Experiences with a multi-user virtual environment for knowledge building

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Declaration

I declare that the work described in this document is, except where otherwise stated, entirely my own work and has not been submitted as an exercise for a degree at this or any other university.

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Abstract

Third level institutions are adopting ever newer technologies to augment their standard modes of communication. From technologies such as email through to the now common virtual learning environments, or VLEs, used to host timetables, lecture notes, discussion boards, etc. A new emerging technology is that of multi-user virtual environments or MUVEs. This new technology may offer affordances not seen in traditional VLEs, these included an immersive synchronous communication and a sense of social presence.

A community of inquiry framework is recognized as one that builds on a social presence to create an effective learning environment (Garrison & Arbaugh, 2007). Therefore it is adopted as a framework to aid in the design and evaluation of a learning experience, mediated by a MUVE designed to facilitate knowledge building. Knowledge building is investigated from an epistemological perspective. Here we see that knowledge building may be viewed as cognitive work on abstract" conceptual artefacts" (Bereiter, 2002). This provides a base for both the learning environment and a framework under which to review the researchers own knowledge during the final analysis of the data.

The data was collect from an opportunistic sample of students from a masters course in Technology and Learning at Trinity College Dublin, over a two month period. Second Life™ was chosen as the MUVE while a Moodle VLE was used to supplement the MUVE restrictions. This implementation was delayed by technical and administrative issues, limiting the number of sessions possible. This limits the study to the basic functioning of the environment, as a more longitudinal study would be necessary to explore knowledge building in more depth. Although limited, there were some interesting results that do merit future research.

The findings suggest that there is potential in using MUVE technology to create an open-source knowledge building environment using open software. There is initially a steep learning curve when using MUVEs to interact and the data does suggest that it may not be ideal for large groups to interact. MUVE technologies do have their limitations, but this is an emerging area and the infrastructures are continuously evolving. The use of the Community of Inquiry framework suggests that parallels to the presences required in the theory (social, cognitive and teacher presences) do emerge from the interactions and how their absence may affect performance. This insight suggests possible techniques or practices to aid future designs and implementations, of similar setups, to be more effective. In essence MUVE interactions may not provide the level of interaction as face to

face, but they do offer an alternative that warrants further research. But to do so it is recommended that full institutional support is acquired and that the community is inducted early on in the process.

Table of Contents

Chapter 1: Introduction

Third-level educational institutes worldwide have embraced internet technologies as a means of communication and enhancing learning. Typical technologies used include websites, email, portal pages, and virtual learning environments (VLEs). While these technologies do provide an unprecedented medium for communication, they tend to be largely used for administrative purposes. They provide a space to host information about timetables, lecture notes, grades etc. They have taken a turn recently towards a more interactive environment with the introduction of discussion boards, chat rooms etc. These aspects have been particularly beneficial for part-time and distant learning programs. Although these technologies include both synchronous and asynchronous communication technologies they generally are only utilised for their asynchronous functionality. These approaches lack the immediacy of natural dialogue and can lead to "lurker" behaviour. One emerging technology that provides both synchronous communication and a sense of social presence is that of multi-user virtual environments or MUVEs (Kemp & Livingstone., 2006).

Although these technologies have become pervasive in the third-level education institutes there has been a limited adoption of theory to complement its use as an effective knowledge building environment.

This thesis intends to explore a broad range of theories to provide a framework to both help design and evaluate a MUVE specifically designed to scaffold knowledge building. Knowledge building (Bereiter, 2002) is explored from a epistemological perspective in order to describe the motivation, direction and approach of this work. Bereiter's schema builds on the ideas of Karl Poppers *"three worlds"* (Popper, 1978), where ideas or concepts maybe be viewed as external conceptual artefacts, and that knowledge building involves the technological manipulation and augmentation of these external conceptual artefacts, in this case through the use of the MUVE. While this does give a theoretical underpinning it does not provide a sufficient framework to design and evaluate the experience within the environment. Therefore the Community of Inquiry (Garrison & Arbaugh, 2007) framework is suggested to provide basic design principles and a rubric when analysing the collaborative interactions.

The learning environment will centre on a Second Life™, MUVE designed to facilitate knowledge building through traditional and peer supervision. Within the MUVE a meeting area was created that provided presentation facilities and links to a VLE, allowing the

participants to externalise the ideas they are working on in order to share with other. MUVE technologies are limited at present and thus the design of the overall learning environment called for the introduction of a Moodle, an open source VLE, and Web 2.0 technologies to augment the MUVE infrastructure.

The research methodology of this study shall be an opportunistic ethnographic case study. It shall therefore hold the perspectives, culture and environment of the participants and researcher as the main driving force behind the data collection. Utilising a mixed methods approach, a transformative strategy will be use the theoretical framework aforementioned as a "lens" to analyses the data collected.

The data shall be collected from participants studying for a masters in technology and learning course at Trinity College Dublin. Using opportunistic sampling, 9 participants from the student and academic staff were involved in both traditional (student and supervisors) and peer supervision sessions within the environment. Due to unforeseen and uncontrollable circumstances the data collection was restricted, thus limiting the transferability of the direct results, but it is hoped that the researcher's experiences, observations and reflections will provide a context to enrich the collected data.

The findings suggest that there is potential in using MUVE technology to create an open-source knowledge building environment. The initial a steep learning curve when using MUVEs to interact and the data does suggest that it may not be ideal for large groups to interact. MUVE technologies do have their limitations, but this is an emerging area and the infrastructures are continuously evolving. The use of the Community of Inquiry framework suggests that parallels to the presences required in the theory (social, cognitive and teacher presences) do emerge from the interactions and how their absence may affect performance. This insight suggests possible techniques or practices to aid future designs and implementations, of similar setups, to be more effective. In essence MUVE interactions may not provide the level of interaction as face to face, but they do offer an alternative that warrants further research. But to do so it is recommended that full institutional support is acquired and that the community is inducted early on in the process.

Chapter 2: Literature Review

Qualitative Research and Knowledge Claims:

> *"Qualitative research is a type of educational research in which the researchers relies on the views of participants, asks broad, general questions, collects data consisting largely of words (or text) from participants, describes and analyzes these words for themes, and conducts the inquiry in a subjective, biased manner." (Creswell, 2005)*

Qualitative research by its very nature is a subjective and biased activity. Therefore it is imperative that any qualitative researcher acknowledges and incorporates these ideas. Biases should be limited or at least made explicit, particularly when interpreting data (Marshall & Rossman, 2006; Miles & Huberman, 1994). Gilovich (Gilovich, 1991) states that people are adept at making ad-hoc explanations, but that they often make these assumptions based on misinterpreted or misperceived data, or put too much weight on ambiguous data, resulting in biased interpretations. Consequently when conducting qualitative research it is necessary for the researcher to make a "knowledge claim", meaning that they will state their approach to the subject and the assumptions that accompany this approach. Socially constructed knowledge, advocacy/participatory knowledge and more recently pragmatic knowledge are three major paradigms that qualitative researchers adhere to when conducting their research (Creswell, 2003), this provides a philosophical framework for their knowledge or ontology formation.

Creswell also states that it is necessary for the researcher to self-reflect on their biases, as this will make their work clear, open and as a result more valid. Other work on bias in qualitative research (Denzin, 1989; Mehra, 2002) has shown that even the research topic chosen by a researcher is a result of their personal interests and biography, again reflection is referred to as a solution in creating a more valid interpretation. Other methods for validating analysis are the use of an external auditor and peer debriefing, this compliments the paradigm of socially constructed knowledge (Creswell, 2003). Therefore general knowledge claims shall be explored in the following sections with the aim of converging on the use of both virtual learning environments (VLEs) and multi-user virtual environments (MUVEs). These concepts shall be utilised in the design an artefact, while also providing qualitative to aid in the analysis of the study as a whole; artefact, learning experience and the researcher's approach and justifications.

Knowledge

Although knowledge is a widely used term throughout the literature, it is rarely explicitly defined and the meaning is usually implied. This issue is broached by Carl Bereiter in his book “Education and Mind in the Knowledge Age” (Bereiter, 2002), in this work Bereiter argues that our current use of the term knowledge is derived from a “folk” psychology and epistemology where personal knowledge is thought to reside wholly in the mind and public knowledge is merely the expression of such knowledge.

Bereiter argues that to effectively work in the “knowledge age” we need to replace this “mind as a container” interpretation. A connectionist explanation of the brain is proposed to show that there are alternative ways of viewing the brain as containing stored “knowledge”. This approach stems from artificial intelligence research whereby thought may be conceived of as “a lot of interconnected units, activating and inhibiting each other by energy transmitted over their connections” (Bereiter, 2002). Here the view is that the mind does not contain an actual representation of a particular instance of knowledge, but rather the externalisation of such knowledge is a result of the interaction of the connections, “all the knowledge is in the connections” (Rumelhart, 1989). Further evidence of this may be found in the somewhat controversial holographic theory of the brain from neurobiology (Pribram, 1991).

Contemporary educational theories such as those of the situated cognition theorists have been slowly moving from this stance. These theories approach knowledge as being distributed, constituted of social practices and embedded in the tools and artefacts used in those practices (Lave & Wagner, 1991). Bereiter argues that although this approach does show a shift in focus, it does not offer a comprehensive interpretation of knowledge and thus limits its applications. Although the situated cognitive theory may not be comprehensive it still contains aspects that are relevant and may be used in parallel with Bereiter’s, we shall return to these later.

The interpretation of knowledge in Bereiter’s book originates from Karl Popper’s “Three Worlds” epistemology (Popper, 1972, 1978). In this elucidation Popper proposes a pluralist reality composed of three worlds. World 1 is the physical world. World 2 consists of the subjective or mental processes. World 3 is that of objective ideas or what Bereiter calls “conceptual artefacts”; it is important here to note that Popper viewed the contents of World 3 as human creations that are fallible yet improvable. As a result they become something to work with. The final point, which may the most important, is that these ideas, once free of their creators, can become semi-autonomous. That is to say that they

may take on characteristics, implications and applications that were not conceived of by their creators.

> *"it does not matter much whether we can clearly separate knowledge of conceptual artefacts from knowledge of the world they pertain to. What matters is that we recognize conceptual artefacts as real things, recognizing creating and improving them as real work, and recognizing understanding them as real understanding."(Bereiter, 2002, p. 67)*

It is the author's belief that this tenet is crucial in designing and implementing an efficient knowledge-building environment. Viewing knowledge as external conceptual artefacts allows them to be subjected to the same analysis one can apply to any World 1 object, while separating it from the subjective processes that occur in World 2. But to do so effectively, we must explore and differentiate World 3 from World 2; this is what the following section sets out to accomplish.

Personal Understanding and Knowledge

Personal knowledge and understanding is traditionally thought of as residing in the mind and communicated through the learning process. But in this new paradigm of Bereiter's there is no content within the mind, so what replaces the void?

Bereiter first posits the idea that instead of viewing understanding as an internal mental state, it should be viewed as a relationship between the person and the object of inquiry. Here learning (for understanding) is seen as the process whereby this relationship is refined, making it not to distant from the constructivist ideology.

> *"By casting everything in terms of mental content, the mental models approach focuses attention on the shortcomings of students' mental models rather than on the richness of what there is to be learned. Major theories have great depth and wide implications. Coming to understand a living theory means establishing a many-faceted relationship and one that will keep developing as one's experience grows and as the theory itself evolves. This grand sense of what is there to be understood —a sense that has guided traditionalists of the classic variety for centuries—tends to get lost in what amounts to a mental remodeling operation."(Bereiter, 2002, p. 119)*

To further explore the idea of understanding Bereiter introduces the work of Kieran Egan (Egan, 1988). Here a number of forms of understanding are introduced, five in total, which

seem to have emerged from society from a historical perspective. Somatic understanding is that which is associated with biological functioning, and is not limited to the human race. Mythic understanding is developed in early childhood and is characterised by understanding through stories. Romantic understanding has emerged through literature, having humans and their feelings as central characteristics of the understanding. Philosophical understanding is quite unlike romantic understanding in that it is detached and objective, and would be most obviously expressed in fields such as science and mathematics. Finally there is Ironic understanding; this form of understanding can be most associated with wisdom and the recognition that all forms of understanding are limited, a position often argued by postmodernists. Here knowledge as we have describe in a general sense would most closely involve philosophical understanding, this said it is still important to realise that there are alternative ways of understanding conceptual artefacts, and thus different relationships a person can have with these artefacts.

Now that we have a description of understanding, what can be described as personal knowledge? Bereiter's solution is to introduce six forms of personal knowledge, it is important to note that although these separate forms are described, when a person utilises their knowledge they will draw on a number of forms and that personal knowledge as a whole is a dynamic process involving these different forms.

Statable Knowledge:

This is knowledge that the knower can make explicit, whether that is through speech, writing, diagrams, equations or enactments. Cognitive theorists usually refer this to as "declarative" knowledge, but Bereiter makes a distinction that his statable knowledge does not include unarticulated, unconscious knowledge that some also consider to be "declarative" knowledge. He does however admit that the distinction is not clear-cut and may vary from situation to situation. This form of knowledge is what has been of most concern to epistemologists and formal education. In fact this is what formal education is mostly about, testing this statable knowledge.

> *"All overt actions and products can be discussed, evaluated, reflected upon, but statable knowledge is distinctive in that it can be discussed, evaluated, and reflected upon as knowledge. … … Statable knowledge is thus the World 2 counterpart of World 3, the world of abstract knowledge objects. It is the personal knowledge that we can objectify and thus bring into the social processes of knowledge building (Nonaka, 1991). However, as we shall see later, its role is*

broader than that, influencing all the other aspects of knowledge that we shall consider." (Bereiter, 2002, p. 138)

This highlights the importance of this form of personal knowledge and it's affects on the other forms. In a research environment this form will play a major role in the communication of concepts, these ideas will be explored in more depth later on.

Implicit Understanding

It is important here to note that Bereiter refers to this as "understanding" as opposed to knowledge; he makes this distinction as implicit knowledge would inevitably influence all the forms of knowledge we are talking about here. This is where a person has knowledge of a thing or situation that would be viewed as intelligent, but would not be able to express their reasoning for it.

"For instance, many adults I have questioned can offer no sensible explanation of why one suffers worse injury falling out of a second floor window than out of a first floor window—this despite the fact that on further questioning they demonstrate the knowledge that acceleration due to gravity means that bodies gain speed as they fall." (Bereiter, 2002, p. 140)

Sometimes it may be appropriate to make implicit understanding explicit and try a merge them with statable knowledge, this may be accomplished if the statable knowledge and implicit understandings are abstracted to World 3, where they may be compared and integrated as conceptual artefacts. It should be noted that this easy no easy task to accomplish and Impressionistic Knowledge, which we shall come to shortly might also play a part in resisting this merging.

Episodic Knowledge

This form of knowledge is composed of memories of experiences; evidence suggests that this is different to "semantic memory" as covered in the previous two forms. It is knowledge acquired through experience that may or may not be useful. "Navigation" of this knowledge is tedious as links are superficial, but it cannot be denied as it is used pervasively in "case based reasoning".

Impressionistic Knowledge

Feelings and impressions influence our thoughts and actions. This is a topic that has only starting to gain ground in the past decade or so. Some literature explores the idea that

feelings can direct thought through bias (Frijida, Manstead, & Bem, 2000), it is even suggested that these feelings affect preference of "experiential knowledge" or Episodic Knowledge over "prepositional Knowledge" or Statable knowledge. This may also explain why there have been cases that have shown that students frequently do not believe what they are learning in class, but may have a good understanding of the subject matter (Chinn & Samarapungavan, 2001). Again this idea that there is a distinction between an affective process and knowledge is explored (Pehkonen, 2003), here belief seems to imply personal knowledge in general while "understanding" seems to come closer to what we mean by World 3 objects. Although the language may vary across the literature the theme remains the same, that emotions and feelings have a large impact on our knowledge formation.

Bereiter also suggests that creative efforts may stem from this form of knowledge, but leaves us with a word of caution:

> *"But feelings and impressions also constitute important knowledge in circumstances where reason and evidence offer no guidance. This is generally the case with creative efforts. … … The reason creativity isn't mere chance is that creative people become very adept, within their particular fields, at making risky choices that turn out to be good ones. They go by feeling, impression, or what in this context is often called intuition. Creativity remains clouded in mystery, however, unless we accept impressionistic knowledge as knowledge that grows and improves with experience like any other. … … Impressionistic knowledge is also the stuff of prejudices, phobias, and crazes, however. Pointing this out is only to recognize that any kind of personal knowledge can be dysfunctional, can lead us to act in ways that may seem intelligent to us at the time but that may be judged quite differently by others or by ourselves from a different vantage point."(Bereiter, 2002, pp. 142-143)*

Skills

The term skill here means the temporal acquisition of any ability; it is constituted of two parts, cognitive and sub-cognitive. The cognitive is the "knowing how", whereas the sub-cognitive component is the temporal change in skill with practice. Although some situated cognitive theories separate the terms knowledge and skills (Brown, Collins, & Duguid, 1989; Lave & Wagner, 1991), they are both categorized under personal knowledge in this theory.

Regulative Knowledge

This final form of knowledge pertains to knowledge about oneself in action, what is also known as "metacognition". Here the knowledge is about how one acknowledges and approaches an action. For example in any scientific study truth and objectivity are usually taken as attributes that one should take to their work and are thought of as obvious attributes of statable knowledge. Unfortunately this argument can come under attack from those arguing that objectivity and truth are debatable. Bereiter solves this issue by proposing an alternative position:

> *"What I propose instead, however, is that truth and objectivity are not attributes of scientific knowledge, they are components of the knowledge that regulates the conduct of inquiry. In short, they are part of regulative knowledge."(Bereiter, 2002, p. 146)*

This form of knowledge plays a major role in shaping a researchers approach to their work. It will therefore need to be explored in more depth; this shall be expanded upon in the following section, when we shall look at the social equivalent of regulative knowledge.

Social Understanding and Knowledge

So far we have only dealt with understanding and knowledge in relation to the individual and in an abstract sense i.e. World 3 objects. Now we shall move into the domain of social and situated cognitive theories, social practice and communities. This area is paramount when constructing and effective community. These theories have a lot in common with Bereiter's but they do differ on a number of interpretations, it could be said that Bereiter has developed and worked on these various theories and their conceptual artefacts.

The main difference here is the level of emphasis, situated cognitive theories emphasises the "enculturation" of knowledge (Brown et al., 1989). Here knowledge that is situated in activity is considered to hold more importance than "school" learning. This situated knowledge allows the learner to become acquainted with the culture that the knowledge is to be used within. It is the author's opinion that these reactionary ideas are too limited and in fact hinder interdisciplinary research as the faculty knowledge and culture may limit the researchers scope and direction (Golde & Gallagher, 1999). Bereiter introduces the idea of social equivalents to the aforementioned personal knowledge, which resides in neither World 2 nor World 3. What the situated cognitive perspectives call situated knowledge would be the social skill, impressionistic, implicit, regulative and episodic knowledge. Leaving statable knowledge equivalent to "school" learning. In particular

social regulative knowledge and skills would resemble this "encultured" knowledge; this would be the norms, traditions and activities of a particular culture. This new approach allows these ideas and practices of any culture to be explored, to do so one would first need to understand the culture, but rather than just going along with as situated cognitive theory suggests, one can take action based on reviewing these processes. This idea lies closer to social cognitive theory (Bandura, 2001) where the learner is actively involved in the shaped and dynamic evolution of the social structure.

Social cognitive theory also fits closer to Bereiter's views, as it extends aspects of personal knowledge into the social arena.

> *"Group attainments are the product not only of the shared intentions, knowledge, and skills of its members, but also of the interactive, coordinated, and synergistic dynamics of their transactions. Because the collective performance of a social system involves transactional dynamics, perceived collective efficacy is an emergent group-level property, not simply the sum of the efficacy beliefs of individual members. However, there is no emergent entity that operates independently of the beliefs and actions of the individuals who make up a social system. … … In this model of reciprocal causality, internal personal factors in the form of cognitive, affective, and biological events, behavioral patterns, and environmental influences all operate as interacting determinants that influence one another bidirectionally."(Bandura, 2001, pp. 14-16)*

This covers most of the personal knowledge forms and extends them into the social domain; here the affective element is acknowledged as interacting with cognitive functions. The ideas that these two aspects are related and also affect social structure are echoed elsewhere. In Oatley's (Oately, 2000) work he mentions three forms of distributed cognition that emphasize the different interactions that occur within a social culture or community, temporal distribution, social distribution and externalization. These forms of distribution are not to be taken independently but as aspects of a dynamic interaction of the three.

Temporal distribution is the distribution of cognition over time, this allows an individual to adapt their behaviour as time goes by, that is they are able to learn to act differently for the future. It also plays a major role in cultural transmission, which develops from the social and sentimental goals of affiliation, an idea supported elsewhere (Jones & Issroff, 2005). Temporal distribution allows for an individual's beliefs to converge with those of

the wider community, thus promoting empathy and the resulting affiliation and identification.

Social distribution allows for humans to distribute their cognition in order to overcome some of the defects of individual cognition, such as bias. This factor is very important in the progress of scientific knowledge as discussed by Popper (Popper, 1963), whereby knowledge evolves not from confirmation of theories, but by seeking disconfirmation, as peer-reviewed systems endorse. Oatley also proposes that this form of distributed cognition is what gives rise to affiliation, as it arises from the desire to accomplish common goals that would not be attainable by the individual, an aspect viewed as important in communities of inquiry (Garrison & Arbaugh, 2007). Here social presence, cognitive presence and teacher presence within the learning environment are necessary for effective learning to occur. Social distribution provides a description for both social and teacher presence to emerge, but they do not guarantee cognitive presence.

Externalization is a process that allows the conversion of difficult to perform tasks to something that is relatively easy to accomplish, through the use of technology. Language and writing are used as examples of such externalization. Writing allows us to refine our use of language allowing us to read, edit, transform and rewrite what we have written. If this is applied to the community of inquiry model, some externalised process may provide "a triggering event, where some issue or problem is identified for further inquiry" (Garrison & Arbaugh, 2007) and initiate cognitive presence. In Forsyth and Eifert's (Forsyth & Eifert, 1996) work they claim that language is not only "verbal-emotive" but also "social-verbal" where "semantic conditioning" and "emotional meaning" are to be considered. Again this highlights the interconnected and holistic picture that is emerging. There is some support for the idea that social distributed and externalized cognition have both conceptual (Bateman, 1995 ; Bereiter, 2002) and technological (Resnick, 1987) expressions.

Knowledge "Objects"

This idea that we externalise in order to help augment our cognition reflected in a work that suggests that like we use language, artefacts and methodologies in order to externalise or cognitive process we also use technology to the same (Skagestad, 1993). This work also embraces Popper's "three worlds" interpretation and views this process as "symbolic manipulation", emphasising a semiotic perspective. This paper follows the introduction of computer technology into this process and supposes that now that

computers can perform symbolic manipulations themselves thus freeing up our cognitive functions. But these technologies capture our conceptual artefacts in their design, but can become semi-autonomous thereafter or contain their own type of knowledge (Resnick, 1987). This echoes Bereiter's interpretation:

> *"Further, our conception of how we think will determine how we structure those external things, just as their structure in turn guides the direction of our thinking."(Skagestad, 1993, p. 13)*

Bateman (Bateman, 1995) posits the idea that language and their resulting ontologies are socio-semiotic constructs. Language is externalised and negotiated, but he does make a demarcation between formal and natural ontologies, here formal ontologies may be closer to our conception of real objects, whereas the natural ontology could be viewed as World 3 objects or conceptual artefacts such as ideologies or contexts. It is important to note that Bateman also views these ontologies as incomplete and always in a state of "flux".

If we take the idea of externalisation and apply it to Bereiter's and Skagestad's World 3 interpretations, we can extend the initial idea that technologies and language may be externalised so that it now include the externalisation of conceptual artefacts. Therefore the idea that we should view conceptual artefacts just as we view technological or linguistic artefacts is justified. We must externalise objects before we can perform constructive operations on them. Otherwise we risk that they will remain implicit and therefore limit our creative exploration of our knowledge and thus our learning ability.

Utilising all of these ideas brings in line with the requirements of the "communal constructivism" paradigm (Holmes, Tangney, FitzGibbon, Savage, & Mehan, 2001) whereby the members of the community not only develops their own knowledge but actively creates knowledge ***for*** their community, where knowledge here can now refer to technology or language. Examples of methods to promote this approach that are mentioned: "peer tutoring and mentoring", "virtual chat rooms", "MOOs", "discussion boards" and "apprenticeship". Although the approach here takes a somewhat alternative route the outcome remains the same, community members will work on externalised knowledge, which should be left for future participants to utilise.

Virtual Knowledge-Building Environments

So far we have explored knowledge-building from an epistemological rather than practical perspective. It is hoped that this diversion has clarified the position that this research

takes when discussing knowledge and thus knowledge-building. We shall now look at what needs to be considered during the design process and how such a system may be practically implemented.

The birth and evolution of computer technologies has enabled learners to augment their cognitive functions, while also freeing them from temporal and spatial constraints with the introduction of the Internet and communication technologies. This ability to input, augment, store and communicate knowledge from a technical sense embodies most points we have discussed so far. But if technology is to be used to create an effective learning environment for a novice researcher community, an analytical framework is required. The community of inquiry framework (Garrison & Arbaugh, 2007) as explored previously in relation to social knowledge may provide a good guideline. As discussed this suggests that for an affective community to develop, three aspects need to be addressed, teaching presence, cognitive presence and social presence.

Teaching presence

This is the traditional approach and is needed to guide and motivate the learner in a certain area. There are three distinct dimension mentioned in the community of inquiry approach, instructional design and organisation, facilitating discourse and direct instruction. Instructional design and organisation involves providing materials to the site of learning, organising meetings, providing personal insights and guidelines of how best to use the medium effectively. Facilitating discourse:

> *"This role is associated with sharing meaning, identifying areas of agreement and disagreement, and seeking to reach consensus and understanding". (Garrison & Arbaugh, 2007)*

Direct instruction:

> *"a subject matter expert, not merely a facilitator, must play this role because of the need to diagnose comments for accurate understanding, inject sources of information, direct discussions in useful directions, and scaffold learner knowledge to raise it to a new level". (Garrison & Arbaugh, 2007)*

Cognitive presence

Cognitive presence means that the learner needs to be engaged. This may be accomplished by having defined tasks or tasks that are relevant to the learner's needs,

utilising what has been considered before, a world three object or externalised object may be applicable here to initiate the cognitive presence.

Social presence

Social presence has a lot to do with the issues discussed in the section on social knowledge. Although these are three separate aspects it is suggested that they all have to interact to produce an effective community of inquiry.

Teacher and cognitive presence may be achieved to a limited degree in regular virtual learning environments (VLEs) that are used pervasively today in higher education; it is the author's belief that they have limited scope to facilitate social presence effectively. They are also generally used a "document repositories" rather than a pure communication medium (Kemp & Livingstone., 2006). Kemp and Livingstone suggest that augmenting these VLEs with Multi User Virtual Environments (MUVEs) provide them with a richer experience.

> *"Compared to other electronic tools for distance communication, there can be an improved sense of being 'there' in a classroom, rather than of being a disembodied observer"(Kemp & Livingstone., 2006)*

3D MUVEs worlds are suggested to provide a more immersive experience that promote a feeling of greater presence (Kemp & Livingstone., 2006; Sanders & McKeown, 2008), while also allowing users to create, manipulate and interact with content (Coffman & Klinger, 2008). It is suggested that the serendipitous encounters that can occur in such an environment act as a catalyst and help learners get more involved in the community. These aspects combined reflect the particulars desired to create an effective knowledge building Environment.

Chapter 3: Design

Design Introduction

As this study will be looking at the interactions of a small group of students from a masters course in technology and learning within a MUVE, it should incorporate the concepts discussed in the previous chapter. This design aims to create an easy to replicate environment with the minimum of technical skills so as to create a reproducible learning experience for future research. In this study two types of learning experience were designed, one that simulated traditional supervision, the other was for peer support. The first case had participants from the first year of the masters course accompanied by members of the academic staff, this group focused on the dissertation writing process. The second case involved a group of second year students collaborating, this group focused on preparation for presenting their finished research. The design choices emerged from the suggestions from the literature and will explored in the following section, this is summarized in Table 1 in the appendix 1.

In this case Second Life™ (SL) will be the instance of a MUVE. SL was chosen as there is research being conducted within the research group running the masters course, so there was the opportunity to utilize some virtual "land" on which to construct a learning experience free of charge. SL is also applicable as it is generally free to use, and does not have any specific task associated making it open for the designer to construct their own environments or tasks. It has an open-source language called Linden Scripting Language that allows designers to create interactive objects. Due to the limitations of SL as mentioned in the literature, a Moodle VLE was used to augment these restrictions (Kemp & Livingstone., 2006). Moodle is a PHP web-based VLE.

As we have chosen to use the community of Inquiry framework (Garrison & Arbaugh, 2007) to design the learning environment, we shall explore the three dynamic interacting presences it calls for when creating such an environment.

Social presence

Social presence is necessary to provide the basis on which the activity will take place; this includes social affinity with the other participants, comfort within the environment and a medium to communicate ideas and discuss meaning (Bandura, 2001; Jones & Issroff, 2005; Sanders & McKeown, 2008). It is possible to facilitate these aspects using the affordances

of MUVE technologies, where Second Life™ (SL) is the chosen instance here (Kemp & Livingstone., 2006). The avatars presence within the environment and the ability to see the avatars of their colleagues creates an immersive environment and creates the potential for serendipitous encounters. The chat or voice functions provide a basis for synchronous communication, that offers a sense of immediacy. Regular users of SL will also notice that the interactions are informal and generally include internet terminologies and emoticons.

Due to the impressionistic nature of personal knowledge it may be important to create a friendly environment, but this has to be combined with the practicality that this environment will be used by novice SL users where clutter and uneven surfaces can cause issues with load time sand navigation. Therefore it was decided that the main meeting area was to be kept flat and relatively uncluttered. This technology provides an interactive, immersive environment that allows for easy communication, but the literature does suggest that it is limited when it comes to hosting information.

Cognitive presence

In order for effective cognitive presence to be achieved the literature suggests that there needs to be an externalized “object” or task to focus on (Oately, 2000), so the design calls for a method of hosting current work for others participants to review and discuss, the Moodle VLE technology provides the tools necessary to store and discuss content. Moodle is a free open-source PHP based VLE that is straightforward to set up and maintain. Although it would be ideal for the Moodle contents to be displayed with SL, the infrastructure does not exist at present to allow this. Unfortunately presently SL only takes in images to display on objects, at a cost and writing on objects is a very complicated affair. To display an image it costs L$10 which is equivalent to $0.34 in US dollars, although small this has to be paid to host the file. Therefore the participants will only be asked to upload there documents to the Moodle before they are converted to images and uploaded to the SL environment and placed within the provided whiteboards by the researcher, in this case fulfilling the role of instructional design and organization as shall be discussed in the following section. Although there is the facility for the participant to do this if they have the funds and knowhow to do so.

Teacher presence

The design also requires teacher presence, this characteristic will not be present directly within the technology, but should emerge from the activities conducted in order to create an effective learning experience. The learning experience itself calls for a teacher presence to organize the experience. Here the researcher is active in organizing times and facilitating the shortcomings of the technology. The Moodle may provide a part-solution by providing an asynchronous communication in the form of forums, where the participants may post up about their projects or suggest a meeting time. The rest of the teacher presence characteristic suggested in the literature will be provided to the learning experience through the choice of participants whom can act in a manner to both facilitate discourse and directly instruct others. Therefore for each session it was expected either a member of the academic staff or at least a peer member who was knowledgeable in the area that was under discussion is present. This characteristic is also promoted by the communal constructivism approach (Holmes et al., 2001).

Temporal distributed cognition

Temporal distributed cognition is noted in the literature as being an important aspect for the development of knowledge, therefore a tool that logs the sessions and allows the participants to these sessions will allow them to both call upon it in future and reassess the past experience. This may allow for personal knowledge to move from implicit to statable. Therefore an open-source technology that combines SL and Moodle technologies, named SLoodle (Kemp & Livingstone., 2006), was utilized as it allows the creation of community viewable logs of the SL sessions within the Moodle. It also offers the affordance of allowing users to communicate with the sessions within SL through the Moodle chat function, this may be useful if there are technical issues and the participant can't access SL for whatever reason.

Implementation:

Fig. 3-1 shows the final layout of the SL environment. As can be seen the avatars are present within the environment, social presence. One of the avatars is a supervisor, teacher presence. There is a whiteboard that is used to display the externalized "object" that is currently being discussed. These whiteboards are widely available within SL educational research communities for free. It should be noted that these objects are

easily duplicated and moved, so the environment can be adapted quickly for the needs of the meetings.

The environment also provides links to the Moodle forums, for easy review and access. Example projects and their accompanying dissertations were provided as links in order to create an incentive for first year students to visit the environment, while also offering examples of the wider communities' knowledge.

During initial design these links would be opened up in an external web browser, which could cause crashes on lower end computers. Another issue is that having to juggle between the two programs may create cognitive overload to the less tech savvy users. A new release of SL created the ability to open web pages within an internal window within SL, this may solve or at least reduce the issues that could arise in the older version.

The SLoodle Webintercom block, above the campfire, records a log within the Moodle after user have "touched" it in SL and allowed it to record their contributions, it also allows for users not able to access SL to participate in the sessions through the Moodle chat system. They appear in the chat thread within SL.

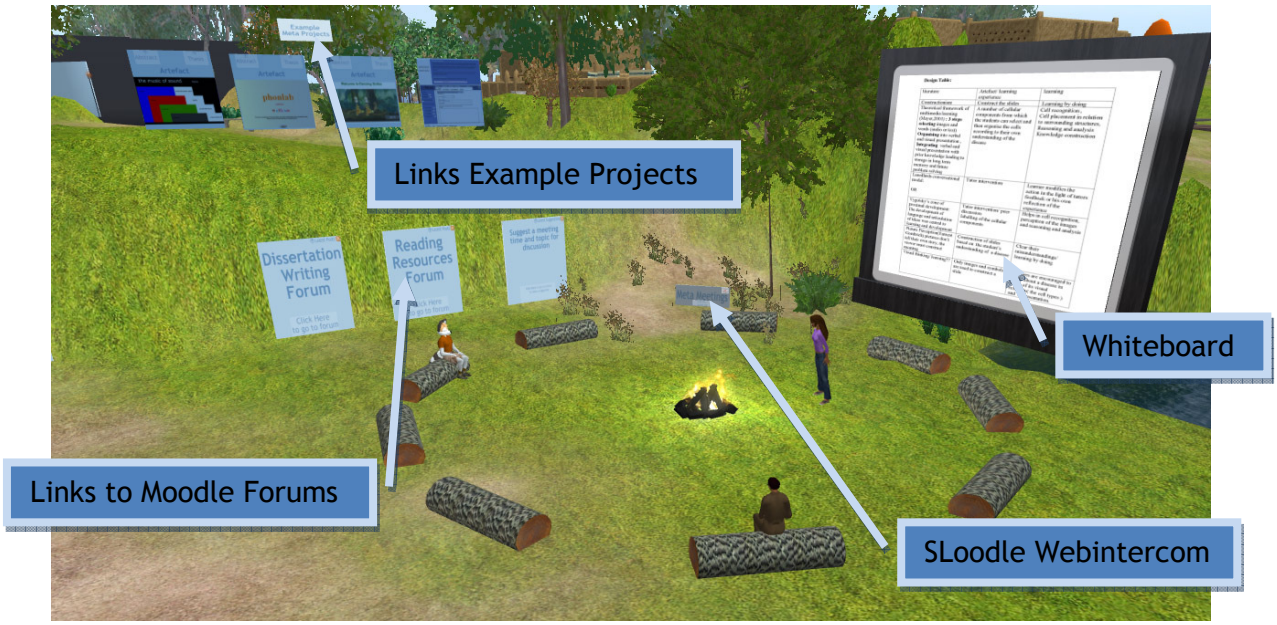

Figure 3-1: General Layout of SL Environment

Figure 3-2 shows the Moodle layout. This was visible to the first case scenario. It includes a chat functions, this is where the log is stored for future reviewing, a forum to post there

abstract and presentation, and a wiki to store relevant information. Another forum is also provided to arrange future meetings. For the second case scenario the chat and forum function were duplicated.

Figure 3-2: General Page Layout

Design for Data Collection:

Some tools were needed to monitor the interactions and visits within SL, as the SLoodle Webintercom already inputs the session logs into the Moodle databases, that communication logging had been completed. It should be noted that SL terms of service require that the permission is acquired before logging communications, the SLoodle Webintercom follows these terms. Visits to the SL environment were captured using simple objects that detect the presence of a user; it then sends basic data about the username and location to a server that adds a timestamps and submits it to a MySQL database via a PHP script. This object checked every 15secs in order to distinguish short pass-through visits from more meaningful longer visits.

Additional Design Features:

Some Web 2.0 technologies were explored as additional tools the participants could use if they explored the surrounding area. These included links to the del.icio.us tagging site where users can tag website based on the content and share these tags. This was realized within SL as a board with a description describing its function and above it an RSS feed would display the last five added term to the del.ico.us site created for this purpose, a forum was also created in the Moodle to make suggestions to add to the del.ico.us tag list. The idea here was to allow the participants to share and create additional resource for their colleagues. Although it should be noted that the RSS feed capability was purchased within SL.

A define and etymology tool were also developed to explore the proof of concept, theses would take a term typed by users within SL and generate a blurb returned from Google define for the define tool and Etymonline for the etymology tool. This was achieved using Linden Scripting Language (LSL) and PHP scripts on a server.

Chapter 4: Methodology

Research Design Methodology

As this research shall explore the interactions of 10 post-graduate educational research students, an ethnographic case study (Creswell, 2003) has been chosen as the research design methodology. A case study was chosen as it allows for an in-depth analysis of a bounded system, as the research will only explore the usage of the environment by a small number of participants whom share a common goal, college course and time constraints, it was deemed that a case study would be applicable. This should help to obtain a more holistic picture of the participants' experiences. A pragmatic paradigm shall be adopted to allow pluralistic and holistic views, this led to a pseudo-grounded theory approach where aspects of the literature were taken as a basis for the design of the artefact and then observations were made to see if these aspects emerged from the data and observations over the implementation period. As discussed in the literature review qualitative research is inherently biased and interpretive (Creswell, 2003). Therefore in the analysis a reflexive approach will be undertaken, while leveraging off the other concepts discussed in the literature review, in particular aspects of the researcher's personal knowledge.

Data Sets

Quantitative Data Sets	Qualitative Data Sets
VLE Login stats	Communications with participants
Virtual Space Visits	Discussion Articles (CMC)
Site Usage Stats	Meeting Logs
Specific Questionnaire Questions	Specific Questionnaire Questions
	Codes from meeting logs
	Codes from Questionnaires
	Themes from meeting logs
	Researcher's reflections

Table 4-1: Data Sets

Most of the data will be collected using the data collection methods mentioned in the design chapter, in Moodle databases, online survey and logs from meeting saved to disk. A data collection protocol was followed whereby each entry was time and date stamped and the usernames of the participants were recorded; for example see Table in the appendix 2.

The quantitative data sets will give an overview of how the users utilized the environment. The login statistics will show how often the users logged in to use the system and how often they returned to the system after they first logged in. The logs will show how often the users viewed the posts made in the discussion on the VLE, or how often they attended the meeting/resource area, this will help explore how often collaboration was pursued and whether users just "lurked".

The qualitative data sets should provide some answers to the research questions. Codes and themes will be extracted from these data sets. These codes and themes will then be combined with the research questions to construct purposeful question for a post-usage semi-structured interview (Creswell, 2003). It is hoped that the results of the interviews will help in exploring some of the unexpected and alternative themes that have emerged from the data. It may then be possible to explore the potential of creating new codes and themes, to get a more rounded view of the case.

Data Handling

For the data from the on-line environment to be analyzed it first had to be extracted from the Moodle database on the server. This was easily done through the web interface of the Moodle site, there are built in logs of both the sessions and the Moodle usage of each participant. These web based session logs were then copied into a word processor for formatting and to prepare it for coding and themeing; an example can be seen in Table 3 in appendix 3. The statistical data for the quantitative data sets was entered into spreadsheet editor for the creation of graphs.

Data was also collected as notes by the research in an informal manner, these were collected during communications with participants when arranging meetings or discussing the experiences of the meetings. This approach was taken due to the ethnographic nature of this study and the researcher's position as a member of the community.

Ethics

All data will be made anonymous before being used within this study and any requests by participants to remove data from the findings will be respected.

Privacy is paramount and only the researcher shall view the original unaltered data, this does not apply to users passwords as are encrypted so as they cannot be viewed by anybody. If it is necessary for any third party to view the data, it will be made anonymous and permission to do so will be sought from the relevant participant.

Data will be kept for a period of five years, after this time it will be disposed of in a manner that will guarantee the anonymity of the participants.

Researcher/designer Bias

Researcher/designer bias is of particular interest as this is a major aspect of qualitative research. It has been noted that during the design process that it is likely that the researcher, as a lone designer, will bring many of their biases to this process. These may include technological implementation, display and interface preferences. What may be intuitive to the designer may not be so straightforward to the user. These issues as well as the implementation and analysis of the learning experience will be explored in the discussion and findings, with particular emphasis in the researcher's reflexive passages.

Reliability and validity

To verify the results a number of strategies will be employed. Triangulation of data; data will be collected from a number of sources: logs, researcher observations and questionnaire. Researcher bias shall be explored in a reflexive fashion. All data shall be explored this includes discrepant data. Any final findings shall be grounded in the data with the aim of reducing researcher bias.

Participant Selection and Implementation

The participants were chosen using an opportunistic sampling method. An email was sent out looking for volunteers, 10 responded. These students come from a single course and are familiar with each other; this should provide a level of trust between them and a sense of community will have already developed.

The environment will be accessed on-line in the researchers own time over a two month period. Unfortunately there are time constraints on the study, both in its implementation and on the time available to the participants, as they will be conducting research of their own.

Methods of data analysis

Although this case study will be mainly one of qualitative research, a mixed methods approach will be employed to allow a thorough investigation of the system implementation and usage. Thus concurrent and transformative strategies of inquiry (Creswell, 2003) will be employed when collecting and analyzing data.

The data from the environment will be collected over two months; it will then be coded and themed, Fig. 4-1.

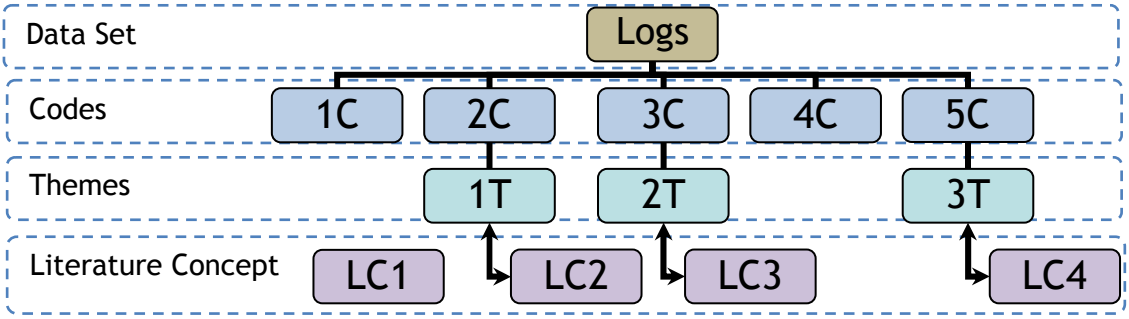

Figure 4-1: Example of Codes and Themes Procedure

To conduct the data analysis it was necessary to compile all the data from the environment into coherent spans of text. The coding and themeing process will be iterative with the aim to sensitize with the data; many passes will be made over each entry looking for codes and themes. After this has been completed, these codes and themes will be supplemented with the researcher's observations and experiences during the process.

Now that the methodology of data analysis has been dealt with, the next section will deal with the implementation of these ideas with the aim to help answer whether the literature concepts emerge out of the data and experience.

Chapter 5: Findings and Discussion

Intro

This section shall explore the data and apply the methodology set out in the previous chapter. Initially some descriptive usage statistics will be used to give an overview of the usage of the environment. Then some ethnographical data collected from the researcher's observations and experiences will describe the culture and context that the study was conducted under. Then the data sets will be explored to looks for codes in order to extract general themes.

As suggested in the methodology section a transformative approach shall be followed where the literature provides a "lens" through which the data is analysed, this should aim to look for, but not be limited to, codes that lie within themes derived from the literature. This should help investigate whether the literature based themes emerge from the process and if so do they offer any insight into the interactions that occurred during the implementation of a MUVE for knowledge building.

Descriptive Statistics

A questionnaire was sent out to acquire some demographics about the participant population, in order to supplement the researcher's observations; obtained as a member of this population. From the questionnaire completed by 9 participants the average age of the users was 40, split 50:50 male and female, this is reasonably representative of the course population from observations. They all owned their own computer with access to broadband at home; this should provide them with the facilities needed to access SL. From the sample 4 rated themselves very good with computers, 4 rated themselves as good and 1 rated themselves as okay, none considered themselves poor; unsurprising considering the course encourages the uptake of computer skills. They had all used VLEs before, with a third currently using them to communicate with their peers; potential for quick uptake of Moodle. Currently 4 use SL regularly, 2 have used it a few times and 3 had never used it, of those that use it regularly only one had a paid subscription account; this suggests that there is a reasonable level of skill and familiarization with SL technologies. 2 have regularly used SL for multi-user activities in the past, 3 have occasionally and 5 have never used it for multi-user activities. 6 believe SL can provide an effective learning environment, 3 are unsure. This sample seems like a decent candidate for conducting

sessions with as some of them have had experience with the VLEs and SL and show interest in the potential of these technologies.

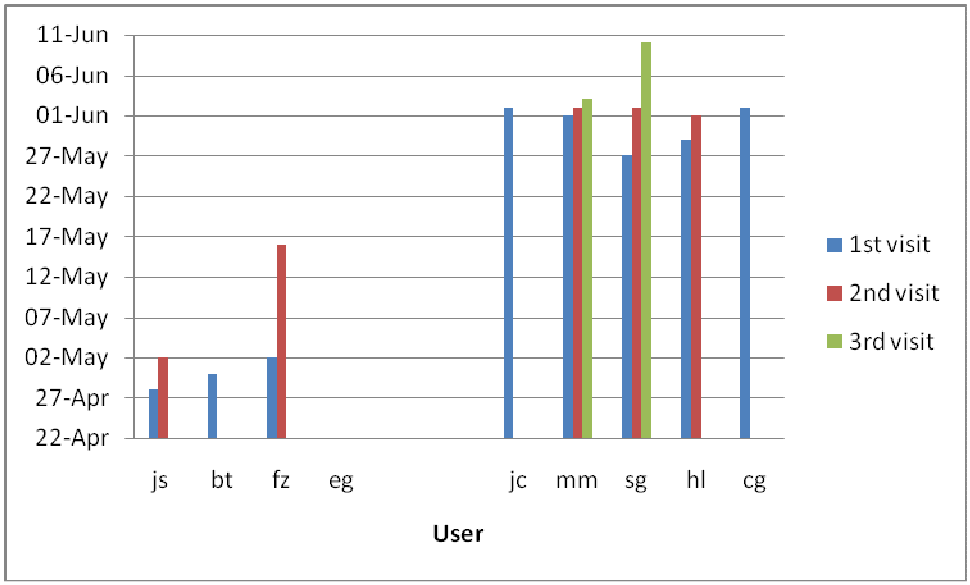

Figure 5-1: Visits to the Moodle site

In Figure 5-1 the group on the left was invited to a traditional group meeting with academic staff, users bt and eg, and peers , js and fz, to discuss the abstracts for the projects they were working on. These abstracts were visible in both in SL and the Moodle, although only one participant posted an abstract, the other claiming time an issue. This is understandable for the first group due to the time constraints on the participants in terms of their own project work, as expressed by the participants during discussions, notably users js and fz. As can be seen in Figure 5-2 user js could not access SL during the session due to it being blocked at his location, but was able to join in the discussion through the SLoodle Webintercom. So although Moodle was not a necessity during the session, it did provide an alternative to SL.

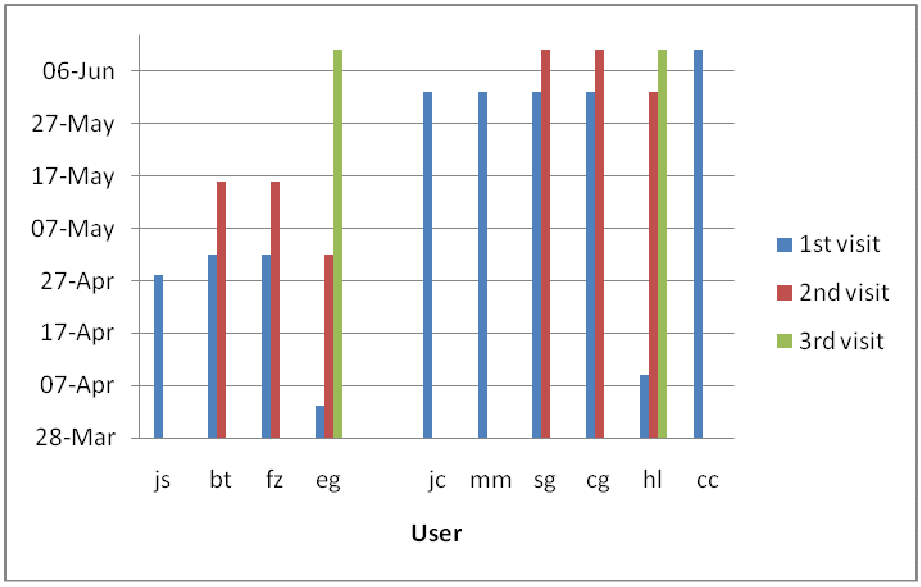

Figure 5-2: Second Life™ Visits

The group on the right was invited to a peer supervision session to prepare to present their work. This group posted their abstracts on the Moodle for review by the other participants, from the data the majority of the participants did so before the meeting and familiarized themselves with the Moodle in their own time. This allowed the research to post up the abstracts in SL for review during the meeting. This group met rather late as the participants had been finishing up their own projects up until this point.

The data shows that most participants only visited the Moodle once or twice, and the majority of those visits coincided with the meetings within SL, that is the April through to June. The context of this data will be discussed from an ethnographic perspective in the following section. A general overview of the research process will be set out before the specific interactions of each meeting are analysed for codes and themes.

Ethnographic Data

The study was conducted as part of a masters in technology and learning at Trinity College Dublin, as a 2 year part-time course. This research was conducted over the second year between October 27 and June 2008.

The study was motivated by the technologies that were emerging within the community, where the class used VLEs to communicate and SL was an emerging research area within the academic staff, where “land” was being acquired for this research. As such the project intended to explore these areas and their use for the course.

The research started with a review of the literature directed towards VLEs for knowledge building during the initial few months, but as the potential of conducting research within SL became possible it was decided that it might be a good opportunity to investigate its prospects. This had brought us to January 2008. Design exploration started within SL at the possible tool and facilities that were possible and to explore the limitations. The researcher was not experienced with the SL technology in terms of design and construction so there was a period of exploration, orientation and investigation. This brought the study up to mid March 2008, at this stage development of tools had been developed on land "borrowed" from the other researcher in SL. Being advised that a new "Island" within SL would be purchased for the course and that the staff would introduce the first years to SL before implementing this study, the research was delayed until these issues had been resolved. Unfortunately the college network administrators' did not allow access to SL on the college network claiming security issues. This delayed the possible introduction of SL to the course. Finally there was a delay on the acquisition of the new "Island" due to financial issues. At this stage it was decided to go ahead in the "borrowed" space. It was now the beginning of April.

Each year of the course is composed of approximately 20-25 students, although this does vary throughout the year due to the part-time nature, that is to say the students do have busy lives outside the course; work, families etc. This combined with the busy schedule of the academic staff made it very difficult to organize meeting times that suited all parties. The staff members were generally off on weekends, and the students were generally at work during the week. At this stage the second years were deep into their projects and deemed unable to participate at the present time, but to wait until they finished. The first years were just about to start their end of year project.

The SL space was augmented to facilitate first years' projects by providing examples from previous years, to act as a draw. They were emailed by their supervisors, suggesting a meeting in SL, four responded but only one found time to attend the first meeting at the end of April, with the a members of the academic staff as supervisors. Connection issues within the college network meant that the supervisor could not attend, so initiative was taken to convert the meeting into an orientation session with the participant. This was soon followed by a proper supervision session, although only two students and two supervisors were available for that time. This session seemed to go rather well with a lot of discourse mediated by the staff present and constructive criticism from the peers present. The second meeting in mid May was only attended by one first year and one staff member, as the other staff member was conducting a face to face meeting with a number

of other students at the time. This session did not seem to go as well as the previous. At this stage the first year students were finishing up their projects so were under a lot of pressure, so no more sessions were planned.

By this time the second year students had finished their research and were preparing to present their finished work. This opportunity was taken to create meetings to help them prepare. They were invited to participate via email and asked to fill out a questionnaire. Again organizing times was problematic and a number of possible participants were having technical issues with their broadband connections. Finally a time was set for the start of June and a graduate of the course was set to come to offer advice. Unfortunately the graduate had to pull out at the last minute, but thankfully the students improvised and a productive session followed that exhibited some interesting dynamics of interaction. A second session with the second year students was conducted soon after, with the graduate present.

This gives an overview and context to the implementation. The following sections aim to explore these topics in more depth by exploring the data collected during the process and then discussing them within the context stated above. This will involve looking at the data from each meeting within the environment and extracting codes and themes, in order to draw conclusions from these interactions. Examples of themes and their corresponding codes can be found in Appendix 4.

Initial orientation session:

This session was planned as a traditional supervision meeting; unfortunately this did not go ahead due to technical issues, a recurring theme with SL use. The supervisor could not make it to the session as the college network had restricted access to the internet and SL was not on the allowed list. The participant who turned up for this session also experienced this problem as they worked within the college during the work, and they could not access SL. This limited the times that certain participants could attend meetings to times outside office hours. Time again became a recurring theme, whether due to technical issues or availability.

As mentioned before this opportunity was not a total waste, as the initiative was taken to orientate the participant with the environment, gauge their impression and to give an initial idea about interactions within SL. From this it was evident that there was a level of social presence as informal dialogue emerged, this may have emerged as the participant is a regular user of SL. This may also explain why the participant found the functionality of

straightforward to use, the user already had their own skills associated with the environment. The participant thought the chat log feature was “great functionality” and “it’s always good to see other peoples work” with respect to the example projects. This suggests a positive impression of the facilities provided by the environment.

The teacher presence was mostly direct instruction, where the researcher explained the functionality of the environment and the participant explored what was being explained. There was however an informal exchange of knowledge about possible extensions or alternative technologies between the participant and the researcher. It is possible that the combination of the social presence of the immersive environment, the cognitive presence focused on the externalised tools, and the teacher presence facilitating the discourse provided the motivation for the participant to interject with these ideas.

The participant was then asked to post up the abstract to their work that they were currently working on, they suggested they would try but they “can’t promise anything” as they have other overdue work. Nothing was posted. This again suggests the time limitations of the participants.

First Meeting (Traditional Supervision):

This session was organised for a Friday afternoon after the first attempt and was attended by two supervisors and two students, the idea being to review their work to date. The student that attended the orientation session could not access SL due to network restrictions at his location, but the affordance of using the SLoodle Webintercom provided an alternative means to communicate with the group. These connection issues were also an issue for the supervisors although a work around was achieved, using an alternative network. The other student was only new to SL and this was their second visit so there were a few minutes dedicated to explaining some SL skills.

For this session the students were asked to prepare an abstract, this was to create “objects” to initialise cognitive presence, as an externalised version of the student’s knowledge. This was both posted in the Moodle and present on the Whiteboard within SL. Therefore it was visible to both the student using the Moodle site and the others present within SL. Unfortunately only one participant provided these items, as the other student did not have time as mentioned in the previous session discussion.

The supervisors quickly took up the teacher presence role; they effectively started to facilitate discourse by asking for critiques and comments on the abstract. This starts a flow of discussion, the student who abstract is under review answers questions from both

peers and the supervisors in a manner that seems to be aimed at creating a shared meaning. There is an instance where the student rephrases something from the abstract under the guidance of a supervisor, a possible example of socially distributed knowledge building. Although another opportunity is missed as a contentious issue is let pass by a supervisor, “mmmm, i’ll let that one pass :-}”, the informal format of the response could suggest that social niceties may have infringed on the cognitive presence, thus limiting the depth of knowledge building.

A number of technical issues are raised at this point. One is the limited ability to demonstrate external artefact within second life, although if hosted online it would be possible for those present to view them through the SL internal browser. But this issue is alleviated by the student as a simple paragraph explains the artefact suffices and consensus as to what the artefact is and how it functions is reached. This suggests again that textual communication is a valid alternative to real world objects, both being externalised forms of knowledge.

Another interesting aspect arises here, this is of shared meaning. A supervisor whom is used to the SL environment and online chat in general slips into online slang, which is not understood by the new comer. This suggests the various levels of skills associated with the group, although it is expected that such skills will be transferred through use and over time. This issue is actually discussed moments later, when the supervisor new to SL ask if “anyone else find the fact that the conversation is getting a little out of sequence a problem?”, the student whom is also new to SL agrees, but those with experience of SL and online chat suggest that it is something one gets used to. They in fact mention that it is not uncommon to have multiple conversations online at the same time, with the experienced student mentioning that he is fact doing that at the time. This draws into question the level of cognitive presence and whether these multiple conversations dilute the depth of cognitive presence, although this issue lies outside the scope of this study.

The conversation again returns to the topic at hand, with the supervisors again facilitating discourse. There are a number of exchanges that are not understood by other participants but these seem to be cleared up within a response or two, this suggests that there is a level of cognitive presence in order to make this misunderstanding explicit, but it also demonstrates that communication medium is effective in overcoming such misunderstanding.

There was one final example where a student made a suggestion that implied impressionistic knowledge and could have been explored, but unfortunately at this time a

supervisor's computer battery failed. It is the researcher opinion that this created a distraction for both the supervisors that created a loss of cognitive presence. Just after this occurred the session was called to a halt and all parties left the environment after a short exchange of farewells.

It is the researcher's opinion and that of the supervisors' that this was an effective session that showed the potential for the environment.

Second Meeting (Traditional Supervision):

This second meeting was again held on a Friday afternoon, but it coincided with a face to face meeting being held by one of the supervisors. As a result only one student and one supervisor were present. Both of participants were relatively new to SL, second or third visit.

In this case an abstract was sent via email between the participants. During this meeting the supervisor suggested that they would logout and email the abstract back with comments attached. This suggests common practice and does not leverage off the affordances of the SL environment, it is then suggested by the supervisors to end the session. The student does ask a question, which the supervisor flat out ignores after asking was it directed at them. The supervisor was asked about this after the session and it was suggested that the supervisor wanted to leave and had other obligations outside of the environment. This could explain the suggested absence of cognitive presence, but also raises possible limitations to this technology as it cannot control the environment in which the user is situated in person.

Unfortunately the researchers SL program crashes at this point, again highlighting the technical issues relating to the use of this technology. When the program was restarted the supervisor was gone. The student was still present and an informal discussion followed. During this discussion two interesting aspects emerged. One was the suggestion also repeated by the supervisor; this was to log out to check their email. This suggests a perceived division between the SL space and other internet resources.

The other aspect was the sensation that the environment is "very cold". The environment was made very minimalistic in order to cater for novice users, but some of the more interesting and landscaped areas that were initially explored during the design process still existed. So the participant was brought on a tour of these areas and they did find it nicer, "this is a nice area". This shows the how the environments look does affect the user's perceptions, but it must be noted that the user's navigation through this alternative

environment did involve bumping into obstacles and other control issues, which is why the design was made simple and “cold”.

Third Meeting (Peer Support):

This meeting was arranged to occur on a Monday evening, as this was a time when four peers were free. This session was designed to provide peer support in preparation to present their finished work. Each participant uploaded their abstract to the Moodle, after which the research as a facilitator uploaded and displayed them on the whiteboards provided in the SL environment. There was originally meant to be a past graduate of the course present, but they had to cancel at the last minute. The session still went ahead.

Again there was a bit of a mix of SL skills, from those that have never used SL to those that had used it regularly. So again as before a few minutes were spent greeting each other and learning a few skills that would help with the session. The researcher acted as the teacher presence initial to get things moving, by asking the others if they had any comments about the others abstracts. The abstract again being the externalised “object” used to initialise and focus the cognitive presence. This created an interesting response as the peers took it upon themselves to quiz each other on their work. A number of peers would ask questions about one particular peers work, and that person would respond. The cognitive presence was evident in the depth of the probing question and the level of answering that went into the answers. Some interesting dynamics could be seen if these conversations were looked at through teacher presence “lens”. The locus of teacher presence was situated in both sides of the conversation and switched back and forth, there were examples where the questioners were directing the conversation, and the peer answering the questions was injecting sources of information, seeking to reach understanding and consensus, and then it would switch back the other way. These are all aspects considered to be teacher presence in the community of inquiry framework. This worked effectively to the most part, but there was a moment where there were too many question at once directed at the peer under review. It is the researcher’s belief that this caused a cognitive overload and thus a loss in cognitive presence. The peer asked to shift focus, “AGGGHHHH!! Can we switch focus now?”. This suggests that although this environment can be effective at exploring each other ideas, there should be limits to the amounts of members that are engaged in this duelling of teacher presence. This aspect is also suggested by the individual whom asks to move on. Another peer does mention the difficulty of typing in this form of communication as the conversation can sometimes outpace the speed at which the participants can type.

The conversation then moves on to another peers work, again it proceeds as it did before with the switching of teacher presence between the various members. During this process one of the participants disappears, it seems SL crashes on them, the conversation continues without them. When they do appear again they are advised to check the log saved to the Moodle in order to catch up without interrupting the flow of conversation, this suggests an affordance of the chat log as crashes do seem to be an emerging technical issue with the SL technology. The current peer under review then suggests moving on to someone else.

The conversation moves onto the next person and continues as before. Until the conversation diverges, the topic changes to an interest in the future research areas of each of the peers. It is possible that this is due the social element of the group as the group knows each other well and has an invested interest in the group after they have spent two years together. This social presence may divert some of the attention away from the subject matter at hand, and suggests that a lack of specified or conscious teacher presence. This goes on for a short while before someone again takes charge and moves things forward.

The conversation again moves on to but two very different questions are for two individuals. This is highlighted by the novice peer, “God this thing makes crossed wires!”, only to be told that one gets used to it by a more experienced user. Again this suggests various levels of skills and experience with SL. It is similar to the comment by the inexperienced supervisor from the first meeting that the chat can get “out of sequence”. Although the issues that were experienced by this peer were addressed and any confusion were diffused. The conversation based on the final peers work finished up.

Finally the peers made a few comments about the use of SL. Two mentioned explicitly that they enjoyed using the environment, with one whom uses SL occasionally suggesting that having a purpose to use SL makes it more interesting for them and another mentioning a sense of immediacy. This could suggest that some level of cognitive presence provides a more stimulating experience, and that the synchronous nature of the environment provides instant responses not found in asynchronous forums. One final technical issue emerged about reading content within SL, with the peers agreeing it was more difficult reading in SL than on the web. This provides a case for using web based technologies alongside the SL technology as it is designed for textual content whereas SL is not.

Fourth Meeting (Peer Support):

This final meeting followed the previous one, the past graduate was able to attend to offer advice based on their experience. Again the graduate was a novice to SL but with a little guidance was quickly able to master all the skills necessary to conduct a conversation.

One peer that turns up to this meeting missed the previous meetings due to broadband issues, again technical issues. So she is asked if she wishes the others to review their abstract. They oblige by sending the researcher the abstract via email. It may be noted that this user is a regular user of SL and that the idea of using both SL and email at the same time is not an issue, as the division between email and SL that emerged in an earlier meeting with less experienced users. This participant also extracts other information relevant to the discussion from their email account. This shows the stark contrast between perceptions of beginner and experienced users and that this perception may be shaped by the users level of skill and experience with the technologies.

The graduate naturally assumes the teacher presence as questions are directed at her, mainly fulfilling the direct instruction dimension, sharing her experience and informing. This continues relatively well with the odd interruption as a late comer arrives, this creates a slight distraction that discusses how a number of the avatars look; one comment about a dress and another about how much the avatar looks like the real person. This could be attributed to the social presence experienced within the environment. That passes quickly with a little intervention, again the need for teacher presence to reinitiate the cognitive presence.

A serendipitous moment occurs when one of the supervisors from the previous meetings appears to see what is happening. This provides an alternative teacher presence to that of the graduate and augments the knowledge present. The focus shifts to any new information that the supervisor may be able to provide. This suggests that the social presence within SL allows for and may even promote the involvement of “passers by”, which may be especially beneficial if the local areas are frequented by persons whom share similar experiences and areas of knowledge. This lasts a short while before the questions are exhausted. The supervisor leaves and is shortly followed by the graduate and one of the peers.

At this stage there are just the peers left. This opportunity is taken to question the peers whose abstract had been uploaded at the start of the session. This is quite effective and an interesting conversation unfolds, this time it is easier as there are only three peers

present and the conservation flow does not get as convoluted as before. When this is finished there is some idle chat and farewells are said before each peer leaves. This aspect, where idle chat both precedes and follows these discussions, emphasises the social presence inherent within SL.

Research Reflexions:

This section aims to explore the researcher's experiences and perception of the study as a whole. In order to do so while keeping within the transformative research strategy pursued so far, it shall take the form of the personal knowledge as discussed in the literature review.

Statable Knowledge:

The intention of this study was to externalise the ideas covered in the literature review. Both this thesis and the SL artefact are examples of externalised conceptual artefacts upon which as a research I have worked. It is hoped that this study embodies the idea of knowledge building as an exercise in itself, where the conclusions of the study can provide a basis for others to build on.

The majority of the knowledge that emerged during the sessions within the SL environment was of the statable knowledge form, thus it was closest to normal learning environment.

Implicit understanding:

My implicit understandings of SL lead me to believe that there was an inherent social aspect to it, and that this could create a richer environment for communication. I hope that the experiences explored above vindicate this implicit understanding I stared with.

This emerged during sessions as assumption of shared internet slang and ability to follow the flow of conversation.

Episodic Knowledge:

I have learnt a lot from these experiences, as a novice researcher I had limited experience conducting any form of educational research. If I was to do this study again I would change many things. In retrospect an earlier implementation and a guaranteed sample population would have benefitted the study, but sadly unforeseen situation conspired against this.

During the sessions there were cases where this knowledge emerged, being offered as advice or as an explanation. Particular cases involved experienced users suggesting that one gets used to the sometime chaotic nature of online chat.

Impressionistic Knowledge:

I do feel that this aspect of knowledge has a large influence over my actions and the direction my work takes. I feel this is the reason my work takes a holistic approach to the subject of educational research, as I find education and learning to be a holistic pursuit encompassing a wide range of ideas and disciplines engaged in rich and dynamic interactions. I also feel that as a qualitative research I need to explore what I mean from an epistemological perspective before I can justify my argument on a more concrete practical level. There was also personal conflict from a practical perspective. As a researcher I was pushing an untested technology on my course that may or may not have had beneficial results, this is an ethical issue but ultimately unavoidable when investigating new technologies.

Skills:

I initially had very limited knowledge with SL, but as I experimented my skill levels increased. I already had knowledge with online chat facilities so the communication format within SL came easy. It was the exploration of possible tools to utilise or build within SL that was a challenge. Having experience in web development made using and maintain the Moodle relatively easy.

Skill levels emerged throughout the various sessions as discussed previously, and it was interesting to watch the skills being transferred, or even simply being made explicit as this is easily overlooked when you have already acquired such skills.

Regulative Knowledge:

This element influenced the work immensely, as an engineering graduate I was very used to the quantitative approach to research. But during my first year of this course I began to see the benefits and scope that a qualitative approach could offer. But adopting a qualitative mindset is a very difficult thing to do, as the qualitative approach can be so diverse and subjective, this can lead to personal conflicts that need serious reflection in order to resolve.

I also found it difficult to conform to a standard research thesis style, this is evident in the adoption of a transformative, pseudo-grounded theory approach that allowed me to develop a framework under which I could design and analyse the data collected.

Regulative knowledge also emerged a number of times from the sessions where it was obvious the participants were directed by their regulative knowledge, this was particularly evident in the case of the supervisors whom naturally assumed the teacher presence within the environment.

Chapter 6: Conclusion

Unexpected Outcomes

Although setting up an avatar within SL can be a lengthy process and may put off novice users initially, the general ease at which the participants with limited SL abilities were able to start communicating and interacting with others was surprising. Although they did not have some of the more advanced skills, they were easily able to get by and conduct meaningful conversations.

The dynamic interactions that arouse in terms of controlling and guiding the sessions during the peer support sessions with the second year students was unexpected. The teacher presence role was exchanged regularly between participants. This was also done with relative ease by the participants, although in certain situations it did become confusing when too many questions were asked and induced cognitive overload.

Limitations

Time was the major limitation of this study; this includes the time allocated for the participants to explore the environment, the time available to the participants to engage in meaningful knowledge building. Although the study set out to explore an environment for knowledge building, there was only superficial knowledge building achieved. This was unfortunately unavoidable as unforeseen setbacks led to delays in the release of the artefact.

The SL technology itself is limited, it is susceptible to crashing. It also requires a decent broadband connection and relatively high specification in terms of computer hardware to run. It is also not the best environment to read material and still lacks the ability to upload anything other than images to present information. Combining the fact that it costs anything at all to upload an image and the fact that one has to convert text documents to images to display them within SL; this creates a technical block for any casual or novice user.

There are also suggestions that perhaps the group sizes should be limited in order not to avoid the conversation becoming convoluted.

Future Research

The key to any future implementation will be sufficient time; this means time for the users to familiarize themselves with the environment and form a close community. The ideal situation would be to introduce the environment at the beginning of the academic year and get the users to use the technology throughout the year. The involvement of the academic and administrative staff of the course, at the early stage with scheduled meeting times arranged every week or fortnight. This would populate the environment with a much larger community than was seen during this study, which would increase the chance of serendipitous encounters. In this way they would be able to engage in a more meaningful knowledge building community.

The use of the VLE extension of the environment was limited in this case, it would be possible to replicate the level of interaction seen here through email. But if this study had been scaled over a longer period and the participants had more free time to become familiarise themselves with the technology it is assumed that more use would be made of the facilities provide, although future research would be need to confirm this.

This research also suggests that the community of inquiry approach provides a possible framework that teachers or mentors can use to asses and direct the proceedings during meetings. It allows points out possible intervention point to either help explore a student's personal knowledge or to make sure that everyone is cognitively present. This being achieved through the clear externalisation of the task or concept under review.

Summary

The findings suggest that there is potential in using MUVE technology to create an open-source knowledge building environment. The initial a steep learning curve when using MUVEs to interact and the data does suggest that it may not be ideal for large groups to interact. MUVE technologies do have their limitations, but this is an emerging area and the infrastructures are continuously evolving. The use of the Community of Inquiry framework suggests that parallels to the presences required in the theory (social, cognitive and teacher presences) do emerge from the interactions and how their absence may affect performance. This insight suggests possible techniques or practices to aid future designs and implementations, of similar setups, to be more effective. In essence MUVE interactions may not provide the level of interaction as face to face, but they do offer an alternative that warrants further research. But to do so it is recommended that full

institutional support is acquired and that the community is inducted early on in the process.

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Appendices

Appendix 1: Design Table

Requirement from the literature	Implementation	Implication
Social presence (community of Inquiry)	Avatar present within Second Life, the participants are already part of a learning community	The participants feel present within the activity.
Cognitive presence (community of Inquiry)	Have task to focus on, participants post up what they are working on/what they want to discuss	The participants feels engaged
Teacher presence (community of Inquiry)	Need someone present who can guide the sessions or give reliable information	Facilitates productive discourse and correct misunderstandings
Facilitate discourse (community of Inquiry)	Communication through SL, facilitated by a teacher presence	Facilitates productive discourse and correct misunderstandings
Ability to Externalise ideas	Can post into the Moodle and discuss and view these within SL	Provide an “object” to help with knowledge building

Table 1: Design Table

Appendix 2: Login Capture Protocol

Name	Time	Location
js	2008-04-28 20:02:15	Meta area
js	2008-04-28 20:02:31	Meta area
js	2008-04-28 20:02:45	Meta area
js	2008-04-28 20:03:00	Meta area
js	2008-04-28 20:03:15	Meta area
js	2008-04-28 20:03:30	Meta area
js	2008-04-28 20:03:45	Meta area
js	2008-04-28 20:04:00	Meta area
js	2008-04-28 20:21:16	Learning Theories area
js	2008-04-28 20:21:31	Learning Theories area
js	2008-04-28 20:21:46	Learning Theories area
js	2008-04-28 20:22:01	Learning Theories area
js	2008-04-28 20:22:16	Learning Theories area
js	2008-04-28 20:22:32	Learning Theories area
js	2008-04-28 20:22:46	Learning Theories area
js	2008-04-28 20:23:01	Learning Theories area
js	2008-04-28 20:23:16	Learning Theories area
js	2008-04-28 20:23:31	Learning Theories area

Table 2: Visit Protocol Collection

Appendix 3: Example of Data Handling

Codes	Meeting log for the 2nd June	Themes
Facilitating discourse (FD)	[13:18] mm: For instance	Teacher Presence (TP) Cognitive presence (CP)
FD	[13:18] jc: is there one thing that was more prevalent	TP, CP
FD	[13:18] sg: what was the most interesting?	TP, CP
Cognitive overload	[13:19] hl: AGGGHHHH !! can we switch focus now?	CP (loss)
	[13:19] jc: ok	
	[13:19] sg: sure we'll grill you later	
	[13:19] You: yeh that was a little overloading	
	[13:19] jc: sorry	
Typing as technical issue (TI), informal text	[13:19] hl: its tough with the typing to be honest! np though	TI, Social Presence (SP)
Explanation	[13:20] You: it's probably good to get the statements written down as you'll be able to cite them off during teh examination	TP (direct instruction)
FD	[13:20] hl: what about yours sarah, any unexpected findings?	TP, CP
Consensus	[13:20] hl: yeah makes sense Jake	CP

Typing (TI)	[13:20] mm: This medium moves very fast doesn't it. As fast as speech but needs the organisation of written	TI
episodic knowledge	[13:20] hl: its' more difficult the more people you have in it [mm] - but with speech it can be easier - sometimes :)	Personal knowledge (PK)
FD, Informal text	[13:21] You: so shall we grill somebody else noe :)	TP, CP, SP
Informal text	[13:21] You: doh ...*now	SP
	[13:21] jc: yes	
	[13:21] jc: who	
FD	[13:21] hl: yes i was starting on Sarah, but	TP, CP
FD	[13:21] jc: yes me too	TP, CP
Replying to question, explanation	[13:22] sg: sorry, I found that the students didn;t use all the skills I expected them to	CP, TP

Table 3: Meeting Log Data Handling

Appendix 4: Example of Emergent Themes

Time:

Code	Data Set	Example
Lack of time	meeting log	"I've enough on plate rite now"
Can't make it to session	Email communication	"I'm away till the 7th June."
Learning curve	F-2-F communication	"Personally steep enough learning curve; it takes a while to get used to it"
Not a priority	Email Interview	"i actually have had something on every night and day"
Earlier release date (in terms of academic year)	Researchers Notes	I feel such an environment would benefitted from being introduced earlier in the year.

Table 4: Time Codes and Examples

Impressions of Using SL:

Code	Data Set	Example
Positive reaction	Meeting log	"I enjoyed it"
Positive reaction	Meeting log	"he is happy with the work and the session"
Sees potential	F-2-F Communication	"it has potential"

Helpful	Meeting log	“yes it was helpful”
Didn’t like atmosphere	Meeting log	“well it look very cold . there is no warmth in the environment”

Table 0: Impressions of Using Second Life Codes and Examples

Social Presence:

Code	Data Set	Example
Social presence	Questionnaire	“sense of presence” [in response to a question about advantages of using Second Life™ for learning]
Social presence	Questionnaire	“Co-presence element” [in response to a question about advantages of using Second Life™ for learning]
Social presence	Questionnaire	“high social presence for users” [in response to a question about advantages of using Second Life™ for learning]
Social presence	F-2-F communication	“Limited sense of presence, good to be able to see the avatars of people and what they are doing”
Immediacy	meeting Logs	“I have a feeling of immediacy, like I have been talking to all of you. I wouldn't get that from the forums.”

Table 6: Social Presence Codes and Examples