly higher than those who would not chat again. In the words of one participant, “It was pretty cool the way it felt like I was actually interacting with Freud . . . he’s deceased though, yeah, but the picture, the fast answers . . . made me pay attention to the answers a lot more than if I had been simply reading a text written by someone else. Plus it was cool to feel like I could voice my own opinion with the most well-known psychoanalyst of all time.”

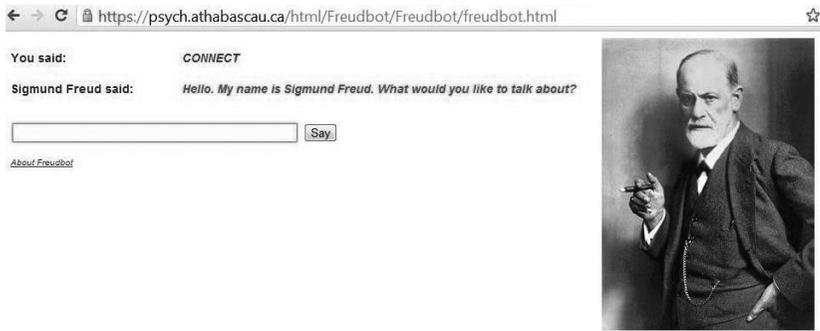


Figure 7.1 Web-based interface to Freudbot in Heller et al. (2005).

Heller et al. (2005) also noted the significance of the visual information that was co-presented with the chat agent, and other notable researchers have identified the “look” of pedagogical agents as a key area of investigation (Cassell et al., 2000; Gulz & Haake, 2006). To examine the influence of visual information, Heller and Procter (2009) looked at evaluations of Freudbot under three visual conditions: no image (see Figure 7.1 less the image), static image (see Figure 7.1), and an animated image of a head with a computer-generated voice. The procedure was similar to Heller et al. (2005) in that students ($n = 88$) engaged in a 10-minute chat with Freudbot under one of the three conditions and then completed a series of questionnaires to assess their evaluation of Freudbot and collect demographic and individual difference variables. Surprisingly, Heller and Procter (2009) found that the no-image condition led to significantly better ratings compared to the other conditions, which did not differ from one another. Clearly, the addition of visual information introduces other complexities and draws attention to the difficulty of simulating a high-fidelity human interaction with a conversational agent (Cassell, Bickmore, Campbell, Vilhjalmsson, & Yan, 2000).

Conversational Agents in Virtual Worlds

Not only is the “look” of an agent important, the look of their world is also of great interest, and the growth of virtual worlds like Second Life provide an extraordinary opportunity to investigate the world of a conversational agent and whether immersion in it can deepen the engagement with CAs. Rickel (2001) argues that an important goal is to enrich virtual worlds with intelligent conversational agents that can support face-to-face interactions in a variety of roles. Similarly, one of the leading developers of embodied Artificial Intelligence in

virtual worlds notes that non-player characters (NPCs, which are controlled by a computer) were the norm in the progenitors of virtual worlds (i.e., multi-user dungeons [MUDs] and massively multiplayer online role-playing games [MMORPGs]), and that their deployment in virtual worlds like Second Life offers a unique opportunity to evaluate embodied artificial intelligence (Burden, 2009). The hidden assumption in much of this work is that the combination of intelligent agents operating in virtual worlds may be greater than the sum of both operating in isolation. Moreover, the combination of conversational agents and virtual worlds expands the available pedagogy in distance education to include computer simulations and game theory.

Unfortunately, the educational use of conversational agents in virtual worlds like Second Life is limited. In our own work, Freudbot was first deployed in Second Life in late 2007 in a recreation of his Viennese office on Athabasca University Island, as shown in Figure 7.2 (<http://slurl.com/secondlife/Athabasca%20University/194/155/249>). Freudbot sits on a chair by a couch and rises to greet people when they walk into his office. He invites them to sit down on his couch and chat with him if they are interested. During the first four years of his residency on Athabasca University Island, Freudbot has chatted with over 351 users. In March 2009, Freudbot was also added to an educational build in Second Life known as The Theorists Project, developed by A. J. Kelton and Edino Renfro-Michel of Montclair State University. The project is dedicated to a handful of well-known counselling theorists, including Freud, and Renfro-Michel uses the build with her counselling students, who create content in Second Life in the offices of each theorist. Like the Freudbot on Athabasca University Island, Freudbot on The Theorists Project will rise to greet visitors and invite them to chat with him by sitting on his couch. However, in contrast to the Athabasca University site, Freudbot at Montclair State University has talked with approximately 634 users over the first 32 months for an average duration of 5.7 minutes and an average of 14 exchanges. The higher traffic is likely a reflection of the student traffic that Renfro-Michel directs to the site as well as the presence of The Iceberg, a separate build dedicated to the theories of Sigmund Freud.

Another example of a conversational agent in Second Life is provided by the work of Danforth and colleagues, who are developing a virtual Standardized Patient using AIML as the conversational engine (Danforth, Procter, Heller, Chen, & Johnson, 2009). The virtual patients reside in a clinic in Second Life where medical students use their avatars to interview the virtual patient and practise their differential diagnosis skills. Students can order tests at the clinic and record their observations for later review. The focus of the project is on

creating a programmable Standardized Patient, but its developers expect the project will ultimately assess the immersion effects afforded by the virtual environment. Finally, Daden Labs creates robotars, or a computer- controlled avatar, with links to multiple intelligent agents that provide it with conversational, navigational, and affective abilities (Burden, 2009).



Figure 7.2 Second Life interface to Freudbot on Athabasca University Island.

Immersion and the Conversational Record

The research question of interest to us is whether immersion in a virtual world and chatting with a conversational agent has measurable effects on the conversational record as opposed to chatting with a conversational agent in the absence of a virtual world. The high volume of interaction with Freudbot on The Theorists Project allows us to compare the conversational record of students immersed in a virtual world with the conversational record of students who interacted with Freudbot in the absence of visual information (i.e., the no-image condition of Heller & Procter, 2009). We hypothesized that the virtual office space and a Freudbot avatar would give rise to a greater sense of social presence in comparison to the no-image condition. Social presence has been defined as the degree of salience (i.e., quality or state of being there) between two communicators over some communicative medium (Short, Williams, & Christie, 1976) and has been associated with greater student satisfaction (Lowenthal, 2010). Furthermore, this quality of a communication medium varies such that some media enable more social presence (e.g., video) than others (e.g., texting). The question is whether virtual worlds enable more social presence

in comparison to a text-based interface. Since measures of social presence are typically derived from language protocols (such as discussion forums), we assumed that the conversational record could also be examined for similar indices (Garrison, Anderson, & Archer, 2000).

We also assumed that engagement would be reflected by compliance with conversational directives, and we further hypothesized that the immersive world of Second Life would be more engaging and, as a result, engender greater conversational compliance. Compliance with Freudbot can also be thought of as persistence in the role-play exercise. As long as students are following Freudbot's questions and directions, they are more fully participating in the role-play exercise as engaged learners. To explore these hypotheses, we examined the conversational exchanges provided by the user for evidence of social presence and conversational compliance under the two conditions: no image versus avatar and virtual office. In sum, the goal of the present case study is to explore the effect of virtual world immersion on conversation by comparing a sample of the conversational record from Freudbot's location in The Theorist's Project in Second Life to the record from 25 students in the no-image condition of Heller and Procter (2009).

Selecting the Transcripts

The transcripts from Second Life were selected from the distribution of all conversations that occurred on The Theorists Project lasting between 7 and 13 minutes ($n = 55$). This selection criterion was established so that the average interaction duration could be matched to the 10-minute duration that was a controlled variable in the no-image condition of Heller and Procter (2009). From the initial Second Life sample, 16 protocols were eliminated because there was evidence in the conversational record of multiple users in the conversation. This selection criterion was established to again match the conditions of Heller and Procter (2009), where participation was solitary. With these selection criteria in place, the average conversation duration in the Second Life sample of 39 protocols was 9.5 minutes, with a standard deviation of 1.8. The average number of exchanges per protocol in the Second Life sample was 31.1 compared to 29.7 from the no-image sample ($n = 25$), a difference that was not statistically different, $t(62) = .38, p > .05$.

Coding the Transcripts

A coding key was developed based on earlier work that focused on categorizing user input and Freudbot output. Both input and output were evaluated

in relation to the previous output and input in the conversational exchange. Freudbot output was coded to look at performance issues and areas of improvement, whereas the user's input was coded in terms of compliance in a conversational exchange. The user input from both samples was coded according to the preceding output provided by Freudbot, which fell into three broad categories: (1) Greeting, (2) Narrative Response, and (3) Default Response.

The Greeting given by Freudbot was always the same: "Hello. My name is Sigmund Freud. What would you like to talk about?" It was designed to elicit a topic of discussion from the user, which was coded according to the domain of interest (Freud's personal life, his theoretical concepts, the user's life, and an "other" category) based on the judgment of a single coder. We targeted the greeting since it is the first point of contact and we were interested in whether the first expressions of interest would differ between the two settings.

Narrative Responses occurred when appropriate questions or comments were provided by the user. User input that followed a Narrative Response was coded by a judge on whether the narrative was advanced using conversational cues or follow-up questions. User input was also coded if it reflected a change of topic or if it was unrelated to the narrative (other).

The Default Responses were executed when there was no match to a Freud narrative and included several subtypes, some of which were questions designed to control the conversation (i.e., suggesting a topic, a request for a topic, a request for clarity, or a redirect question). User input to the subset of default responses was coded by a single judge on whether users complied with Freud's default request.

In addition to coding the user input according to the preceding Freudbot output, each was also coded on social presence using a 3-point scale based on the degree of acceptable evidence. Following Garrison et al. (2000), the primary measure of social presence was the use of emotional or affective messages. Input was assigned a 0 if there were no evidence (e.g., one-word responses unrelated to the previous output). Compliance through appropriate conversational behaviour was regarded as intermediate evidence, and assigned a value of 1. Finally, compliance with positive affect was assigned a value of 2.

Findings

Table 7.1 displays the summary of the coding categories for the Freudbot conversations in the no-image sample and the virtual world sample. A t-test for independent samples was carried out for each measure. Our analysis of the user's response to Freudbot's greeting did indicate differences between samples,

as participants in Second Life were less likely to ask about Freud's theory and more likely to invoke the other category compared to participants in the no-image sample. However, when exposed to Freudbot's narrative, participants in both samples behaved similarly in terms of advancing the conversation or asking appropriate follow-up questions. Participants in the no-image condition did access more narratives than the Second Life sample, but the difference was not significant.

Table 7.1 Summary of Coding Categories for Freudbot Conversations in Two Settings

Freudbot output	No image	Second Life	<i>t</i>	<i>df</i>	<i>p</i>
<i>Greeting</i>					
Freud personal	.16	.10	0.67	62	.51
Freud theory	.56	.26	2.53	62	.01*
User	.20	.33	1.15	62	.25
Other	.08	.33	2.40	62	.02*
<i>Narrative output (avg.)</i>					
Follow-up question	43.0%	37.5%	0.85	62	.85
Advancing comment	31.5%	40.2%	1.16	62	.25
Change topic	20.1%	21.0%	1.25	62	.22
Other	4.5%	8.4%	1.42	62	.16
<i>Default output</i>					
Topic request	.52	2.38	3.60	62	.00*
Compliance	65.0%	69.2%	0.31	62	.76
Clarity request	3.08	2.31	1.48	62	.15
Compliance	56.5%	64.0%	0.73	62	.47
Suggest topic	4.44	5.95	1.55	62	.13
Compliance	78.4%	62.3%	1.99	62	.05*
Redirect	1.92	1.74	0.42	62	.68
Compliance	92.0%	92.0%	0.06	62	.96

* $p \leq .05$.

In terms of the default responses, there was a greater number of topic requests made by Freudbot in the Second Life sample compared to the no-image condition, but this likely reflects some minor modifications made to Freudbot to deal with default responses. Importantly, there were no differences in compliance with the default output between samples, with the exception of topic suggestions. Participants in the no-image sample were more likely to comply with the suggested topic in comparison to the Second Life sample.

Table 7.2 displays the social presence measure expressed as a percentage of the total number of user inputs. There were no differences between samples in how the social presence measure was distributed across user inputs, although there is a slight, non-significant trend of greater social presence in the Second Life sample compared to the no-image condition.

Table 7.2 Distribution of Social Presence Measures

User input	No image	Second Life	<i>t</i>	<i>df</i>	<i>p</i>
No evidence of social presence	14.7%	10.2%	1.21	62	.23
Evidence of social presence	59.0%	60.8%	0.60	62	.55
Evidence of social presence + affect	22.5%	24.1%	0.68	62	.50

Discussion

The findings from this case study did not support the hypothesis that an immersive environment leads to more social presence and greater engagement than a text-based environment when chatting with a conversational agent based on a historical figure. There was evidence, however, that the nature of the conversation was different between the two settings. In particular, users in Second Life were more likely to invoke a default response from Freudbot, indicating that their input was less likely to be recognized by the conversational agent. Conversely, users in the no-image condition were able to access more of the Freudbot narratives, although the difference was not significant. We suspect that part of this difference reflects the conversational space afforded by the virtual world. That is, users in Second Life have more things to talk about because of Freud's virtual office and other aspects of the environment that might be more salient compared to a text-based web page devoid of any visual information. We are currently preparing an office for Freudbot that is more interactive,

so that objects and images in the room are also embedded with intelligence; together the multiple agents will cooperate to produce an interactive virtual learning experience. Instead of a default response, Freudbot would be able to discuss the objects and events in his office.

It was interesting to note that in both samples, evidence of social presence was quite high, as less than 15% of the user's input showed no evidence of social presence. Although the expected increase in measures of social presence for an immersive 3D visual experience was not detected, the fact that evidence of social presence was high in both studies is encouraging, and may speak to the robust contribution of conversation itself. Of course, null findings are difficult to interpret, and may also reflect problems with the validity of our social presence measure. Unfortunately, there are very few direct or objective measures of social presence, which is a general weakness of the social presence construct (see Annand, 2011). Reliable measures of social presence will be necessary in order to fully assess the value of conversational agents in virtual worlds. It is possible that the medium of conversation maximizes the extent of social presence such that immersion adds very little additional presence. It is equally possible that the foundational feature of social presence, the concept of immediacy (Mehrabian, 1969), is poorly implemented in Second Life since immediacy is operationalized by paralinguistic communication channels (i.e., eye gaze, gestures, and facial expressions).

Future Directions and Conclusion

In distance education, conversational agents hold promise as an intuitive and engaging interface to course content, and in particular, are well suited for creating personas representing historical figures in all disciplines (Heller et al., 2005). The findings from Heller and Procter (2009) suggest that visual information associated with the persona needs to be added carefully and thoughtfully in order to enhance the overall conversational experience. The same type of observation can be made in the present case study, in that the visual information associated with the virtual world also needs to be carefully and thoughtfully integrated with the conversational capacities of Freudbot and other historical figures.

Heller and Procter (2009) noted that their findings were generally consistent with the idea of an Uncanny Valley. The Uncanny Valley is a term used to describe the relation between simulation fidelity and likeability. In general, as the simulation approaches perfect fidelity likeability ratings increase until

some point just prior to perfection, where ratings drop significantly (the valley) and then rise dramatically when perfection is theoretically achieved. The term was first coined by the roboticist Mori (1970) and although controversial, is well known in humanoid robotics, embodied interface agents, and computer animation.

Although our understanding of the Uncanny Valley phenomenon is incomplete at this stage, it does draw attention to the complexity of simulations involving human-like characters. Moreover, strategies to manage the Uncanny Valley, such as staying on the left side of the valley (where fidelity is lower), can be considered in the present context in order to manage the complexities. One example is the use of text chat in Second Life, which persists as a popular communication medium despite the growing uptake of Voice over Internet Protocol (VoIP) tools in virtual worlds and the Web. Although text communications are limited in social presence compared to voice, text is far easier to integrate with the avatar animation and environmental context. A text-based conversation with a software agent will appear the same as that with a human avatar, whereas a computer-generated voice may fall short and detract from the experience. Understanding and accommodating the effect of the Uncanny Valley as it applies to programmable avatars in virtual worlds may hold the key to maximizing the benefits of combining virtual worlds with conversational agents.

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VIRTUAL BOTS

Their Influence on Virtual Worlds, and
How They Can Increase Interactivity and
Immersion through VirtualPREX

Torsten Reiners, Sue Gregory, and Vicki Knox

In 2011, seven academics from five Australian universities and one international university received an ALTC (Australian Learning and Teaching Council) grant to explore role play in a virtual world for professional experience, hence the project was called VirtualPREX. These academics are now all based at four institutions: the University of New England, Curtin University, Charles Sturt University, and RMIT University. Through VirtualPREX, pre-service teachers can practise their teaching in a risk-free environment before engaging in real-life professional experience. VirtualPREX provides a learning environment for pre-service teachers, where the use of role play in a virtual classroom is a key factor within distance education (Gregory et al., 2011). The pre-service teachers synchronously practise their teaching skills with peers through role-play activities in Second Life. We chose this virtual world for the project as all team members had existing, extensive experience in using Second Life as a teaching and learning tool. In the first phase of the project, we conducted a pilot study to test the virtual classroom environment where pre-service teachers were role-playing as either a teacher or primary school student. The teacher presented a seven-minute teaching episode or provided an idea, and their peers acted as the primary school students in either an “on-task” or “off-task” role. This required synchronous role plays. Information for the on-task and off-task roles came from a focus group held with school teachers and principals. On-campus

pre-service teachers conducted the role plays in a computer laboratory in which all participated. Off-campus pre-service teachers undertook the role-play activity from their own homes. The results of these synchronous role-play activities are discussed in the chapter, “VirtualPREX: Providing Virtual Professional Experience for Pre-Service Teachers” (see also Gregory et al., 2011). Another component of the project focuses on developing bots (non-player characters [NPCs], alternatively known as “animated pedagogical agents, conversational agents, chat bots, conversational avatars and virtual characters”: Veletsianos, Heller, Overmyer, & Proctor, 2010, p. 124) to act as the primary school students to provide asynchronous role play for pre-service teachers. Heller and Proctor (2010) emphasize that the term “agent” in virtual worlds does not have a consistent definition across disciplines, and even though these agents might use different technologies (for example, Artificial Intelligence Markup Language [AIML], as well as ALICE [Artificial Linguistic Internet Computer Entity]; FreudBot uses AIML), they are all virtual representations embedded in learning environments that serve pedagogical purposes. In VirtualPREX the use of agents or interactive bots will enable pre-service teachers to visit Second Life on their own time, in their own place, and at their own pace, to practise teaching the interactive bots before they embark on their real-life professional experience. This will be of particular benefit to off-campus pre-service teachers.

Honest reflection on virtual worlds, namely large mainstream worlds such as Second Life, reveal that most places are empty, and city replicas, malls, bars, or educational places often look interesting but abandoned at the same time. Options designers use to attract visitors to locations in the virtual world are generally promotions, freebies, and some interactive designs (Friedman, Steed, & Slater, 2007). Less often, scenarios are enhanced by different kinds of avatars to entertain visitors. These interactions are either guided by user-controlled avatars (a personalized graphical representation of themselves; Gregory & Tynan, 2009), unanimated and unscripted avatars, or scripted avatars (bots: computer-controlled avatars, generally personalized by the owner of the bot).

There are excellent examples of innovative bot design, performance, and interactivity being used in virtual worlds within the past few years. Nowadays, bots representing people wander through virtual worlds to create the impression of the societies we live in. Some do not interact but are similar to everyday people we see on our way to work; sitting next to us in bars and filling theatres. Additionally, bots can do the work of real people by fulfilling different tasks such as demonstrating objects, explaining manuals, or guiding the way to new locations. These bots require simple scripting as the tasks they are following are

step-by-step procedures and need almost no interaction with the environment. Nevertheless, they enhance immersive feelings in a virtual world and provide answers to users that are seldom available through other means. Finally, the intelligence of the bots can be increased by advanced scripting and further sensory feedback to enable actual interaction with human avatars. Examples of these types of bots are social workers, tour guides who adapt to the situation, or victims in training scenarios such as hospitals. More sophisticated bots could add to the enrichment of virtual worlds. Continuous enhancement of autonomous behavioural skills could contradict prejudices many users have about the loneliness and boredom in many parts of a virtual world. Ullrich, Bruegmann, Prendinger, and Ishizuka support the notion that using bots in the virtual world provides a space with a sense of being alive, although they suggest that bots are “almost missing from Second Life” (2008, p. 282), the virtual world we predominantly discuss here. Bots have increased in number considerably since Ullrich et al.’s (2008) observations, with more people seeing the value of using them in their virtual space. As Veletsianos et al. (2010) suggest, bots need to be programmed to undertake a conversation with people inworld and respond to non-verbal cues (such as walking closer). They need to be created so that they are consistent with the environment they are placed in, and must be believable. Heller and Proctor point out that there are “challenges associated with programming to interact in such an unrestricted and often unpredictable environment” (2010, p. 312) like Second Life.

In this chapter we first present a short literature review examining distinct achievements for realizing intelligent bots in the context of learning in virtual worlds. We approach bots from the theoretical perspective of hard and soft technologies, and describe the effects that they can have on the degree of freedom, flexibility, and creativity in virtual worlds. That is, we present the hardening of a soft technology and then demonstrate how this restricts users in their interactions while increasing their immersion at the same time. Before we describe the development of bots in our project, VirtualPREX, we provide a brief overview of examples and technologies that utilize bots in Second Life—frameworks, programming environments, languages—and how these can be developed in the future by providing vibrant interactivity.

In VirtualPREX, pre-service teachers are given the opportunity to practise their skills and develop confidence in dealing with the different behaviours of schoolchildren. One element of VirtualPREX is to have these behaviours simulated with bot primary school students. In this chapter, we focus on the development of the bots; that is, on their anticipated behaviour, control mechanism,

and implementation. As VirtualPREX is about learning and interaction with a human-controlled avatar, the requirements for the capabilities of the bots are far different and more advanced than for the scenarios we described previously, such as demonstrating processes or products. We briefly look at the underlying concept of the bot recognizing teacher movements and/or instructions that would trigger a reaction. It should be pointed out that the project is still ongoing, and the described framework outlines our path for implementation based on the preliminary results of the pilot. Our research is geared toward educators with a strong understanding of pedagogical models but not necessarily technical specifics like state diagrams or pseudo code.

From Peers to Bots in Authentic Learning

Activities such as role play, simulations, and case studies need to occur in authentic learning environments to preserve a link with reality, as this supports information recall. Virtual worlds are well suited to providing simulated learning by modelling a process or interaction that closely resembles real-world situations in terms of fidelity and outcomes. Authentic learning environments can be created in both digital and physical settings (Ingram & Jackson, 2004; Lombardi, 2007). Realistic digital environments that use simulations to closely replicate the world and workplace have become popular over the past decade (Ferry, Kervin, Cambourne, Turbill, & Puglisi, 2004), however, these have primarily been 2D applications employing video playback or streaming and text-based simulations, with limited use of graphics and social networking tools. There are fewer instances of the use of 3D virtual world environments. A comprehensive research project (Hew & Cheung, 2010) conducted across the media arts, health, and environmental disciplines in 2008 on using 3D virtual worlds in K–12 and higher education settings found that they were primarily used for communication, simulation, and experiments.

Digital environments have many advantages for addressing current problems in professional experience, including wider access, the potential to present a broader range of situational learning experiences, increased communication and interaction opportunities, greater safety than real-life learning environments for exploring the consequences of decisions, and more facility for reflection (Ferry et al., 2006). Dalgarno and Lee (2010) show that the representational fidelity and aspects of learner–computer interactivity in 3D environments provide extra advantages over 2D alternatives. The affordances they isolate include facilitation of tasks that lead to enhanced spatial abilities, greater opportunities

for experiential learning, increased motivation/engagement due to higher levels of interaction and a sense of “presence” born of the immersive nature of the interaction, and improved contextualization of learning and richer/more effective collaborative learning. Among the few studies on simulated classroom environments, Foley and McAllister (2005), Ferry et al. (2005), Girod and Girod (2006), and Mahon, Bryant, Brown, and Kima (2010) have explored the possibilities of linking simulations and workplace experiences. This blended approach is proving helpful to cognitively prepare pre-service teachers for real classroom experiences, supporting the transfer of knowledge and skills learned in virtual environments to real classrooms. Recent research confirms that using Second Life to practise teaching with peers creates a significant difference in personal teaching efficacy after inworld practice sessions, and that collaborative practice teaching is an effective way of practising teaching (Cheong, 2010). Cheong’s research showed that pre-service teachers can practise teaching skills in Second Life without having a negative impact on students, and the practice can be performed repeatedly and more easily than in real life, making virtual worlds well suited to provide authentic environments where newly developing pedagogy can be practised and assessed.

Only preliminary consideration has been given to challenges that emerge from the pedagogical, social, and technological aspects of active online learning. While best practices in content structuring may be transferred from stand-alone educational simulations to virtual world-based simulations, metrics and learning objectives for the two contexts should be different. Much more work is needed to derive guiding principles to inform the design, development, and use of 3D virtual environments for learning, especially in cases of solo learning.

In recent years, virtual worlds have been firmly established as an effective means of building social networks and communities of learning (Boulos, 2007). The availability of synchronous communication means virtual worlds provide enhanced interactivity (Petrakou, 2010). Synchronous communication allows for immediate, contextualized feedback, which has been shown to relieve feelings of isolation characteristic of online learning. By utilizing peers to operate avatars, pre-service teachers can interact synchronously; however, such interaction is often not available due to different time zones or conflicting schedules. Bots can fill this gap by enabling asynchronous active interaction in the absence of peers. This flexibility provided by asynchronous interaction supports and enhances solo learning, student–student interaction, and academic–student interaction (Petrakou, 2010). Bots can be useful for distance education when they can interact and undertake conversations with other

human-controlled avatars and increase engagement and motivation of the learning task (Heller and Procter, 2010); they also allow for both passive and active learning (Affiliated Computer Services, 2009). Creating an automated classroom in Second Life where pre-service teachers control avatars to interact with bots provides them with authentic experiences that they are likely to encounter in their professional role as well as a safe, low-risk environment in which to practise, experiment, and react to real-life scenarios to see the consequences of complex decisions (Gregory, Reiners, & Tynan, 2010). This is particularly beneficial for the professional experience of off-campus education pre-service teachers who have limited availability to interact with peers and academics.

Bots are a technology being applied either following the intentions of their inventors or utilized in a completely new way. Technology itself is described by Arthur as an “orchestration of phenomena to our use” (2009, p. 53), which are assembled to achieve individual, group, or society-derived goals. Bots might be defined for a single phenomenon to react on; for example, providing a document when being approached by a human avatar. But then again, the bot may be part of another technology where its function is defined by the overall context—for example, at the entrance of a meeting room to distribute the agenda; or combined with other technology to enhance its functionality, such as mounting the bot on a vehicle that travels through the virtual world to distribute advertisements to as many avatars as possible. Thus, the orchestration of technologies—here the bots and the pre-existing virtual world scenario—creates the experience and purpose for the users, as well as defining their degree of freedom, flexibility, and creativity. From a theoretical perspective, we classify technology based on the scope of action along a scale from soft to hard (see also Dron, Reiners, & Gregory, 2011). In a soft technology environment, the user is able to do as much as possible without many restrictions, whereas in a hard technology, the options are provided by the environment; for instance, each step is predefined and the user can only follow these steps. Soft technology is about the latent possibilities and potential available to human-controlled avatar or bot that enables many creative and flexible uses. Instead of defining or restricting the next activity, a free choice and decision is required to progress in the virtual environment. Hard technology constrains the freedom by aiming for efficiency, replicability, and the elimination of errors (Ellul, 1970). Here, the human-controlled avatar or bot is confronted with instructions on how to proceed with a limited set of well-defined alternatives to choose from. Strictly scripted games often follow this scheme, where the protagonist is challenged

by a sequence of individual tasks to solve in a certain way. Note that environments have to find the right balance between soft and hard according to the expectations of the user, thus giving some freedom while still directing them to a specified target.

Referring to virtual worlds, Figure 8.1 demonstrates the difference between soft and hard technologies. The empty space in Figure 8.1 on the left side is considered a soft technology, as the creativity is not constrained by restrictions placed on it by Linden Lab (the proprietors of Second Life) or the Second Life software program. Thus, the landowner can build, for example along the given Australian theme, change the landscape, or integrate objects from other scenarios, real or not. The second example, on the right side of Figure 8.1, depicts a hard technology as the user is strictly guided by a one-way sign, has to perform specific tasks, and is not allowed to leave this path unless he or she has achieved the defined objective. Here, the user cannot express him or herself, but has to proceed according to the requirements of the technology.

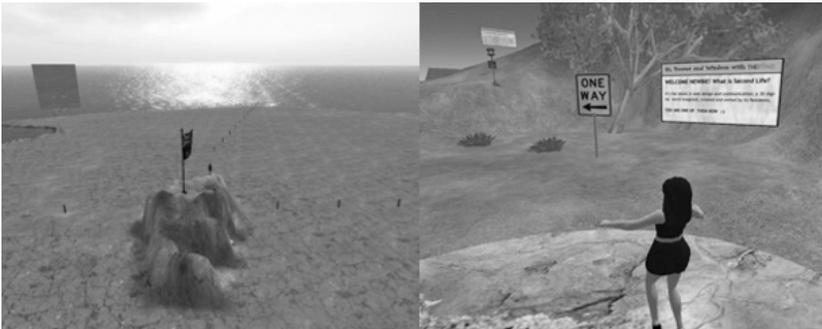


Figure 8.1 Information being provided to a newbie.

In relation to bots, the technology is generally hardened as bots have a certain set of functions predefined through their programming. A salesperson bot is unlikely to get involved in actions but, as a result of their programming, will provide the offered goods efficiently, even though their programming might include individual preferences and therefore offer to the user a higher degree of immersion compared to, for example, a vending machine. Additionally, the hard technology can also simplify interactions and provide a recognizable purpose, for example, a bot representing a student in a classroom provides the immersive environment of a classroom in which the user can engage in roles like teacher or observer, as demonstrated by the VirtualPREX project.

Overview of Examples and Technologies for Bots in Second Life

The development of bots in games and MMORPGs (massively multiplayer online role-playing games) has progressed considerably over the past few years. Besides simple scripts reacting to the users' movements, intelligent algorithms create strategies to increase the immersion, providing unpredictable or challenging actions. Unfortunately, Second Life does not provide major (intrinsic) support for the bot programming required in VirtualPREX, as bots are restricted to simpler and less complex tasks. One reason for this is the design of Linden Scripting Language (LSL), where scripts are part of an object and not avatars (Friedman et al., 2007). Nevertheless, several projects incorporate bots using a combination of Second Life technologies and external applications; some examples are shown in the Table 8.1.

Table 8.1 Various Projects Incorporating Bot Activities

Project	Bot functions	Reference	Description
TeachLive	Bots who talk, look, and even act like students from real classrooms.	Dieker (2011)	Pre-service teachers can practise their teaching skills with bots being controlled by a human or as programmed avatars.
PRESENCIA	Bots wander around to find interesting locations and interact with human-controlled avatars.	Friedman et al. (2007)	Analyzes social behaviour in Second Life.
QoE	Crawler that gathers information about the virtual world that includes a player to playback the collected experiences.	Varvello, Ferrari, Biersack, and Diot (2011)	Explores Second Life to measure the quality of experience.
Improv	Real-time behaviour-based animated actors.	Perlin and Goldberg (1996)	The system consists of an animation and a behavioural engine to create actors in virtual worlds.

Project	Bot functions	Reference	Description
Emotion	Extends Second Life bots with emotions.	Slater and Burden (2009)	Adds emotions to already existing bots using an AI engine.
MPML3D (Multimodal Presentation Markup Language)	Specifies communicative behaviour and the interaction of bots using this markup language.	Prendinger, Ullrich, Nakasone, and Ishizuka (2011)	To improve the usability of the scripting language for bots, MPML3D is used as an interface to write XML-based control scripts.
Experiment using SPIN (SPARQL Inferencing Notation)	Conversational behaviour of the agent using SPIN, a rule-based language generation system.	Pallay, Rhem, and Kurdyukova (2009)	An investigation of human-agent interactions in virtual environments like Second Life.
Team Handball	Moves bots around a virtual handball field.	Lopes, Pries, Santos, Sequeira, and Camerino (2009)	A trainer can control bots through an external environment and inworld. Controls the positions of players to demonstrate different tactics.
Medical Education	Chatbots that can convey some emotions through facial expressions.	Danforth, Proctor, Heller, Chen, and Johnson (2009)	Simulates doctor-patient communication using AIML technology (similar to Chatbot and Pandorabots).
Uruk	Embodied conversational agents that can reason and act based on the environment and context.	Ijaz, Bogdanovych, and Simoff (2011)	Simulates the ancient city of Uruk using a very profound integration of the context.

TeachLivE (evolved from TeachME), although not using Second Life, is a project with similar goals to VirtualPREX (see also Dieker, 2011). TeachLivE explores virtual teaching experiences in an automated classroom using a different

medium. It is a mixed-reality teaching environment (Dieker, Hynes, & Hughes, 2008) where bots are programmed by software but rely on an actor controlling the bots via puppetry (known as an interactor), to respond to the teacher depending on whether they use “effective” or “ineffective” teaching methods. This automated classroom can be used for practising teaching skills and can also detect “unfit” teachers early to reduce attrition. Also, as with VirtualPREX, the bots enable pre-service teachers to learn from their mistakes prior to teaching live classes in a risk-free environment.

The technology of how bots are used varies from unique implementations to frameworks consisting of whole environments and programming languages. The following list is just a sample of existing approaches available to make the bots do almost exactly what the creator wants, with different requirements of programming knowledge. In this chapter we outline an overview of different tools—which can also be combined—to create, in our case, an authentic primary school child bot that can be used in the classroom. All these tools have been created by different developers and are available in Second Life and OpenSim. Note that the list shows only an extract of available tools, as further, often very specialized, systems exist. However, we focus on those being considered—after a preliminary benchmark test—for implementation within the VirtualPREX project.

Pikkubots (<http://www.pikkubot.de>)—enable interactive learning activities to take place between bots and avatars in authentic learning settings. These bots can interact with, and respond to, other avatars in the virtual world. They can make over 500 different comments using a web-based tracking system (Second Life, 2011). For example, Pikkubots can be used to (i) send out notices to other avatars without having to log into the virtual world in the time range specified by the user (Gray, n.d.); (ii) talk with other avatars; (iii) talk around pre-programmed routes; (iv) follow your avatar; (v) drive vehicles; and (vi) greet visitors and give gifts (Second Life, 2011).

Pandorabots (<http://www.pandorabots.com>)—a bot hosting service that enables users to create, design, and publish bots, making them available to anyone via the Internet. Anyone can create an account and set up the script for their bot. Prepared scripts are available, or the user can insert their own text. Responses by bots, verbally through text, to what other avatars say are programmed into the Pandorabot scripts. The script is then placed in a bot made out of objects. Bots

and scripts are both freely available. Pandorabots also have blank templates so that the script can be written from scratch, providing owners with the ability to make a unique personality for the bot. Pandorabots are able to recognize speech, which is transmitted to the bot after the user acknowledges the text.

The Logic System—enables users to make choices so that a bot reacts to a human avatar teaching by creating branched, decision-based activities. Simulations, orientations, information kiosks, games, decision-making systems, and interactive stories are learning activities that the Logic System supports (Jamison, 2009). There are now two versions of the Logic System—one that reacts to the human user’s avatar, and one that is linked to a bot (using Pikkubots).

By using the Pikkubots, Pandorabots, and Logic System together, authentic learning, actions, and reactions can take place through conversation, movement, and the provision of different decisions. Figure 8.2 is an example of a human avatar and bots interacting and existing together in the one space.



Figure 8.2 Bots interacting with one another while a human avatar looks on.

LIBOPENMV—a library that implements core functionality like protocols, networking, and programming interfaces for clients to interact with virtual worlds such as Second Life and OpenSim. *LIBOPENMV* resembles several .NET libraries, is open source and maintained by the non-profit OpenMetaverse Foundation (<https://github.com/openmetaversefoundation>). The library supports messages currently used by Second Life or OpenSim, and enables their integration in other software projects to gain access to virtual worlds. This use

of messages allows clients access on a system level so that they can achieve further information and control than would be possible via other interfaces like web-based protocols. One of its main applications is the control of bots (Sugar, 2011), and the library is also part of toolkits like SLbot (<http://www.niendir.de/slbot>) and the infamous CopyBot, used to access and archive objects from Second Life (see Second Life Wiki, 2011).

As we mentioned, the scripting in Second Life using only Linden's script language limits the possibilities such that external systems are needed to improve the quality and functionality of bots. To our knowledge, there exists no standard for designing and implementing bots in Second Life. Although various technologies have been developed over previous years (see Table 8.1), none of these systems have established a common denominator for creating bots; that is,, allowing bots to exist in more than one virtual world or even enabling complete interworld communication between bots. From a technological perspective, bots in Second Life have come a long way, and by combining approaches in a common framework, educators can model the behaviour they desire in them without advanced programming skills. A standard would allow for bots that are interchangeable across platforms which can be easily set up. New behavioural scripts could be integrated into the same framework, or parts could be re-used from other technologies.

Bots in VirtualPREX

In this section, we discuss how bots can be integrated in VirtualPREX to provide an interactive, immersive classroom for the pre-service teacher. In the pilot study, pre-service teachers participated in a workshop where, through role play, they taught a lesson to their peers acting as primary school students in order to establish ways in which to immerse and engage the whole class in the lesson. By using bots, pre-service teachers will be provided with increased opportunities to practise, try out skills, and apply concepts in an authentic and immersive learning environment, asynchronously through interaction in and with the bots. Bots will provide more opportunities for off-campus pre-service teachers to practise, as they are not usually afforded the opportunity to synchronously role-play with their peers.

Pre-service teachers can immerse themselves in high-quality education as they are provided with opportunities to interact with bots and peers in authentic learning environments, real or simulated (Gregory & James, 2011). The rather soft technology of a classic classroom would leave pre-service teachers without any guidance with respect to how to proceed when dealing with keeping

students engaged and attentive. “Hardening” the classroom by adding scripted bots specifies the scenario such that the pre-service teacher is restricted to certain methods available to them through interaction with the bots. The same applies to, for example, exams where each pre-service teacher is supposed to have the same conditions and reactions. There are a variety of behaviours that bots can display to interact with the pre-service teachers. It could be as simple as the bot ceasing to misbehave and interrupt the class when the teacher walks closer. After all, links with reality are provided through authentic learning environments. Teaching methods (analogous to soft technologies) that pre-service teachers learn in the classroom can be translated through VirtualPREX by practising in a virtual world. The hardening of these soft technologies in defined scenarios with scripted bots offers pre-service teachers an opportunity to repeat and experience certain situations in an immersive space. Both automated and role-play activities that are modelled on the real world, like VirtualPREX, can provide a greater sense of presence and realism than non-3D spaces (Dalgarno & Lee, 2010).

The prototype bot is lifelike, interactive, automated, and looks and behaves like a primary school student. This bot is programmed to respond in a variety of ways to the pre-service teacher by reacting to basic terms and questions using a combination of several different programmed systems available in the virtual world. In general, the prototype bot is based on the LIBOPENMV library.

Bots can be used to act as any required character, such as on-task or off-task school students—a common use for non-player characters (see Mahon et al., 2010; Jolie, Katzky, Bredl, Kappe, & Krause, 2011). The learner can engage with bots who undertake multiple roles where they have predefined reactions to events that occur in the teaching scenario (paying attention, writing, drawing, disturbing the class, throwing paper planes, etc.; see Figures 8.3 and 8.4). The pre-service teacher can practise the same teaching scenario multiple times without variation. Conversely, bots can be configured in advance so that they will react to different teaching strategies when they have changeable behaviours using script libraries.

By using original avatar technology, Second Life provides an environment where most users can program bots with a high level of sophistication. The framework that is currently being developed is demonstrated in Figure 8.3, which consists of inworld and external components. Complete inworld control of avatars is, on the one hand, too slow due to the script engine, and on the other, is also restricted by the functionality that the script language (LSL) used in Second Life offers (Ranathunga, Cranefield, & Purvis, 2010; Kumar et al., 2008).

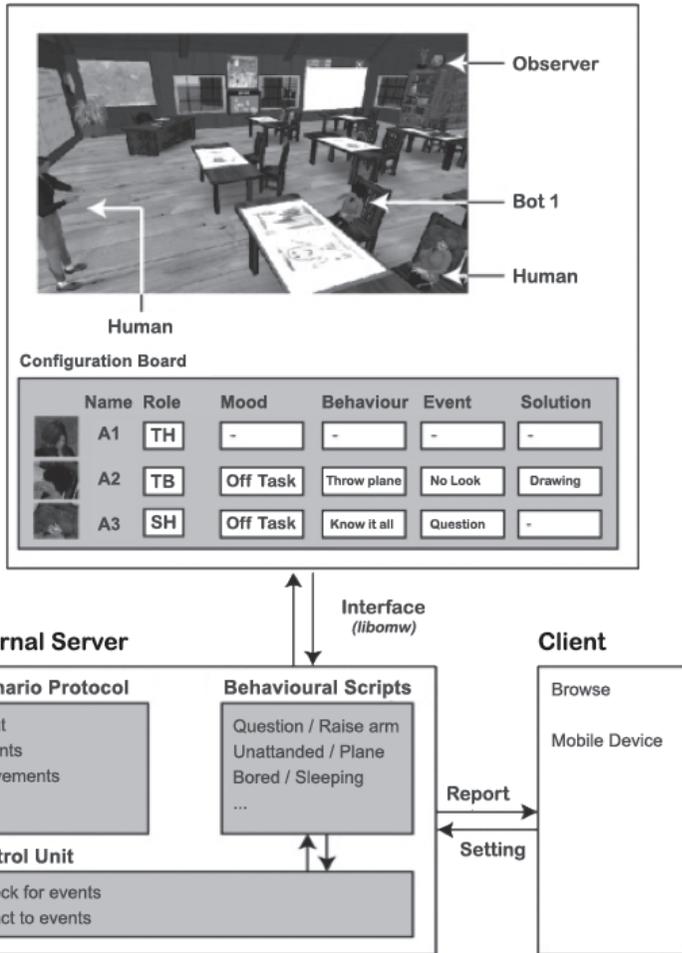


Figure 8.3 Schematic framework of inworld and external components of bot creation.

Figure 8.3 depicts one of the two intended systems to implement the bots for VirtualPREX. The classroom is situated in Second Life where avatars are either controlled by humans or through the system (bots). The behaviour of the bots is configured in advance, even though live modifications are possible if someone is observing the classroom. The basic configuration is done by assigning each role in the classroom to either a human or a bot. The bot can be programmed with a variety of behaviours (state of the bots) which are

triggered by teacher actions (such as his or her proximity or him or her addressing the bot). The behaviours are assigned depending on the teacher’s actions, to provide him or her with a number of scenarios that may occur in a “normal” classroom. Underneath the surface, a server is recording all events in the classroom: the movements of avatars, gestures, or objects being passed between students. Based on triggers, the server initiates actions. For example, an off-task bot student who is not noticed by anyone starts throwing paper airplanes at the teacher. See Figure 8.4 for an example of how the bot is triggered to throw a paper plane as soon as the teacher turns away without implementing a strategy, such as leaving a book to keep the student busy.

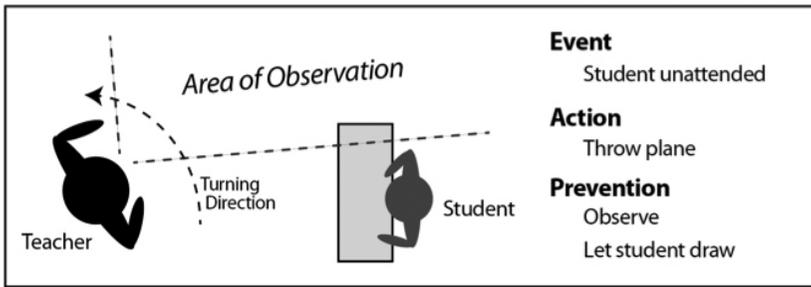


Figure 8.4 Example of an event the student bot triggers based on the teacher avatar’s behaviour.

In VirtualPREX, bots require the capability to perform at least four activities, and furthermore, the design of the system should not limit further extensions and scenarios (Gregory et al., 2011, p. 498):

1. All roles/characters are either assigned to a human-controlled avatar by wearing the corresponding outfit, or a bot is initialized by requesting the external server to log in and take control.
2. Bots must be able to configure the mood, behaviour, event, and solution for each avatar. For human-controlled avatars, this is only a guideline, as the software cannot influence their behaviour. Bots, on the other hand, perform based on these settings; e.g., A2 is off task (mood) and will throw paper airplanes (behaviour) whenever the teacher’s area of observation is not on the student (event; see Figure 8.4). Asking the student to draw a picture or keeping the area of observation on him can prevent the behaviour. At this stage of the project, only a single event or

action has been programmed. The configuration board can be in Second Life (e.g., hidden behind a flipchart that only the teacher can turn around) or on external clients.

3. During the experiment, all events (including chat, movements, and actions) have to be observed and archived for later analysis. This can either be done by the developed system or by inworld objects that report all events to an external server.
4. The results must be exported in different formats depending on how they are later used. For analysis, quantitative (e.g., timing, success rate, grading, movement) as well as qualitative (e.g., chat, screenshots) data are archived. Furthermore, all movements and events can be recorded as a script to be later reused for replaying a scenario to a pre-service teacher for analysis or training bots for future scenarios.

VirtualPREX uses bots based on a similar approach to LIBOPENMV (see Gayle & Manocha, 2008; Prendinger et al., 2011; Ranathunga et al., 2010). With the current trend of mobile applications (apps), we decided to develop VirtualPREX for platforms like Android and iPad to give lecturers the flexibility of observing and controlling the classroom from any location rather than just desktop computers. The interface is adapted for simple use and quick access to functionality as well as protocols from courses for later analysis. The focus for the interface is on “easy to use” elements that allow users to intuitively control the bots’ reactions to events and define actions that teachers have to perform to modify the behaviour of the bots, such as eliminating delays during a session. From a technological perspective, the design only allows server-based bots, so that no human observer or controller is needed after setting up the scenario. For benchmarks as well as backup, VirtualPREX also incorporates a combination of Pikkubots, Pandorabots, and Logic System, which provides the user with a selection of bots to be used for interaction. Figure 8.5 outlines a bot schematic to demonstrate how the bots are programmed depending on the action (or non-action) from the teacher.

A more complex schematic that outlines the step-by-step process of programming the bots is displayed in Figure 8.6. This schematic demonstrates how the bots would be programmed depending on the actions of the teacher. There are random branches where the bot may move to on-task behaviour, stay off-task, or become more problematic, requiring teacher intervention to guide the bot back to being on-task.

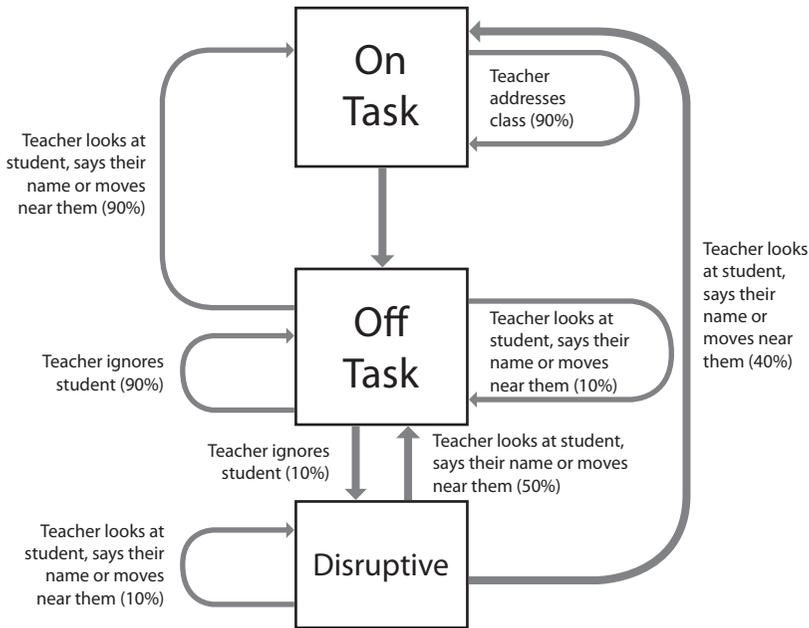


Figure 8.5 Bot schematic.

Discussion and Outlook

We envisage that VirtualPREX will lead to the creation of bots that will be able to react for different lessons. The aim is to slowly build up the repertoire of types of lessons that the pre-service teacher and bots participate in, to eventually enable a suite of curriculum subjects to be taught across different teaching levels, and thus offer an alternative to the traditional classroom with humans interacting with one another in role playing exercises. This will be beneficial, especially in the case of distance education, where obstacles like time zones, connection quality, bandwidth, and language can all hinder pre-service teachers from achieving full immersion and the ability to interact. In the VirtualPREX virtual classroom, the opportunities to practise role-play situations independent of other pre-service teachers or academics, at any time, provides the freedom to distance learners to use the environment matching their pace and timetable. Further, pre-service teachers will be able to repeat scenarios for additional practice without the need to be monitored by their teacher, therefore allowing them to build more confidence in their teaching.

Schematic for Bot Programming

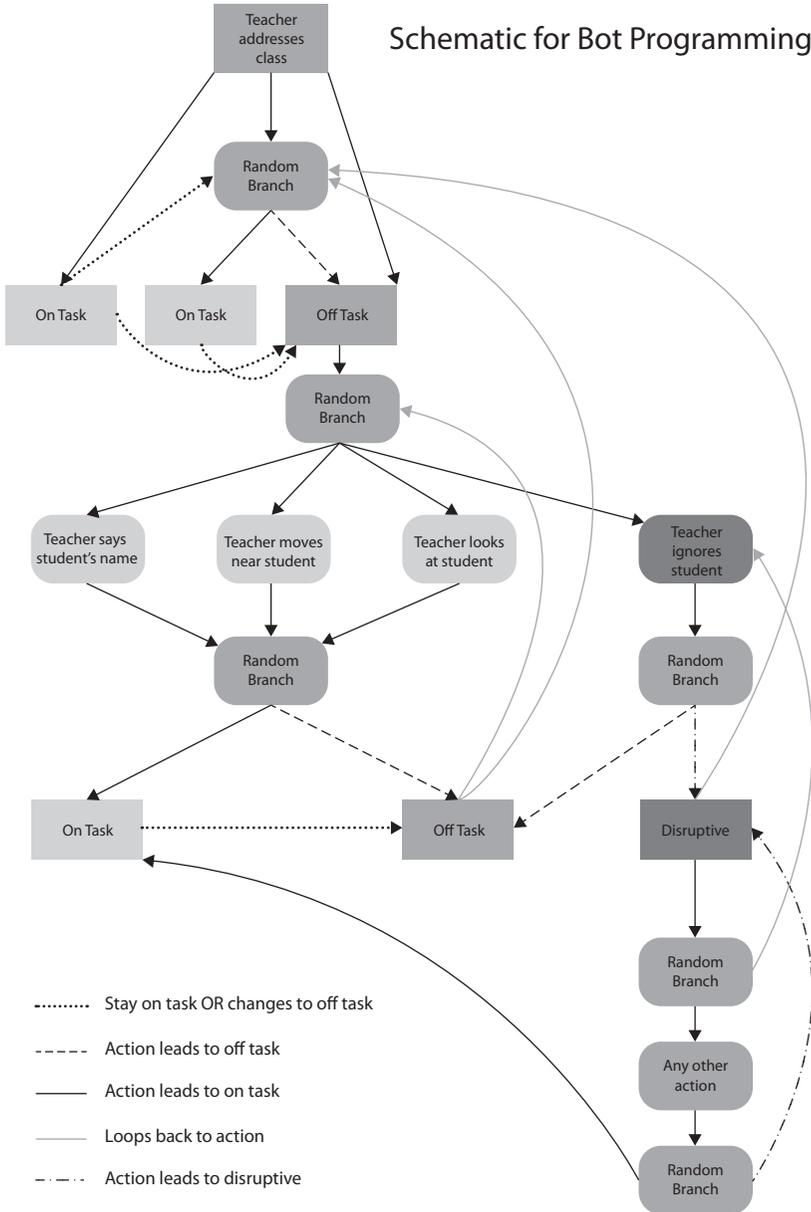


Figure 8.6 Bot schematic with step-by-step procedures.

There are risks with using bot-based role play, or any bot as a learning tool, as the user must be mindful that they are interacting with a bot and not a real person, even though the bot may respond and act realistically. Although bots can be authentic, this is also a limitation, since users may forget that they are dealing with a pre-programmed avatar. Bots are not able to interact spontaneously with the teacher avatar as is possible in peer role plays and the real-life classroom.

Bots are programmed for certain situations and are not able to act out of their scope of predefined functions. The programmer, based on focus group feedback and evidence in the literature, has to predict as many actions and behaviours as possible that the pre-service teacher may demonstrate. The programmer has to define default actions for cases outside the teaching scope to prevent unrelated, and therefore confusing reactions. Similar to non-player characters (NPCs) in computer games who use phrases like “Sorry, I do not understand you” when asked unexpected questions or comments, bots in VirtualPREX should be able to respond to the pre-service teachers about actions they do not understand so that the pre-service teachers are able to reconsider and try different approaches to achieve a given task. For example, if the bot anticipates a certain input to change its state (e.g., from off-task to on-task) and the pre-service teacher is providing something similar but not the exact input, the bot will not react. In reality, the combination of multiple activities (words, gestures, different items) might work, but these are almost impossible to map to a scripted environment.

Most important for improving the bots is an analysis of pre-service teacher behaviour in the virtual classroom. While the first bots will represent the experience from real classroom settings over several years, the transfer to an immersive space with a pre-service teacher acting on his or her own represents a completely new environment, with its own rules and events. With each conducted run of the classroom, the results will be used to learn about the deviation from the real classroom and to improve the bots’ behaviour by adapting or enhancing their scripts. The hardened system, with restricted bots and little room for freedom, is softened again as the bots are adapted to the pre-service teachers’ behaviour. Even though the immersive space still has restrictions, it provides more flexibility as bots responses are not limited to just one answer but allow for different teaching approaches.

Future Directions and Conclusion

In this chapter, we took a closer look at bots in Second Life in the VirtualPREX project focusing on how they can be used to improve inworld teaching and learning. Our main interest was in current developments being undertaken by

the VirtualPREX project, where bots are to be used to interact with pre-service teachers while teaching a class. The VirtualPREX project is aware of the limitations of using bots to teach in a virtual world classroom, as not all scenarios can be created, and it is impossible to predict how a real-life school student may respond to different actions and statements by teachers. Therefore, it is important to emphasize that the VirtualPREX teaching scenario bots are a tool to be used to practise teaching and can never take away from the need of real-life professional experience in classes with real primary school students.

Although in its infancy, VirtualPREX role-play interactions with bots has the potential to be a widely used and sought after resource for pre-service teachers to add to their repertoire of skills to take to the classroom. While the first version of bots will provide sufficient functionality for basic learning scenarios, the feedback will be continuously used to improve their capabilities for interacting with pre-service teachers. One might say the bots need to face the same challenges as the pre-service teachers, especially as the challenges of the immersive space are not equivalent to the real classroom. Without doubt, the first results of the VirtualPREX pilot study indicate that there are a variety of ways different people react in role-play scenarios and one way forward is through the scripting of bots. Through the use of VirtualPREX bots, pre-service teachers will be able to asynchronously practise teaching in their own home, on their own time, and at their own pace, giving them the opportunity to repeat the practice to perfect their teaching skills. This can supplement their real-life professional experience and lead to major innovations in how they prepare for the real world classroom.

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PART THREE

**LEARNING
DESIGN AND
IMPLEMENTATION**



ANALYZING TEACHING PRACTICES IN SECOND LIFE

A Design Taxonomy for the
Implementation of Workshops in Virtual
Worlds

Steven Warburton and Margarita Pérez García

An assessment of emerging technologies carried out in the *Horizon Report* (New Media Consortium and EDUCAUSE Learning Initiative, 2007) identified massively multi-user virtual environments (MUVEs) as one of the major technological platforms that would impact the innovation and enhancement of the student learning experience. This expectancy was framed by a description of the almost limitless possibilities for cooperation and content creation afforded by MUVEs. These were virtual spaces where teachers and learners, embodied as avatars, could engage in extended and safe social interaction in a 3D world lacking a pre-set structure and narrative.

These spaces offer opportunities for education that are almost limitless, bound only by our ability to imagine and create them. Campuses, businesses, and other organizations increasingly have a presence in the virtual world, and the trend is likely to take off in a way that will echo the rise of the Web in the mid-1990s. (New Media Consortium and EDUCAUSE Learning Initiative, 2007, p. 18)

At that point MUVEs rapidly gained interest and credibility among a range of forward-thinking educators looking for new opportunities to extend their modes of teaching. These compelling virtual spaces offered a sense of freedom, otherness,

and re-embodiment that could take the learner outside of themselves and into a life not simply on the screen but inside it (Schroeder, 1996, 2008; Turkle, 1995). What has continued to attract educators to MUVes such as Second Life (SL) is the particular range of possibilities for enhancing learning that are not found consistently in other learning and teaching platforms, including:

- Flexible engineering of learning spaces;
- User-content/object creation and ownership;
- Extended social and human-machine interactions: person-to-person, person-to-object, and between objects;
- The potential to develop classrooms and community-based scenarios that mirror or extend those that exist in the real world;
- Implementation of non-traditional learning approaches and methodologies such as socio-constructivism and situated learning, experiential learning, project-based learning, game-based learning, simulations, and role play;
- The potential to use them as tools to engage learners, foster motivation, and facilitate self-organization of learning.

MUVes have therefore been represented as an appealing, technology-enhanced learning space for educators to exploit. However, the expected impact of virtual worlds on mainstream education, or indeed distance education, has not yet taken place. There are a number of reasons that are often cited to explain the difficulties that educators have experienced in passing the tipping point. These include the high training threshold for end-users, limitations on scalability, hardware costs, and lack of interoperability (Warburton, 2009; Smith-Robbins, 2011). But between the lines of these experiences, we can also read the difficulty that educators have found in negotiating the tension between building the required pedagogical practice for teaching online, and developing the necessary expertise in technology, both of which are required in order to make effective use of a virtual world like Second Life. As Martinez, Martinez, and Warkentin comment, “although the teacher has more than 15 years of experience in academia, he found problems while designing lecture and during the delivery due to the relatively unknown media capabilities” (2007, p. 52).

Because virtual world classrooms often resemble, and indeed try to mirror, their real-life counterparts, there has followed an assumption that “if one is a teacher in the real world then one can, by extension, teach in this different yet recognizable virtual space.” The emerging literature on the use of virtual worlds for education provides some evidence to the contrary and seems to indicate that

experienced real-life (RL) educators struggle to make their virtual teaching practice as effective as their RL teaching practice, or even to integrate Second Life successfully into their teaching repertoire. The freedom of the environment, the lack of technological skills, and a poor understanding of socio-cultural codes are some of the reasons that have led many educators to overcompensate by trying to recreate traditional learning scaffolds and replicate RL teaching practices, with variable degrees of success (Carr, Oliver, & Burn, 2010). This has highlighted one of the key problems about working with cutting-edge tools: there is often a paucity of material, such as guides and good practices, to help steer those who are enthusiastic but unsure of how to proceed. That said, the body of material is increasing and there are guidelines that have been published describing principles of virtual world teaching in a variety of areas, such as in cooperative and collaborative learning (Robertson & Kipar, 2010; Warburton & Pérez García, 2009), but there is a gap in concrete design guides or inventories to help educators practically instantiate their inworld teaching sessions.

Despite these questions about the transferability of RL teaching practices into MUVes, it was clear that an experienced observer of teaching activity inside Second Life could find pockets of successful practice. While many formal education bodies were struggling with their virtual spaces, there were a host of non-professional educators who did appear to be teaching successfully within more informal learning settings and who possessed a high level of specific technical skills to help design their educational experiences. Preliminary field observations were revealing, indicating that teaching expertise was not the only factor that impacted positively on the planning and delivery of instruction in virtual worlds. A combination of other factors were playing an important role and provided a potentially rich source of good practices that could be studied and collected to pass onto others.

In order to explore the question of the transferability of RL teaching practices into MUVes, and contrast the impact of pedagogical expertise against other factors such as the control of the technological environment, we conducted field research in Second Life between October 2007 and July 2009 and focused on the study of hands-on workshops.

Hands-On Workshops Inside Second Life

There are a variety of teaching practices taking place inside virtual worlds at any one time. These range from formal to informal interventions, with one of the most popular being hands-on workshops. These can be defined as synchronous

teaching events that generally aim to develop a participant's practical skills, such as technical skills in building and/or scripting. In this study the workshops were non-formal, of short duration (on average, about one hour), and targeted small groups—the number of participants usually fluctuated between five and twenty. For the most part, these kinds of workshops are organized by non-formal learning providers in commercial or not-for-profit modes, who target the Second Life community at large with these opportunities to learn new skills and will cater to participants with differing levels of expertise.¹ The primary mode of instruction is usually text-based communication—a response to the often technical nature of the content being delivered and the requirement to be able to access and review the instructions after these are given by the facilitator. Some workshops did incorporate the use of voice with text, with a minority that made use of voice communication alone. The facilitators of these workshops are often experts in building and scripting who have been recruited as distance learning educators. While professional educators can and do organize workshops inside Second Life, most of these facilitators are non-professionals who have followed a few weeks of specific tutor training. By being publicly advertised as inworld educational events, we found the workshops were easy to access. Second Life citizens could use the search function to locate ongoing and upcoming educational events, though at the time of this research the list of workshops could only be sorted by keyword, maturity rating, and length through the search tool. There were no advanced search functionalities that would allow ordering by subject, tutor, learning provider, skill level, or language. With several workshops being offered each hour of the day, they represented one of the principal resources for learning Second Life-related skills inworld.²

In summary, the short duration of these teaching events, their popularity, and the ease of access made them an ideal object of study for observing and understanding the relationship between pedagogical expertise and technological knowledge in virtual worlds, and approaching the critical factors of effective design and delivery of instruction.

¹ That is, educational organizations that deploy their teaching activities exclusively inside Second Life—for example, activity was recorded from Tul, Rocklife University, NCI Classes, FSBU, Fermi Sandbox and University, SL Learning Centre, and Insight Virtual College.

² Other possibilities for those inworld included following self-paced tutorials, learning by informally watching others in public sandboxes, peer learning among friends, or being guided by a mentor, just to cite a few. External resources included public forums, dedicated Second Life wikis, and watching video tutorials on YouTube.

Objectives of the Research

The overall aim of this study was to identify the critical factors that impact positively on the design and delivery of workshops in virtual worlds. Our initial observations during preparatory fieldwork suggested that the control of the [virtual] physical environment where workshops took place played a fundamental role in their success. With the control of the environment being proportional to the technical skills of the workshop facilitator, we investigated how the technical skill levels of the facilitators impacted their pedagogical practice. The first step in this process was to objectively examine the workshops to better understand their composition. For this reason a threefold objective guided the research activities:

1. to identify the commonalities and differences of workshops in order to map patterns and existing declinations;
2. to develop an analytical device for planning, implementing, and evaluating hands-on workshops; and
3. to identify the factors that impact positively on their success.³

In addition, we expected that the results would lead to the identification of the kinds of knowledge needed by experienced RL educators to effectively design and implement workshops inside Second Life. The work presented here introduces the analytical device that we developed for planning, implementing, and evaluating workshops, and the results of the analysis show which factors played the greatest role in the effective delivery of workshops inside the virtual world, Second Life.

Our research focused exclusively on the analysis of workshops delivered through text-based interactions that were aimed at developing technical skills in building or scripting objects inworld, with each lasting a minimum duration of one hour.

Two distinct types of workshop activity were explored:

1. Analysis of 125 workshops organized by non-formal learning providers, and facilitated by people with strong technological content knowledge (about building and scripting 3D objects in virtual worlds) and technological knowledge (about the use of Second Life in general, and for facilitating a workshop). We, the authors, directly evaluated 25 of

³ Impact assessment is based on the contextual evaluation of the effectiveness of teaching in relation to the knowledge, skills, and satisfaction gained by learners.

these workshops, which took place over a three-month period. The remaining 100 were evaluated from January to July 2009 by participants in the MUVEnation program using the analysis grid we developed.⁴

2. We designed and delivered two workshops, and a further 50 workshops that were organized during the MUVEnation program, facilitated by experienced educators with recently developed technological content knowledge about building and scripting 3D objects in virtual worlds. When they created their own workshops they were still developing their skills in using Second Life for educational purposes employing a learning-by-designing approach (Mishra & Koehler, 2003).

Methodology

The study was carried out in three distinct phases, and gathered qualitative data from multiple inquiry sources that were subsequently analyzed using a mixture of a grounded theory approach (Glaser & Strauss, 1967), thematic (Hayes, 2000), and narrative analysis (Kohler Riessman, 2008):

1. Participant observation was used to collect data during the analysis of the first 25 workshops inworld. The research involved a range of methods: direct observation, participation as learners in the workshops, collective discussions with other participants post workshop, informal interviews with the facilitators, and analysis of commentaries within secondary literature sources. The study of these workshops led to the design of a preliminary or “proto-analysis” grid ready to be validated as an evaluation tool for inworld instructional sessions presented in a workshop format.
2. The proto-analysis grid was distributed to members of the MUVEnation program who then, guided by the grid, used participant observation to collect the data from a further 100 inworld workshops. Their research involved a range of methods: direct observation, participation as learners in the workshops, synchronous collective discussions with

⁴ MUVEnation was a European project co-funded by the European Commission under the 2007 Lifelong Learning program, Comenius–School education sub-program. The project developed a European peer-learning program for teacher training in the use of “Active learning with multi-user virtual environments to increase pupils’ motivation and participation in education.” The nine-month program attracted 107 participants from 26 countries worldwide (Pérez García, 2009).

other participants in the workshops, and asynchronous discussions within four online forums dedicated to the main themes identified in the analysis: (a) the planning and preparation of the instruction, (b) the delivery of the instruction, (c) the follow-up and evaluation, and (d) the activities for recalling and transferring learning. In total, the analysis of the 100 workshops evaluated by MUVEnation participants included

- Transcripts of online discussions about workshops between the authors and the participants in the MUVEnation program.
 - Notes from observation and participation in the workshops made by MUVEnation participants in the program's forum and wiki, and also in their individual blogs.
 - Transcripts of synchronous discussions within Second Life or Skype about workshops with the participants in the MUVEnation program.
3. With the aim of testing the grid beyond the sole purpose of its use as an evaluation tool, we prepared two workshops, taking into account the identified themes as a rubric for their design and implementation. We analyzed these by completing case-stories in the form of personal narratives and collective discussions with the participants of the workshops. This resulted in
- Two case-stories in the form of personal narratives retelling and reflecting of the design experience.
 - Non-structured feedback from participants in the workshops.

Following this initial effort, 50 participants of the MUVEnation program were then encouraged to design and implement their own workshops in a similar manner. Post-workshop analysis was then carried out on the case-stories written in the form of personal narratives, documents prepared individually such as blog entries with personal reflections, design briefs and collective peer evaluation reports, as well as collective discussion in the forums.

For the analysis of the 50 workshops designed and implemented by MUVEnation participants, the results included

- Fifty design briefs of the workshops organized by the MUVEnation participants
- One hundred peer evaluation reports of the workshops organized by the MUVEnation participants
- Photos of the educational settings and recordings of the workshops

- Eighty-one case-stories in the form of personal narratives retelling and reflecting on the design experience.

Results

Part One: Development of the Proto-Analysis Grid for the Design, Implementation, and Evaluation of Workshops

We developed the first or “proto-analysis” grid from the detailed analysis of 25 workshops that covered notes gathered during direct observation and participation in the workshops, photos of the educational settings in which the workshops took place, and 15 interviews conducted with the facilitators of the workshops. The grid itself comprises 27 discrete criteria that are distributed under four main headings, or themes, that relate to the design and implementation of inworld workshops (Table 9.1).

Table 9.1 Guidelines Based on Positive Design Aspects that Aid Navigation and Wayfinding

Theme	Guidelines
<i>A. Planning and preparation of the instruction</i>	<ol style="list-style-type: none"> 1. Spatial design and layout 2. Instructional design 3. Organization of instructions and discourse 4. Physical organization of learning material 5. Business model 6. Maturity level Development version
<i>B. Delivery of the instruction</i>	<ol style="list-style-type: none"> 7. Assessment of prior/required knowledge 8. Pre-prepared activities to meet the knowledge requirements 9. Prior knowledge 10. Preparation of user interface and viewing controls 11. Technical preparation of participants 12. Conversational flow 13. Communication dynamics 14. Movement of learners and teachers 15. Presentation of outputs and results 16. Delivery of learning material 17. Use of tools to deliver both contents' instruction 18. Use of media to enhance teaching 19. Concurrent learner activity 20. Personalization of learning

Theme	Guidelines
<i>C. Follow-up and evaluation</i>	21. Provision of guidance, support, and feedback 22. Monitoring of student progress 23. Quality of feedback 24. Assessment model
<i>D. Activities for recalling and transferring learning</i>	25. Recapitulation 26. After-session resources 27. After-session activities

Each criterion corresponds to a constitutive element or characteristic recurrently observed across the workshops, for example, the “Physical organization of learning material” refers to the form in which the learning materials are presented and delivered to participants. During these types of workshops learning materials are always delivered in a certain form: instructions in notecards, objects, and scripts. However, this may vary from workshop to workshop. In some cases, an unstructured set of objects gathered in a folder are passed from inventory to inventory, compared to more structured workshops where they may be delivered on demand by “giver” devices or automatically delivered by objects being used by the participants, such as a virtual chair. In order to make the grid a self-explanatory practical device, each criterion is labelled an “activity” and completed by a leading question. The answer, or concrete implementation, is indicated by the “range.” For some activities, the range is a set of alternatives, a continuum of possibilities, and extreme polarities or tensions. The information described under the range is generic enough to be implemented in a variety of ways.

Part Two: Description of the Analysis Grid Criteria as Validated against 100 Inworld Workshop Evaluations

The proto-analysis grid was tested and validated against 100 inworld workshop evaluations. The results of the evaluations led to the finalized version of the grid, which we describe below. The questions on the left of the grid relate to the activity/criteria, and the information on the right represents the range of responses. The complete grid is also freely available for download.⁵

⁵ Permission is granted under a Creative Commons Attribution license to share and remix freely the content of the grid. To view a copy of this license, visit <http://creativecommons.org/licenses/by/3.0>, or send a letter to Creative Commons, 559 Nathan Abbott Way, Stanford, CA 94305, USA. The grid can be downloaded at <http://www.muvenation.org>.

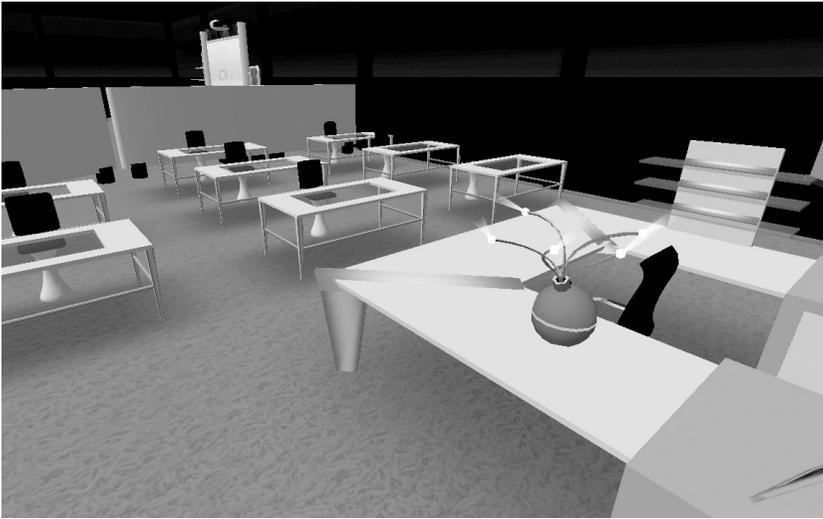


Figure 9.1 A classroom space that emulates a real-life traditional spatial design and layout.



Figure 9.2 The participants learn how to build a street lamp while working within an enclosed individual area, allowing for comfortable camera movement in a virtual space that simulates a street corner.



Figure 9.3 A workshop setting where the avatars can freely move around the teaching space. The chat range is demarcated by the boundary of the circular platform.

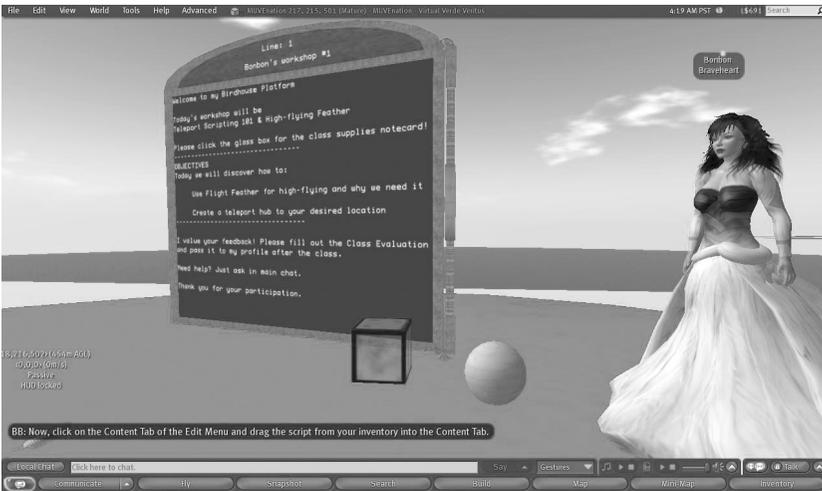


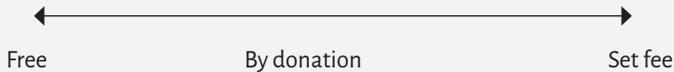
Figure 9.4 At the beginning of the workshop “Creating a teleport hub and using the Flight Feather,” the tutor presents the learning objectives on a whiteboard.



Figure 9.5 For the workshop “Building a holodeck with the Builder’s Buddy script,” the tutors prepared the materials within a hierarchical structure where basic materials and materials for each scene are clearly indicated.

5. Business model

What is the economic model for learner participation?



Workshops were run using different business models and ranged from “free” to “paid.” However, it was common to see donation boxes available to the participants when “free” workshops were being run. The access to paid workshops was determined by the payment of a fixed fee, and these varied according to the learning provider, the tutor, or the subject.

6. Maturity level | Development version

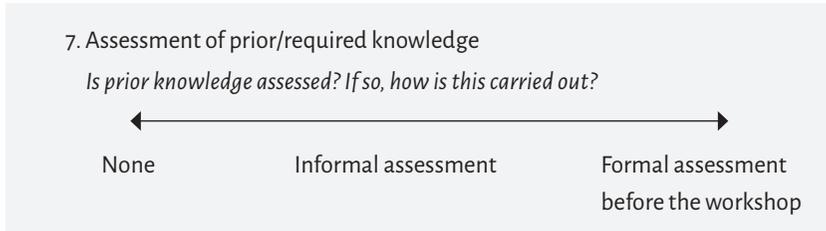
What is the maturity level of the workshop and its lifecycle?



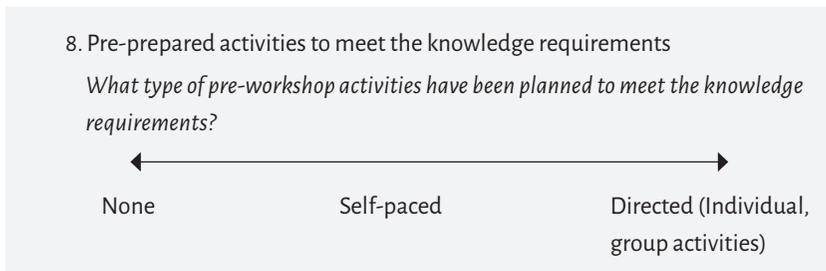
The maturity level of a workshop was defined as the degree to which the tutors felt they had developed a stable and reusable format for their workshops

and ranged from “alpha” stage to “fully tested.” The level of maturity was closely related to the number of times the workshop had been delivered and was based on tutor appraisals of both the efficiency in delivery of the instructions and also in the participants’ performance.

Theme B: Delivery of Instruction



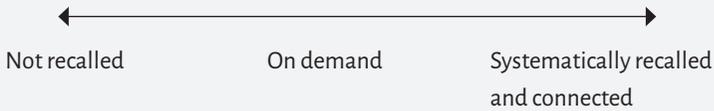
Prior knowledge can be assessed before or at the beginning of the workshop. Often, however, during the free access workshops, the tutors had little way of knowing in advance the skill profile of participants. In some cases, tutors carried out an informal assessment of required skills by either asking the students directly or by making explicit the skill level required at the beginning of the workshop. There was scarce evidence of formal assessment of prior knowledge before the workshops, though it was not completely unheard of. Some tutors assessed their participants’ skill profile using a self-declarative questionnaire via notecard or a quiz maker.



According to the results of the assessment exercise indicated above to assess prior skill levels, tutors invited participants to attend other training sessions or to consult specific resources before the workshop. It was left up to the participant’s responsibility to ensure their skills profile met the workshop’s requirements. As a final resort, in some cases, tutors discouraged potential participants from accessing the workshop if their skill level seemed inappropriate.

9. Prior knowledge

How is prior knowledge recalled and connected to the workshop activities?



Basic workshops teaching Second Life skills do not always require prior knowledge. Where appropriate, tutors recalled and applied prior knowledge on demand while running the workshop in response to the questions that arose. In other workshop situations the tutors stimulated recall of prior knowledge at the beginning of the workshop by imposing a specific task to refresh skills more quickly, for example, thus facilitating the development of new skills and making efficient use of time. It was also possible for tutors to integrate the recollection of prior knowledge into the workshop script (see 3. Organization of instructions and discourse).

10. Preparation of user interface and viewing controls

To what extent are the instructions for organizing the viewer user interface and camera controls given?



Tutors fell into two groups: first there were those who did not pay attention to the organization of the participants' viewer user interface, and consequently provided no instructions regarding the state or locations of windows, nor how to use the camera controls. Second, there were those tutors who chose to help participants to make the best of the user interface by indicating the best locations for the chat history, inventory, and object properties windows. In some cases, tutors used scripts built into objects that could modify the avatar's point of view to make certain that all participants were directed automatically to look at a precise location.

11. Technical preparation of participants

What technical advice and background information are provided?



None

Instructions cover different technical issues

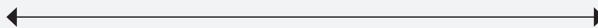
Avatars, AO and HUD, video performance, locations, landmarks, teleports, lag

Inworld workshops can be prone to technical problems due to lag, scripts, and animation interference or conflicts. For this reason, tutors at the beginning of the workshop (or even during delivery) provided the participants with a clear set of instructions regarding critical technical aspects such as

- Setting the graphic performance of the Second Life client;
- Switching on and off any animation “over-riders” and HUDs;
- Taking off objects that may interfere with the tutor’s notecard readers;
- Providing instructions on using the IM (Instant Messenger) channel; and
- Creating landmarks.

12. Conversational flow

How is the conversational flow structured between tutor and learners?



Free and improvised

Ordered and controlled progressively by behavioural interactional rules, textual codes, scripted objects, and communication tools

Conversational flow refers to the organization of the exchange between tutors and learners. The exchange can be free and improvised where participants intervene without constraint. However, with an increasing number of participants these exchanges can quickly become chaotic. When there are more than a handful of active participants in a single chat space, the rapid and unthreaded flow of exchanges makes it difficult to maintain a coherent and productive conversation. Chat spaces are democratic in that anyone can post comments as and when they feel. On the one hand this freedom can be empowering for participants, yet on the other it can reduce the fidelity of the conversation when larger numbers are involved. In order to apply structure to the chat, tutors

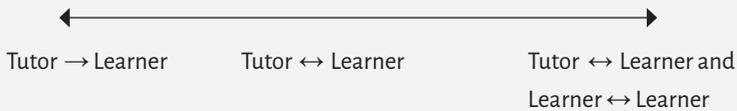
can set ground rules for intervention like asking the participants to label their questions so they are traceable within the chat history, throttling the exchanges by turn-taking or using tools as a question queue, refraining from asking questions until the tutor finishes or allows it, and using or refraining from using the IM channel for asking questions to the tutor (Figure 9.6). Organization, management, etiquette, and maintaining a good signal-to-noise ratio all play a role in successfully navigating synchronous chat to achieve prescribed outcomes.



Figure 9.6 A question and answer session after a workshop using the “CloseText rezzer” on channel 99 to drop participant questions.

13. Communication dynamics

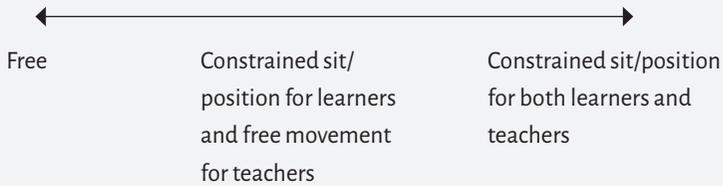
What are the dominant communication dynamics during the workshop?



Where exchanges were structured by tutors, we observed several communication dynamics taking place: the tutor provides contact information to the learners whose role consists of following instructions; the learner–tutor relationship is a bidirectional exchange; and finally, learners communicate between themselves during the workshop in a peer learning support-style mechanism.

14. Movement of learners and teachers

How are the movements of participating avatars in the learning space?



A range of constraints can be applied to, or expected of participants during a workshop. These can range from allowing free movement with avatars circulating as they want and building where they feel like (Figure 9.7), to adopting a sitting position on a prim where body movements are constrained (Figure 9.8). Sometimes the tutor circulates freely among the participants, approaching them to answer to a specific question or taking a closer look at their projects (Figure 9.9), mimicking RL since the flexibility of inworld camera controls means this avatar movement is not actually required. Finally, a tutor may choose to remain in a seated position, on a prim, and manage the class using only the camera controls.

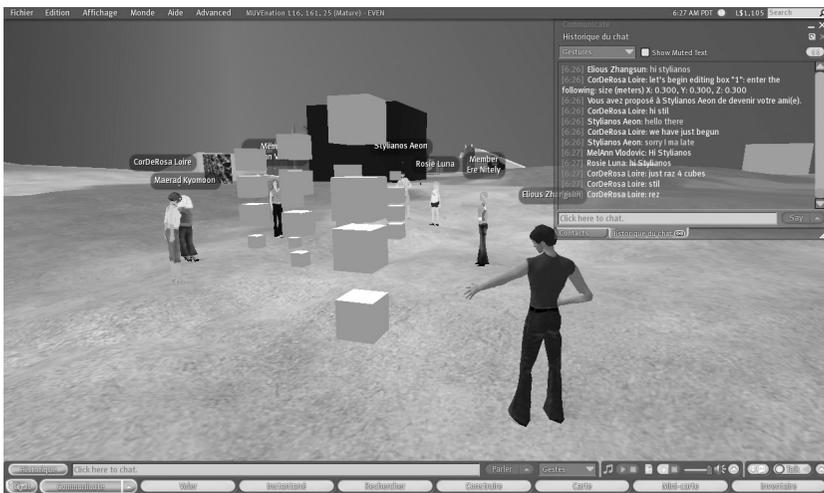


Figure 9.7 Avatars freely occupy a workshop space as they build their own projects.

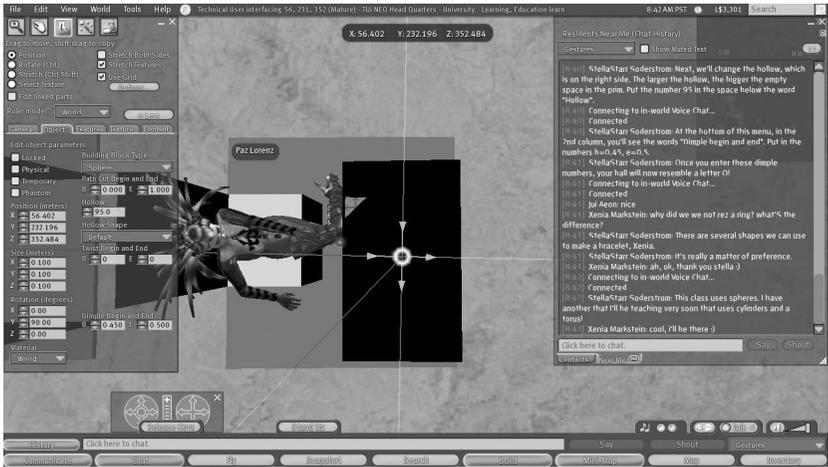


Figure 9.8 During the “Bracelets, bracelets, bracelets!” workshop, the participant sits on a chair and builds her project on a desk.



Figure 9.9 While avatars are constrained to their allotted space, the tutor circulates freely among them.

15. Presentation of outputs and results

How are the expected outputs and results presented?



Examples of the final output of the workshop can be presented in a central location or demonstration area visible to all the participants. Often these were presented on a much bigger scale and situated on the upper area over the tutor (Figure 9.10). In some cases, the stages of development were also shown so the participants could, at any point, compare their intermediate results (Figure 9.11).

16. Delivery of learning material

How are the learning materials given to learners?



Learning materials can be provided on demand, often from tutors' to participants' inventories, or tutors give them out progressively as the workshop unfolds. In the workshops we reviewed, for the most part materials were delivered at the beginning of the instruction, predominantly by "giver scripts," objects, or bots that automatically sent the materials required to the participant's inventory. One example of delivering learning materials without requiring specific action from the participants was the use of a giver script built into a chair, which, once the avatar is seated, immediately offers the materials to the avatar's inventory. Vendors were also used during paid access workshops with participants requested to buy the learning materials while the instruction is then delivered "for free."



Figure 9.10 During the “Bracelets, bracelets, bracelets!” workshop, the tutor displays the three bracelets on a large scale in the sky overhead.



Figure 9.11 While the participants work on their own projects, progressive stages of development remain visible in the sky to serve as a reference.

17. Use of tools to deliver instructional content

What tools are used to deliver instruction to learners?



The chat facility was the most commonly used tool to communicate with participants during workshops. However, text-based exchanges could be enhanced with a variety of tools for delivering content: notecard givers, notecard readers, material givers, whiteboards and slide viewers, interactive whiteboards, html on a prim (from notecards, scripts, or the Internet), video viewers, sound, music, and podcast players.

18. Use of media to enhance teaching

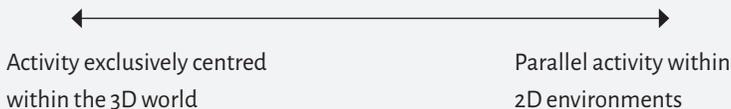
What type of media is used to enhance/enrich the teaching/learning experience?



Workshops were not limited to the use of the chat facility and non-verbal communication. Tutors also often incorporated rich media such as audio and video to enhance the largely text-based exchanges. In some workshops, where instructions were automatically delivered via a notecard reader, the tutor used Second Life voice to “speak” to participants to complete guidance and instruction.

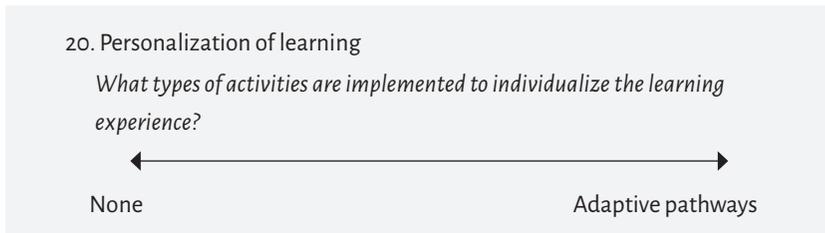
19. Concurrent learner activity

What type of concurrent learner activity is promoted?



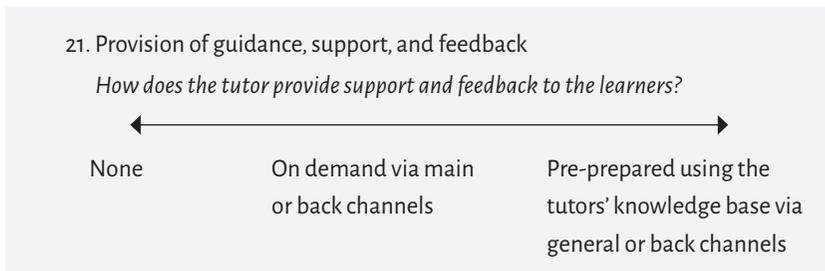
Tutors had the choice of concentrating participation exclusively within Second Life or developing concurrent activities that involved the use of the Web, for example, from within Second Life or in a parallel window for visiting hyperlinks or to search for scripts. They could also use note-taking within a

wiki, communicating using Voice over Internet Protocol (VoIP), or visiting a course Virtual Learning Environment (VLE).



Given the short length of the workshop, most tutors attempted to make the experience good *for all* participants. However, some tutors attempted to take into consideration the often variable skills of the participants by designing adaptive pathways: ones that gave the slower participants a chance to finish the task at hand while at the same time providing faster learners with the opportunity to progress their activities so they do not get bored. To make this possible, instead of delivering the instruction via the chat facility, the tutors delivered their instructions via notecards. In this scenario the participants could carry out their activities at their own rhythm, knowing that the tutor was present to provide support as and when needed.

Theme C: Follow-up and Evaluation



As with the delivery of instructions, the tutors can use a variety of communication channels to provide guidance, support, and feedback. When feedback concerned the group as a whole, the tutors preferred the main channel or a group channel. When feedback concerned a named individual, then back channels like personal IM was used. Guidance, support, and feedback were found to be extemporaneous, provided on demand, or else pre-prepared using a tutor's knowledge base.

because the freely accessible workshops were often one-off in nature, they were rarely followed up by any kind of activity, except for dissemination purposes.

Part Three: Using the Grid as a Design Tool for Planning and Delivery of Inworld Workshops

We completed the final phase of the study by taking the analysis grid and testing its value as a design tool that could potentially be passed on to other educators to help them plan and implement an inworld workshop event or similar teaching activity. Here, the grid was deployed as a rubric in the planning and delivery of 52 inworld workshops that we and the MUVEnation participants designed. The analysis of post-workshop case-stories and recorded feedback from participants strongly indicated the potential value of the grid as a tool for scaffolding the design and then implementation of workshop sessions inworld. The analysis of the case-stories and feedback from the planning, design, and implementation was carried out using content analysis on the transcripts of interviews with teachers and the narratives that were gathered after the participants had delivered their own workshops. This allowed us to create an inventory of codes, and the number of occurrences of each of these coded units was then grouped and ranked. Next we identified key criteria by correlating judgments on the success or failure of the designed and implemented workshop as triangulated by the tutor and participant feedback. This process revealed six key criteria that were shown to have the biggest impact on the success of the workshop. Finally, we mapped and grouped all the criteria to show the interconnections between these critical elements (see Figure 9.12). This mapping activity provided insight into another layer of the tension between the pedagogical approach and teaching expertise versus the technical expertise in controlling the environment.

Discussion

The primary purpose of the study was to develop insights into learning and teaching inside virtual worlds, and the vehicle for this exploration was the popular MUVE Second Life where we sited the object of study within the easily accessible inworld workshop-format teaching events. We successfully achieved the observation, analysis, and categorization of workshop planning, design, and implementation criteria into a taxonomic grid, and the subsequent validation activity confirmed the value of the classifications we adopted, as evidenced in the resulting positive evaluation carried out by MUVEnation participants across 100 workshops. The grid itself proved relevant as a taxonomic device

detailing those factors that are likely to impact most forcefully on the successful outcome of an inworld workshop teaching and learning session. Furthermore, although we designed it as an observation grid with the initial purpose to gain understanding about a specific Second Life teaching practice, the taxonomy could be used successfully to support decision-making processes undertaken during the design and development of new workshops.

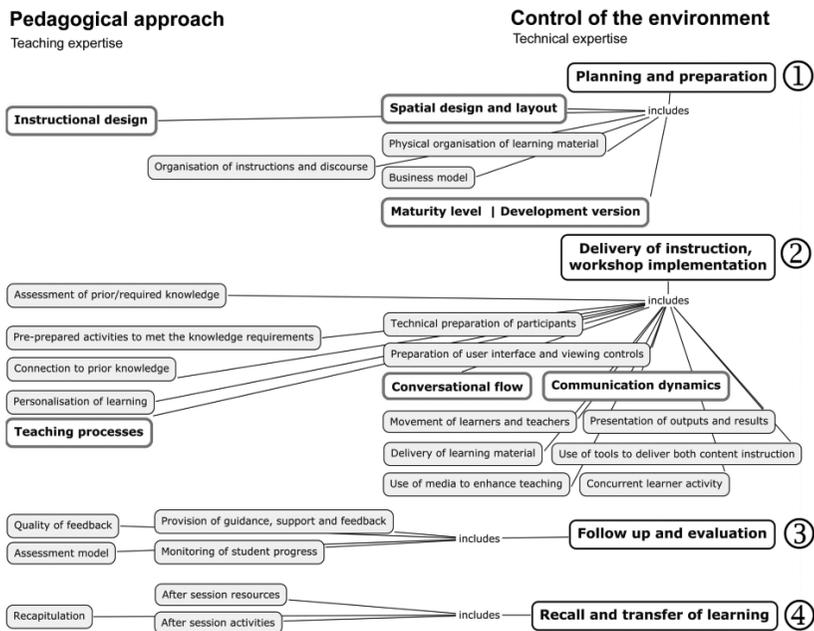


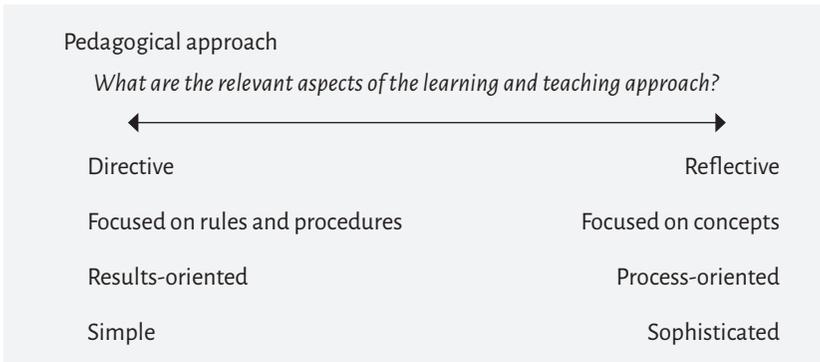
Figure 9.12 Mapping of all the analysis grid criteria is grouped according to theme and relationship to pedagogical or technical expertise. The criteria with the most impact are highlighted in red.

From using the taxonomy as a design rubric, it became clear that certain factors had a higher impact on the success of workshops:

- the technical design of the virtual teaching spaces, particularly the spatial layout;
- the establishment of clear and understandable interaction/communication policies and flows;
- the instructional design and the individualization of the learning experience; and

- the setting aside of adequate time for designing and preparing the workshop and then iterating the session to improve and develop its maturity level.

When we more closely scrutinized these elements of success, it became clear that some of the factors corresponded not simply to content but to pedagogical knowledge, and others corresponded to matters relating to the ability of the tutor or facilitator to control the virtual environment. Focusing on the pedagogical aspects alone revealed that one of two distinct teaching approaches tended to be adopted, namely, directive versus reflective learning:



When examining the results, we identified an interplay between technical skills, visible in the ability of the tutor to control of the virtual space, and the sophistication of the pedagogical approach he or she adopted (see Figure 9.13). The majority of criteria within the analysis grid relate to control—for example, the more controlled the virtual environment was, the easier it was for participants of a workshop to engage in the learning experience. It was also evident that the success of the learning experience directly related to the tutor’s pedagogical approach. A reflective, process-oriented teaching approach was more successful in transferring skills than focusing on a precise outcome such as a particular object. Participants may want to learn how to build furniture, not just a specific type of chair, and therefore the objects are the means to learning, not the learning itself.

These two polarities can be plotted against each other. The first axes represents control of the teaching space and ranges from unstructured to structured versus the broad pedagogical approach that ranges from a directive, results-driven approach to one that is process-based and reflective (Figure 9.13).

Moving towards good practice in implementing a 'hands-on workshop' in Second Life

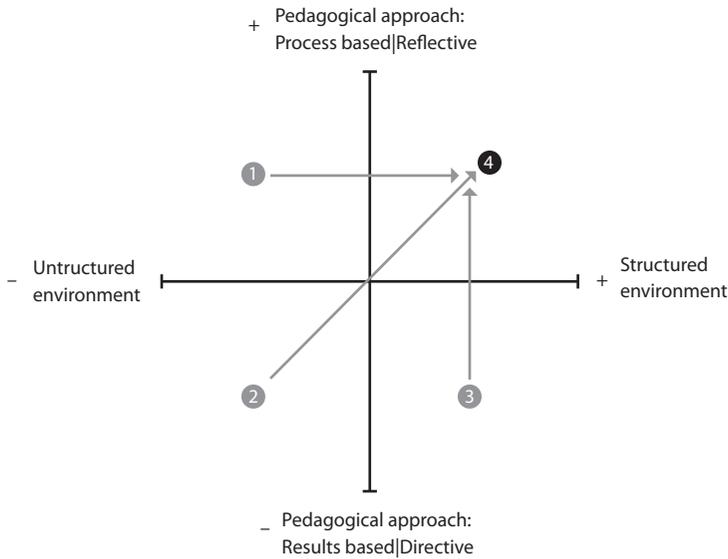


Figure 9.13 Pedagogical approach versus structure of the environment: moving toward good teaching practice (quadrant 4) in a virtual world setting.

The two axes produce a matrix divided into four areas that reveal four potential profiles for learning and teaching in virtual world settings based on practitioner skills and activity. Each quadrant describes a specific scenario:

1. *Unstructured space + reflective learning*: Confusing. A disorientating space for the learner and a hard one for the tutor to teach in. An approach often taken by the innovative educator who does not possess Second Life technical skills.
2. *Unstructured space + directive learning*: Cognitive overload. Adopted by the more behaviourist inclined tutor who lacks experience inworld. An approach adopted by the inexperienced tutor who is struggling to master Second Life.
3. *Structured environment + directive learning*: Mechanical. The most common situation: not innovators, these tutors take a simplistic teaching approach but do possess a more than adequate mastery of the Second Life environment.

4. *Structured environment + reflective learning*: The ideal situation. An innovative tutor fully trained in the use of Second Life and able to master the virtual environment.

What the matrix reveals is a particular area, quadrant four, that indicates where good teaching practices in a virtual environment such as Second Life should lie. The design and delivery of the ideal session is one where the tutor is confident not only in the session's content but also in the sophistication of her pedagogical approach and technical mastery of the virtual setting. This finding resonates strongly with the work of Mishra and Koehler (2006), who proposed a conceptual framework for educational technology that extended Shulman's (1986) well-known formulation of "pedagogy content knowledge." Mishra and Koehler's (2006) framework tried to capture the essential knowledge required for technology integration in teaching, while at the same time addressing the complex and situated nature of this knowledge. They termed this Technological Pedagogical Content Knowledge (TPCK) and it is this combination of capacities that is reflected in what expert teachers bring into play. Like the tutor approaches uncovered in quadrant four of the matrix above, the TPCK framework shows us that quality teaching requires this nuanced understanding of the complex relationship between technology and pedagogy.

Future Directions and Conclusion

The analysis grid has provided a tool for understanding the wide range of practices and tools related to the design and implementation of workshops situated inside a virtual world setting such as Second Life. It highlights those that impact on the quality of the learning experience measured via the level of satisfaction of students and the successful completion of the assigned tasks/objectives. The grid has not only proven its utility for self-assessment and evaluation but also for design. It shows the different alternatives that the tutor has when designing the workshop, and in this way has proven its value as a tool to help workshop planners to design and implement their sessions. Despite the apparent familiarity of the virtual setting, RL teaching experience does not guarantee Second Life teaching expertise. The plotting of the two key polarities of technology and pedagogy allowed us to identify the appropriate level of structured design of the teaching and learning environment and the promotion of process-based learning approaches. It is clear that workshops do require a high level of preparation, and are somewhat unpredictable. Tutors can never be fully prepared for what a workshop might hold in store: they have few means to anticipate the

number of attendees or ways to know what their skill level will be. But using the grid as a design tool has shown value in mitigating unexpected surprises. Finally, like the work of Mishra and Koehler (2006), this study suggests that advancing the inworld teaching skills of tutors can be accomplished through a learning-by-design approach, and that technology skills should not be taught out of context and in isolation.

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NETCONNECT VIRTUAL WORLDS

Results of a Learning Experience

Francesca Bertacchini and Assunta Tavernise

In recent years, several researchers have investigated virtual worlds as learning tools, showing that students' perception of new technologies are positive (Bayle & Foucher, 2011; Dalgarno, 2002; Dalgarno, Lee, Carlson, Gregory, & Tynan, 2011; Iqbala, Kankaanranta, & Neittaanmäkia, 2010; Peachey, Gillen, Livingstone, & Smith-Robbins, 2010; Wankel & Kingsley, 2009). Researchers mainly refer to educational environments where learners are actively engaged in the process of skill development (de Freitas & Neumann, 2009; Parsons, Leonard, & Mitchell, 2006; Adamo, Bertacchini, Bilotta, Pantano, & Tavernise, 2010) and to the involvement of young people, thanks to the offer of a new kind of experience that is instructive and engaging at the same time (Bilotta, Gabriele, Servidio, & Tavernise, 2009; Pantano & Tavernise, 2011; Pantano, Tavernise, & Viassone, 2010; Bertacchini, Bilotta, Pantano, & Tavernise, 2012). However, a rapidly growing area of virtual worlds is related to cultural heritage education (Bertacchini, Feraco, Pantano, Reitano, & Tavernise, 2008; Febraro, Naccarato, Pantano, Tavernise, & Vena, 2008). In fact, exploring archaeological sites from a distance, visiting historical cities that are ruined or that no longer exist, looking at monuments that are not static 2D images, and manipulating specific objects all enhance students' ability to contextualize abstract knowledge (Bertacchini, Gabriele, & Tavernise, 2011; Chittaro & Ranon, 2007; Pantano & Tavernise, 2009; Bertacchini & Tavernise, 2012). As a result, a number of European projects dedicated to modelling historic cities in 3D have emerged to contribute to the field of cultural heritage education, and provide

the opportunity for students to engage in serious archaeological investigation. Among these, we can cite the international project Rome Reborn (Frischer, 2008), illustrating the urban development of ancient Rome from 1000 BC to AD 550, the *NUovo Museo Elettronico* [New Electronic Museum] (Nu.M.E) initiative (Bocchi, Bonfigli, Calori, Guidazzoli, & Petrone, 2001), a virtual reconstruction of the centre of Bologna, Italy and demonstrating its historical transformation from the twelfth to the twentieth century. However, these reconstructions are mainly virtual tourist sites rather than advanced tools for learning.

In this chapter, we present three virtual worlds endowed with educational paths related to cultural heritage. They have been developed under the “Connecting European Culture through New Technology—NetConnect” project, promoted by the European Commission’s Culture 2000 Programme (Bertacchini et al., 2008), and downloadable from the “3D Reconstructions” section in the portal of the NetConnect project. We describe the three immersive NetConnect virtual worlds, explaining how they offer asynchronous technology-enhanced constructivist learning (Gärdenfors & Johansson, 2005; Kafai, 2006; Kafai & Resnick, 1996) using personalized educational paths. After that, we present a case study of a distance education lesson taken by 50 students aged 15 to 18, assess learning achievements and student motivation, and also collect the participants’ opinions on positive and negative aspects of the experience. We end by proposing possible future developments for cultural heritage education.

NetConnect Virtual Worlds

The main aim of the NetConnect consortium has been to deploy emerging information technologies to make the rich material from archaeological sites accessible to learners, in order to promote understanding of the importance of cultural heritage among the younger generation. The project has mainly been focused on the design of three historic settlements that reached their zenith between the eighth and the fifth century BC: Biskupin in Poland, Glauberg in Germany, and Magno-Greek Lokroi in Italy. Using a technology-based approach, anything that was present in ancient daily life has been realized virtually on a computer screen through the interpretation of the remaining evidence studied by archaeologists: the city’s layout, specific buildings and squares, houses/huts, and the various objects in them. In this way, users have been able to explore lost locations, and to manipulate 3D objects that are now only fragmentary (or visible through in a museum window) in the physical world, following a

technology-enhanced constructivist approach (Bilotta, Gabriele, Servidio, & Tavernise, 2008).

NetConnect virtual worlds show what daily life was like in the relevant historical age or period. Thus, by discovering the different elements of a specific cultural heritage in an ordinary day of the past, a learner can have unique and personalized experiences by engaging in activities and tasks that coincide with his or her own interests (Naccarato, Pantano, & Tavernise, 2011). In particular, the user can choose from among the following educational paths: (1) a visit to the virtual world to follow a list of points of interest; (2) a personal exploration, done by walking across the town and looking at a map; and (3) access to different kinds of content (videos, texts, pictures) present in the multimedia sections for each ancient city.

In each NetConnect virtual world the user can look at a menu that offers the opportunity to choose selected places to visit from a list of points of interest at the various historical sites (Figure 10.1). This path leads to a multimedia section and then directly to the selected point of the site. The user can choose to explore the city as he or she would in real life, walking in the streets, courtesy of a map on the right side of the desktop; large arrows over the important points of interest can help him or her to find the way to them.

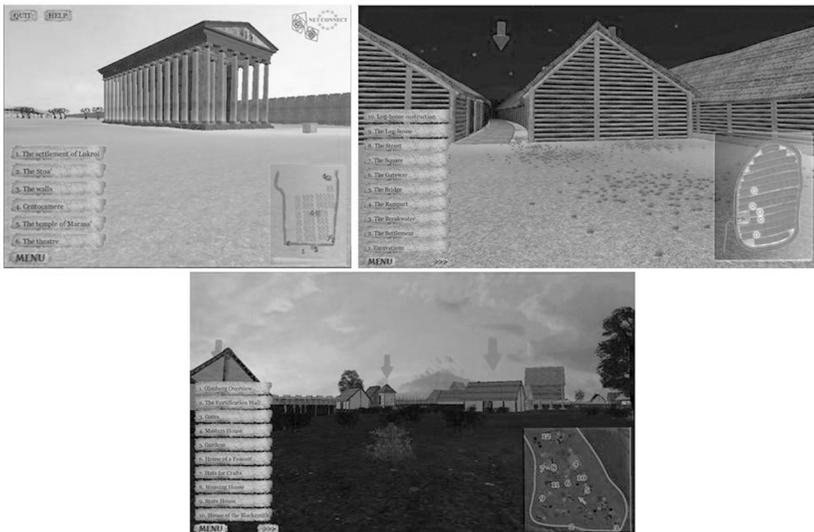


Figure 10.1 The list of historical sites in NetConnect virtual worlds: Lokroi, Biskupin, and Glauberg. Courtesy of the NetConnect project.

The user can also go inside some structures (Figure 10.2), indicated by a brilliant light. For example, in Lokroi users can visit the temple, the Sacellum, and the Stoà, but cannot enter the two houses, indicated by a red light.

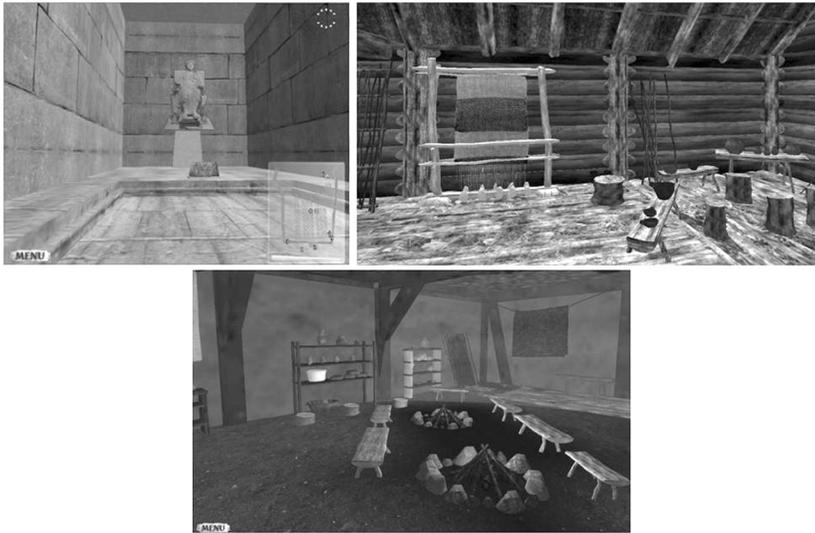


Figure 10.2 The temple in Lokroi, the houses in Biskupin and Glauberg. Courtesy of the NetConnect project.

Multimedia sections are available for each historical site, and users can choose to examine material in four subsections: Video, Pictures, Text, and Extra. Users can watch a video about a specific place in the city they have selected, read the text that accompanies the video or additional documents, or view the reconstructed object in its original state (Figure 10.3).

At some points of interest in the virtual world it is possible for the user to virtually manipulate cultural artifacts (Figure 10.4). By doing this, the user can understand the function of an object, its specific dimensional and typological characteristics, and its place in the city/house and time period in which it was used. These objects are reconstructed in 3D based on real tools from the collections of major museums (Chowaniec & Tavernise, 2012).

The user can also take the virtual tour using the “I-vision” camera view: in this mode, the user’s avatar is not shown in the virtual world. During virtual visits users can meet both non-interactive avatars (Figure 10.5) and domestic animals; using the categories suggested by Yu, Brown, and Billett (2007), we classify



Figure 10.3 Screenshots of the multimedia sections in Lokroi virtual world: Videos, Pictures, Extra. Courtesy of the NetConnect project.

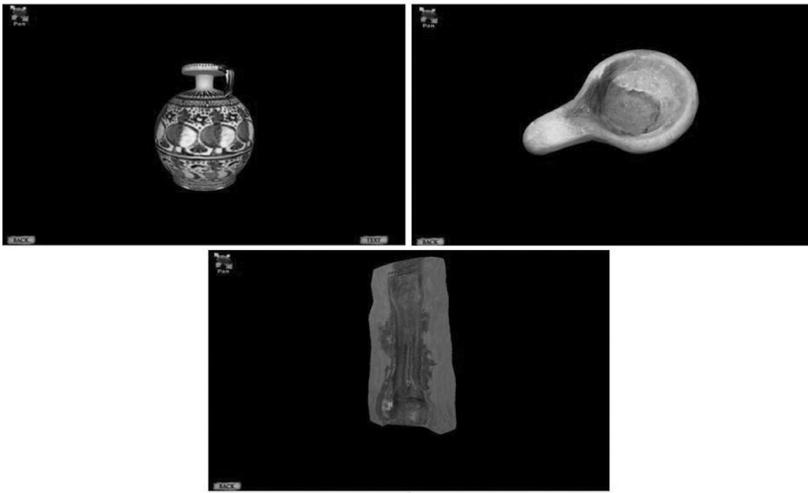


Figure 10.4 Objects that the user can manipulate in the NetConnect virtual worlds of Lokroi, Biskupin, and Glauberg. Courtesy of the NetConnect project.

these characters as “atmosphere agents.” Avatars dress in the exact reproduction of clothing typical of the time period and engage in activities derived from historical sources, allowing users to gain knowledge about this cultural heritage. For example, in Lokroi the clothes and activities of avatars are mainly inspired by imagery found on vases and *pinakes* (painted scenic panels made out of terracotta and dated to the period between 490 and 460 BC) (Bilotta, Bertacchini, Laria, Pantano, & Tavernise, 2011). An example of a pinake and how it helped inform the design is displayed in Figure 10.5.



Figure 10.5 A pinake, courtesy of the *Sistema Museale Virtuale della Magna Graecia* (Virtual Museum System of Ancient Greece) project, and an avatar in Lokroi. Courtesy of the NetConnect project.

The atmosphere agents are inserted in a virtual world containing many other models and objects, and thus they have been designed using a small quantity of polygons. They have less than 2000 polygons and details have been added to create textures at a resolution of 1024x1024 pixels applied to the mesh with UV maps (Bilotta et al., 2011). The designers developed the 3D environment using the Unity platform, and the user can move through it in a way that is very similar to moving about in videogames, using the mouse and keyboard, or a joystick. Moreover, the virtual worlds can be accessed using a Wii™ wireless controller and console, which can provide an appealing experience for young users (Pantano & Tavernise, 2011).

The Case Study

In this study funded by the NetConnect project, secondary school students from three different European cities (Warsaw, Frankfurt, and Rome), studied the topic

“Magno-Greek colonialism in Italy” using the virtual world Lokroi. Here we examine the results from one of the network nodes (Rome).

We measured what 50 students aged 15 to 18 learned in a 12-hour laboratory course using quantitative pre-entry and post-entry questionnaires, then used 24 items from the Intrinsic Motivation Inventory (IMI), measured on a 7-point Likert scale, to assess students’ motivation. Finally, we collected the students’ opinions on positive and negative aspects of the experience. All the questionnaires were administered online and student participation was mandatory, as they were given extra credits for school.

The method, including both quantitative and qualitative approaches using pre- and post-entry questionnaires to measure knowledge gained, and interviews, has already been utilized by Liu, Horton, Olmanson, and Toprac (2011) and O’Tuathail (2011). In this study, we chose the knowledge and motivation tests to investigate the effect of a virtual world on students’ learning and motivation, and the relationship between students’ motivation and their learning. The IMI has already been utilized in a number of studies related to intrinsic motivation and self-regulation (e.g., Ryan, 1982; Ryan, Connell, & Plant, 1990; Ryan, Koestner, & Deci, 1991; Ryan, Mims, & Koestner, 1983), and includes four subscales connected to our interests for this study: interest/enjoyment, perceived competence, effort/importance, and value/usefulness. We also added questions on motivational characteristics in virtual worlds because of the positive aspects of qualitative research highlighted by Iqbala et al. (2010) and Thompson (2011), and for the purpose of triangulation (Creswell, 2009).

Quantitative Analysis

We designed a questionnaire in order to collect some personal data (age, sex, grade level), and to assess each student’s level of Magno-Greek history knowledge upon entering the virtual world. Fifteen multiple-choice questions were administered online before students navigated in the virtual world and after the visit; they were not identical but very similar, in order to prevent the students from learning from the initial questionnaire. One point was attributed for each correct answer and zero for each incorrect one, for a maximum of 15 points.

Each question had three choices. Examples of the questions are as follows:

- (1) What was the ancient Magno-Greek city called?
 - (a) agorà
 - (b) polis
 - (b) chora

- (2) When was Lokroi funded?
 - (a) IV cent. BC
 - (b) VIII cent. BC
 - (b) VIII cent. AD
- (3) Lokroi was surrounded by . . .
 - (a) walls
 - (b) a fence
 - (b) the sea

Motivation

Twenty-four items from the IMI, measured on a 7-point Likert scale (1 being not at all true and 7 being very true), were used to assess the students' motivation. This instrument assesses participants' interest/enjoyment, perceived competence, effort, value/usefulness, pressure and tension felt, and perceived choice, thus yielding six subscale scores. The IMI has been reported as reliable and valid by McAuley, Duncan, and Tammen (1987).

In this study we selected, four subscales because of their connection to the research; the same subscales have been chosen in similar studies, such as Liu et al. (2011). Cronbach's alpha values were computed for this sample: interest/enjoyment (seven items $\alpha = .87$), perceived competence (five items $\alpha = .81$), effort/importance (five items $\alpha = .85$), and value/usefulness (seven items $\alpha = .77$). The IMI as a whole had an alpha value of .82.

At the end of the IMI, we added two open questions: "Please indicate the positive aspects of your experience" and "Please indicate the negative aspects of your experience." We requested this description of the activities in the students' own words in order to enrich the study with the nuances of personal opinions.

Results

For the knowledge questionnaire, a Wilcoxon signed-rank test showed that the scores after the visit to the virtual world were significantly higher than the scores of the pre-test ($Z = -2.054, p < .001$). The mean score on the pre-test was 1.36 out of 15 ($SD = 1.08$) and on the post-test was 13.38 out of 15 ($SD = 1.18$). Gender differences were also examined, since literature indicates a male bias toward computer-based learning (Mitra, LaFrance, & McCullough, 2001; Mitra, Lenzmeier et al., 2001). However, the correct responses in the knowledge test increased significantly from pre-test to post-test for both male and female students. Table 10.1 shows students' mean scores and standard deviation.

Table 10.1 Knowledge Questionnaire: Students' Mean Scores and Standard Deviation

Knowledge questionnaire	N	Pre-test		Post-test	
		M (0–15)	SD	M (0–15)	SD
Boys	25	1.28	1.24	13.04	0.88
Girls	25	1.44	0.91	13.72	1.34
Total	50	1.36	1.08	13.38	1.18

For motivation, we ran a multiple regression analysis to investigate the relationship between the scores obtained in the post-test knowledge questionnaire and the IMI compared to those for the pre-test, showing a significant R^2 of 0.65, $F(2, 28) = 22.5, p < .01$. The motivation test scores, obtained after the virtual world activities, can be considered a predictor for knowledge post-test scores.

The subscale “Interest/Enjoyment” emerged as the strongest predictor, while we also noted a significant relationship between knowledge scores and the subscale “Perceived competence.”

For qualitative analysis, at the end of the motivation test the students answered two open-ended questions about what they thought were the positive and negative aspects of their experience. Their answers were excitedly positive, mostly commenting on the use of the computer and the feeling of play. Furthermore, the majority of the students expressed the wish to use the same kind of tool to study other subjects. They expressed no negative comments; only one student commented that the test after the lesson was boring additional work.

Discussion

The pre-test results have highlighted that, even though Greek history is a topic covered by the Italian secondary school curriculum, Magno-Greek colonialism in southern regions is a very specific subject almost unknown among students. However, the rise of correct answers in the post-knowledge test suggests that the developed virtual world can be an effective support in the study of an unfamiliar subject. Moreover, from the students' point of view, the use of virtual worlds and, in general, of computers, has a positive effect on motivation and the feeling of enjoyment. Outcomes confirm those obtained by Verhagen, Feldber, van den Hooff, Meents, and Merikivi (2012) concerning the role of extrinsic and intrinsic motivation as behavioural determinants. As for the

qualitative analysis, all the students interviewed in the research by Iqbala et al. (2010), like the participants in the present study, emphasized the opinion that education was more interesting as a result of immersion in virtual worlds. They saw the value in exploiting opportunities for bringing together education and virtual worlds, acknowledging, for example, the potential to use virtual worlds to practice for exams.

Properties highlighted in other studies as being highly motivating for young users are present in NetConnect virtual worlds, especially the possibility of exploring new places (Tychsen, Hitchens, & Brolund, 2008), and users' freedom to do things following their own interests. Competition and challenges, intrinsic properties of games, were shown to be not quite as essential and powerful in virtual worlds. Finally, since the majority of virtual worlds connected to cultural heritage learning are simple 3D reconstructions of archaeological sites and due to the fact that precise statistical data on learning have scarcely been collected, we cannot provide an adequate comparison to other studies here. Moreover, the data we examined are incomplete with respect to more complex research involving three network nodes (Warsaw, Frankfurt, and Rome). All the results coming from distance learning experiences will need to be analyzed. Furthermore, data collected in secondary schools should be compared with additional data collected in primary school studies, as well as in courses with a synchronous version and the presence of multiple users.

Future Directions and Conclusion

Our research has demonstrated that the use of 3D technologies such as virtual worlds can support and enhance the learning of history by secondary school students, as a result of the global desire to create various archaeological cultural heritage sites, and the motivating opportunity to play with the virtual artifacts as in a videogame. In fact, in NetConnect virtual worlds, users can choose what to explore and access using personalized paths of learning. We collected both quantitative and qualitative data, measuring: (1) students' understanding of learning concepts linked to Magno-Greek history with 15 closed-ended questions using a pre- and post-lesson questionnaire; (2) students' motivation to use the virtual world, by a 1–7 Likert-type questionnaire adapted from the Intrinsic Motivation Inventory (IMI); and (3) students' opinions on positive and negative aspects of the learning experience. The results show that NetConnect scenarios present an advanced learning opportunity to cover the topic of cultural heritage, because learners are not only allowed to look back into time and witness history but they also have access to an effective hands-on approach

that encourages a deep understanding of all the elements of cultural and artistic heritage. While sweeping generalizations cannot be made, the evidence does speak to the efficacy of the approach in addressing both the cognitive and affective aspects of learning.

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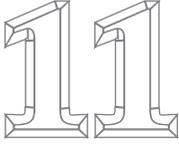
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SCAFFOLDING LEARNING THROUGH THE USE OF VIRTUAL WORLDS

Chris Campbell and Leanne Cameron

Virtual worlds are being increasingly used in education, often for their flexibility in facilitating student-directed learning. They offer opportunities for open-ended learning activities, such as simulations, role plays, and design tasks in which students are encouraged to be creative and innovative while taking responsibility for their choices and activities. Within virtual worlds, students are able to collaborate, move and explore, build, and interact with virtual objects and media. As flexibility for self-directed learning increases, the challenge of guiding students' learning toward the intended outcomes also increases, as does the need to provide appropriate support and guidance (Cram, Lumkin, & Eade, 2010).

Some early research suggests that virtual worlds may provide pedagogical advantages for specific learning styles and learner groups, as well as for specific subject areas (Bradshaw, 2006; Roussou, Oliver, & Slater, 2006; Slator et al., 2005; The Schome Community, 2007). They provide students with the opportunity to collaborate, design, experiment with learning, and use different personas. The studies we describe in this chapter demonstrate that virtual worlds can be employed with students to enhance their learning through the use of well-structured scaffolding.

The first project we describe used Second Life (SL), which is a quickly evolving virtual world that remains one of the most accessible of the newer virtual worlds. The students were provided scaffolding through course readings, group presentations, immersion in the software, and experimentation within Second

Life in a supportive classroom environment. These students used Second Life as a tool to equip themselves with the skills to critically and purposefully engage with emerging technologies in order to enhance their teaching practice.

The second project we describe explored an alternative virtual world platform, OpenSimulator (OpenSim). OpenSim can be used to simulate virtual environments similar to Second Life. The OpenSim virtual world can be accessed with the standard Second Life viewers; however, OpenSim is not a clone of SL. On the contrary, it lacks support for many of the game-specific features of Second Life (Overte Foundation, 2011). OpenSim was chosen in this case for the open customizability of its setup, which allowed the research team to maintain strict access control to the virtual world, and for the versatility of the inworld construction tools.

These studies used Second Life and OpenSim as examples of virtual worlds and as new technological tools that could be used in classrooms. In this chapter we analyze teachers' attempts to scaffold student learning, and how these evolved while students used the virtual worlds. In both studies, the researchers saw Second Life and OpenSim as accessible examples of virtual worlds, a rich social network, and a technological teaching tool new to the students.

Providing Scaffolding in Educational Settings

Using virtual worlds will not automatically engage students in the higher-order thinking that is desired by contemporary educators. To do this, teachers need to carefully consider the mix of tasks, questions, and challenges within the virtual world activity to encourage learners to respond using higher-order thinking (Cram et al., 2010). Two of the most significant issues highlighted within educational research are the need to internally align the learning outcomes, assessment, and activities, and to adequately guide and support learners throughout the entire process. Biggs (1996) provides a compelling argument for learning designers to carefully align the learning objectives, activities, and assessment. With alignment, he argues, it is possible to set up courses that provide clear outcomes for students, provide appropriate activities through which students are likely to achieve these outcomes, while gathering data that allows the teacher to make valid evaluations of student achievement.

The path students take within a learning activity is important, especially when it is within a virtual world that allows great scope for play and other interactions. There is a risk that even when alignment between learning outcomes, activity objectives, and assessment is achieved, students will engage in off-task behaviour, or lack clarity in how to achieve expected goals.

In both projects described in this chapter, providing adequate guidance and support—or scaffolding—for students was vital to their success. Scaffolding in educational contexts is a process through which the teacher provides students with a type of temporary framework for their learning (Lawson, 2002). This type of structure encourages students to develop their own initiatives, including motivation and resourcefulness. Structure is seen as the key. Without a clear and obvious structure and specifically stated expectations, many students are vulnerable to a kind of educational “wanderlust” that can pull them off task (McKenzie, 1999). Scaffolding can organize and support student investigation or inquiry, and keep them from moving too far off their learning pathway while still seeking “the truth” about the issue, question, or problem that was driving the learning activity. Learning occurs effectively when students have been well prepared, well equipped, and well guided.

Scaffolded instruction is “the systematic sequencing of prompted content, materials, tasks and teacher and peer support to optimize learning” (Dickson, Chard, & Simmons, 1993, p. 12). Students are generally given support until they are able to apply these new skills and strategies in an independent way (Rosenshine & Meister, 1992). Once students have gained knowledge and developed skills on their own, the elements of the supportive framework can be gradually dismantled (Lawson, 2002). Eventually, the scaffolding can be removed altogether as it is no longer required. This type of instruction has been recognized for its ability to engage students because they are constantly building on prior knowledge, forming associations between new information and concepts (Coffey, 2002).

The idea is for scaffolding to eliminate any distracting frustrations to the greatest extent possible, and to both maximize learning and efficiency (McKenzie, 1999). Students do not generally passively listen to information presented but, with teacher prompts, they are able to build on their prior knowledge and form new knowledge (Van Der Stuyf, 2002). Scaffolding presents opportunities for students to be successful before moving into further unfamiliar territory (Coffey, 2002).

This concept of scaffolding is based on previous work by Vygotsky, who proposed that with an adult’s assistance, children could accomplish tasks that they ordinarily could not perform independently (Bruner, 1975). It is an instructional technique associated with the Zone of Proximal Development (ZPD), in which the teacher provides support by incrementally improving the student’s ability to build on his or her prior knowledge: “The zone of proximal development is the distance between what children can do by themselves and the

next learning that they can be helped to achieve with competent assistance” (Raymond, 2000, p. 176). When students are constantly supported by teachers within the ZPD, they are able to keep their attention on the task, are motivated, and actively working (Coffey, 2002). Upon completion of the task, students are better able to make the connection between prior knowledge and new information (Pennil, 2002).

Within this zone, students are constantly challenged, yet each component or concept is more accessible and less intimidating when it is presented gradually. The teacher demonstrates and models the successful performance while keeping the task at the proper level of difficulty. While doing this, the teacher must avoid frustrating students, as frustration with a concept or activity can cause students to become either discouraged or withdrawn. It is a delicate balance, as too much scaffolding can undermine a student’s sense of accomplishment, but too little creates frustration and discouragement (Henry, 2002).

Scaffolding allows students to be self-reliant while they are still receiving support. The goal of the teacher when using this strategy is ultimately for the student to become an independent self-regulating learner and problem solver (Hartman, 1997). The dilemma created by this strategy has been outlined by McKenzie (1999, p. 1) who stated, “how do we provide sufficient structure to keep students productive without confining them to straitjackets that destroy initiative, motivation and resourcefulness?”

Supporting Students, Just-In-Time Advice, and Keeping Students on Task in a Virtual World

There are a few options available to virtual world designers in response to the need to structure and guide students’ learning. One technique is to embed the alignment and supports for the students’ learning within the virtual world. This technique was employed in Quest Atlantis, a highly successful implementation of an educational virtual world that uses embedded narratives, called quests, to provide structure and guidance within the learning activities (see Hickey, Ingram-Goble, & Jameson, 2009). For each quest, a student will interact with non-player characters (NPCs, also called scripted agents), objects, and data within the virtual world. The pathways within each quest are carefully directed so that students gain exposure to the relevant concepts and skills, and have opportunities to apply them in ways that highlight their use for problem solving and reaching goals (Barab et al., 2007). Students are supported by their classroom teacher, who reviews and marks quest submissions (assignments) and may provide additional direction and discussion when necessary.

Educators have also embedded the activity alignment and guidance successfully in the virtual worlds of River City (Ketelhut, Nelson, Clarke, & Dede, 2010) and Virtual Singapura (Jacobson, Kim, Lee, Lim, & Low, 2008).

While embedding narratives within the virtual world has some clear benefits, there are also some significant limitations to this technique (Cram et al., 2010). Embedding narratives is labour intensive, and requires significant technical understanding. Flexibility is reduced, as the virtual space is bound up in that specific use and may be difficult to re-purpose for other educational activities or research objectives. Quest Atlantis, for example, adds new virtual worlds to cater to the new activities that educators have develop. This represents a considerable additional cost for technical infrastructure and support, which is not realistic for smaller projects.

Every virtual world platform has restrictions on the forms of interactions that may be embedded within them. OpenSim, the platform used in the second research study we report on in this chapter, has severe restrictions on the forms of multimedia and interactivity that may be embedded within it. Other virtual world platforms support a broader range of media and interactions, but present other undesirable tradeoffs, for example, difficulty in controlling access or a lack of inworld construction tools (Cram et al., 2010).

Rather than embedding the narrative, we describe some alternate methods of scaffolding in this chapter. In the Second Life project, the scaffolding was provided face-to-face on a just-in-time basis. The OpenSim project used a variety of Web 2.0 tools to structure student activity and guide the students.

Project 1—Second Life

This project focused on fourth-year pre-service education students, who were enrolled in an elective course called Interactive Technologies at La Trobe University during Summer Semester 2008. It was an intermediate educational technology course where students created websites, gained experience using interactive whiteboards, and learned about emerging technologies. Instructors taught the course in block mode over one month and included several assessment tasks, one of which covered the topic Second Life. By incorporating the use of Second Life into the course, the project's researchers hoped the students would undertake an enriched approach to using a new and emerging technology and have the opportunity to reflect on the unique characteristics of virtual worlds and their relevance to contemporary teaching practice. This was done through systematic scaffolding.

Project 1 Methodology

Qualitative methodology within a case study framework was used for this study of 36 participants. The researchers collected data using a variety of qualitative methods, including questionnaires, focus group interviews, and online reflective journals written by students. The online journal was worth 10% of the total assessment for the course. Other data included lesson plans from each group and audio recordings of class presentations that utilized Second Life. Since the instructor taught the course in block mode, the entire class went for five weeks, with students participating on several full days. This project had ethics approval from the university and students were required to sign a consent form prior to participating. Their participation was not compulsory, and they were able to withdraw from the study at any time.

The participants were all of the students from the two classes involved in the study. However, not all students participated in the final questionnaire or the focus group interviews, with 25 students completing the final questionnaire. There were two focus groups from each of the two classes. One of the limitations of this study is the small sample size, but as this is a pilot study, it could perhaps be repeated at a later time, thus adding to the rigour of the findings.

Participants completed one online questionnaire at the beginning of the course and another at the end, both in SurveyMonkey. The questionnaire contained a mixture of open-ended and closed questions, including matrix style questions that focused on students' ICT use, such as general use of technology both at home and at work, mobile phone usage, email, social networking website use, and any preconceptions they had of Second Life prior to being introduced to it. Students were asked if they had used Second Life previously, and how they thought they may be able to use the virtual world for educational purposes. They were also asked about other virtual environments and if they had used them before. The final questionnaire asked students about their use of Second Life during the course (e.g., number of hours of use) as well as whether and how they anticipated using Second Life for educational purposes in the future, including in their professional practice as teachers.

To add depth to the data, the researchers conducted focus group interviews at the end of the course. At this time students were asked about their experiences using Second Life both prior to and during the class. They were asked about the learning activities they created in class, if they thought they would use Second Life in the future, and if they felt they might use Teen Second Life in their own classes once they became qualified teachers. There were two groups who

participated in the focus group interviews from each of the separate cohorts, with a total of 24 students participating. Students had access to their own online journal in the university's Learning Management System (LMS), which was kept private between the course instructors and the individual. In it, the students were able to reflect on their experiences in the course such as working as a group, moving their avatar around in Second Life, and the advantages and uses they thought virtual worlds would have when they became classroom teachers. They were able to reflect on class discussions about the learning styles teaching with Second Life might be useful for, and how it may fit in with the curriculum taught in schools in the Australian state of Victoria, or extracurricular activities. The journal was designed to be open ended so that students could record any of their thoughts and not just comment on the suggested topics. The journal was not meant to be an arduous task for the students, and so the researchers expected they would complete approximately five entries, although some did more than this. The students were also given two academic articles on Second Life: Bradshaw's early paper on virtual worlds and pedagogical reflections (2006), and "Virtual or Virtual U: Educational Institutions in Second Life" (Jennings & Collins, 2008), as well as the report on the Schome Community (2007). Class discussions also revolved around these readings.

The researchers collected and then synthesized data from the participant questionnaires, focus group interviews, and other sources. They then categorized and explored emerging themes. Once the categories were assigned, the analysis relied heavily on description rather than inference. This allowed the researchers to do a broad analysis, as this was a pilot study and thus unexpected themes were likely to emerge.

The Learning Activity

Working in groups the pre-service education students were introduced to Second Life, and using an inquiry-based learning model they completed a scenario that required two class sessions of approximately 1.5 hours each. Day one consisted of the students initially exploring Second Life and listening to a presentation that included a history as well as practical information about the virtual world. After this presentation the students were given login details and then signed into Second Life in groups and began exploring, figuring out how to navigate, fly, talk, and engage in other inworld skills.

The students were given focus questions so that after they learned how to use basic inworld navigation they actually investigated how high school

students might use a virtual world as a learning tool, and how Second Life might teach teenage students in a different way than conventional classes.

In their second session, the pre-service education students were given an inquiring and designing task to complete. This was a problem-based learning experience: the task was for the students to design a learning activity using Second Life that they wanted to try with a high school level class. The learning activity needed to support inclusive practices, that is, it had to ensure everyone's learning needs were being met. The pre-service education students were then required to examine a scenario they were given, decide how to approach the task, assign roles, and then locate and analyze recent Second Life research. After reflecting on the research they found they had to identify their cohort, including relevant curriculum and learning objectives. The students then began designing their learning activity.

The third session involved each group of students giving a five-minute oral presentation to the class. Groups were self-selected and made up of approximately four students. Each group also wrote a 500-word summary called a learning activity report. This briefly described their learning design, including a rationale and critical reflection, and was later emailed to the researcher. The presentations were audio recorded, and the entire class reflected on the activities presented after each group's presentation. The class then reflected on using Second Life as an educational tool.

Student Improvement

By the end of the sessions the pre-service teaching students had created a variety of learning activities to use with secondary students. They mostly used environments already available in Second Life and Teen Second Life, although one group's activity involved using building skills to create the ideal classroom. Different groups focused on activities such as

- Cyber bullying
- Going on an excursion
- Mapping
- Languages other than English (x two groups)
- Scavenger hunt
- Role-playing occupations
- Communication skills
- Students building/creating an ideal classroom
- Exploring water channels, i.e., mathematical angles, depth, and volume.

The pre-service education students took this problem-based learning task very seriously and produced quality detailed summaries of their activity. The summaries included learning objectives for the activity and evaluation and assessment sections. Once the researchers reviewed the students' presentations, it was evident that the designed learning activities were quite practical lessons that utilized the available resources well.

The majority of the pre-service education students, 87%, thought the activities they created during the class would work in environments such as Teen Second Life. One student reported, "students are always willing to try new things, and technology is in this day an [sic] age a very popular means of doing so. Our activity—re-design and build your own classroom—i [sic] feel would be appealing to teens in Teen SL," while another also thought that Second Life "encourages students to develop their technical skills in Second Life." A third student stated, "students will realize that there is an educational purpose for using SL, not just socializing. If they respect that, they are likely to appreciate SL as a different type of learning tool within a unit of work." Overall, the students felt that the scaffolding assisted them in using Second Life and helped them to complete the activities. One student stated, "the immersion in these activities and the rich learning that they could provide would be a very powerful tool to incorporate into the classroom," while another commented, "before this activity I was really struggling to see any educational uses for Second Life." The students also indicated that the scaffolded activity helped them develop their ideas.

Structure and Scaffolding Activities

A series of highly scaffolded activities provided the students with some valuable hands-on experience, as most had never been inworld. These activities were designed to provide minimum risk for the students new to the environment and get them quickly familiar with it so that they became comfortable enough to explore and complete the tasks asked of them. The majority felt that completing the activity with the scaffolding made them more comfortable exploring new technologies. In the final questionnaire, one student stated, "I may not have looked at these emerging technologies if they were not introduced into this class." Another declared, "practice and sharing information in the classroom (lab) is great, it's when I do the most learning!" A third student had this perspective: "having been in Second Life at the Uni, I am more willing to try it at home and also to try other new technologies." However, one student disagreed with these statements, as she or he "was already comfortable exploring

all areas of technology.” With the exception of the last, these statements suggest that the scaffolding of the activities was successful.

Opening up the possibilities of using virtual worlds in the classroom with a cohort of pre-service teachers who had never experienced one was a challenge. However, the scaffolding provided by the study proved to be extremely effective.

Project 2—Exploring Construction using OpenSim

The second project focused specifically on activities that involved students developing construction skills within a safe environment. This project looked at the potential for students to learn design and construction within a 3D virtual world, and then apply their learning to real-world contexts. Using the OpenSim virtual world, this project employed a variety of Web 2.0 tools to structure student activity and provide guidance.

The Learning Activity

Two high school classes completed one unit of work on site-specific artworks, intended to develop students’ appreciation and application of spatial awareness. One class designed and refined their ideas using the OpenSim virtual environment, while the other class used traditional concrete materials. To begin, both classes learned appropriate concepts and techniques by visiting a real world exhibition and completing classroom activities. Then, the students conducted a survey of a specific site within their school, taking photos and running an analysis. One class learned construction techniques within the virtual world, and designed and refined their models using sites in a virtual environment that simulated the actual spaces in the school for the final art installation. The other class learned construction techniques using concrete materials, then designed and refined their artwork ideas using those materials. After the models were constructed, students joined groups and constructed a final large-scale art installation at the selected site within their school (Lumkin, Eade, Cram, Buck, & Evans, 2010).

Students initially completed two days of training, involving discussions of cyber safety, activities covering design and construction, and an introduction to online tools. After this, they worked in the classroom, with lessons focused on either design and construction activities within the virtual world, or a PowerPoint activity designed to develop their conceptual understanding. The design and construction lessons had a consistent structure, with 10 minutes allocated for planning, 30 minutes for completing the design and construction within the virtual world, and then 10 minutes recording progress and reflecting on the lesson.

A range of scaffolding materials and techniques were included to support student activities; classroom teachers and the Macquarie ICT Innovations Centre team provided feedback, both face-to-face and using a number of online tools. These included a variety of images and videos depicting learning spaces provided through the online tools, a sustainable learning spaces checklist to support students' evaluations of their designs, and a measurement post with height demarcations within the virtual world to help students check the scale of their objects. The students were encouraged to provide peer and self-assessment both in the virtual world and using the online tools (Lumkin et al., 2010).

Project 2 Methodology

The project was a joint venture between a NSW Department of Education school and the Macquarie ICT Innovation Centre based at Macquarie University. Two co-educational high school classes participated, each consisting of one teacher and 15 students. A wide variety of research data was collected during the OpenSim project. The research methods chosen for the project were selected for their ability to record innovative teaching; the instruments needed to be able to report on student-centred pedagogies, learning beyond the classroom, and the use of a virtual world in teaching and learning, then translate what was being reported into measurable indicators. The researchers collected data via survey instruments and classroom observation protocols.

Both students and teachers filled in a survey before and after the project. Additionally, the researchers conducted post-training session surveys with all participants to determine the effectiveness of the training. The teachers and researchers documented classroom observations. Classroom teachers were also able to collect and evaluate the artifacts of the project. These included the students' visual arts process diaries and design portfolios, which provided documentation of each student's learning process throughout the project. Additionally, students' work from the project was evaluated in a presentation of each group's final product, the installation of their artwork. Prior to the study, the researchers gained ethics approval through both the university and the New South Wales Department of Education and Training.

The Learning Activities

These classroom activities were intended to provide students with curriculum-centred learning opportunities that involved deep engagement and higher-order thinking (Lumkin et al., 2010), with an emphasis on the need to appropriately guide and support students' learning. To ensure students were sufficiently

scaffolded and supported, this project combined the OpenSim virtual world and two Web 2.0 tools, LAMS (Learning Activity Management System), and Edmodo with training videos.

LAMS is “an online web-based system for creating, managing and delivering sequences of collaborative learning activities” (Cameron, 2007, p. 112). It features a visual drag-and-drop editor that allows designers to create a learning sequence from a range of different activities involving various media and interactions. A LAMS sequence specifies the learning activities to be completed, and the workflow sequence that should be followed. Students within a LAMS sequence are able to pace themselves by proceeding to the next activity in the sequence only when they are ready to do so (although teachers are able to control and track students’ progress through the use of stop-gates and the monitor feature).

One of the benefits of the activity sequencing provided by LAMS is that it provides a tool to implement the alignment of objectives, learning activities, and assessment. Students could be oriented to the learning objectives at the start of a sequence, and then engaged in interactions and collaborations that are likely to elicit the required learning, all while assessment data can be collected. Additionally, LAMS can also facilitate the delivery of guidance and learning support such as worked examples and process worksheets.

One activity provided a link to a separate website that hosted additional support videos demonstrating inworld construction skills. These videos were delivered externally to LAMS, to provide just-in-time student access. The video acted as a worked example, demonstrating how to complete the activity. The research team and classroom teacher provided regular formative assessments by walking around the room and discussing concepts and skills with the students. Occasionally, teachers demonstrated skills for the entire class using the interactive whiteboard. The voting activity was included to elicit a sense of community, with students indicating their favourite virtual world prior to the class (Cram et al., 2010).

In the first activity, 11 of the 12 students who completed the survey reported that they found the scaffolding provided via the LAMS software to be helpful or very helpful. Overall, student achievement of learning outcomes was satisfactory. All students were able to customize their avatars and construct a tower, although one student was assessed at a “basic” level of achievement, which indicated that he or she still had several learning goals to reach.

Throughout the activities, the students were initially able to pace their progression by following the processes and instructions within the LAMS sequences. However, once the students were actively engaged within the virtual world,

none were observed proactively returning to the LAMS sequence to clarify task requirements or definitions, or move to the next step of the activity. Instead, once the students were satisfied with the completion of a task, they would explore or play within the world. For example, the assessment submission processes at the end of the activities needed to be initiated by the research team.

Overall, these results indicated that the level and forms of support provided to the students were generally sufficient, as was the level of internal alignment of outcomes, activities, and assessment. However, the integration of the LAMS sequences with the learning activities within the virtual world was inhibited by the resistance of students to return to the LAMS sequence, indicating a limit on the ability of the LAMS sequence to guide their learning pathway through the activities.

On reflection, the researchers determined that the core skill required for success in the training activity was the ability to manipulate the virtual object primitives into different forms. The LAMS sequence was modified to define “form,” then ask students to consider the link between form and primitives by completing an image gallery activity which presented a series of sculptures, highlighted contrasting features, and posed questions on how the sculptures might be built in the virtual world. The teacher presented the image gallery on an interactive whiteboard for face-to-face group discussion. This allowed the teacher to explain the relationship between concept and application, which was determined as the most efficient way of conducting this activity. Another series of refinements concerned the desire for collaborative reflection (Cram et al., 2010).

In the later iterations of the project, the LAMS chat activity was dropped in favour of a reflective blogging tool, Edmodo, which provided a single repository for all collaborative reflection throughout the project. This provided a single stream of discourse across the different sessions, facilitating tagging, searchability, and a platform for formative feedback (Cram et al., 2010).

Edmodo was introduced as a reflection and collaboration tool for students to use throughout the unit of work. It is an enclosed, safe and secure micro-blogging environment where students were able to record their development and evaluations of their design process. It allows teachers to attach documents, embed media, send links and assign homework, and grade student work. Using Edmodo, teachers could provide information, suggestions, and feedback to students during the unit (see Figure 11.1). The use of Edmodo in this project had a major impact on how learning was supported within this unit of work. Students used Edmodo to describe and document their work, to explain and

justify their designs, and to collaborate with their peers both during and outside school hours (Lumkin et al., 2010).

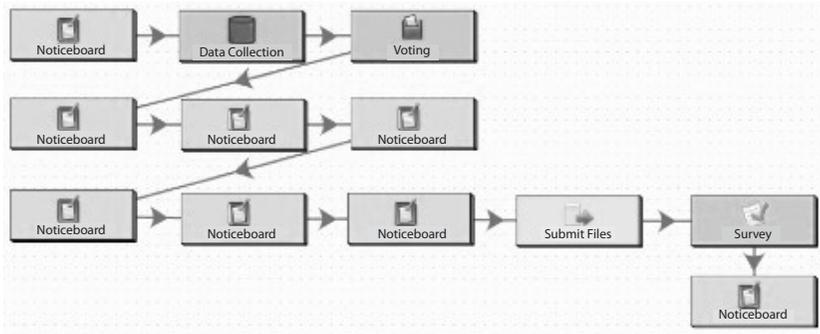


Figure 11.1 An example of a LAMS sequence.

Edmodo was effective in facilitating student reflection and collaboration while also recording each student's design process. Their initial use of Edmodo was scaffolded through participation in a joint construction and recount exercise using the interactive whiteboard to describe what and how their sculptures were constructed in the second training session. Students were also assigned a basic research task as homework to encourage them to use Edmodo at home (Lumkin et al., 2010). The research team recommended the use of Edmodo in future implementations, to complement student activities within the virtual world.

Instructors and research team members also encouraged and supported peer and self assessment within Edmodo and while in the virtual world.

Structure and Scaffolding Activities

The research team found LAMS was valuable in scaffolding students because it can provide a connection between the content and the support material (Pirrakeas, Papakadis, & Xenos, 2009). Within this project, it was mainly used for information delivery and workflow structuring, while the majority of the students conducted their learning efforts when they were active within the virtual world. Elsewhere, Powell (2007) discussed the use of LAMS to structure learning activities within a virtual world.

LAMS was intended to provide structure and guidance for the learners as they progressed through the activities within the virtual world. Figure 11.2 depicts the sequence used for the initial activity in the pilot study: avatar

customization and tower building. The sequence was used to structure the students' learning pathways and provide learning support through gradual and sequential release of information and instructions. Internal alignment of outcomes, activities, and assessment was achieved by providing clear expectations, learning intentions, and task requirements through these activities and facilitating assessment submission. Learning support was also delivered throughout the activities, which included concept definitions and process instructions (Cram et al., 2010).



Figure 11.2 An example of an Edmodo site page.

How Teachers Can Facilitate/Support On-Task Behaviour in the Virtual World

In this section we focus on how teachers can facilitate and support on-task behaviour in virtual worlds. In both the projects we have described, providing appropriate just-in-time guidance and support (scaffolding) for students was seen by the respective research teams as vital to the success of the projects. By providing clear instructions that outlined the process in manageable stages, students were less inclined to stray from the set task. These projects clearly demonstrated that when students are well-organized and supported, they learn effectively.

There are three key ideas that this research developed:

- Timely feedback
- Collaboration (both teacher–student and student–student),
- Keeping students on task.

Timely Feedback

In both projects the researchers found that providing immediate feedback to students had a major impact on the final outcomes of their activity. In the OpenSim project, students were able to act on teacher responses, and other students could also see responses. Laurillard's (2002) Conversational Framework highlights the significance of teacher–student and student–student discourse in learning. The fact that students used Edmodo to reflect and record ideas and modifications to the design, and used chat within the virtual world, are evidence to support this. Teachers were able to immediately direct the skills of their class in order to achieve the outcomes (Lumkin et al., 2010). One example of this is evident from the OpenSim project in size and scale: “if your avatar is standing near the items, compare this and ask yourself if the size is correct. Think of yourself using this item” (Lumkin et al., 2010, p. 42). Students were able to move on when faced with a difficulty they would have otherwise not been able to solve immediately themselves. This is also evident in Project 1, where students were able to reflect on how they used Second Life and document this in their journals. They were then able to use the discussion board to ask any questions they had as well as bringing them up in class.

Collaboration

In the OpenSim project, collaboration was a central component of student activity due to the requirement that students work in groups to complete their design and construction task. The collaboration occurred during face-to-face interaction within the virtual world and through Edmodo (Lumkin et al., 2010). Peer and self-assessment were also encouraged and supported both in Edmodo and Second Life.

The Second Life Project also supports the notion of collaboration being integral to teachers facilitating and supporting students in virtual worlds. This is evident from the student-centred tasks they were required to complete.

Keeping Students on Task

Scaffolding also provided increased opportunities for students to stay on task. One teacher noted that he “... did not experience one student log onto any

page on the Web that was not directly related to exactly what they were doing” (Quote from teacher Robert Croucher in Lumkin et al., 2010, p. 41).

Future Directions and Conclusion

Although there is a lack of research relating specifically to scaffolding and virtual worlds, scaffolding is a well-established approach that has been widely used and studied in a range of traditional and technology-enhanced/technology-mediated educational settings. Our research here shows that providing systematic scaffolding is successful as it provides students with a temporary framework for learning (Lawson, 2002).

As reported by Cram et al. (2010), it is important to provide support and guidance to students so that they can achieve the intended learning outcomes. These projects demonstrate that by providing this support and guidance, students are able to succeed with their learning. The projects also demonstrate how scaffolding can organize and support student investigation or inquiry, and keep them from straying too far off their learning pathway. Because they were introduced to virtual worlds with well-structured tasks, course readings, group presentation assignments, immersion in the software, and time for experimentation, the students achieved their learning outcomes effectively and efficiently, and without undue levels of frustration.

We believe it is worth conducting further research into the use of scaffolding in virtual worlds, particularly with regard to the various types of scaffolds available, how they support students, and how effective they are.

Acknowledgements

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CHALLENGES AND STRATEGIES IN DESIGNING CROSS- NATIONAL LEARNING

Team Projects in Virtual Worlds

Paul Resta and Miri Shonfeld

In this chapter we discuss an exploration of the ways that virtual worlds can facilitate cross-cultural collaboration in higher education, and the benefits, issues, and challenges in designing and implementing cross-national collaborative learning activities in virtual worlds. The case involves graduate students in Israel and the United States working together in virtual teams in Second Life (SL) to design a learning activity that uses the affordance of a 3D virtual environment. The goal of this collaborative learning activity was to enable the students to understand the learning strategies as well as the potential benefits and limitations of virtual worlds like Second Life to support collaborative learning. The results provide insights on cognitive, social, and teaching presence factors in virtual world learning activities.

Background and Related Work

Virtual worlds offer new opportunities for cross-national collaboration. Games such as World of Warcraft, in which over 11 million participants from different countries collaborate in guilds and on quests, have demonstrated the power of cross-national collaboration (Jarmon, Lim, & Carpenter, 2009).

Virtual worlds also offer the potential for cross-cultural collaboration in higher education because they provide conditions for experiential, embodied, and social reality spaces (Jarmon, 2009). In a virtual world environment, students can see one another's avatars, teleport themselves, or meet with the group on an

island to create the feeling of being together. The virtual world offers a stronger sense of place and the presence of others than text-based environments such as online forums and bulletin boards. Even in other synchronous environments like Elluminate, where you can speak with peers and see them using a web camera, there is still the sense that “they are there, and you are here.” In contrast, characteristics of the real world, such as topography, movement, and physics all contribute to the sense of “being there” in a virtual place (Smart, Cascio, & Paffendof, 2007). Virtual worlds such as Second Life provide opportunities for performative, experiential, collaborative, and game-based learning (Warburton, 2009). These environments also allow students to explore their own identities, or take on new ones (Mayrath, Traphagan, Jarmon, Trivedi, & Resta, 2009). Thus, the experience may be much more than immersion in a new context, but rather, the adoption of new and different roles.

Virtual worlds provide a unique context to explore cross-national collaborative activities in order to better understand the effects of cognitive, social, and teaching presence on engagement and motivation in the learning of transnational students. Previous studies show that environments such as Second Life enhance student motivation and engagement, facilitate collaboration, and provide immersive, experiential learning opportunities unavailable in other asynchronous and synchronous environments offered by traditional learning management systems (Aldrich, 2009; Dede, Clarke, Ketelhut, Nelson, & Bowman, 2005; Gee 2003; Kirriemuir & McFarlane, 2003; Prensky 2006; Shonfeld, Resta, & Yaniv, 2011).

This case study was focused on understanding: (1) the student experience of working collaboratively with students from another culture and country in a virtual world environment; (2) the strategies for, benefits from, and challenges of planning and implementing transnational collaborative learning activities in such environments; and (3) student perceptions of social, cognitive, and teaching presence when completing the collaborative learning task in a virtual world environment. In the following sections we provide a summary of the learning activities in Second Life, the students’ perceptions of the learning experiences as indicated in their surveys and interviews, and implications and recommendations for the design of virtual world collaborative learning activities.

Case Description

In this case study we explored the experiences of students participating in a transnational collaborative learning activity in Second Life. The data was collected during the fall of 2009, 2010, and 2011. In the second and third year of the project,

two graduate classes in Texas and Israel participated in the project. Most of the students were graduate students who worked, mainly as teachers.

The 2009 virtual world project involved graduate students in an Environmental Education class at Kibbutzim College in Israel, graduate students in a computer-supported collaborative learning class at the University of Texas at Austin (UT), and pre-service teachers at the University of Calgary. Graduate students enrolled in courses titled “Online Environments for Teaching and Learning” at Kibbutzim College and “Computer Supported Collaborative Learning” at UT participated in the 2010 and 2011 projects.

In all three projects, the collaborative learning activity took place over a period of six weeks. Because of the steep learning curve of Second Life, the students were provided opportunities to establish their avatars and explore the virtual world before meeting and working with students from the other country. The instructor at the University of Texas at Austin held his office hours in Second Life prior to the collaborative learning activity. The students at Kibbutzim College were asked to create their avatars and explore Second Life before the start of their class, which began in the middle of the semester for the US class.

Three important factors related to collaboration in online environments are teaching presence, social presence, and cognitive presence.

Teaching presence is the ability to manage and coordinate learning activities and environments (Rourke, Anderson, Garrison, & Archer, 2001), including design, facilitation, and direct instruction (Garrison, 2007). It also involves directly and indirectly facilitating social interactions and stimulating higher levels of cognitive processing. To support teaching presence, the teams were provided with training in the use of Second Life and given strategies for effective learning in teams. The collaborative learning task was a complex one that required the effort of all team members. Social interactions were monitored and mentored by the instructors who frequently participated in team meetings in Second Life.

Cognitive presence is the degree to which the learners can construct understanding through sustained communication and reflection (Rourke, et al., 2001). There are four phases of cognitive presence (Garrison, Anderson, & Archer, 2000):

1. The Triggering Event, which generates issues for consideration. In this project, the triggering event was the learning task. Each team had to design and carry out a collaborative virtual world learning activity

that would use the affordances of a particular setting in Second Life to support it. If the focus of learning was on, say, an historical event, it required selecting a place in Second Life in which the atmosphere of the period would provide an authentic context for the activity. The teams could design their project to include any of the following activities:

- Conducting a small-scale qualitative research study that involved observing or interviewing participants in a social space;
 - Role-playing that involved an historical re-enactment or performance;
 - Providing a virtual field trip to a 3D environment that facilitated the students' understanding of scientific concepts and principles;
 - Providing a language immersion experience in a culturally appropriate context to facilitate dialogue in the language and foster cultural understanding; or
 - Designing a Virtual World Quest using the WebQuest model, in which at least part of the quest involves an experience in a specific Second Life environment.
2. Exploration of issues through brainstorming, questioning, and information exchange. To make a decision related to the type of learning activity and site to be used for their collaborative learning project, the students jointly visited prospective sites such as museums, famous structures, and historical places. Then they brainstormed ideas for the type of collaborative learning activity that might take place at the site, and researched the history or aspects of the real world site represented in the virtual world.
 3. Integration to construct meaning based on the ideas generated in the exploration phase. The teams met synchronously in Second Life and communicated asynchronously to *evaluate* the relative strengths and weaknesses of the learning activities and sites being considered.
 4. Resolution to build consensus as learners confirm their understanding and apply new ideas to solve *problems*. The teams came to consensus on the learning activity and site and began to work jointly on the development of the learning activity storyboard.

Social presence is the degree to which learners can present themselves socially and emotionally in a learning community (Rourke et al., 2001). Social presence facilitates cognitive objectives by creating conditions for learners to feel secure enough to openly communicate with one another and develop a sense of community (Garrison, 2007; Garrison & Cleveland-Innes, 2005). At the beginning of the project, each of the team members introduced themselves and shared information about their professional and academic background and personal interests. The meetings in Second Life, where students could see the avatars of their team members and hear their voices, built a greater sense of “knowing” their colleagues. The challenging task and time constraints helped develop trust among the team as they worked on the design activity. As they made progress on the activity, team members reported an increased sense of community and group cohesion. Teams that experienced problems in communication reported less of a sense of community and group cohesion.

One of the major challenges in conducting a transnational project in a virtual world is finding times when students are available to meet in the virtual world. This problem was most prevalent in the 2009 project because there were a few teams that had one or more team members who could not attend the planned Second Life meetings. To address this problem in subsequent projects, the students were asked to provide the days and times they were able to meet in Second Life. This information was used to ensure that there was at least one day and time each week that all team members were available to meet.

Description of Activities

The teams were composed of four to six students, with approximately the same number of students from each class on each team. This varied based on day/time availability, level of competence in English, and members’ technology skills. Planning meetings were held in Second Life in informal settings to provide a more relaxed environment for discussion (Figure 12.1). There were also outdoor areas in the virtual world where groups could meet if the class meeting space was not available (Figure 12.2).

To select the appropriate context for the collaborative learning activity, the students visited various Second Life sites, such as universities, museums, synagogues, mosques, historical sites, and cities. The teams also had asynchronous discussions using Moodle to discuss their ideas and develop the storyboard for their planned collaborative learning activity. When the teams completed the project design, it was implemented in Second Life, recorded using Camtasia, and evaluated by other teams and the instructor.

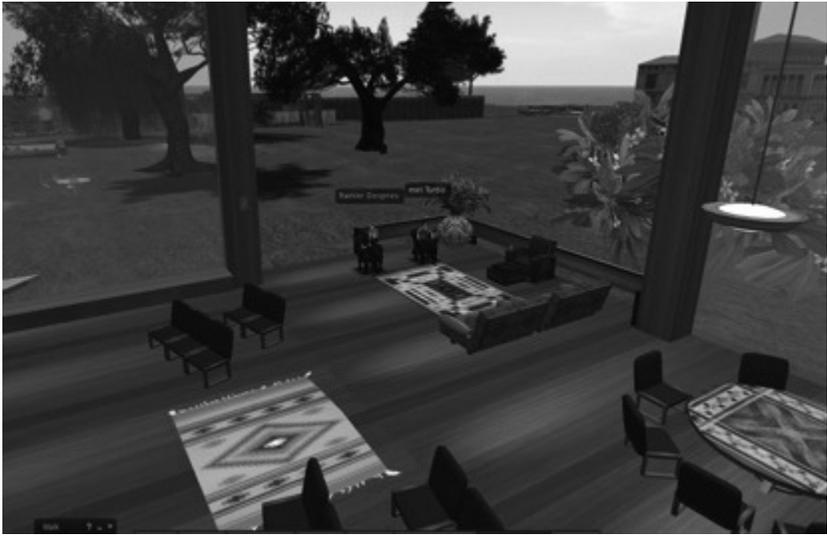


Figure 12.1 Classroom and meeting space.

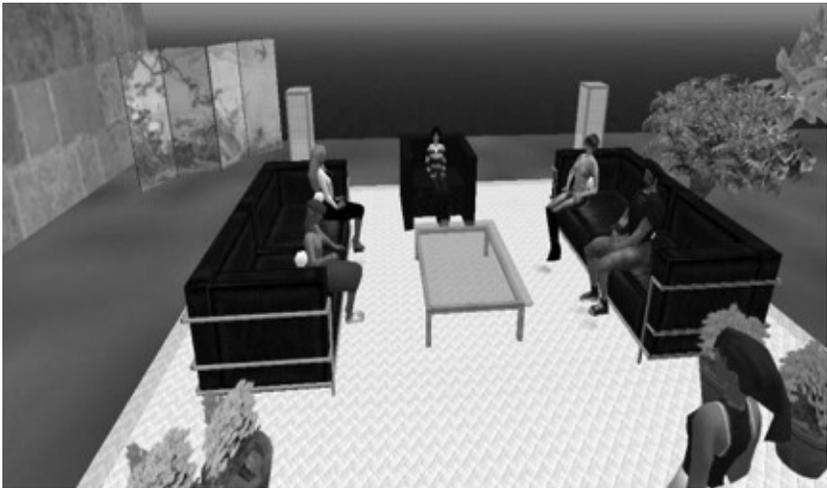


Figure 12.2 Outdoor team meeting space.

The final product of each team was a PowerPoint presentation with video clips or pictures from the virtual world collaborative activity. The clips showed how students changed their avatars according to the location and period where their activity took place. For example, students dressed as Mayans in Ancient

Mexico (Figure 12.3) or as Muslims and Jews for a discussion about the conflict in Jerusalem. The first year project required students to develop a collaborative inquiry activity similar to a WebQuest. The second and third year projects allowed teams to choose from a variety of activities, such as a Virtual WorldQuest, field trips, or role-playing.



Figure 12.3 Students' avatars dressed like Mayans in Chichen Itza, Mexico.

Evaluation Method and Results

To understand the students' experience in this activity, the researchers used both a survey and interviews. The online questionnaire was used to gather student perceptions of engagement, social presence, and sense of community in the project. Eight students and one Teaching Assistant were selected for follow-up interviews to obtain more extensive information on perceptions of the learning experience.

Social Presence and Engagement

Twenty-seven students answered the questionnaire. Most of them (85%) had not used Second Life before the project. The three main variables that emerged in the study were engagement, social presence, and satisfaction. Our findings reveal that there is a significant connection between social presence and satisfaction, and between group connection and engagement. There is also a significant connection between engagement and satisfaction. There is a significant correlation between the number of meetings and engagement (Table 12.1).

Table 12.1 Pearson Correlation Between Main Variables: Social Presence, Engagement, and Satisfaction

	Social presence	Engagement	Satisfaction	Meetings
Social presence				
Engagement	.681***			
Satisfaction	.674***	.495**		
Meetings	.186	.334*	.310	

* $p < .05$. ** $p < .01$. *** $p < .001$.

The qualitative results of the interviews were similar to the quantitative results, providing additional evidence of students' sense of social presence and engagement in virtual world collaborative learning environments, as these statements show: "We had an avatar, in Second Life you feel like you are in new real life. . . ." (A). "That actually opened my thinking about Second Life. . . . In fact I got so excited that we have gone afterwards into the telecampus and worked on building some other things in Second Life. . . ." (M). Other students made similar statements, also expressing their increasing engagement in both the context and interactions in the virtual world.

Intercultural Collaboration and Group Work

Most of the students answered the question about what they liked most about the project. They emphasized the diversity of the groups, the international collaboration, and the process of building group cohesion while designing the collaborative learning activity. The students found sharing intellectual work with those of another culture informative and exciting, and, as one student describes, the opportunity to work with students from another culture added to their sense of engagement. "It was thrilling because we were always meeting someone who lived at the opposite end of the world and we did some project together in the virtual world, which is the part I'm very interested in. . . ." (G).

The students' descriptions of the collaborative learning activity included many of the elements of cognitive presence:

1. The triggering event was the task to design a collaborative learning activity in a virtual world.
2. It required *exploration*, the process of selecting and designing the collaborative learning activity *through brainstorming, questioning, and information exchange*.

3. The process involved the *integration of ideas*, not only in terms of the type of collaborative activity to be designed but also the most appropriate context to carry out the activity.
4. The team reached consensus and a *resolution* when they chose the project to design.

The students explained that they learned more because they were exposed to multiple perspectives and dealt with topics they would not have otherwise considered. One of them stated, “Exposure to different ways of looking at things, different knowledge that they bring into particular topics out there, absolutely help you understand the topic that you are studying a lot more. . . .” (G). Collaboration was also seen as one of the advantages: “What I liked in the project is the cooperation between the teams. . . .” (Mu).

However, “Group Work” was problematic when some team members were unable to participate in the Second Life meetings: “Actually, group work on the project was somewhat problematic . . . they had a snowstorm . . . so most of our group work was accomplished asynchronously” (R). Some teams also had problems pacing the collaborative work, which affected the sense of group cohesion. Comments reveal that collaborative work is not always easy: “the students from Israel brought a slower pace to the conversation. . . . I think Americans have the tendency to just blow ahead real fast. . . . It teaches me to slow down.” (M). Clearly, students must make adjustments for cultural differences. Despite these difficulties, once students experienced the intercultural collaboration, they learned about not only the subject but also about cultural styles of work. M’s comment was one of many that highlighted the perceived benefits of the project, including culture, language, learning skills, learning management methods, and technology skills.

Time Constraints

The six-week duration of the project meant teams had to work intensively to complete the project within the allotted time. Although ideally such a project should be carried out over a longer period, this was not possible because of the differing academic calendars of the institutions.

A second time-related problem was the differing time zones the students lived in, and the difficulty of scheduling meeting times that would work for all team members. One of the students referred to these complexities: “The difficulties were in time zones, time zones differentials, and in particular with the students in Tel Aviv, although it turned out to be almost as problematic for the

students in Canada as well.” (Y). The difference in time zones required students to be flexible and open to meeting at times that would not normally be convenient, such as very early in the morning or late evening.

Language as a Challenge

Another challenge was students’ varying levels of competency in English, which we chose as the official language for team members’ communications. The groups that included Israeli students with a limited level of English proficiency encountered problems in communicating with and understanding their UT team members. The problems were exacerbated on some of the teams that included UT students who also were non-native English speakers. One of these students noted, “my native language is Korean . . . the language barrier in this situation wasn’t easier for both of us to make a fine piece of artwork. . . .” (D). One Israeli explained that the language problem affected his ability to contribute: I couldn’t be effective . . . because of my poor English.” (E).

Interestingly, the native English speakers did not perceive language as a barrier: “I found they could speak English for the most part very well. Do they have an accent? Sure, but most people in Texas have an accent too” (M). These statements reflect the tendency of non-native English speakers to often underestimate their ability to effectively communicate with their native English speaker teammates.

Technology/Tools

Several interview questions related to the use of virtual worlds technology. One issue that arose in the project was that of bandwidth. Second Life requires a specific computer capacity and bandwidth to run effectively. Some of the students in Tel Aviv had limited bandwidth access that negatively affected their participation in Second Life meetings. The other students had little patience with the technology barriers and, based on their frustration level, suggested that students without adequate bandwidth should not participate in the project. One student expressed the frustration that resulted from the lack of access to adequate broadband connectivity by other team members. “[T]hen the biggest problem was lack of Internet activity for the students in Tel Aviv in terms of broadband connection . . . I felt . . . the software ran more fast when I talked with X one of my classmates from San Antonio.” (M). Students also expressed frustration about audio and communication problems, and certain Second Life features that restricted group work.

Discussion

In this case study, we explored the learning experiences of students in a transnational collaborative learning activity in a virtual world, using the framework of cognitive, social, and teaching presence. We observed all three presences in the project, showing that the community of inquiry model is a useful framework to understand the interactions of students in a virtual world. The survey and interview results identified both the benefits and challenges of planning and implementing a transnational collaborative learning activity in Second Life.

Among the key findings were the connections between

- Social presence and satisfaction;
- Group connection/cohesion and engagement; and
- Engagement and course satisfaction.

Most teams indicated a positive experience and a sense of community and group cohesion that increased during the project. There were four reported factors that weakened group cohesion, sense of community, and task performance:

- Limited English language skills of team members;
- Limited attendance of Second Life meetings because of time differences and schedule conflicts (in the early project);
- Technical problems using Second Life because of limited bandwidth; and
- Challenges in pacing the collaborative work during the project's short duration.

Learning to use Second Life was difficult and time-consuming for most of the students who had no previous experience with it. This challenge was less significant for the UT students, who were able to use Second Life for a month before the project began. The virtual world collaborative learning task also posed challenges because many students had no experience in online collaborative work. Despite these limitations, the collaboration style of the teams was established as members became familiar with one another and the task.

The results of this case study support the findings of an earlier study that examined a collaborative learning activity in Second Life (Traphagan et al., 2010) with on-campus and off-campus UT students. Both studies indicate the ways social, cognitive, and teaching presence interact with virtual world tools and learning tasks and effect group cohesion. The relationship of these factors in the case study is depicted in Figure 12.4.

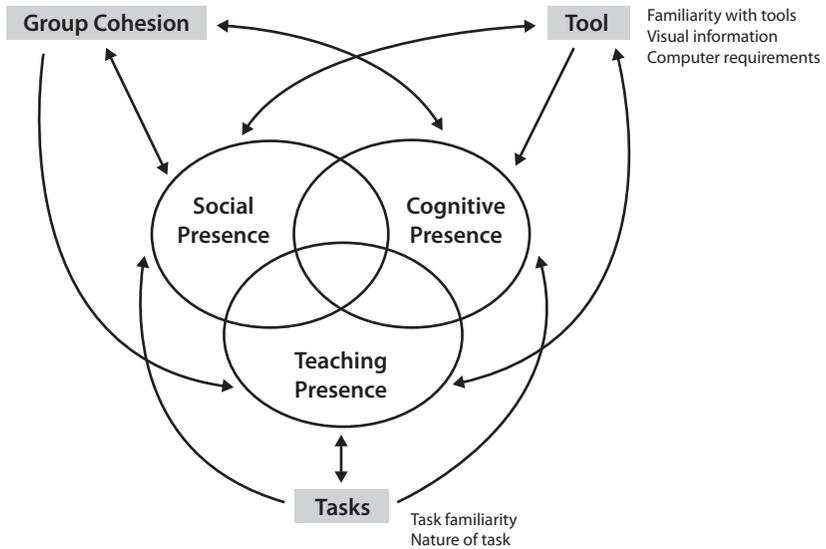


Figure 12.4 Relationships between Teaching, Cognitive, and Social Presence and Tools, Tasks, and Group Cohesion.

In summary, the case study identified many benefits to students who engage in a collaborative learning activity in Second Life. It also identified a number of challenges that should be carefully considered in planning this type of project. We make several recommendations:

- Provide time for students to become familiar with the virtual world before engaging in a time-constrained collaborative learning task.
- Assign to teams a student from each country with high language proficiency to help teams communicate more effectively.
- Have students provide information on their availability to attend virtual world meetings. Use this information to organize teams and assure there is at least one weekly time that all team members can gather to meet.
- Be specific about bandwidth and computing capacity minimums required to work effectively in the virtual world.
- Provide training and scaffolding on working effectively as a member of an online collaborative learning team.
- Provide mentoring to guide the teams in developing effective collaboration strategies.
- Monitor virtual meetings to identify teams that need help carrying out the collaborative activity.

Future Directions and Conclusion

Future research is needed to better understand the relationship of teaching, cognitive, and social presence to tools, tasks, and group cohesion. Our experiences in this case study have led to other virtual world projects that have fostered cross-cultural understanding between Israelis and Arabs, or enhanced the learning of a second language (Shonfeld & Raz, 2012). Virtual worlds offer new opportunities for collaborative learning, and their promise and potential will be realized through further research.

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13

INTRODUCTION TO LAWS RELEVANT TO VIRTUAL WORLDS IN HIGHER EDUCATION

Layla F. Tabatabaie

Common Problems in Virtual Classrooms

There is no mainstream form of technology that mimics reality and enables human interaction the way that a virtual world does. But even here, as educators have found, a teaching presence is vital in order to optimize student retention of information (Ferguson & Tryjankowski, 2009). Assembling students in a physical environment, however, is not the only way to inspire group involvement. Mobilizing people together in a virtual world also promotes collective action and participation as a group (Noveck, 2006).

In this chapter I will attempt to answer several key questions about the legal issues that higher education institutions might face when teaching in virtual classrooms. I will focus on these main questions:

- What intellectual property does a virtual classroom create, and how should it be protected?
- If students develop property within the virtual classroom, should it belong to the student or university?
- If multiple students create a property within the virtual classroom, who is the owner of that property?
- Are students' avatars speech, image, and likeness protected?
- Can virtual classrooms be video or audio recorded without consent?

- Can a university distribute student educational records without permission?

I will consider these questions individually by means of the laws and policy of the United States, England, and China. Although virtual worlds are rife with issues not addressed by legislation or tested by courtrooms, this chapter offers a starting point for educators who implement virtual worlds in their modules.

Contractual Obligation: Accessing the Virtual World

In the American, English, and Chinese legal systems, almost all rights related to virtual worlds used in post-secondary education can be established or revoked by contract, except for certain educational requirements and non-economic rights that I analyze later in this chapter. Normally, participation in a virtual world is a two-way transaction between the company that provides the virtual world and the person wishing to access it, called a user. A user agrees to the terms and policies of the virtual world in exchange for using the virtual world in whatever manner is desired within the confines of the program. When land in the virtual world is rented or sold to a third party, like a university, that land is turned into private property. A user aiming to visit a private property must adhere to the terms and policies of both the company hosting the virtual world and the third party that has a legal interest in the virtual space. A university may impose punishments for violation of their virtual world policies, including banishment from its virtual school grounds and sending a report to the platform owner that can result in termination of a user's account (e.g., Texas Women's University, 2012). In the United States, England, and China, the terms and conditions for passage into virtual worlds are found in the two leading virtual world contracts: The End-User License Agreement (EULA) and the Terms of Service (TOS, or sometimes called "Terms of Use"). How does a student gain access to and agree to these legal documents?

The United States

In order to participate in a virtual world or use any virtual item, a user must be either its personal owner or receive permission from its owners. Authorization may come in the form of a license, which is an agreement that expressly gives permission from the owner of rights in a property to use that property. Similar to businesses that run virtual worlds, educational institutions may have an interest in preserving either ownership or licensing rights of student-created

work in order to use it in other works, promotional materials, and advertising for the university's virtual teaching environment. Educational institutions that provide their virtual worlds instead of utilizing an existing one may secure licensing rights in all parts of the virtual learning environment by placing appropriate language within the EULA and TOS.

As the platform owner, the university may exhibit the EULA and TOS in two forms. First, the contracts may be in a click-through agreement, which is an agreement that pops up and requires the user to actively click on a button indicating acceptance of the terms before he or she may utilize the computer program (see *In re: 2703(d) Order* 2011). Second, a platform owner may post a link that leads to the EULA and TOS so that potential users can examine the documents at their convenience. Both ways assign the obligation to read and agree to the documents to the user (see *Swift v. Zynga Game Network, Inc.*, 2011). In general, courts will enforce a TOS or EULA. There are exceptions, however, particularly in cases where the documents are too one-sided and accommodating to the platform owner but not the participants of the virtual world (see *Newton v. American Debt Services, Inc.*, 2012)

Platform owners should not craft a TOS that is so onerous it is unlikely to be honoured by a court. For example, if the university, acting as platform owner, has a TOS that contains a heavy-handed arbitration clause restricting the type of statutory remedies that students may seek and other unbalanced provisions, a court may rule the TOS unenforceable against the students because it is "unconscionable," which is legal term that means "extremely unfair" (Garner, 2006; see *Newton v. American Debt Services, Inc.*, 2012). Conversely, if a TOS commits remedies to both the university and the student, the courts will likely support the instrument (see *Evans v. Linden Research, Inc.*, 2011).

England

England is similar to the United States in that statutory law and common law on contracts wholly govern virtual worlds. Though the EULA and TOS have not truly been tested in English courts, the documents both remain the industry standard (Grossman, 2008). The documents may be presented as a "click-through" license, which is also a valid form of conveying a virtual world's TOS (*Sas Institute Inc. v. World Programming Limited*, 2010).

Unambiguous TOS and EULAs that provide reasonable notice to all voluntary participants are unlikely to be deemed substantively unconscionable. English courts have typically applied the doctrine of unconscionability to a few areas of law that are traditionally connected to real property (Angelo & Ellinger,

1992; *Barclay's Bank Plc v. Varenka Goff*, 2001; Johns & Blodgett, 2011; Tjio, 1997). The doctrine seems to only bear upon negotiated contracts. It would be difficult to find English unconscionability pertinent to standard form contracts like click-through agreements or EULAs because of another requirement of an unconscionable bargain: The party drafting the agreement knows, or ought to know, of the other party's disadvantage, such as lack of business acumen or income (see *Fineland Investments Limited v. Janice Vivien Pritchard*, 2011; Phillips, 2010).

English courts do frequently exercise other equity-based contract principles that exist in American law, such as prohibiting contracts that have one-sided terms (see *Boustany v. Pigott*, 1995). The incorporation of equitable terms into agreements is further strengthened by the Unfair Contract Terms Act 1977, which directly applies to the terms of a standard form contract such as a click-through agreement. Therefore, university administration should include fair terms in their TOS and EULA that equally affords relief to all parties.

China

Contracts supported by national legislation reign over the law of virtual worlds in China. The National People's Congress enacted three laws: The Civil Law, Secured Interests Law, and the 1999 Contract Law (Zimmerman, 2010). These acts uphold and establish commercial contracts, including the EULA and TOS contracts, which are also embraced for Chinese virtual worlds. For example, China's version of Second Life, called HiPiHi, has a click-through agreement which a player must agree to before finishing installation of the virtual world software. Enabled by national legislation, a people's court or administrative agency has the power to declare a contract null and void for being obviously unfair. Therefore, to mitigate risk and err on the side of fairness, contracts should contain remedies equally available to all parties.

Intellectual Property in the Virtual Classroom

A virtual classroom is made up of many bits of code that translate into images within a virtual room. Code may appear as desks, tables, blackboards, chairs, signs, a clock, doors, and avatars that represent students and faculty. Items designed and placed in the virtual world by the software program clearly belong to the platform owner, but who owns new items created by the students and faculty members that are assimilated into the program?

Similar to the new media journalism class currently offered at the University of North Carolina at Pembroke, imagine Professor W, a professor at University X, is offering a class on journalism within a virtual classroom. Also assume that

the journalism classroom is hosted in the online virtual world Second Life, which allows players to retain intellectual property rights to assets they create within the virtual environment, and University X has an agreement with the creators of Second Life, Linden Labs, that allows the university administration use of the world for its community and the right to manage their classrooms in whichever manner they choose. The platform owner, here Linden Labs, provides the floor of rights within the world. For example, Section 7.3 of Second Life's TOS states that users are granted a license to engage in certain activities, such as taking screen shots of publicly accessible areas (Linden Research, 2010).

Not all virtual space is deemed public. A landowner or renter of private virtual property may turn their space into a private area by utilizing inworld tools to restrict access to their space. Thus, if University X is turned into a private space, and it wishes to enforce stricter rules on its users, such as demanding that its users obtain permission to take screen shots of the classrooms, it may. However, by adapting an existing virtual world, University X may not require that same permission from Linden Labs, because the university is contractually bound by the platform owner's EULA, TOS, and other policies. Here, Second Life expressly states in Section 7.2 of its TOS that any content submitted or published in Second Life automatically grants Linden Labs the right to use a copy of that work in any way it desires. Users should note that ownership of the work is not affected, only use. Therefore, University X would not be able to prevent Linden Labs from using screen shots of the classroom in promotional materials and advertising. Apart from the platform owner's licensing rights, who owns materials in a virtual classroom, and who is permitted to use them?

The United States

Copyright is the primary protector of virtual worlds. Under the United States Copyright Act of 1976, the virtual world code and all of its elements are copyright protected as literary works. Going back to the hypothetical, suppose students in the journalism class are free to contribute content to the virtual classroom. This freedom is realistic given that many Second Life users create new objects using the tools in the software program or write code from scratch (Ondrejka, 2006). Imagine Student Z creates a PowerPoint presentation of original, currently unpublished research, uploads it to the private virtual classroom, and presents it to the class. Who owns and may use that new virtual item?

The architect of a new virtual item can classify the code behind it as a literary work, or the visual item itself as an audiovisual work, and therefore can bar others from a legion of uses, such as to use the item in trade or advertising (Copyright Act, 1976). If multiple students intentionally joined Student Z in creation of the PowerPoint presentation, all collaborators would be co-owners of that virtual item. As I previously mentioned, the university has its own set of policies and procedures governing the behaviour of faculty and students even in the virtual world. Therefore, University X may place the proper licensing language in their legal documents to establish permission to use a student-created work.

If faculty or other students in the journalism classroom desire to use Student Z's PowerPoint presentation, but have not gained express written permission to do so, they may nevertheless be granted permission under educational fair use. The United States Copyright Act (1976) dedicates a section for "fair use" of protected work, which means in particular circumstances copyrighted material may be used without permission or compensation. Courts emphasize that there is a presumption of unfairness for one who uses another's work for monetary gain (*Harper & Row Publishers, Inc. v. Nation Enterprises*, 1985). However, a court might not conclude educational fair use for a professor, even when the copyrighted material is confined to only educational purposes and given to students for free (see *Marcus v. Rowley*, 1983). The safest route for adopting another's work is by obtaining written permission from the creator.

Normally, copyright exemptions for non-profit educational institutions exist for only the performance or display of a work during "face-to-face teaching activities" (Copyright Act, 1976 § 110[1]). This means distributing, reproducing, or making derivatives of a work are strictly prohibited (Copyright Act, 1976). The face-to-face requirement alone would displace eligibility for any non-profit educational institution that employs virtual classrooms. However, there are exemptions for use of copyrighted works transmitted digitally if the school meets a series of limiting criteria, including that the transmission of the work is only received by students enrolled in the class (Copyright Act, 1976). Thus, for example, Professor W may show another virtual class Student Z's PowerPoint presentation, but may not distribute it, make copies in whole or in part, or create a new work from it, like a poster.

What if Student Z integrates a modified version of the school's name and logo into the PowerPoint presentation without permission? In all three legal systems, the university's name and logo is protected by trademark even in the virtual world (Lanham [Trademark] Act of 1976 [US]; Trademark Law 1982 [CN];

Trade Marks Act 1994 [UK]). Fair use also applies to trademarks. Determining fair use is a test for the courts, and depends on how different factors are weighed. Students cannot weave modified versions of a university's name or logo into their work if the public believes that the university controls and endorses the work (*Villanova Univ. v. Villanova Alumni Educ. Found.*, 2000). A 2011 Alaskan case demonstrates that even if the scope and size of the application is minimal, such as a student placing the protected logo on a single slide of a PowerPoint presentation in one class in a secluded state, a court may hesitate to find educational fair use (see *Campinha-Bacote v. Rearden*, 2011). Even so, a court might find educational fair use for Student Z's work if its use is for productive, educational purposes (*Rubin v. Brooks/Cole Publishing Co.*, 1993). Students should seek written permission from the trademark owners, or at a minimum, restrain the use of the work to productive, educational purposes only.

England

Similar to American copyright law, English domestic law states that the codes that make up the entire virtual world and its "substantial parts," including clip art, graphical artistic work, sounds, and films contained within the virtual world are copyright-protected as literary works (Copyright [Computer Programs] Regulations 1992; Copyright, Designs and Patents Act 1988). Usually, written consent from the creator is needed to make copies of a copyrighted work, or to use trademarks (Copyright, Designs and Patents Act 1988; Trade Marks Act 1994). If Student Z plasters multiple slides of her PowerPoint presentation with a third party's name and logo, she must obtain prior written approval from the third party to add it (see *Codemasters Software Company Ltd. v. Automobile Club De L'Ouest*, 2009).

England's version of fair use is referred to as "fair dealing" (see *Newspaper Licensing Agency Ltd. v. Meltwater Holding BV*, 2011/2012). Professors and students may use copyrighted work without compensating or obtaining permission if the creator is sufficiently acknowledged and the work is used for non-commercial research purposes (Copyright, Designs and Patents Act 1988). Similarly, criticism and review of protected works fall under this exception provided the works are already in the public, and the creator is sufficiently acknowledged by name and other identifying details (Copyright, Designs and Patents Act 1988; see *Newspaper Licensing Agency Ltd. v. Meltwater Holding BV*, 2011/2012).

The Copyright, Designs and Patents Act 1988 also lists copyright exemptions specifically for educational establishments, teachers, and students. Professors and students may make copies of protected work for non-commercial purposes

with sufficient acknowledgement of the creator (Copyright, Designs and Patents Act 1988). Student Z's addition of the university's name and logo in her virtual item might also be permitted as expressive and cultural fair use (Naser, 2009). While some English courts have stated that using a protected work for non-commercial research is likely to raise less problems than using a work in criticism and review, absent written permission, students and faculty run the risk of a court rejecting their use as fair dealing or falling under the educational establishments exemption (see *Forensic Telecommunications Services Ltd v. Chief Constable of West Yorkshire*, 2011).

China

Virtual worlds are protected under two laws in China. First, the entire virtual world is sheltered under the Copyright Law of the People's Republic of China (2010; hereafter Copyright Law) as "computer software," while graphic images and characters are protected as art. Second, the virtual world may acquire additional copyright protection because it qualifies as a computer program under the Regulations on Computer Software Protection (2001). China's copyright law obligates users to acquire written permission from the creator to use or make copies of her or his work (Copyright Law, 2010).

Chinese law also provides general educational fair use that allows teachers, researchers, and students to use copyrighted work without permission or paying a fee. Specifically, Article 22 of the Copyright Law (2010) permits reproductions of publications in small quantities for only "classroom teaching or scientific research" provided the creator's non-economic rights (moral rights) are preserved, and his or her copyright rights are not affected by the distribution (Copyright Law, 2010, ch. II, § 4, art. 22[6]; Schlesinger, 1995). Therefore, going back to my example, if Professor W desires to distribute copies of Student Z's PowerPoint presentation, then the professor should print only enough copies for the class, and each copy of the work should contain Student Z's name and other identifying factors. The principles of fair use also apply to trademarks. Student Z's unauthorized reproduction of University X's trademarks within her virtual item might be considered a fair use of the school's trademarks for education purposes (Young, n.d.). Unlike the laws of England and the United States, China does not have an exemption specifically for educational institutions, likely because the Chinese government places heavier emphasis on criminal liability for copyright infringement and Internet copyright infringement.

Avatars or Virtual Representations of Users

Avatars are the graphic representations of users. One way to build one is for a user to select from a set of stock avatars that are contained in the virtual world software. As part of the software, these stock characters belong to the platform owner. However, avatars can also be built from scratch. Normally, a character belongs to its creator, but ownership rights may change depending on the TOS of the platform owner and university. An avatar that is distinctive, or conversely, that closely resembles an existing person's appearance may rise not only to the level of copyright protection but also several other types of protection.

Character disputes may arise when one person adopts the name and appearance of another person. If an imposter is simply creating trouble within the virtual world without any monetary gain, generally the only form of redress is the platform owner's internal policies. For example, if Student Z built an avatar that matches her physical appearance, her discovery of another student in her journalism class using an identical avatar with her name attached to it is certain to cause a disturbance. Student Z may seek refuge within Section 3.2 of Second Life's TOS, which prohibits attributing a name to a character that will cause confusion and mislead others as to a user's identity (Second Life, 2012).

A dispute may also emerge if the university makes a copy of a student's avatar and uses it in advertising and promotional materials without the student's written permission. For instance, if the university took screen shots of Student Z's avatar and placed the images on flyers, subway posters, and banners, does Student Z have any arguments beyond copyright?

The United States

For the legal systems of the United States and England, generally, characters are not afforded separate copyright protection from a work as a whole unless they are distinctive (Zecevic, 2006; *Olson v. National Broadcasting Co.*, 1988). On certain occasions, a student or faculty member may assert her or his right of publicity (publicity rights) protection to ban third parties from exploiting the avatar for pecuniary gain (Pollack, 2011). Publicity rights are defined as the inherent right not to have one's image and likeness used for another's financial gain without authorization (see Garon, 2008). These rights are rooted in state statutory law or common law and thus vary by state (Pollack, 2011). When the avatar has the image and likeness of a specific person in a setting comparable to his or her ordinary occupation, and is conducting work-related tasks that are regularly done in his or her real-world occupation, publicity rights may prevent others

from commercial use of that person's avatar (*No Doubt v. Activision Publishing Inc.*, 2011). Arguably, Student Z may acquire publicity rights that expand to her avatar if it closely resembles her image and likeness, the avatar is solely in the role of a student, and it carries out tasks that the student usually performs.

The bulk of publicity cases involve celebrities. Yet some states have passed privacy rights laws that give ordinary people nearly the same protections (e.g., New York Civil Rights Law, 2011). Privacy rights defend against third party exploitation of a person's name and likeness, are inclusive of all people, and are codified in either a state statute or by state tort common law (see *Alfano v. NGHT*, 2009; e.g., New York Civil Rights Law, 2011). Although no definitive law or ruling speaks directly to avatars of ordinary people in virtual worlds, similar to characters in a video game, in the future, avatars based on people may have the right to privacy (see *Reece v. Marc Ecko Unltd*, 2011). Therefore, the state that has jurisdiction over the dispute will play an important part in any publicity rights or privacy rights cases.

Millions of people engage in commercial activities within virtual worlds (Lastowka & Hunter, 2004). In the absence of a contract surrendering all legal rights, a student may earn trademark protection for her or his avatar if the avatar operates like a brand to sell a good or service. Contrary to publicity rights, trademark law does not demand that the image match the user's appearance (Trademark Act of 1988). For example, if Student Z constructs a distinctive avatar for journalism class but then uses that avatar in multiple virtual worlds and attains a reputation as a merchant who executes business transactions there, her avatar may secure trademark protection if the character functions as a brand. Student Z can build a higher legal wall by filing a trademark application for her avatar with the United States Patent and Trademark Office (USPTO; Crittenden, 2008; USPTO, 2011). Trademark law can also prohibit third parties from adapting the avatar for a myriad of objectives, such as advertising and trade. A university can eliminate almost all of these legal issues and secure economic use of all virtual items and avatars within the virtual world by inserting the proper language within the EULA, TOS, or other school policy.

England

England does not recognize publicity rights, and though it created privacy laws related to data protection, the absence of a domestic, general privacy law is widely known (*Love v. Sanctuary Records Group*, 2010; Parliament UK, 2008). Therefore, contrary to the publicity rights and privacy rights in the United States, there are no legal shelters for a person's image and likeness or that

person's avatar in England. Characters have a greater chance of receiving protection as a symbol in business. It is possible that this legal shield will extend to an avatar used in commerce the way that representations of fictional characters and names are currently trademark-protected (Leaffer, 1993–1994). To illustrate this point, the name and representation of Superman, a fictional character that has a look and name that is distinctive, are afforded trademark protection (UK Intellectual Property Office, 2012). Thus, presently, copyright law is a student's best form of redress for her or his custom-made avatar.

China

Similar to England's stance, there are no publicity rights or general privacy rights in China (Liu, Yao, Jiao, & Jie, 2011; Jingchun, 2005). Chinese law does provide a right of "portrait, name and reputation" for people, which so far has not been argued to apply to avatars (General Principles of the Civil Law of the People's Republic of China, 1986; Groscost, 2008). Given the attention and impact that one particular case involving hurdler Liu Xiang had on Chinese law, if in the future avatars elevate to the same status and recognition as the image of a well-known person, the argument may be made that characters also qualify for the right to portrait protection (Levine, 2007).

Analogous to the trademark law of England and the United States, representations and names of fictional characters may be trademarked. For example, the Teletubbies name and representation have registered trademark protection in China because both the name and representation are symbols for a specific children's television show, dolls, and other children's goods (Yi, 2010). Along that line of reasoning, if Student Z's avatar is associated as a symbol in commerce for goods or services and is distinctive, it may be eligible for trademark protection (Trademark Law 1982). Outside of copyright law, a user's best chance of gaining legal protection for their avatar is seeking trademark protection by establishing their avatar as a brand.

Recording the Virtual Classroom

In a virtual classroom, a learner participates in one of two ways, depending on the platform and personal preference. Either she can speak through a headset directly inworld, which makes her speech audible within the virtual classroom. Alternatively, she can write, which makes her responses appear as typewritten text on the screen. In order to review class later, the student or teacher may wish to record the class. Is permission required to record the classroom? Figure 13.1 provides an example of how text may appear in a virtual world.



Figure 13.1 Example of how text may appear in a virtual world (virtual classroom in Freie Universitaet Berlin in Germany). Used with permission from Undine Frömming.

The United States

Normally, lectures, syllabi, and other tangible educational materials that are furnished to a class are copyright protected by the professor who is the author of the materials or the university who is the professor's employer. Scholars differ in opinion as to whether the university owns the copyright for these materials (Patry, 2011). In either case, recording the virtual classroom by any means is creating a copy of these materials without authorization. There are exceptions to this general rule (Copyright Act of 1976). The Copyright Act (1976) permits a recording solely for personal use (see *Lewis Galoob Toys, Inc. v. Nintendo of America, Inc.*, 1991). This means a student may record the virtual classroom if she or he is the only person accessing the recording. Distribution of the student's recording is strictly prohibited, unless considered otherwise under the copyright fair use exceptions. A professor may easily retain some rights and permit others by adopting a free, ready-made license from Creative Commons, a non-profit organization that advocates for universal access to research and education.

England

Analogous to the copyright law of the United States, recordings are classified as digital copies of a work. Thus, for example, creation of a video recording is a violation of that owner's rights (Copyright, Designs and Patents Act 1988). Various methods of capturing the classroom lead to the same result. For instance, if Student Z desired to take screenshots of the journalism virtual classroom, she

would still be in violation of the university's rights. English common law protects the frames or "images displayed to the user" in video games, and would likely protect the frames of a virtual world as well (*Sas Institute Inc. v. World Programming Limited.*, 2010; *Nova Productions Ltd v. Mazooma Games Ltd*, 2007). Student Z should avoid gambling on a claim of fair use by simply asking Professor W for permission to record the class.

China

A professor's lecture is sheltered by copyright in two categories. If the lesson is written down, it is classified as a "written work." If the lesson is only performed orally, it is categorized as an "oral work" (Copyright Law, 2010). Whether a student must first seek approval for audio recording or video recording the virtual classroom will depend on whether the lesson presented that day is either an unpublished or published lesson. If the lesson is an unpublished work, the copyright owner must grant approval before any recording can be made by another person (Naser, 2009; Zimmerman, 2010). If the lesson is a published work, a student or faculty member may make a recording, but will have to compensate the copyright owner. The most inexpensive route for Student Z is to receive written authorization from Professor W to record the journalism classroom, and—upon clarifying that the recording is for personal use—negotiate either no fee or a reduced one.

Educational Records

In many countries, a student's educational records are considered personal information and are given special protection from public dissemination and use. Because the virtual classroom is conducted like a conventional classroom, students will receive test grades based on the material learned there. If placed on an academic transcript, these grades and achievements qualify as educational records. What happens when a university uses student grades derived from the virtual classroom as part of an advertising campaign? Can a university publish information about students and faculty that is harvested from activities inworld?

The United States

American educational institutions have a special responsibility to securely store student educational records. Universities may maintain educational records of a student, but may not release them to any third parties without the student's written authorization (Family Educational Rights and Privacy Act

of 1974). Therefore, if a university desires to distribute a student's educational record in any fashion, it must first receive written consent from the student. Post-secondary schools should exercise caution when selecting what information to use from a virtual classroom in advertisements to ensure that a student's educational records are not compromised.

Moreover, federally funded universities that monitor, log, and store information about students or "human subjects" for the purpose of using the collected information for experimentation and research must first receive authorization for their virtual world and its method of collecting information by an institutional review board (IRB) (see Protection of Human Subjects of 1991). Earning IRB approval can take several months. A university may accelerate the process by collecting only information that is necessary to properly run the virtual classroom, reducing third party access to information about students, and only releasing information that students have expressly approved.

England

Institutes of higher education should curb the amount of information they collect from the virtual classroom. As determined by Section 7 of the Data Protection Act 1998, upon request by student or faculty, English universities must provide a privacy policy or notice that details what data on the individual is being held, why it is being stored, and provide a list of the outside parties that are receiving the data. The amount and type of information permitted for collection may vary by a number of factors, including who is collecting information and for what purpose. To that end, universities are encouraged to contact their local education authority or attorney to verify what information may be gathered regarding students and faculty (Carey, 2004).

There are also additional limitations on which outside parties may solicit educational records, also called curricular records. In England, universities must follow the procedures in the Education (Pupil Information) (England) Regulations (2000) when disclosing a student's curricular records to parents, teachers, schools and government agencies. The type of information that can be passed on to these parties is subject to Section 5 of the regulations. It states that the headmaster of the school, or whoever is responsible for maintaining curricular records, may not disclose any information that is subject to the Data Protection Act 1998, which protects personally identifying information. Therefore, universities may only disclose general non-identifying information. It follows that the safest course for collecting information on students and faculty in the virtual world is to adhere to the Data Protection Act 1998, which

deals primarily with privacy and data storage, and thus I will not discuss it in this chapter.

China

Unlike the Family Education and Privacy Rights (1974) in the United States and the Data Protection Act 1998 affecting England, China does not have a law specifically protecting educational records from distribution. There are no regulations on human-subject experimentation that apply to collecting data from human subjects using a virtual world, except for Hong Kong, which has passed legislation on preserving privacy and data protection of human subjects (United States Department of Health and Human Services, 2011). As such, universities are able to accumulate a great deal of information related to educational records without worrying about violating an educational statute or privacy law.

Future Directions and Conclusion

Virtual classrooms will become commonplace in the future. Students are being introduced to online and virtual education even before they attend institutions of higher education. High schools in several regions of the United States are beginning to mandate enrolment in online classes for graduation (e.g., Idaho, Alabama, Florida, and Michigan). In addition, post-secondary universities such as the New York Law School, Harvard University, and the University of Texas have used virtual classrooms and virtual worlds in education (New York Law School, 2011; Virtual Learning Community Initiative, 2011; Wong, 2006).

For common law countries, a throng of virtual world issues have not yet been tested in courts, and in civil law countries there is an absence of legislation addressing them. In all three legal regimes, contract law remains the body of law that produces the most predictable results for resolving virtual world disputes. Therefore, universities should effectuate a comprehensive model of self-governance by installing internal policies and procedures that anticipate conflicts in the virtual world and are suited to remedy them. Educational institutions may put participants on notice about these domestic rules by sending some form of communication, such as an email or letter to a verified address, and by ensuring that the TOS, EULA, and other policies are simply phrased, easily accessible, and discoverable.

Further, teachers should either require students to sign and submit a contract affirming that teachers and university administration may use the student's submissions, or prepare a detailed form template to send to students at the time that teacher wishes to use a student's work. I urge the latter approach,

which promotes transparency of intentions and invites student engagement. Informed decisions are likely to prevent a multitude of disputes and promote group cohesion. By being aware of the legal and policy issues that surround virtual worlds in higher education, university administrators, faculty, and students in post-secondary schools may fully enjoy this dynamic learning environment without any unpleasant surprises.

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CONCLUSION

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Although virtual worlds, and 3D virtual environments more broadly, have been used in educational contexts for more than 20 years, there remains a great deal that we still do not know about how best to design and use them to maximize learning effectiveness and outcomes. The contributors to this volume have explored a range of research topics related to the use of virtual worlds in education. Topics spanned human–computer interaction issues related to navigation, communication, identity formation, and authentic learning; leading-edge technologies that have the potential to take learning in virtual worlds forward in new directions, with a specific focus on conversational agents and computer-controlled avatars; and considerations and frameworks for designing and implementing learning in virtual worlds. The contributions made by these chapters within the broad areas of human–computer interaction, advanced technologies, and learning design and implementation are discussed in turn in the following parts before concluding with a summary of the main contributions of the book as a whole and the opportunities that exist for future research.

Part I: Human–Computer Interaction

Chapter 1 by Shailey Minocha and Christopher Hardy, “Navigation and Wayfinding in Learning Spaces in 3D Virtual Worlds,” described their studies examining various interface issues that affect navigation and wayfinding in a virtual world, leading to guidelines for virtual world educators and learning designers. The studies involved interviews with students, educators and designers, observations of students undertaking virtual world-based learning activities, and heuristic interface evaluations. As a result, Minocha and Hardy pinpointed a

number of navigation and wayfinding problems, including the inability to identify the interaction possibilities of objects, difficulty locating and using navigational aids, and becoming disoriented and needing to return to the entry point. The design guidelines they proposed include the provision of maps, the use of notecards for ease of teleporting, the inclusion of objects replicating real-world objects to aid familiarity, and provision of a range of navigation mechanisms to cater to different user preferences and needs. Their key recommendation is that the design of virtual world learning spaces should be undertaken in an iterative fashion drawing on user evaluations.

Chapter 2 by Stephany Wilkes, “Communication Modality, Learning, and Second Life,” described a study that investigated how the choice of communication modality within a virtual world-based learning environment—voice only, text only, or a combination of both—influenced learners’ cognitive load, their perceptions of presence and co-presence, and their achievement of learning outcomes related to short-term retention. Wilkes found that communication modality had an effect on cognitive load and retention, but not on sense of presence. Surprisingly, cognitive load was highest for the voice-only participants and lowest for the text-only participants. One possible explanation for this is that the ability to retain and re-read text chat logs may have allowed participants to relax in the knowledge that they did not have to commit everything to memory. Retention was also highest for text-only participants, but only for those with experience in Second Life. Wilkes expected that voice communication would contribute to sense of presence, but this was not the case—there was no significant effect of communication modality on sense of presence. It is worth noting, however, that the lesson did not require peer discussion and the levels of communication were relatively low. This study is important because it illustrates that the ways in which communication modality affects learning experiences are complex and may be dependent on both the prior experience of the participants and the nature of the learning task. More studies are needed to confirm the findings and also to explore the way different learning designs, especially those which involve substantial peer discussion, affect the results. At this stage, educators should be cautious about making assumptions about the relationship between communication modality and learning experiences.

In Chapter 3, “Virtual Body: Implications for Identity, Interaction, and Didactics,” Laura Fedeli studied the relationships between avatar appearance, sense of embodiment, social relationships, and identity in a virtual world. By analyzing the data from various qualitative sources, she scrutinized the rich

experiences of the teacher participants in depth. Her key finding was that experiences gained in a virtual world should not be interpreted purely as representational experiences, but are perceived by participants as “real” experiences, even if separated to an extent from “real-world” experiences.

Chapter 4, “(In)Accessible Learning in Virtual Worlds” by Robert Todd, Jessica Pater, and Paul Baker, explored the degree to which virtual worlds are accessible to people with disabilities, and examined various proposed solutions for improving virtual world accessibility. The authors identified accessibility problems likely to affect people with visual or hearing impairments and those with limited hand-eye control or dexterity. They found that technologies such as screen readers, which are commonly used to support visually impaired users, were limited in their application in virtual worlds due to the lack of a standard for the inclusion of non-visual metadata. The use of text chat catered well to hearing impaired users, but the increased use of audio for communication has introduced new problems for this group. The authors considered alternatives such as sound amplifiers, word-to-text software, and environmental sound-to-text software to be promising. Traditional mechanisms to support low-dexterity users such as track-and-ball mice, head-pointer mice, and voice activation were also considered to be valuable in virtual worlds. On the positive side, Todd, Pater, and Baker suggested that the use of virtual worlds could be particularly valuable to people suffering from Asperger’s Syndrome and those with limited physical (real-world) mobility.

In Chapter 5, “Benefits of Second Life in the Ageing Population” Ann Smith discussed pilot studies of the use of virtual worlds by elderly people, highlighting the potential value to these users but also underscoring the need for specialized training and ongoing support. Aside from the navigation and usability obstacles already reported in the literature, problems encountered by elderly users included difficulty involving their use of Second Life to accommodate to interface changes, emotional discomfort when flying, and difficulty in communicating through avatars. Interestingly, the users showed a greater interest in using the virtual world for self-enrichment and lifelong learning purposes than for socialization and community engagement. The experiences of the elderly users Smith documented highlight the need for further studies in this area to allow designers of virtual world activities to develop a better understanding of the unique usability issues encountered by this important group of potential students.

In Chapter 6, “The Reality of Authentic Learning in Virtual Worlds,” Helen Farley questioned some of the claims made explicitly or implicitly by many

authors about the authentic experiences that are possible using current virtual world platforms. In particular, Farley argued that in many knowledge domains authentic tasks cannot as yet be feasibly carried out in virtual worlds, and that the limitations in the physical representation of the environment and the types of interactions and tasks that can be carried out result in an absence of many of the cultural and social aspects of real-world experiences. Further, Farley argued that the necessary reductions in complexity of the environment result in constrained rather than open-ended and well-structured rather than ill-structured problems, which restrict the degree of authenticity of the learning tasks. According to Farley, the additional cognitive load imposed by the virtual world software interface and the unnatural interaction mechanisms can interrupt flow and interfere with the apparent potential for increased sensory immersion or sense of presence. The claims and ideas Farley put forward in this chapter are important because the limitations do not just apply to particular virtual world implementations but to any applications of virtual worlds using current technology, thus suggesting that virtual world educators and designers need to be more cautious in their expectations.

Part 2: Advanced Technology

Chapter 7, “Conversational Agents in Second Life” by Robert Heller, Mike Procter, and Corbin Rose, explored the use of conversational agents in virtual worlds and, in particular, their impact on the social presence experienced by learners. Contrary to expectations, their study found that there was no difference between conversations held with the Freudbot agent in Second Life and those held with a similar agent in a text-only environment in terms of the social presence and engagement arising from the conversations. A possible explanation the authors posited for these findings was the possibility that virtual world participants may have been distracted at times by the contents of the environment (modelled on Freud’s office) and this may have prevented them from getting to the depth in their conversations with the agent that text-based participants achieved. Another possibility Heller, Procter and Rose raised was that the absence of “paralinguistic” communication channels in both the virtual world and the text-only communication environment (e.g., body language, gesture, facial expression, etc.) may limit the degree of immediacy in the conversation and consequently the social presence experienced. A limitation of this study, which needs to be addressed in future studies, is that participants

were drawn from different samples, conversing with the agent for different purposes within different learning contexts.

Chapter 8, “Virtual Bots” by Torsten Reiners, Sue Gregory, and Vicki Knox, considered the value of non-player character (NPC) or “bot”-based avatars in virtual worlds where a minimum number of avatars are needed to create a realistic experience for users. The authors drew a distinction between virtual worlds based on what they termed “hard” technologies, in which user action is constrained by the environment, and “soft” technologies, in which user action is less constrained or more open-ended, arguing that allowing bots to operate in an unconstrained, soft-technology environment is challenging. They discussed how bots were designed for use in VirtualPREX, a project aimed at providing inworld professional learning experiences for pre-service teachers, and described different frameworks for enhancing and enriching virtual world-based learning experiences through the use of bots.

Part 3: Learning Design and Implementation

Chapter 9 by Steven Warburton and Margarita Pérez García, “Analyzing Teaching Practices in Second Life,” presented a learning design taxonomy for virtual world-based workshops. The taxonomy is grounded in an analysis of data gathered from a large number of workshops conducted by the authors and other educators, and was systematically validated through its application in further workshops conducted by participants of a large, pan-European program. Evaluation of the taxonomy led to the finding that certain aspects of the design and delivery of the workshops had a major impact on their success, including the technical design of the virtual teaching spaces, the establishment of clear and understandable interaction/communication protocols, the overall instructional design (including strategies for individualization of the learning experience), the setting aside of adequate time for designing the workshop and for further improvements, and refinements following delivery and evaluation. A taxonomy of this type is an important contribution to the field, since despite the acknowledged potential of virtual worlds for addressing a range of learning design challenges, their uptake has been relatively modest, due in part to the difficulties faced by teachers in adapting their face-to-face teaching strategies to a virtual world context. The chapter is the first thorough analysis of the design issues in the use of virtual worlds as a synchronous teaching space, and it is important for educators considering the use of virtual worlds in their teaching

as well as more experienced virtual worlds educators wanting to evaluate and refine their approaches.

Francesca Bertacchini and Assunta Tavernise illustrate the design of three virtual worlds devoted to cultural heritage in Chapter 10, “NetConnect Virtual Worlds.” They looked at three historical settlements from Poland, Germany, and Italy. Students aged from 15 to 18 were able to explore the sites to discover new knowledge and motivation for their experiences. Archaeological sites were made available to learners through virtual worlds so they could explore cities, buildings and squares, houses and huts, and objects that were found in the buildings. These virtual worlds enabled students to explore lost locations and manipulate 3D objects that are too fragile or rare to handle in real life. There are three paths in the NetConnect virtual world that students can take: they can follow points of interest, engage in personal exploration, or learn/view/read about different contents. Students in this study undertook a 12-hour laboratory course in the virtual world. This type of learning enabled secondary students to look back into time to witness history and provided them with a hands-on approach for a deeper understanding of cultural and artistic heritage in all of its components and relations.

In Chapter 11, “Scaffolding Learning Through the Use of Virtual Worlds,” Chris Campbell and Leanne Cameron explored the way in which learning in virtual worlds can be supported through “scaffolded” tasks drawing on resources outside of the virtual world. They contrasted the proposed approaches with the alternative of providing scaffolding through the structuring of tasks within the environment, as illustrated by virtual worlds such as Quest Atlantis (Barab et al., 2007), River City (Ketelhut, Nelson, Clarke, & Dede, 2010), and Virtual Singapore (Jacobson, Kim, Lee, Lim, & Low, 2008). The evaluations of the activities in the two projects (one involving teacher education students using Second Life, and the other involving secondary students using OpenSim) led to Campbell and Cameron’s recommendations, including the need for timely feedback for students as they undertake virtual world activities, the importance of student–student and student–teacher collaboration, and the value of scaffolding of tasks to ensure that students stay on track with the overall task goals.

Chapter 12, “Challenges and Strategies in Designing Cross-National Learning” by Paul Resta and Miri Shonfeld, discussed the learning design issues and challenges involved in using virtual worlds to house collaborative learning activities for geographically dispersed teams of students. Findings from surveys and interviews conducted with graduate education students from Israel and the US who participated in cross-national team projects, indicated that social

presence and engagement correlated with satisfaction and group cohesion, and course satisfaction correlated with engagement. Some of the challenges that arose included scheduling difficulties due to time zone differences and technical difficulties relating to audio communication, which are not “new” problems as such, but are commonly encountered when using synchronous technologies for learning across the boundaries of time and space. Resta and Shonfeld recommended providing advance orientation and training, allocating ample time for the activity, mentoring students during the activity, and exercising care when assigning students to groups.

The final chapter, Chapter 13, “Introduction to Laws Relevant to Virtual Worlds in Higher Education” by Layla Tabatabaie, explored the legal issues involved in the use of virtual worlds, with a particular focus on the contrasting of laws and legal frameworks within the US, the UK, and China. The specific legal issues Tabatabaie addressed in the chapter were intellectual property issues associated with student and teacher creation of virtual world spaces and artifacts, the protection of student avatar images and speech, and distribution of records of student actions in a virtual environment. Tabatabaie’s key recommendation, applicable across legal domains, is the advance documentation of terms and conditions of use because many of the legal problems identified can be avoided if there is a written agreement between students and the educational institution prior to use of the virtual world. It is important, however, that such agreements are written with awareness of the legal framework in operation, because they can be rendered null and void by courts in some jurisdictions if they are considered unfair. Some of the challenges Tabatabaie identified in anticipating the way in which a court would view a case involving virtual world activities or artifacts relate to the fact that the real-world equivalents of situations occurring in virtual worlds are not always obvious. In the UK, for instance, recording activities undertaken by students in a virtual world would be considered educational records, for which there are strict laws relating to distribution, whereas the absence of such laws in China means that privacy laws would have to be applied instead. The author also highlights the challenges in constructing terms and conditions that are applicable in multiple jurisdictions.. For example, in some jurisdictions, virtual world artifacts are treated as art (e.g., China), while in others they are considered to be literary works (e.g., England).

Emerging Themes and Future Directions

A number of key issues and directions for future research have emerged across the chapters in this book. Here, we attempt to draw together some of the

common issues and highlight some research opportunities that could be taken up by other researchers.

The chapters in the “Human–Computer Interaction” part report on research into some of the most important aspects of the learner experience in virtual worlds. Ease of navigation is an important prerequisite for almost any virtual world activity, and there are a number of virtual worlds design issues which if not considered could result in confusion, disorientation, or disengagement from the learning task. Even minor navigation usability problems have the potential to increase the learner’s cognitive load, reducing the attentional resources available to focus on the key aspects of the learning task. Given this, the design guidelines derived by Minocha and Hardy should be a key inclusion in the design “kitbag” for all virtual world educators and developers. The range of studies undertaken by the authors, the thoroughness of their evaluations, and the grounding in the wider human–computer interaction literature allow designers to be very confident about the validity and applicability of these guidelines. Although further studies are needed in other learning contexts using other virtual world platforms to provide additional validation of these guidelines, it is even more important for efforts to be made to ensure that guidelines such as these are made available in clearly understandable forms to virtual world developers and learning designers. Work to package guidelines such as these, along with those developed by other researchers, in ways that ensure they can be easily applied, is essential to ensure that we avoid repeating the mistakes of the past and genuinely move forward in the design of usable virtual worlds for learning.

Ease of use is particularly important but sometimes hard to ensure for elderly and disabled users of virtual worlds, as discussed in the chapters by Todd, Pater, and Baker and by Smith. The virtual world accessibility issues they highlighted, and the somewhat limited range of solutions available, suggest that if virtual world use is to become more common in educational institutions, substantial additional research is needed to devise design standards and assistive technologies to enable both people with disabilities and older users to participate on an equal footing. This said, the authors highlighted a number of promising projects which aim to increase accessibility of virtual worlds for people with a disability, including work at the IBM AbilityLab focusing on users with vision impairments, the development of Radegast, a non-graphical virtual worlds viewer including text-to-speech and speech-to-text capabilities, and Virtual Guidedog, which assists visually impaired users in virtual worlds by listing nearby objects and avatars in a way so that screen readers can pick them up. Smith argues that similar research is needed which explores the customization

to virtual world interfaces to make such environments comfortable places for elderly users. Given the rapid increase in the use of communication technologies such as Skype by older people (see, for example, Loeb, 2012), there is a real need for this research if we are to see virtual worlds become a mainstream alternative social space accessible to all.

The choice between the use of voice, text, or a combination of voice and text for communication by learners is one of the key decisions made by designers of virtual world-based learning experiences as explored in detail by Fedeli. Wilkes' research also illustrates the complexity of the situation, and the fact that some of the prevailing assumptions about the effect of communication modality on sense of presence, retention, and cognitive load may not in fact be valid. In particular, it would appear that, at least for experienced Second Life users, text communication may result in just as great a sense of presence, increase retention, and not increase cognitive load when compared to either voice communication or a combination of the two. Given the problem of ensuring that all learners have access to voice communication without technical difficulties, this finding, if confirmed by other studies, will be important. Confirmation of such a finding would also be good news for users suffering from a hearing impairment, who were able to participate freely in virtual world activities through the use of text chat prior to the more widespread adoption of voice communication by virtual world communities.

Even though the wider application of user-interface design guidelines, along with ongoing improvements to the user interfaces provided by virtual world viewers has enormous potential, Farley highlights the need for a reality check before we assume that such enhancement will remove all barriers to authentic learning. She suggests that even if we get all of the design elements right there are still some fundamental limitations of virtual worlds that will continue to reduce the authenticity of the learner's experience. We need to be careful not to adopt inflated expectations with regard to virtual world designs but rather to design tasks with a view to complementing rather than replacing real-world tasks.

The chapters in the "Advanced Technology" part raised some interesting points about conversational agents and computer-controlled characters (or bots) more broadly. The lack of a difference in the social presence experienced in communicating with a Freudbot historical-figure agent with a realistic appearance in a virtual environment versus communicating with a similar agent in a text-only environment is surprising as discussed by Heller, Procter, and Rose. Further studies are needed to explore whether the same findings emerge when undertaken with participants randomly assigned to the virtual world and text-based

conditions. An additional promising avenue for future research could be combining conversational capabilities such as those exhibited by Freudbot with physical interactivity such as that exhibited by the VirtualPREX student bots, as outlined by Reiners, Gregory, and Knox. It is possible, for example, that an enhanced Freudbot with both conversational and physically interactive capabilities would be more realistic to interact with and would result in increased social presence for users.

The chapters in the “Learning Design and Implementation” part collectively proposed a number of key principles to be taken up by the designers of learning activities in virtual worlds. Warburton and Pérez García highlighted the challenges of designing for effective learning in Second Life, and in particular the importance of providing a well-structured learning environment, of tutors being skilled in the use of the environment so that they can adequately support learners, and of pedagogies that focus on learner reflection rather than directive learning. Bertacchini and Tavernise discussed a different pedagogical strategy: one that enabled students to witness and experience history firsthand through a hands-on approach, thereby encouraging them to develop a deeper understanding of cultural and artistic heritage in all of its complexity. Campbell and Cameron made a compelling argument for the value of various types of scaffolding to support learners in undertaking virtual world tasks, both inworld and in the physical classroom. Warburton and Pérez García echo this argument, with the monitoring of student progress, provision of guidance, and support and feedback key aspects of their model. Future studies could further explore the feasibility of translating the face-to-face support advocated by Campbell and Cameron into online support (which could be delivered in and out of world), which is necessary for the use of virtual worlds for students studying at a distance. These recommendations are also in accord with those of Resta and Shonfeld, who focused on collaborative activities undertaken by users in disparate locations in Second Life, in that they also recommended mentoring and scaffolding as well as monitoring of meetings during the activities. Other recommendations emerging from their study include advance training for students so that a lack of familiarity with the virtual environment does not impinge on the ability of students to participate in group activities, and careful allocation of students to teams, including balancing their language capabilities within groups.

The final chapter by Tabatabaie delivered some key messages for educational designers and institutions more broadly about the legal issues to consider when using virtual worlds in a learning context. Most important is the conclusion that across all three legal jurisdictions studied (US, UK, and China)

contract law provides the most consistent and predictable framework. As a consequence, universities and colleges are advised to focus their attention on clear documentation of their internal policies and procedures and, in particular, the provision of clear and simply phrased Terms of Service (TOS) and End-User License Agreement (EULA) documents. Such documents, assuming that they are clear, unambiguous, and free of unreasonable conditions and clauses, will provide a robust foundation for any legal disputes or disagreements that might emerge.

Closing Remarks

The thirteen chapters in this anthology bring together some of the leading contemporary virtual worlds research from around the globe, with findings synthesized for the benefit of both educational practitioners and scholars. The book in its entirety is a recommended resource for teachers in an online or distance context who are considering adopting the use of virtual worlds into their practice and who want to avoid repeating the mistakes of others, as well as for researchers or research students wanting to get a sense of the researchable issues and key unanswered questions within the virtual-worlds-for-education landscape. Equipped with the knowledge of theories, strategies, and frameworks gained from reading the chapters in this book, readers will be well placed to look to other scholarly and professional sources for more examples and case studies of innovative and exemplary use of virtual worlds for learning and teaching, and to approach those examples and case studies with a critical and analytical eye. They are urged to consider the discipline-based applications in the literature, as well as other applications they encounter in their own work, in light of the issues and findings reported in this book, carefully weighing up the implications of the evidence presented for their own practice and/or research pursuits.

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INDEX

- Abyss Observatory, 16–17, 22–23, 25–27, 29–31
- accessibility, 27, 87–93, 95–97, 101–2, 106, 110, 297, 302: alternative text, 90, 93; barriers, 89, 101; issues, 88, 91–92, 96
- ageing population, 117–21, 123, 125, 297
- AIML. *See* Artificial Intelligence Markup Language
- analysis grid, 198, 200–201, 219–21, 223; proto-analysis grid, 198, 200–201
- architectural landmarks, 13, 16–17, 33–34
- artificial intelligence, 139, 154–56, 168: AI bot, 140; embodied, 155–56
- Artificial Intelligence Markup Language (AIML), 154, 156, 168, 175
- assessment, 47, 51, 53, 62–63, 131, 136, 143, 193, 197, 200, 207, 217, 242, 245–46, 251–56
- assistive technology (AT), 88, 90, 97–98, 100–101, 105, 110, 302: assistive technology tools, 98; assistivetech.net, 101; ATWiki, 101; dexterity, 89–90, 95, 99, 104–5, 297; hearing, 90, 93–94, 99–100, 297, 303; vision, 89–90, 93–94, 99, 101–2, 230, 302
- authentic learning, 129–43, 170, 176–79, 295, 297, 303
- automated classroom, 172, 175–76
- Avatar Kinect, 135
- avatars: computer-controlled, 168, 295; human-controlled, 163, 169–70, 172, 174, 177, 181
- best practice, 27, 36
- blind, 92, 105
- bots, 140, 168–69, 173–76, 179–81, 184–85; interactive, 168; scripted, 179
- BreakThru project, 88, 105, 109–11
- business model, 200, 206
- business simulations, 140
- camera controls, 14, 21, 25, 208, 211
- case study, 158, 161–62, 228, 232, 246, 262, 271–73
- Chinese law, 282, 285, 290
- cognitive load, 44–46, 51, 53–60, 141, 296, 298, 302–3
- cognitive map, 7
- collaboration, 3, 80–81, 107–8, 118, 138, 140, 253–54, 256, 261–63, 268–69, 271–72, 300
- commerce education, 133
- communication, 3, 7, 43–55, 57–61, 82–83, 88–91, 93–94, 107, 109–11, 122–24, 133–35, 170–71, 209–10, 295–99, 303: authentic, 134–35; environmental, 7; non-verbal, 215; text-based, 196; textual, 94; channels, 129, 162, 216, 298;

- dynamics, 200, 210; modality, 43–45, 47–51, 53–55, 57–59, 61, 296, 303; technologies, 89, 303; tools, 59, 122, 209
- computer games, 12, 26, 185
- constructivist learning, 88, 111, 228
- conversational agent (CA), 153–57, 159, 161–63, 168, 175, 295, 298, 303
- co-presence, 43–44, 46, 52, 61, 296
- copyright, 52, 279–83, 285–87

- deaf, 90, 93–94, 100
- decision points, 7, 27, 37
- DELVE. *See* Design of Learning Spaces in 3D Virtual Environments
- design: environmental, 8; learning space, 35; navigational aid, 33–34
- design considerations, 33
- Design for All, 90
- design guidelines (DGs), 4, 24–25, 36, 296, 302–3
- Design of Learning Spaces in 3D Virtual Environments (DELVE), 4–5, 10
- digital technologies, 117–19
- directional signs, 5, 7, 16–17, 21, 24, 27, 29–30, 33, 35
- disabilities, 87–93, 95–101, 105–6, 108–11, 142, 297, 302
- disorientation, 9, 302
- distance learning, 88, 111, 118, 196, 236
- districts, 7–8
- document analysis, 11–12, 19
- dual-coding theory (DCT), 43

- eAccessibility, 89–90, 109
- Edmodo, 252–56
- educational records, 276, 287–89, 301
- educational technology, 223, 245
- edutainment, 119–20, 125–27
- efficiency, 24, 38, 172, 207, 243
- e-inclusion, 89, 109, 127
- eInclusion, 90
- elderly, 117–27, 142, 297, 302–3
- embodiment, 44, 67–68, 75, 77, 79–81, 83–5, 124, 194, 215, 296
- EmployAble, 108
- End-User License Agreement (EULA), 276–79, 284, 289, 305
- engagement, 4, 10, 24, 36, 88, 94, 111, 120–21, 141, 171–72, 262, 267–68, 271, 297–98, 301
- entry point, 21, 23, 27, 29–30, 34–35, 296
- environmental communication, 7
- EULA. *See* End-User License Agreement
- experiential learning, 194
- exploration, 14, 76, 92, 123, 219, 229, 261, 264, 268, 300
- exploratory walkthrough, 15, 20

- fair use, 280–82, 286–87
- flight simulator, 143
- flow, 23, 67, 141, 144, 200, 209, 252, 298
- focus groups, 36, 70–72, 74, 81, 84–85, 167, 246
- formative feedback, 217, 253
- Freudbot, 153–62, 298, 303–4

- Genome Island, 19, 24–27, 29–31, 33
- global landmarks, 8
- good teaching practices, 223
- grounded theory, 198

- hands-on workshops, 195, 197, 224
- haptic feedback, 137, 141–43
- hard technology, 172–73
- HCI. *See* Human-Computer Interaction
- heuristic, 6, 11–15, 20–21, 36–8, 295:
 - categories, 12–14; evaluations, 6, 11–15, 20–21, 36–37
- higher education, 170, 261, 275, 277, 279, 281, 283, 285, 287–90, 301
- Human-Computer Interaction (HCI), 5, 11, 21, 27, 36, 47, 295, 302
- human subjects, 288–89
- hyperlinks, 27, 215

- IBM Virtual Worlds Accessible User Interface, 93, 101

ICT. *See* Information and Communication Technologies

identification signs, 16–17, 21, 24, 29, 34

identity, 7, 67–68, 72–77, 82, 139, 262, 283, 295–6

IMI. *See* Intrinsic Motivation Inventory

immersion, 13, 43, 46–7, 52, 60–61, 82, 87, 111, 136, 141–43, 155, 157–58, 162, 167, 173–74

instructional design, 43, 84, 200, 202, 220, 299

interface design, 11, 123, 143, 303

intersections, 7, 30, 33

Intrinsic Motivation Inventory (IMI), 233–36

inworld workshops, 198, 200, 209, 219

island, 5–6, 9–10, 12, 15–19, 21–22, 24–35, 106, 110, 119–20, 125–26, 156–57, 262

isolation, 118, 121, 142, 156, 171, 224

knowledge: declarative, 53, 58; implicit, 13–14; technological, 196–97

knowledge requirements, 200, 207

LAMS. *See* Learning Activity Management System

landmarks, 7–9, 11, 13–14, 16–17, 25–26, 31, 33–35, 209

language learning, 107, 134–35, 153

languages, 107, 134, 169, 176, 248

learning: game-based, 262; problem-based, 107; process-based, 221, 223; project-based, 194; reflective, 221–23; situated, 194; student-directed, 241

Learning Activity Management System (LAMS), 252–54

learning-by-design, 198, 224

learning-by-doing, 131

Learning Management System (LMS), 75, 82, 247, 262

learning spaces, 3–7, 9–13, 15, 17–19, 21–23, 25–27, 29–31, 33, 35–38, 194, 251, 295–96

legibility, 33

license, 201, 276–77, 279, 286, 305

lifelong learning, 119, 121, 125–26, 198, 297

Linden Lab, 20, 91, 97, 101, 123, 279

Linden Scripting Language (LSL), 174

LMS. *See* Learning Management System

local landmarks, 8

low vision, 90, 93–94, 99, 101–2

massively multiplayer online role-playing games (MMORPG), 4, 156, 174

Microsoft Kinect, 135, 142

MMORPG. *See* massively multiplayer online role-playing games

mobility, 93–95, 122–23, 125, 297

motivation, 19, 119, 171–72, 194, 198, 228, 233–36, 243–44, 262, 300

multi-user virtual environments (MUVE), 3, 68, 77, 91, 136, 193–95, 198–99, 219

MUVE. *See* multi-user virtual environments

Navigation and Wayfinding Project (NAVY), 5–6, 10, 13, 15, 20, 33, 35–36

NAVY. *See* Navigation and Wayfinding Project

NetConnect project, 227–32, 236–37, 300

NetConnect Virtual Worlds, 227–28, 300

Nintendo Wii, 142

non-formal learning providers, 196–97

non-player character (NPC), 156, 168, 179, 185, 244, 299

non-verbal cues, 135, 169

notecards, 16–17, 25–26, 34–35, 201, 204, 215–16, 218, 296

NVivo (software), 73

observations, 11–12, 15, 17–18, 20–21, 24, 30, 35–37, 70, 156, 169, 195, 197–98, 200, 251, 295

OpenSimulator (OpenSim), 4, 88, 91, 97–98, 101, 104, 177, 242, 245, 250–52, 256–57

orientation, 7–8, 12–13, 15, 108, 301

Pandorabots, 175–77, 182

participant observation, 198

participants: active, 132, 209;
 experienced, 59; study group, 124;
 teacher, 297; text-based, 298; virtual,
 120; voice-and-text, 44–45, 55

Pater, Jessica, 87–88, 90, 92, 94, 96, 98,
 100, 102, 104, 106, 108, 110, 297

paths, 7, 9, 11, 13–14, 16–17, 22, 27–29,
 34–35, 68, 84, 228–29, 236, 300

pedagogies, 67, 83–84, 129, 219, 221–23,
 251, 304

peer, 96, 110, 185, 196, 198–99, 210, 243,
 251, 254, 256, 296

personalization, 108, 200, 216

Pikkubots, 176–77, 182

post-observation discussions, 11–12, 18,
 20

presence, 43–44, 46–47, 51–62, 69–71, 78,
 80–83, 141–44, 156–59, 161–63, 261–
 63, 267–68, 271–73, 296, 298, 303–4;
 presence questionnaire (PQ), 51

privacy laws, 284, 301

privacy policy, 288

privacy rights, 284–85, 289

Procter, Mike, 153–54, 156, 158, 160, 162,
 298

psychological counselling, 133

publicity rights, 283–5

qualitative methodology, 246

quality, 82, 121, 157, 174, 178, 183, 201,
 217, 223, 249

Quest Atlantis, 244–45, 300

readability, 14, 33

redundancy, 26, 31

reflection, 70, 76, 83, 156, 168, 170, 248,
 253–54, 263, 304

researchers, 15, 36, 45–48, 88, 90, 97, 110,
 118, 155, 227, 242, 245–47, 249, 251,
 302

results-driven approach, 221

retention, 44–46, 51, 53–63, 102, 275,
 296, 303

retrospective protocols, 36

right of publicity, 283

role plays, 167–68, 185, 241

Rule, Audrey C., 130

scaffolding, 219, 241–45, 247, 249–57,
 272, 300, 304

screen reader, 93, 103

screen shots, 279, 283

Second Life (SL): accessibility, 101; for
 educational purposes, 198, 246;
 learning spaces, 26; Wiki, 91, 95, 101,
 104, 178

self-assessment, 223, 251, 256

semi-structured interviews, 11, 18, 121

seniors, 117, 124

sensors, 16, 34

sensory immersion, 141, 298

sensory motor skills, 68, 70, 74

short-term memory, 44–45, 60, 62

signs, 5, 7–8, 13–14, 16–18, 21, 23–25, 27,
 29–31, 33–35, 37, 278

simulations, 37–38, 88, 108, 111, 119, 131–
 32, 137, 140, 142–44, 156, 163, 170–71,
 177, 194, 241

Sistine Chapel, 137

social interaction, 88, 111, 119, 122–26,
 135, 193

social isolation, 118

social presence, 47, 52, 78, 157–59,
 161–63, 263, 265, 267–68, 271–73,
 298, 303–4

soft technology, 169, 172–73, 178

spatial design, 200, 202–3

spatial knowledge, 7–9

spatial planning, 7

speech, 44–45, 93, 100, 102, 105, 135, 177,
 204, 275, 285, 301–2

structure, 8, 13, 16–17, 21, 25, 34, 45, 71,
 122, 137, 193, 202, 243–45, 249–50,
 254–55

student engagement, 10, 141, 290
 student learning, 4, 193, 242

task-based walkthrough, 15, 20
 Technological Pedagogical Content Knowledge (TPCK), 223
 technology, 38, 89, 97–98, 100–101, 105, 109–10, 118–19, 123, 131, 172–73, 223–24, 228–29, 245–46, 269–70, 298–99
 Teen Second Life, 246, 248–49
 teleportation, 14, 16, 21, 25–26, 29, 31, 34–35, 205, 261
 Terms of Service (TOS), 276–79, 283–84, 289, 305
 TextSL, 93
 thematic analysis, 20, 25
 think-aloud protocols, 11, 36
 timely feedback, 256, 300
 TOS. *See* Terms of Service (TOS)
 TPCK. *See* Technological Pedagogical Content Knowledge
 trademark, 78, 280–82, 284–85
 transferability, 195
 transfer of knowledge, 171
 transition points, 22, 27–28

Uncanny Valley, 162–63
 unconscionable, 277–78
 Universal Design (UD), 90, 96
 usability, 4–6, 9, 11–15, 20–21, 24, 27, 29, 36–37, 90, 96, 175, 297, 302: defects, 13, 15, 20, 24, 27; experts, 6, 11, 13
 user experience, 20, 37, 100
 user interface, 11, 89, 93, 101, 136, 141–42, 200, 208, 303
 user observations, 11–12, 15, 17–18, 20, 30, 35–7

Virtual Ability, Inc., 106, 110
 Virtual Ability Island, 27–8
 virtual environment design, 8
 virtual environment navigation, 8
 Virtual Guidedog, 93, 100, 102, 106, 110–11, 302
 Virtual Hajj, 137
 Virtual Helping Hands, 93, 103, 106, 110
 VirtualPREX project, 167–70, 173–76, 178–83, 185–86, 299, 304
 virtual reality, 46, 52, 108, 137
 Virtual Representations of Users, 283
 virtual world classrooms, 194
 voice communication, 59–61, 196, 296, 303
 Voice over IP (VoIP), 104, 163, 216

Wallace, Richard, 154
 web usability, 5, 12, 29, 36
 working memory, 44–47, 60

Zone of Proximal Development (ZPD), 243–44