Multi-User Virtual Environments for the Classroom:

Practical Approaches to Teaching in Virtual Worlds

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Chapter 10
Learning by Building in SL:
A Reflection on an Interdisciplinary and International Experience

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ABSTRACT

This chapter will report on, and critically assess the outcome of a two year-long experimental educational project using Second Life (SL) as a teaching and learning platform. The project's main goal was to investigate the added value of a multi-user environment in a multi-disciplinary and international context for learning about history, archaeology, acquiring a scientific approach and methodology to historical reconstruction and 3D visualization, as well as the skills to use different media technologies for communication and collaboration. This chapter will describe educational facilities and resources as well as heritage visualization projects built in the Digital Humanities Island in SL, where the collaboration between King's College London and the University of Pisa took place.

INTRODUCTION

In July 2007, following a highly successful one-year Erasmus studentship of Marco Bani[1] (a student from the Digital Humanities degree at the University of Pisa) to the Centre for Computing in the Humanities (CCH) at King's College, Hugh Denard, one of Bani's tutors at King's, submitted a proposal to the Director of CCH to start a collaboration with the Digital Humanities program of the University of Pisa (DH-Pisa).

The proposal was to jointly develop a "Digital Humanities" Island in Second Life (SL), to create a focus for a strategic relationship between CCH and DH-Pisa involving teaching, research and conferences to generate economies, synergies

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and opportunities by sharing costs, expertise, resources and contacts.

"Digital Humanities" Island, jointly hosted and developed by CCH and DH-Pisa, had the potential to be the basis for a wider international collaboration around shared sets of resources.

Given that both institutions offer modules in visualization for the humanities, this was also seen as an opportunity to develop a shared syllabus and associated teaching and learning resources, with a view to develop possible future collaborative initiatives in this area including internships.

A further aim was to develop joint cultural heritage projects, with DH-Pisa providing access to contacts, resources and authorizations necessary to undertake cultural heritage sites in Italy, and CCH securing additional cultural heritage visualization skills, equipment and methodologies. Projects envisaged included the complex in which "The Leaning Tower of Pisa" is situated, the Roman theatre at Lucca, and the historic, medieval walls of Pisa.

CCH and DH-Pisa also wished to study, collaboratively, the methodological implications of the Second Life platform in relation to current developments and debates, especially *The London Charter for the Computer-based Visualization of Cultural Heritage* (The London Charter, 2006). In particular, it was interesting to identify specific issues and opportunities that the SL platform raises regarding London Charter implementation, and to explore questions such as, for instance, whether a more or less fixed set of visualization and documentation conventions for humanities and cultural heritage uses of SL would be desirable, or whether a variety of approaches should be allowed to emerge in tandem with the technology as it evolves. A collaboration would allow researchers in both institutions to draw on their teaching and learning activities, developing and observing a wider range of case studies with student groups, and to provide a well-defined research agenda and set of approaches according to which participation by other humanities and cultural heritage researchers in SL, including the EPOCH network of excellence (http://www.epoch-net.org/), could be encouraged.

Between 2007 and 2010, King's and Pisa made notable advances in realizing each of these objectives. Together, they established "Digital Humanities Island" (DHI), complete with welcome center, teaching, learning and display spaces and interactive guide, and successfully hosted a number of virtual exhibitions and "mixed-reality" live events there; in 2007-2008, they created several proof-of-concept cultural heritage visualizations in SL including of Galileo Galilei's Laboratory and the Leaning Tower of Pisa; in 2008-2009, they carried out a successful teaching and learning collaboration on ancient maritime archaeology; and in 2009, they secured funding for, and completed, a project on applying the London Charter (discussed below) within SL.

At the time of writing, we at Pisa and King's find ourselves, on the one hand pressed for the resources that would enable us further to evolve our shared teaching and learning activities, but also, on the other hand, poised to leverage our work in SL into real-life installations and planning consultations in both Pisa and London. The story of our collaboration thus far is one that encompasses ideals and errors, hopes and frustrations, achievements and, today, a renewed and revised sense of possibilities. This chapter will give an account of these pedagogical experiments and reflect upon what they have taught us about the use of virtual worlds in humanities teaching and learning.

HUMANITIES VISUALIZATION AND VIRTUAL WORLDS

The University of Pisa offers a degree in Digital Humanities, an interdisciplinary study program in which students receive a solid education in humanities together with the technological skills and methodologies to master the tools for processing cultural contents in different digital forms. Most

of the students involved in the project specialize in a graduate-level program within a master degree in Digital Humanities, called "Graphics, interactivity, virtual environments". This study program aims to produce professionals for the cultural, entertainment and educational industry, by forming competences and skills for jobs which rely on creative expression by means of new technologies such as: virtual environments and augmented reality, graphics, 3D modeling, animations, multimedia production, digital audio, computer games, computer art, interactive performances and exhibitions. Given their specific background, students have the necessary competences to play an active role in the construction of artifacts in SL.

The Centre for Computing in the Humanities at King's College London offers a taught Masters in Digital Culture and Technology, which attracts students from the full range of traditional humanities disciplines as well from film and media studies, computer science and the social sciences. In an elective module called Applied Visualization in the Arts, Humanities and Cultural Heritage, students study significant examples of computer-aided, applied visualization – past, current and emergent – in teaching and research contexts, encompassing a wide range of purposes, technologies, approaches and methods and, working under the guidance of members of King's Visualization Lab (KVL), plan and carry out a visualization project. KVL has nearly fifteen years of expertise in the reconstruction and visualization of cultural heritage.

KVL now also has a significant profile in SL. In June 2007, generously supported by the Eduserv Foundation, KVL commenced work on its first major, teaching and learning project in SL, Theatron3 (Childs, 2009, http://www.theatron3.cch.kcl.ac.uk/). Theatron3 transformed the team's earlier, award-winning Theatron project (http://www.kvl.cch.kcl.ac.uk/theatron.html) into a range of content-rich, research-based virtual environments in SL comprising digital 19 milestones in European theatre design from the Theatre of Dionysus at Athens to the Teatro Olimpico at Vicenza, and from Shakespeare's Globe Theatre to the Schaubühne am Lehniner Platz in Berlin (Denard, 2005). Each virtual theatre has extensive associated historical and interpretative materials delivered through location-sensitive, media-rich Heads-Up Displays (HUDs) containing in-depth contextual and interpretative educational resources, as well as a framework enabling teachers and students to create their own versions of the HUD responsive to their own teaching learning objectives. In collaboration with the Higher Education Academy Subject Centers for English and for Dance, Drama and Music, Theatron3 also disbursed five small grants to university tutors to conduct pedagogical projects exploring its potential as a rich environment for practice-based learning, from creative writing to scene design, and from Shakespearean dramaturgy to mixed-reality performance. A report by the project's educational technologist, Mark Childs, can be found through the Theatron3 Website, above (Childs, 2009).

KVL is also notable for having instigated, and for continuing to lead the development of The London Charter for the Computer-based Visualization of Cultural Heritage (London Charter) – a set of internationally-recognized principles that provides a framework ensuring that digital visualization methods are, and are seen to be intellectually rigorous and robust. The London Charter insists upon intellectual accountability, or "transparency" that enables subject communities "to evaluate the choice of a given visualization method, and how it has been applied in a particular case without having to rely exclusively on the *authority claims* of the author" (Beacham, Denard, & Niccolucci, 2006). The current version of the London Charter (2.1, February 2009) sets out six main principles (each being elaborated through several sub-sections):

- **Principle 1 – Implementation:** The principles of the London Charter are valid wherever computer-based visualization is

applied to the research or dissemination of cultural heritage.

- **Principle 2 – Aims and Methods:** A computer-based visualization method should normally be used only when it is the most appropriate available method for that purpose.
- **Principle 3 – Research Sources:** In order to ensure the intellectual integrity of computer-based visualization methods and outcomes, relevant research sources should be identified and evaluated in a structured and documented way.
- **Principle 4 – Documentation:** Sufficient information should be documented and disseminated to allow computer-based visualization methods and outcomes to be understood and evaluated in relation to the contexts and purposes for which they are deployed.
- **Principle 5 – Sustainability:** Strategies should be planned and implemented to ensure the long-term sustainability of cultural heritage-related computer-based visualization outcomes and documentation, in order to avoid loss of this growing part of human intellectual, social, economic and cultural heritage.
- **Principle 6 – Access:** The creation and dissemination of computer-based visualization should be planned in such a way as to ensure that maximum possible benefits are achieved for the study, understanding, interpretation, preservation and management of cultural heritage.

The deep and widespread impact of the London Charter, the current draft of which (2.1, February 2009) is available in English, Italian, Spanish, German and Japanese, is apparent not only in such occurrences as the Italian Ministry of Cultural Heritage and Activities funding of implementation case studies, but also in developments such as the newly-drafted Seville International of Virtual Archaeology (June 2010) which explicitly describes itself as an implementation of Principle 1.1 of the London Charter, which states that: "Each community of practice, whether academic, educational, curatorial or commercial, should develop London Charter Implementation Guidelines that cohere with its own aims, objectives and methods."

Interdisciplinary Education

In a series of separate and joint projects between October 2007 and June 2009, DH-Pisa and King's College built, on Digital Humanities Island, Galileo Galilei's Laboratory, the Leaning Tower of Pisa, the Tower of London, a Roman ship (Alkedo) and an orientation center, "Arketipo", equipped with a conference room, offices, tools for organizing meetings, information panels and an interactive guide called "IUMI". All the "builders" were students, under supervision and guidance of the teaching staff, and they did everything – the modeling and the development of tools – in the few months available within the curriculum.

The partners used SL not only as a building yard, but as a real area of collaborative work, given that the organizational and planning meetings were held in the virtual world as part of the practical lessons; the usefulness of SL as a platform for meetings and workshops indicates its significant value within the educational domain (a former example was the Kamimo Island, 2007).

The main barriers were thus not so much cultural or linguistic in nature (these exist, but can be largely addressed through the use of SL as a social networking tool) but rather reside in the concrete bureaucratic and administrative problems that affect the organization of joint courses in two (or more) universities: the differences and rigidity in timelines and schedules, unclear relationships between face-to-face lessons and independent study, the difficulty in accrediting the time students and staff spend working in the virtual environment, and the challenge of getting university authorities to understand the nature and

benefits of these modes of teaching and learning as well as the shifts in working practice and assessment models they imply. If these barriers were reduced or eliminated altogether, SL could actually constitute a practical and economical platform for internationally-taught modules which would become "naturally" interdisciplinary because they would require students to learn and use a shared language: we do not refer here only to the spoken language, but to the specialized language of each subject material treated (in our case History, 3D Modeling, Art, Architecture, Computer Science), that differs from country to country.

The great interdisciplinary value, as well as potential limitations, of a Multi-User Virtual Environment (MUVE) such as SL lies in the fact that, within it, students can learn by doing, complementing the (often inadequate and un-motivating) combination of reading/writing or reading/explaining that characterizes the vast majority of university courses in the humanities (Kemp & Livingstone, 2006; Joseph, 2007; Ondrejka, 2008; Wankel, & Kingsley, 2009; Molka-Danielsen, & Deutschmann, 2009; Gütl, Chang, Kopeinik, & Williams, 2009).

The construction of the Arketipo learning and information center; the IUMI interface; Galileo's Laboratory; the Leaning Tower of Pisa; the Roman ship, Alkedo; and the East Wing of Somerset House, London enabled students to acquire, share and improve knowledge and skills not only in history and archaeology, but also in 3D digital modeling; digital video and audio; writing; reading aloud; human computer interaction and Web design; as well as advanced skills in independent learning; multi-partner collaboration; project planning and management; collective problem solving; implementation of relevant methodological standards; communication across disciplinary, cultural and technical divides, as well as how to assess the utility and potential of a technical platform for cultural content creation, technical development and exploitation.

In the volume edited by Molka-Danielsen & Deutschmann (2009), we discussed in some detail the pedagogical significance of the Arketipo, IUMI Interface, Galileo's Laboratory, and Leaning Tower of Pisa projects, all carried out during the 2007-2008 academic year. We briefly review these projects now, both because they provide essential context for the teaching and learning strategies underpinning the "Alkedo" and recently-completed Somerset House projects of 2008-2010, and because our experience of these later projects has given us further perspectives on the work of the 2007-2008 session.

CREATING AND DEPLOYING VIRTUAL LEARNING SPACES

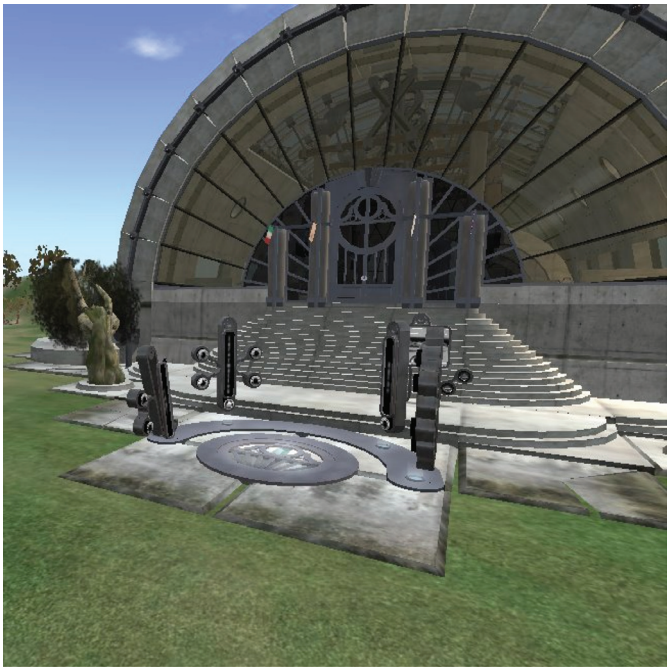
We now turn our attention to the learning experience of creating and using the "virtual classroom" and "virtual learning infrastructure".

Arketipo

Arketipo is the conference center and meeting place of the DHI community. It was especially designed for teachers and students of Humanities computing; however the solutions adopted, some of them innovative, as well as the problems encountered, apply to any virtual environment which aims to reproduce traditional educational facilities.

We envisioned the center to become an effective *bonding place* where the reference community could meet and engage in a number of activities introducing them to the humanities computing culture. The conception of the building itself was ambitious and highly symbolic. All the constructions in Sl, including this building, are the result of student projects; this provides major skill acquisition opportunities including the ability to create from scratch a new "learning space" from minimal input from the supervisors. The chief builder, Francesco Genovesi, one of our most

Figure 1. Arketipo



skilled students, put a lot of imagination, care and effort in designing and building Arketipo; the result was a grandiose building, high quality when compared to the standards of SL (Figure 1).

The building hosts a garden dominated by the *tree of knowledge* rising among ancient ruins. The branches of the tree form the shape of a hand stretching towards the sky (Figure 2). You can sit on the tree to chat with fellow avatars (Arketipo blog, 2009).

Arketipo, however unique, is not much different from other virtual educational environments;

Figure 2. Knowledge Tree

it offers the virtual counterpart of traditional teaching places and tools: an auditorium, meeting places such as the garden, an exposition space, offices, slides projectors, blackboards …). Multifaceted information services integrate in SL information sources already available in the university setting: Web site, blog, forum, mailing list, RSS feeds.

Information is made available both in *asynchronous* mode, by way of special panels, interfaces, notecards, HUD displays and in *synchronous* mode, by means of lectures in the auditorium, meetings and contact hours with professors.

HCI (*Human Computer Interaction*) is the discipline concerned with the design, evaluation, and implementation of interactive computer systems for human users. The design of interactive, human-machine interfaces is no easy matter, and designing *avatar*-machine interfaces for *virtual worlds* can be even more difficult. In accessing a virtual world, the user must first learn the *client* interface before identifying the interface that has been created on purpose for the space where he/she is interacting through the avatar interface, which changes continuously depending on the places being visited. This lack of standardization often generates confusion.

Special care was dedicated to designing effective interactive devices and natural solutions for the "affordance"[2] of objects (Norman, 2002). New entry students and occasional visitors land exactly in the middle of the arrival platform, in front of the entrance hall of the center. They find before them a set of four pillar-like interactive panels: Rules, Teleport, Information, Iumi (Figure 1).

When approaching any of these panels, within a range of 5 meters, a round-rotating script associated to the buttons is enabled and a rotating text appears around the buttons, explaining their function. This is the only *non-static* element and is especially designed to immediately catch user's attention on the action to be performed. This rotating effect only appears within a certain distance from the avatar, thus preventing any visual interference problem. Depending on the type of information, standard *notecards* are offered or SL's integration features are used to directly access Web pages with relevant content.

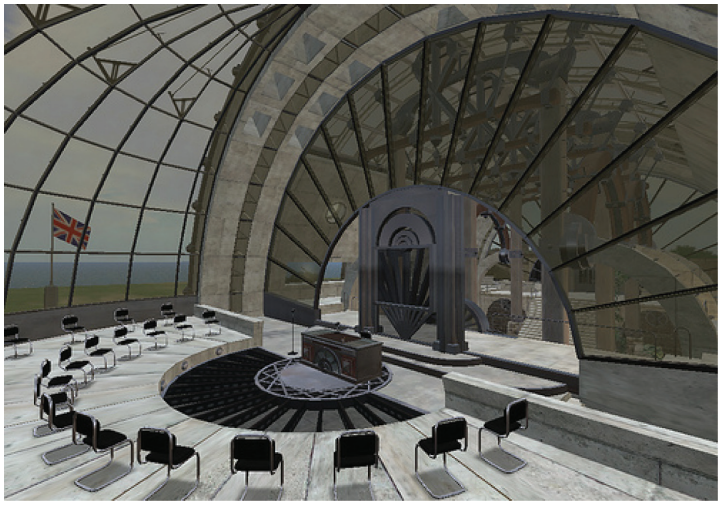
The *Teleport* allows a person to be immediately transferred to the desired location. In order to differentiate between levels in the building, a legend has been implemented in the *associating perception* style**:** the user easily associates the two upper buttons to level I and the lower two to level -I by exploiting form and color as clues. In practice, the black buttons refer to the upper level, the white buttons to the underground level. This idea was tested on different subjects and proved easily understandable and intuitive.

The first floor hosts a big semi-circular auditorium for conferences, fully equipped with a screen for slide and movie projection, blackboards, a teaching desk and a number of chairs for the audience (Figure 3).

In the underground floor there are a number of offices, fully equipped with uniquely designed desks and chairs, where professors can meet with students. Contact hours are advertised on message boards in the atrium in front of the offices. The underground floor also hosts a special secret room where the students can find other student's notes and suggestions on how to pass the exams.

Arketipo's exhibition hall is a place for showing the best projects completed by the students. They appear as pictures hanging on the wall, leading to Web sites when clicked. More complex is the solution adopted for showing 3D models of buildings. Since the number of prims is limited, we cannot afford to display all the constructions permanently on the island. The solution was to acquire and deploy a mechanism for displaying them on demand, a so-called *rezzing panel*. This device is able to store 3D objects composed of large number of prims, provided they are built in the appropriate way, and to reconstruct them when needed in the space outside Arketipo.

Figure 3. The Auditorium of Arketipo



The Value of Arketipo as a Learning Environment

Overall the solutions adopted to recreate a learning environment in SL were state-of-the-art and we consider this in all respects a valuable learning experience for our students and a great achievement for our team. The motivation and engagement of the best students was a driving force for other students to work jointly towards common goals and to contribute in a shared effort as part of a community. The educational value of this experience cannot be underestimated. Arketipo received a lot of attention in the metaverse the day of its inauguration, with enthusiastic comments from other educators and SL builders.

However, without a designated curator or manager, the actual use of the center was quite limited and the excitement of visiting the place accordingly quickly faded away; virtual venues evidently require proactive programming just as much as a physical venues.

We managed to use the auditorium for a few conferences and seminars with remote distance participants. Organizing slide and movie projections in the conference hall is not an easy task with current technology: It is to be planned and prepared in advance by people with the right technical skills and the right permissions to manage the virtual land. Depending on the client hardware the quality may be not satisfactory. For events with a large number of in-world participants, we experienced problems with the audio setting and with sometimes unbearable delays in rendering time. However, with the right technical know-how and facilities, live and mixed-reality events can enable an audience, which could otherwise not be present, to participate, either as avatars in SL or simply through accessing Web streaming video of the live event. In October 2009, for example, the Royal Irish Academy's Digital Humanities Observatory, with sponsorship from *Architecture Ireland*, arranged a public lecture by Denard on "Recreating Research, Art and Education in Shared Virtual Worlds", which took place in both Dublin City Council's Wood Quay Auditorium and the Arketipo conference room on Digital Humanities Island (Figure 4).

Just as many people attended the lecture virtually in Second Life as did physically in Dublin, and a moderator relayed questions from the virtual audience to the live event. While the sound signal lagged several seconds behind the physical event, virtual attendees nevertheless mostly re-

Figure 4. Audio-video stream from the Wood Quay Auditorium, Dublin, October 2009

mained present for the duration of the session. The technical and logistical effort of deploying this mixed reality mode could be justified by the presentation's reliance on visual, and especially virtual world, content.

While the physical audience enjoyed the heightened immediacy of physical co-presence in the Dublin auditorium, the virtual audience, as their avatars followed that of the presenter from site to site in Second Life, had higher status within the experiential hierarchy of the virtual world. Escaping the single, projected viewpoint to which the live audience in Dublin was constrained, each avatar's navigational choices created its own parallel "narrative" as a counterpoint to that of the presenter. The parity of their virtual presences invited a quite different quality of engagement from that offered to passive receivers of audio-video signals. At the same time, the physical audience's view of the virtual audience's avatars, as seen through the data-projected visual field of the presenter's avatar, accentuated their awareness of the ephemeral nature of the virtual event, as well as its randomness: the physical and the virtual, umbilically connected by the internet, seem to have exposed two different sets of "rules", as well as modes, of experience. In Second Life, what begins as an experiment in teleconferencing quickly becomes an exploration of presence and performativity – the kind of creative collision that is common on this frontier. As of the time of writing, Arketipo remains live in SL as a virtual venue available for digital humanities-related activities.

As for the other educational facilities we have built, a few adventurous professors made some attempt to set up times for contact hours in their virtual offices. They managed to meet some enthusiastic first year students and a few of the students attending their courses. After a few weeks however nobody showed up any more and the experiment was discontinued.

The project team had a number of discussions about design decisions made in building Arketipo: we aimed for high quality and the result is impressive, but this was not without a cost. The number of primitive objects needed to achieve the desired degree of accuracy and detail was excessive: of the 15000 prims allowed in a sim, as much as 8000 were used by Arketipo alone; all the other educational activities and buildings had only 7000 prims left to share and this created some issue on how to ensure a fair allocation of prims to projects. A secondary effect of using such a huge count of prims, was the lagging experienced in rendering, which made Arketipo difficult to use with cheap hardware. Since the building was complete and

quite spectacular, it was painful to have to destroy it and labor intensive to simplify it. Finally the decision was made to give up the underground floor and leave the rest.

Arketipo's quality did not go unnoticed: a copy of the building was sold to an educational institution of one of the big regions in Italy. Their main motivation in using SL was to reach a large number of students in high school, without moving educators to different locations. Their reasoning was along these lines: an avatar (student) per class, 30 students per class participating, 30 avatars in the auditorium, make nearly 900 students from different schools that can be reached simultaneously. At this time we cannot tell whether their expectations were met.

Overall our impression is that, given the current state of technology, for normal purposes, the use of SL as a virtual classroom, or more in general as a place for classes, seminars and conferences, does not offer clear advantages in comparison to other communication media such as Skype, teleconferencing or instant messaging. Specific tools for teaching (blackboards, slide and movie projectors) exist but are difficult to use, require some planning and have a clear additional cost. However, our challenge is to identify – or perhaps all we can do sometimes is guess, or intuit – those contexts and activities that might take on new dimensions if filtered through Second Life's evocation of virtual space and presence; this is the brave new world that we are, even now, only beginning to be able to perceive, much less chart.

IUMI: An Intelligent, In-World Interface

One fascinating student project, started in 2007-2008 and further refined and developed 2008-2010, has the ambition to develop an "intelligent" and cooperative in-world user interface for delivering location-aware and user-sensitive information.

Iumi is a *pseudo-animated* pet that can be worn on the avatar's shoulder and acts as a chatting companion during the visit to the DH island. The idea of the character was inspired by the logo of Informatica Umanistica (DH in Pisa), a bizarre combination of a book and computer screen (http://infouma.di.unipi.it/).

Iumi was created by Francesco Genovesi as an experiment in providing contextual and customized information about the virtual world objects in a natural conversational style form. This first instance of Iumi can be described as a context-aware user-adaptive guide, but the communication goes only in one direction: Iumi delivers information to the avatar (Figure 5).

The idea was further developed by Alan Zucconi, a computer science student, with a passion for Artificial Intelligence, by adding to the pet the functionalities of a *chat-bot*, i.e. a computer program able to carry out a possibly quite large set of language interactions according to a set of predefined rules and thus making it able to simulate a believable and sensible conversation with the user. Alan had already created a Web chat-bot, called Doriana, very successful with teenagers all over Italy, and was challenged to extend and adapt its technology to work within SL.

Figure 5. Iumi, Virtual Guide and Chat-bot

Iumi has been programmed in such a manner, that it can communicate with the avatar who wears it (i.e. the object owner) over a private channel; as an alternative, IUMI answers questions expressed in the public channel, when its name is explicitly mentioned. The request from the avatar goes to the chat-bot engine, residing on a server, where the answer is generated and sent back to the appropriate SL communication channel.

The chat-bot exploits location awareness in two different ways: (a) by volunteering appropriate information when the avatar enters a place or the range of an object for the first time *(location specific suggestions*), and (b) by answering a set of pre-defined questions related to the location (*location specific answers*). Communication is triggered upon entering the *range* of an object, by exploiting one of the positioning methods available. In practice, the avatar is free to go wherever it wants, and only when it happens to be in a specific context it gets from Iumi the information relevant to the context.

Iumi is also able to *adapt* to the avatar profile by offering different contents for different profiles. Living in an intercultural environment, Iumi is characterized by identity crisis: it does not know whether it is a book or a computer screen. Even if one of our missions as educators is to make both cultures coexist in our students, it is funny and engaging to imagine a tension between cultures that are so different. Thus, Iumi implements two profiles: *the computer science* and *humanistic* profiles according to the fact that our visitors may be more inclined towards technology or rather towards humanities: in the first case it delivers information more focused on the technological aspects, such as implementation methods and building techniques; in the second case, it will talk about the history of the buildings, important events, artistic aspects and so on. Other, maybe more significant, forms of adaptation to the user profile, are possible by writing specific rules and greatly enhance communication.

If everything else fails, Iumi has a large repertoire of sentences to express its inability to understand, a form of graceful decay mechanism to hide the shallowness of the interaction.

Finally, with the purpose of making the character more believable and human, Iumi's schizophrenia manifests itself in randomly generated sentences, which can be uttered once in a while. The sentences were collected within a forum, where contributors were DH students were challenged to invent ways to personalize Iumi's behavior.

This project was very significant since the result of the experiment is a proof of concept for how scholars, tutors and students may deliver location and user-sensitive information in world by using a natural paradigm of interaction. Other means of delivering information exist in SL, such a notecards or HUD's, but they are more artificial and more difficult to grasp than having a friendly conversation, even with the obvious limitations of today's natural language technologies. The possible extensions to the chat-bot are endless, as unlimited are the sources of information that the chat-bot engine can access; we tried for example to use a question answering system on contents from the Wikipedia, build as part of another project.

Equally important, and quite rewarding for us and for the students, was the possibility of working together at a truly challenging and interdisciplinary project, where different competences were required (programming, contents creation, graphics) and where the virtual world provides an ideal terrain for experimenting with real world issues such as location-aware behavior and real time human interaction, and the gratification of instant visibility of the project.

CREATING CULTURAL CONTENT IN SECOND LIFE

We now move from the learning experience of students creating and using the "virtual class-

room" and virtual learning infrastructure, to that of creating and using virtual heritage content in Second Life.

Rebuilding the Tower of Pisa

Elisa Ciregia, then a graduate student of Digital Humanities at the University of Pisa (Ciregia, 2009) undertook to build a *London Charter*-compliant visualization of the famed, "Leaning" Tower of Pisa – the universally-recognized icon of the city and, indeed, of the nation as a whole. The effort was authorized the *Opera del Duomo* which carries the responsibility for the entire *Piazza dei Miracoli* area containing the *Duomo* (Cathedral), Leaning Tower, Baptistry, *Camposanto* and Museum. The central aims of Ciregia's project were twofold: (a) to test the capabilities of Second Life as an environment for both faithfully representing and providing, virtually, widespread public and information-rich access to precious monuments; (b) to strengthen the existing positive relationship between the *Opera del Duomo* and the Faculty of Humanities at the University of Pisa as a focus for exploring opportunities for further, shared activities relating to interpretation and dissemination.

Ciregia's model was rooted in her study of plans and technical documents relating to the Tower held by the Department of Civil Engineering at the University of Pisa. However, despite the effort to ensure the fidelity of the model to the original, the work presented many problems. The first challenge was the policy, then in force on Digital Humanities Island, that heritage visualizations, in the interests of consistency of user experience, should be built at 1:1 scale (using the in-world unit of measurement). This stipulation, together with the extraordinary complexity of the Tower, would have required a number of prims ("primitives" - the basic building blocks used to create three-dimensional content in Second Life) many times in excess of that available within Second Life in general and in the shared space of Digital Humanities Island in particular. Consequently, Ciregia had to devise ways of greatly simplifying the model both decoratively and structurally. Rather than detailing each of the unique column capital designs on the actual Tower, for example, Ciregia was forced to use a single, standardized capital. Similarly, entering the "virtual" Leaning Tower, one finds it completely hollow; where the 296 stairs should be is, instead, an interactive teleport tool inviting avatars to beam themselves up to the top floor. Ciregia's deployment of subtly overlapping prims, as a necessary concession to the limited maximum size of Second Life prims (10m x 10m x 10m), gives the viewer a sense of, but does not accurately reproduce the Tower's cylindrical circumference (Figure 6).

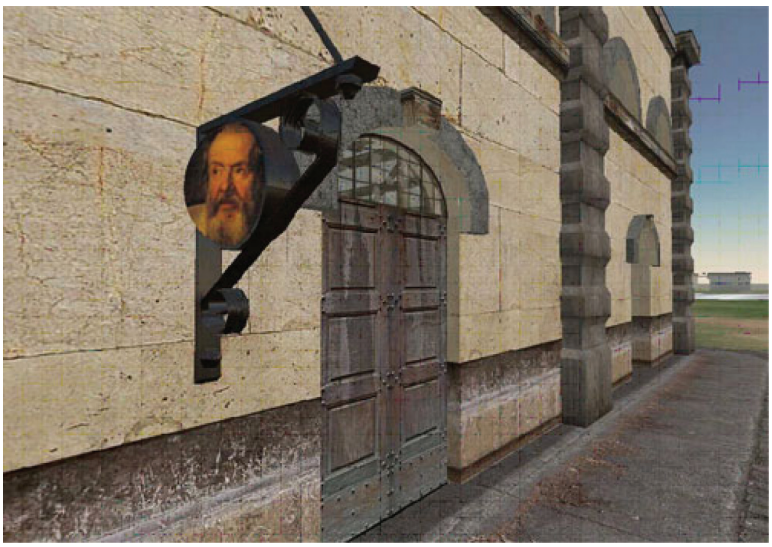
Figure 6. The Tower of Pisa

The *London Charter* provided a highly accessible framework, for staff and students alike, to discuss the complex issues of intellectual integrity to which the Tower project gave rise, and assisted in maintaining an emphasis on the importance of following a rigorous scientific method even in a visualization designed to further popularize a monument. While Second Life imposes particularly stringent constraints on the modeling process, every type of modeling software, in fact, even the most accurate, involves operational decisions that affect the quantity and quality of information vehicles: there is no perfect model. To the question: "Can Second Life successfully accommodate and communicate to mass audiences high-quality, faithful, representations of complex, large-scale monuments?" the project established some not insignificant limitations, and in the process became a wonderful occasion to add to the bouquet of interdisciplinary learning other flowers, most notably restoration theory and practice, and the methods and problems of popularizing cultural heritage. These extended observations and understandings now become the starting point for future conversations about virtual heritage representation between the *Opera del Duomo* and the University, as well as for curriculum development within the University.

Galileo Galilei's Laboratory

The next project followed, in some ways, a similar path to the Tower of Pisa project, since this virtual building too was "enriched" by notecards and audio files; but it also presented different challenges and problems. *Galileo Galilei's Laboratory* is a virtual representation of an actual building in the old slaughterhouse area of Pisa dating to the early 900s that today hosts the Museum for Computation Instruments (*Museo degli Strumenti di Calcolo*) in which the Galileo Galilei Foundation stores and displays to the public several Galilean experiments. The building and the virtual experiments were modeled as part of a taught module in *3D Graphics*, while students studying *Introduction to Historical Studies* produced audio and text files relating to the life of Galileo, his experiments and the history of science (Figure 7). The project explored not only the potential benefits that a virtual world might bring to two separate modules – one primarily historical and one primarily technical in nature – but also how

Figure 7. Galileo Galilei's Laboratory



inter-module collaboration might prompt us to rethink our learning objectives and outcomes in both of these, quite distinct, subject areas.

In the *3D Graphics* module, students first took photographs of the real Laboratory and of the Museum's physical reconstructions, designed by Professor Vergara Caffarelli, of experiments described by Galileo Galilei. Using these photographs both as primary reference materials for modeling and as sources for textures, they then undertook to build their own virtual reconstructions, in Second Life, of the "inclined plane", "pendulum", "inclined plane with pulley", "double pendulum" and "hydrostatic balance" experiments. Meanwhile, the students taking the *Introduction to Historical Studies* module undertook extensive readings on the life of Galileo and on the importance of his works in history of science. They then wrote, and recorded as audio files, informative texts suitable for the general public which the *3D Graphics* students, as well as publishing them through Web-pages, also embedded in the virtual library so that Second Life users could read or hear them by clicking on the experiments and pictures hanging on the walls.

What, then, was the significance of this pedagogical experiment? Overall, the opportunity to work in groups on shared objects in a common environment, the awareness that the project would produce something to be enjoyed by all people, and the continuous online interaction with teachers beyond the class schedule, all acted together to provide a powerful impetus towards learning and participation, which contributed notably to efficacy of the teaching process.

For the students of *Historical Studies*, the collaborative, virtual world-orientated process drew upon the traditional skills of reading books and articles, but also shifted the emphasis of these activities by conjoining them with the additional tasks of: (a) selecting from rich, complex and deep historical materials subsets to be deployed in the context of a particular exhibition/installation; (b) summarizing, explaining and correcting sources to create new texts appropriate for a specific audience; (c) adapting content for use as hyperlinked segments, rather than as linear narratives; (d) authoring and publishing historical content for the non-print technologies of the digital, mass media age. In this way, the engagement with the virtual world platform, in addition to developing their knowledge and understanding of historical materials, also drew attention to, and developed their skills in confronting, the numerous, nuanced choices we make when we attempt to interpret and communicate the past in different contexts.

The virtual world environment also changes, and augments, the learning experience of students of *3D Graphics*. Firstly, and most importantly, their standard workflow, and conventional aims of modeling, have to be redesigned to make allowance for, as well as take advantage of, a collaborative, real-time, avatar-based, content-creation environment. A particular challenge in this respect is that of understanding the implications of working in an environment that, unlike most 3D modeling tools, is not designed to provide industry-level, or near-industry-level, graphical quality and performance, or to facilitate complex modeling operations, but rather aims to enable user-generated content and social interaction via a form of virtual embodiment. In this context, even the very aims of graphical representation need to be reconsidered: it may, for example, be more appropriate to think of the outcome itself as a kind of "laboratory" designed to invite and facilitate meaningful, creative interactions by users, rather than – as may be more commonly the case in 3D Graphics modules – as a polished, finished product to be "visited" or "used".

Other major challenges, or learning opportunities, are those of devising approaches to digitally representing three-dimensional cultural heritage that anticipate the requirements of both the user and the avatar. In the games industry, for example, the layout of the virtual terrain and the environment are laid out by the virtual world designer so as to optimize ease of navigation and viewing.

By contrast, real-world monuments, with their frequently complex, confined and irregular interior spaces, are rarely so obliging to the avatar: the camera (the "eyes" of the user, which typically floats behind and slightly above the avatar's body so that users can see their virtual selves in relation to their environments) finds itself stranded on a different level or different room to the avatar to which it supposedly belongs; avatars, trying to cross a room to view an object or climb virtual stairs, find the default avatar speed that the system bestows has them bumping into walls, overshooting doorways, or falling through gaps.

Computer games also typically do not aspire to hold themselves accountable to high standards of historical integrity, or to deliver extensive, detailed historical information. Historical visualization, however, operates in a domain in which the conventional means of communication is lengthy, linear text; the heritage visualization strategy must therefore also include plans for communicating the relationship of visualization to the historical sources from which it derives, for adapting historical materials into genres and formats that are appropriate to the virtual world, as well as for providing access to them through non-intrusive, intuitive interfaces.

Thus, 3D Graphics students confronted by *both* an avatar-based, user-generated, virtual world *and* complex cultural heritage content, must attempt to develop sophisticated responses to these several difficult challenges that a static, commercially-orientated 3D Graphics module would not normally encounter. The learning context that virtual worlds such as Second Life present to 3D graphics students in the humanities is therefore particularly demanding, both conceptually and technically.

Old-Style Modeling in a New Technology: Early Experiments at King's

While the students from Pisa were building Arketipo, the Leaning Tower of Pisa and Galileo Galilei's Laboratory, in the 2007-2008 sessions, students at King's College London were taking a different approach: each of them was asked to define, and then to realize, an individual visualization project within Second Life. Their proposals ranged from an interactive model of the Tower of London, to a media-rich, black-and-white simulation of part of the films set for Kevin Smith's 1994 film, *Clerks*.

At the end of the module, we found that students had either done unusually well, or unusually badly: if a student managed to surmount the technical challenges of content creation, they were inclined to lavish upon their work significant amounts of time and creativity, producing results with impressive attention to detail and imaginative use of textures and scripts providing exciting user experiences. By contrast, if individual students discovered themselves to have limited aptitude for 3D modeling – which is only one aspect of humanities visualization as a taught subject – they had no means of demonstrating their competence in other areas such as research, data capture and processing, project design, planning and documentation. On reflection, we noted that this isolated approach, while it provided excellent opportunities for able students, also unfortunately tended to imitate the product-orientated approach of conventional, off-line 3D modeling, and so failed to exploit the collaborative, real-time properties and potential of the Second Life environment.

In this 2007- 2008 session, we had indeed attempted to offer students an introduction to 3D modeling in Blender – an open-source version of an industry-type 3D modeling platform – before introducing them to Second Life's much less technically demanding 3D modeling system. As the semester progressed, however, we realized that, even if we had dedicated all of six of the available practical tutorials within the teaching schedule wholly to Blender, it would not have afforded sufficient training time to enable students to carry out a substantial, collaborative heritage visualization project, either individually or col-

lectively. Given the diverse, and typically non-technical backgrounds of our MADCT students, we determined that Second Life, despite its severe limitations as a modeling platform, did at least provide an accessible introduction to some of the core principles of 3D content creation that students could draw upon if choosing further to pursue 3D modeling. More importantly, however, we were – and remain – convinced that the real-time and collaborative nature of Second Life, as well as accessibility to a mass audience, constituted challenges and opportunities significantly different in nature to static modeling that it is important for students of the Web 2.0 age to come to terms with. With that experience under our belts, we decided, in the following academic year, to concentrate the practical tuition exclusively on Second Life.

The Alkedo

The very significant success of the Galileo's Laboratory project at Pisa, with its combination of the two very different "cultures" of modules on *Historical Studies* and *3D Graphics*, both prompted us, at King's, to emulate its collaborative approach in the next academic session (2008- 2009), and also gave us the confidence that the virtual world could enable us to do what we would never previously have attempted, namely: to link modules in two different institutions in two different countries. We therefore prepared ourselves to undertake a much more ambitious, collaborative project.

In 1998, lying in the soft silt of an ancient river bed on the outskirts of Pisa, was found the remains of several boats spanning 1,000 years of maritime history from the Augustan age to medieval times, all wrecked, at one time or another, by violent tidal floods. One of these, Ship C, is the only Roman vessel ever to have been found with a name carved into her timbers: her deeply incised Greek letters clearly spell out the word "Alkedo" – Seagull. The Alkedo is a 13m-long vessel in the shape of a small, sail and oar powered Roman warship, which may have acted as a coast-hugging patrol boat, or a shuttle designed to carry personnel and supplies from port to larger, sea-going vessels in the fleet, or – perhaps retired from active service – the pleasure boat of a wealthy local. The hull and its contents have been lovingly and painstakingly preserved by the Centre for Restoration of Waterlogged Wood (*Centro di Restauro del Legno Bagnato*) at the Shipyard of Ancient Pisan Ships (*Cantiere delle Navi Antiche di Pisa,* http://www.cantierenavipisa.it/) and the ship will soon be the subject of a display in the new Museum of Ancient Pisan Ships (*Museo delle navi Antiche* di *Pisa)*, soon to open on the banks of the Arno in Pisa.

The archaeological riddle of this unique ship, the intrigue – even romance – of its lost histories, the complexity of its tidal environment and the energy surrounding its imminent transition from an archival object to a museologic exhibit made it a compellingly attractive subject. Equally promising was the existence of a substantial body of scientific documentation of the site, the ship and its contents, and a number of scholarly publications providing interpretation of the remains from a variety of perspectives.

Finally, the Centre for Restoration of Waterlogged Wood had also created a large-scale, physical reconstruction of the Alkedo, which would provide both a reference point and a rival hypothetical interpretation in relation to which we could situate our own virtual, reconstructive efforts.

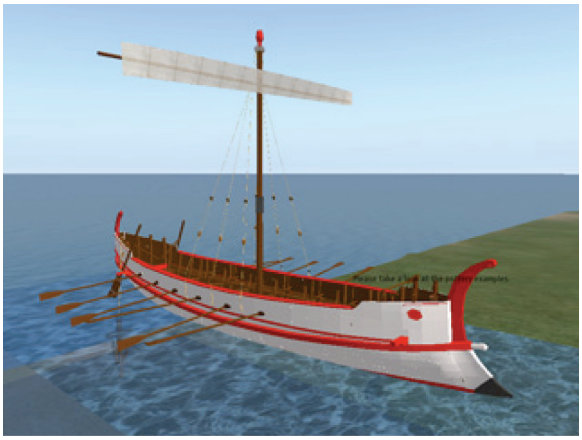
Initially, we sought for a way for the students from Pisa and from King's to work together, but it quickly became clear that departmental and institutional constraints on the schedule and requirements of our curricula would preclude direct collaboration. We therefore, instead, devised a project with two associated, but autonomous, phases: in the first semester of 2008-2009, students at Pisa would model, in Second Life, the archaeological remains of the Alkedo; then, in the second semester, the students at King's would create, also in Second Life, a virtual reconstruction of the Alkedo as it may originally have been in its

prime. The two projects, together, would provide different perspectives of the one, shared object, and would encourage each group of students to consider their own project in the context of a wider program of work.

This affiliation of the two "Alkedo" projects became significantly more substantive with the inception of an additional new joint King's-Pisa initiative: the *London Charter in Second Life* project (The London Charter in Second Life, 2009). Martin Blazeby (King's) and Beatrice Rapisarda (Pisa) applied for, and received, funding under the British-Italian Partnership Program for Young Researchers, 2008-9, a joint initiative of the Italian Ministry of University Education and Research (*Ministero dell'Istruzione dell'Università e della Ricerca*) in collaboration with the Conference of Rectors of Italian Universities (*Conferenza dei Rettori delle Università Italiane*) and the British Council. The funding enabled Blazeby and Rapisarda to convene a series of workshops in Pisa and London designed to develop tools, guides, a heritage visualization ontology and visual conventions to aid the implementation of *The London Charter* in Second Life. This joint venture resulted in both the Italian and UK student projects on Alkedo becoming constituent elements of a shared best practice investigation, and that students and staff in both institutions would be exchanging ideas and approaches on burning methodological issues of common concern during the course of the year.

At King's College London, the hypothetical reconstruction, in Second Life, of the original state of the Alkedo formed the focal point of both tuition and assessment for the whole, one-semester *Applied Visualization* module (Figure 8). By the time the King's students were about to embark on their phase of the project, the students from Pisa had largely completed their model of the archaeological remains of Boat C, and their tutors were ready to visit London for a three-day workshop with KVL as part of the *London Charter in Second Life* project. During their visit, they gave a presentation on the Alkedo, and expressed

Figure 8. Alkedo



the intention to leverage the visualization project into a real collaboration with the new Museum of Ancient Ships (*Museo delle Antiche Navi*) shortly to open in Pisa. This gave the students of *Applied Visualization* at King's a strong sense of being involved in a significant, international collaboration with a real-world dimension; one that invited, and would reward, their best efforts.

In 2008-2009, through the Alkedo project, we trialed, and subsequently in 2009-10 consolidated, the following combination of theoretical and practical tutorials. Throughout the semester, students attend a weekly, two-hour, traditional seminar which, in addition to discussing the history and theory of humanities visualization, provides tuition in the principles and practice of project management, and offers hands-on project review sessions, in which the tutor, Denard, helps the students to develop and monitor their project plan as the work unfolds, and to keep their activities in dialogue with both the *London Charter* and the specific assessment criteria of the module.

In addition, in the first six weeks of the semester, KVL Senior Research Fellow, Drew Baker, gives tutorials on conducting *London Charter*-compliant visualization projects in Second Life. In the first week of the practical workshop, tutors and students meet physically in a seminar room in

London. Thereafter, Baker and usually one or two students join the session virtually, while Denard and most of the students continue to meet physically. One of the laptops in the seminar room is connected to standard plug-in speakers, a Sony ECM F8 desktop conference microphone and Skype (rather than the unreliable Second Life voice client) to establish an audio link between the room and the remotely-located participants: this is an inexpensive and highly effective means of running a hybrid, virtual-physical session.

Baker and Denard ask students to complete, in their own time, a number of freely-available, in-world tutorials created by SL residents – in particular, the well-known "Ivory Tower Library of Primitives" – to ensure that they acquire rudimentary skills in modeling and texturing. This allows the workshops to concentrate on the more methodologically-rigorous standards and techniques of content creation that a collaborative, humanities context imposes, lending particular emphasis to: prim-efficient building; accurately introducing measurements and images of real-world assets into the virtual environment; permissions management; creating regular multi-inventory back-ups of project content; and iterative documentation of the visualization process.

Baker also provides, and teaches students to use, a number of Linden Scripting Language (LSL) scripts, that enable them to work with Universally Unique Identifiers (UUIDs) to achieve automated manipulation of in-world objects and absolute positioning and rotation of 3D assets. Mirror scripts accelerate modeling of symmetrical objects, while other scripts allow students to apply floating text to objects; develop heads-up displays (HUDs) that provide in world information to users; create links to external resources; embed rich media; and implement location-sensitive technologies such as chat engines, hot spots and sonar.

Examples of recommended good practice that Baker teaches include:

1. recording editing operations and queries on notecards stored within each object, or in the root object of each linked set of objects
2. when building, each student using, instead of the generic SL prims, their own set of primitives, stored in their inventory, each primitive pre-set with the correct permissions (i.e. allowing full permissions to group members) and containing a blank notecard ready for use in documenting parts of the visualization process
3. removing, after each work session, all "prim litter", so as to avoid wasteful expenditure of prims

At the end of the project, students submit their in-world content by "selling" the project to the tutor's avatar for L$0, with each individual object, texture and script set to give the "next owner" full permissions: this ensures that tutors are able to pack the project into a rezzer so that the model can be preserved without being permanently present – taking up prims and space – on the island.

The module's combination of theoretical and practical tuition, while details can always be further refined and improved, appears successful:

The mixture of a theoretical class and a practical class [provided] a very good framework for the course. The theoretical class allowed students to get an understanding about the arts and a perspective about visual regeneration of historic venues. It allowed me to gain a perspective on how scholars and practitioners used modern technology to try and unravel the secrets of the past. If not for this class, I would never have imagined the meticulous process one has to undergo whilst trying to regenerate an image of something that stayed in the past. (Student feedback from 2010)

The lecture in world format I really liked. The tutorials from Drew were good and enabled us to getting up and running pretty quickly. (Student feedback from 2010)

When the students began to work on the Alkedo itself, it became clear that the principles of interdisciplinary learning observed in the case of the previous year's recreation of Galileo Galilei's Laboratory remained valid: students engaged in the modeling work had to learn aspects of Roman-era shipbuilding, the morphology of the Pisan coast over time, and of marine archaeology excavation and preservation techniques, as well as how to make these concepts and materials accessible to a wider audience through the creation of a Website and documentary.

The student project team at King's, comprising eight students, assigned roles so that each student was responsible for some combination of defined tasks including: project management; historical research; translation into English of Italian sources; archaeological data acquisition and analysis; liaison with subject experts; in-world modeling (of interiors and exteriors); 3D Studio Max modeling (of artifacts) and creation of sculptured prims ("sculpties") in SL; texturing; scripting behavior of in-world objects; in-world visitor interface design; 3D animations; video documentary creation; wiki creation; Website design; Facebook page creation; publicity materials creation; glossary compilation; copyright management (Alkedo project, 2009).

We recognized, from the outset, that it would be necessary to devise a means of assessing this project that would give the students a clear framework of activity spanning project planning, content creation, documentation and dissemination, as well as requiring them thoughtfully to reflect upon the process in a structured way. The assessment model would also need both to reward individual effort and achievement, and to place a fair emphasis on collective responsibility for the project – a core principle of collaborative work. While the project would require teamwork, in which each student would attend to a particular set of tasks while at the same time remaining aware of, and coordinating with the work of others, the assessment model would have to cope with inevitable disparities. Indeed, commenting on the project after the fact, one student noted:

Group dynamics were hard to manage, with some people working a lot more than others, or working at different standards (Student feedback from 2009)

Student responses to this assessment model have been universally favorable:

"It's a good thing to get away from 3-5,000 word essay format which seems a terribly old-fashioned way of assessing such a forward looking subject." (Student feedback from 2009)

The model of the Alkedo that the students produced in Second Life was an impressive achievement: despite the limitations, as a modeling platform, of Second Life, through a combination of ingenuity and perseverance, the students meticulously captured the irregular contours of the boat, each rib and plank of the hull being composed of several, painstakingly measured and placed prims. Relevant literature was combed to allow the team plausibly to restore, from valid studies or *comparanda*, lost elements such as the anchor and steering oar. Each artifact found in the hull was modeled in 3D Studio Max, and converted into a sculpted primitive (Second Life's way of introducing complex organic shapes that its primitive-based modeling system cannot reproduce), and scripts attached to oars and sail to evoke the vessel's means of movement.

The project team conducted numerous experiments to determine successful ways of publishing documentation of the visualization process that would render the visualization "intellectually accountable", or "transparent", as stipulated by the *London Charter*. The challenge was to find an approach that would not be unduly intrusive for the casual visitor, but which would allow interested users to drill down to highly detailed documentation providing full "transparency".

The solution was combined in-world "hotspots" – detectable only by a change in cursor icon – which, when clicked, offer both notecards with information about the individual component in question and offering a live link to a Webpage where was presented full, illustrated documentation of both the evidence on which the component was based, and of the process of interpretation and visualization. The whole process of planning, research and modeling was captured via a wiki (Alkedo Project wiki, 2009) while a multilingual, interactive panel situated beside the SL model directed visitors to a separate Website designed to present the project and its methodology to the public (Alkedo Project, 2009).

The integration of product and documentation of process continued through to the brief audio-visual documentary created by the team (Alkedo Project video-documentary, 2009), which included footage of work in progress, animations illustrating topographical changes in the Pisan coastline over time, and a commentary on the theory and practice of implementing the *London Charter*. Finally a formal, 33-page report (available through the wiki) recorded and reflected upon the project's aims, process and outcomes, relating it to wider issues in heritage visualization, and a signed, collective statement – together with wiki entries and SL's record of which avatar created each object – allowed tutors reliably to track, verify and assess the quantity and quality of each participant's contribution. The deployment, by students and staff alike, of a formal methodological framework, such as the *London Charter*, encourages a mutually-reinforcing coalition of product- and process-orientated learning: documenting and reflecting on process contributes greatly to the conceptual, contextual and technical coherence of the activity and, consequently, of its outputs.

While the audio-visual documentary provides an elegant record of the project suitable for online or event-specific display, a A1 project poster affords the project a physical presence suitable for exhibitions. This focus on dissemination within the learning process is consistent with best practice within the field of historical visualization, which asks those engaged in creating digital representations of cultural heritage to attend to the value that their efforts have, beyond their own immediate contexts, for wider society:

The creation and dissemination of computer-based visualization should be planned in such a way as to ensure that maximum possible benefits are achieved for the study, understanding, interpretation, preservation and management of cultural heritage. (The London Charter 2.1 (February 2009) Principle 6: Access)

Student assessments of the experience were overwhelmingly and strongly positive, but not without qualifications. The following comment, in particular, reflects the difficulty of identifying a subject that strikes the right balance between being challenging and achievable, between being sufficiently clearly defined to provide focus, and open-ended enough to allow students scope for creative input:

I think choosing the right subject matter is important and it should be chosen specifically with Second Life in mind in order capture peoples' imagination. In this respect I thought the Roman ships were an average subject matter as I think there is more room improvisation on behalf of the student. I think the ship was basically a little bit too much like a building project - we get given a set of plans and then reconstruct it in 3D. Whilst this is clearly an excellent way to introduce people to Second Life I think we could have been stretched a bit more with the subject matter. (Student feedback from 2009)

Another reservation was the consequences of working in, and having content locked into, the proprietary Second Life system:

the fact that everything has to be done online and through [Linden Labs'] server meant a lot of restrictions on where and when one could model. At the end we could not save and export the model outside SL and this is a huge drawback I think, as we would have liked to be able to have each a copy of our hard work. (Student feedback from 2009)

The cost of the necessary decision to concentrate on Second Life to the exclusion of more standard 3D modeling tools is also noticed:

Whilst I liked working in Second Life and found it both useful and fun I'm not sure it laid the best foundation for getting deeper into the world of visualization... I'm now looking to use more advanced 3D software for visualizations and feel I would have been better placed if we had learnt to model in a more standard 3D environment. (Student feedback from 2009)

There is no question but that these are valid concerns, and indeed ones that tutors share; there are ways of both importing and exporting SL content, but none of them, yet, is easy, reliable or quick; and, short of extending the module into a second semester, the benefits of real-time collaborative content creation, as well as the excellent results achieved in Second Life, including elements of social engagement, validate our decision to concentrate on the SL platform, as further student comments attest:

[modeling in SL is] easy to pick up and quite quickly it becomes obvious that as a tool it has great potential. (Student feedback from 2009)

In addition, the cognitive effort required in modeling, the powerful stimulus given by the aim of producing a polished functional model for public consumption, and the added efficacy and motivational impetus of working in a group, clearly did also combine to make for a highly effective module on the digital reconstruction of the past:

we all had a sense of real achievement having collectively produced work on a larger scale than any of us could have hoped to individually (Student feedback from 2009)

This sense of achievement is not without foundation; later this month, tutors from both Pisa and King's will meet with the Director of the Museum to take forward, we hope, plans to create a permanent, public visual installation on the Alkedo based on our students' work in Second Life.

LEARNING BY VISITING AND PLAYING

If it proves difficult or impossible to enable students to undertake content creation in a MUVE, a good option is to use Second Life as a learning environment for "searching", "visiting" or "playing". The Leaning Tower of Pisa, Galileo's Laboratory, the Roman ship Alkedo and the Somerset House projects can now be viewed on Digital Humanities Island, and elsewhere in Second Life many other historical "reconstructions", such as the Basilica of Assisi, the Sistine Chapel, Stonehenge, the ancient city of Uruk, the Great Wall of China, the castle of Matsumoto, not to mention KVL's Theatron3 project, mentioned above.

Unfortunately there isn't yet a serious catalogue of the cultural heritage in Second Life, where it could be possible to understand - in accordance with the *London Charter* - if modeling followed a method, which are the limits, who the authors and with which purposes. In most cases, we must admit, we face poor quality models, created mostly by people with no educational purpose or scientific concerns. When, however, reconstructions are scientifically valid or at least acceptable, when digital models show rich data as result of interdisciplinary projects - as those described above - the teacher would face a "homogeneous context" (historical, artistic, cultural context) where actually "immerse" students making them

interact, communicate, search, evaluate or answer to questions.

Several tools make these functions easy: from simple ones (notecard, chat, and inventory of objects) to more complex software. Second Life, for example, can be integrated with a popular and open source e-learning platform Moodle that can be used "in world" with its rich set of functions to distribute texts or images, create quizzes, manage classroom management and create glossaries. Obviously it depends on the purpose of the course and on the ability of teachers how using of Second Life, starting from a simple visit up to the construction of scenarios for a role play, with students and teachers for players.

We tried this option too in Galileo's laboratory: we thought to create three avatars from the characters of *Dialogue Concerning the Two Chief World Systems* (Sagredo, Simplicio and Salviati) making them interact with each other and any visitors. That project stalled for lack of financial support and some technical difficulties (partially solved improving IUMI guide, see below), but it can only be achieved spending time and money. The road, however, looks promising, especially if we carry on experiments in open source MUVEs, which allow a greater freedom in computer programming.

The Theatron3 project, in addition to the content-rich Heads-up Display, included the development of a "Director Tool" which allows users to compile sequences of actions and events, that are, during "performance", sent as in-world text prompts to each participating "actor". In one notable experiment, KVL Senior Research Fellow, Drew Baker, used this tool to facilitate the recreation of a medieval drama in the Cornish language, comprising sound clips, sub-titles and moving scenery. He even developed an "Audience HUD" that enabled spectators to cheer, boo or whistle, or even throw (virtual) rotten fruit, ensuring that the performance was a fully participative event. Theatron3 also actively encourages its users to bring and develop their own costumes, props, scenery and scenarios and mixed-reality modes of engagement so that it becomes not just a place to visit, but a laboratory in which users can conduct their own, complex, experiments that exploit virtual embodiment within a spatial metaphor of Second Life.

Again, however, we recognize the need to create, in education just as in research, close collaboration between scholars of Humanities and Information and Communication Technology (ICT) experts, to go beyond a merely instrumental use of technology, and study, together, both how technology can influence the dissemination of humanistic knowledge and, conversely, how new technologies will evolve and change in response to the demands of the Humanities. Such endeavors become increasingly attainable as the discipline of Digital Humanities acquires more recognition within the scientific community (Dacos, 2010).

SOME CONCLUSIONS

Obviously the kind of work described above best suits "digital" students, who are not only able to live in Second Life and hopefully to create objects there, but who could also benefit from linking together different courses by, for instance, organizing a set of interdisciplinary lessons in which History works in collaboration with a course of 3D graphics, or Archaeology with Web Design, or Art with Digital Audio. Exciting as these possibilities are, there are real-world considerations: teachers need to have good skills in organizing workgroups, the availability of powerful enough computers, the will to devote a greater amount of time than is usually required, and one or more additional supporting tutors. In the absence of these conditions, it must be acknowledged that the risk of failure is high.

Given the objective difficulties in several Italian universities to carry through such an operation, especially in view of the poor incentives provided by the Italian university system for interdisciplin-

ary courses, such a goal will be beyond the reach of many teachers. Interdisciplinary education could be a turning point in term of quality of learning, especially in the Humanities, and the digital world could be in the vanguard of change, but only if cultural, financial and structural investments are forthcoming.

In our experience, Second Life proved to be a good learning environment, owing to:

- The wide creative possibilities available to users in customizing objects, environments and avatars;
- The ability to acquire, for free or at low cost, in-world objects and textures, thereby saving considerable time and energy;
- The possibility to bring together into a single, virtual, communal space several students who may be physically distanced from each other, and thus to enable them to communicate in writing and by voice; in other words, the opportunity inexpensively to create truly international "classes";
- The availability of tools and accessories that make communication and interaction between avatars and between objects and avatars easier.

Second Life has, however, also problematic aspects. First it is not a particularly "intuitive" environment, given that it requires to users to learn skills even to navigate the world – mouse and keyboard commands become "natural" only after hours of use – much less to create content. In order to become a successful "resident" in Second Life, one needs to overcome a period of "training", which newcomers will find more or less difficult depending on their level of initial skills in related technologies, and the outcomes they wish to achieve. This is why new users in Second Life are normally directed to Welcome Island, where other avatars, guides, panels and notecards help them learn how to walk, watch, chat, stand and sit, fly and teleport from place to place. The Second Life introductory materials are sufficient to enable students to acquire such basic skills without supervision, but the demands on technical infrastructure – hardware and internet access – and tutors become significant if students are required to use institutional facilities to be in world, especially during class.

It is also noteworthy that very few students are ever likely to number Second Life among their preferred technologies; indeed, when asked if they would continue to use Second Life beyond the duration of the assessed project, the responses of the CCH students were equivocal at best, and more often negative (from student feedback 2009-2010):

...although it does give some important advantages, Second Life seems rather obscure, and I do not think I am very likely to use it after the project's completion.

I have uninstalled SL from my laptop once the MA was over and I don't think I will use it again, the reason being that I do not find it useful for my interests.

I have used it a little bit, mainly just for amusement.

I would never enter SL for social or virtual bonding reasons, however I would be inclined to log in, for educational, informative and observatory reasons.

While SL does have drawbacks as a virtual classroom for the kinds of reasons discussed above, including the considerable cost, in time, of developing course resources or delivering content to SL, it is also true that the power of SL (unlike Skype or Powerpoint, for example) is to integrate a variety of technologies in such a way that they are more than the sum of parts, creating an holistic, interactive, sensory-experiential environment. The question to keep in mind is: what kinds of teaching and learning experiences can be uniquely enabled by the specific capabilities of SL that are

also sufficiently distinctive and beneficial that this level of investment is worthwhile?

The truth is that we are still learning, ourselves, what are the unique, and uniquely enabling, properties and possibilities of integrated, virtual experience, and the future is likely to hold many interesting "failures" as well as "successes" in our quest for understanding. In this venture, we will need to remind ourselves, our students and colleagues, that we must define "success" in terms of progress on this shared journey of discovery, rather than as a sum of predictable "outcomes".

So far, early experiments suggest that SL's combination of the perceptual, social and psychological aspects of avatar-based experience; together with SL's facilitation of collaborative content creation, make SL – despite its myriad of constraints and frustrations – can make it a superb learning laboratory wherever spatial and temporal dimensions are important.

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KEY TERMS AND DEFINITIONS

3D Modeling: Building a three-dimensional model of an object or building.

Computer-Based Cultural Heritage Visualization: Visualization of cultural heritage assets by means of computer-based/digital reconstruction and rendering methods.

Interdisciplinary Education: Education spanning several disciplines.

Multi User Virtual Environment: A persistent virtual world, usually accessed over the Internet, allowing a large number of simultaneous users to interact through their 3D counterparts, i.e. their *avatars*.

Second Life: A Multi User Virtual Environment managed by Linden Lab.

The London Charter: A set of internationally-recognized principles ensuring that digital visualization methods are, and are perceived as, intellectually rigorous and robust.

ENDNOTES

1 Bani, in collaboration with the Museum of London, completed a 3D model and documentary video on the Roman fort of Londinium (Bani, 2008)

2 An *affordance* is a quality of an object, or an environment, that allows an individual to perform an action.