

**Learning Design in Hybrid Spaces: Challenges
for Teachers and Learners**

Submitted for the degree of Doctor of Philosophy

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DECLARATION

I hereby declare that, except where explicit attribution is made, the work presented in this thesis is entirely my own.

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ABSTRACT

The issue of how to design and implement novel learning spaces that work across physical and virtual domains simultaneously is the concern of this thesis. It investigates the conceptualisation of *hybrid learning spaces*; the iterative development of a *learning design process* for teachers; and the nature of *learner and teacher practice*, including their *roles and activities* in implementing this new form of learning space. The thesis explores the challenges that teachers face in embedding novel learning designs and interventions in their practice, and the related challenges that learners face in engaging in the new forms of learning interactions that result from these novel interventions. The thesis emphasises the evolving roles and activities of the learners, how these roles and activities inform each other, and how they relate to the learning design. The changing nature of teacher design and implementation practice, including their use of the learning design framework is assessed.

The thesis is comprised of two separate empirical studies, each with a distinct design and implementation aspect, and with two different populations. In the first study, the learning design process is developed by the researcher and then implemented with a group of young learners in a hybrid learning space. In the second study, a learning design process is iteratively developed by a group of teachers, and is then implemented in the hybrid space with a group of PGCE students.

The thesis contributes to the literature on learning spaces, by establishing both a conceptualisation of a hybrid learning space, and a learning design process to support teachers. It contributes to the CSCL literature by examining how learners and teachers develop highly specific roles and activities to support collaboration, whilst exploring how these inform novel learning practices in the hybrid space. The thesis challenges the

dominant position of scripts in the CSCL literature by arguing that support for particular interactions, closely aligned with the affordances of the hybrid space, is more effective at supporting collaboration than the outside imposition of specific roles. The thesis is grounded in a socio-constructivist epistemology, a theoretical perspective on mixed physical-digital spaces, and a methodology derived from Interaction Analysis.

To my parents

Martin and Marie

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Chapter 1

Introduction

This thesis is concerned with the process of how to design and implement novel learning spaces that work across physical and virtual domains simultaneously. Primarily, the thesis investigates the following issues: the conceptualisation of *hybrid learning spaces*; the iterative development of a *learning design process* for teachers; the nature of *learner and teacher practice*, including their *roles and activities* in implementing this new form of learning space. The thesis thus contributes new pedagogical innovations in learning spaces, underpinned by both the theoretical and empirical findings and reflections on my professional practice as a secondary school ICT teacher. More generally, the thesis discusses the challenges teachers face in embedding novel learning designs and technology enhanced learning interventions in their practice, and the related challenges that learners face in engaging in the new forms of learning interactions that result from these novel interventions.

1.1 Motivation

This thesis emerged from the researcher's work as a secondary school ICT teacher, and the use of a variety of virtual worlds and simulations in the classroom. It was observed that the learners, when using the software, interacted with each other in diverse, and sometimes unexpected, ways. These interactions often encompassed both the virtual world and the classroom. In some cases, the learners would observe the actions of their peers in the virtual world, decide (in the classroom) how to respond to this, and then return to the virtual world to carry out the response. This was often fast paced, with the focus of the learners successively moving between the virtual world and the classroom.

Learner interactions were frequently characterised by breakdown, conflict and argument. This sometimes led to the end of the activity, as learners were unable to, or refused to, work with their peers. Alternatively, the learners would resolve the problem as a group, continuing to work together.

The researchers' initial interest in this chaotic and complex scene was threefold. Firstly, the nature of the space was unclear to the researcher. At a basic level, it evidently included both a virtual world and the physical space of the classroom. The specific features of the space, along with the extent to which these contributed to, and shaped, the work of the learners were somewhat less clear. Therefore, it was important to better understand the characteristics of the space, and the ways in which these could inform the interactions of the students. The interactions themselves formed a second point of enquiry. It was not clear to the researcher how the learners organised and structured their interactions, across the virtual world and the classroom. It was difficult to forecast when the students would successfully collaborate, and when their efforts would result in argument and breakdown. It appeared that individual learners played an important part in managing their peers and organising the work of the group, with varying degrees of success. What was unclear to the researcher was how this phenomenon originated. What determined whether such efforts were successful or not? Parallel to the practice of the learners was that of the teacher. Specifically, how could a teacher design learning activities to take advantage of the features of this space? How should one start this design process? Moreover, what determined the nature of the activity in practice, and how might it be developed or improved over time?

1.2 Research Background

The initial motivation was to define what constituted a hybrid learning space. This was achieved by drawing on the existing literature on hybrid spaces (and learning spaces more broadly) and extending the field of application to that of learning. In chapter two, this was conceptualised as an interaction space where learner and teacher activities and interactions were shaped by the physical and virtual contexts of the space. This was significant, as it allowed early exploration of how the context of the space supported learning and teaching practice. It provided a basis for the later empirical work examining how learners and teachers used the affordances of the space in practice, and how innovative practices (informed by the context of the space) emerged and developed.

With the space defined, it was critical to investigate the process by which teachers could be supported to embed innovative technologies into their pedagogical practice, and detail how their practice changed (or not) as a result. This challenge was particularly interesting in the context of hybrid spaces because of the lack of pre-existing resources developed specifically for hybrid spaces. An original learning design process, based on the Conversational Framework (Laurillard, 2002), and on a series of templated supports for learner collaboration and teacher interventions was therefore developed. This drew on the literature on pedagogical frameworks and on support for collaboration in Computer-supported collaborative learning (CSCL). This process was iteratively refined through the two studies, and through ongoing implementation with the teachers. This was important both as a means of improving the quality and application of the process, and for identifying the many perceptual and practical barriers and constraints surrounding the implementation of the process.

The final challenge was to define and examine learner and teacher roles and activities. These were introduced in the context of the CSCL literature in chapter two. In the later empirical work, learners and teachers developed a number of highly specialised roles and interactions. These were significant as the roles changed in both nature (becoming more diverse and complex), and importance (playing a greater part in sustaining and shaping learner collaboration), within and between the studies. These roles contributed to novel learning practices in the hybrid learning space, and it was important to examine both how and why this occurred. The extent to which this related to the evolving learning design process became of greater interest as the research progressed.

Drawing on the three strands (conceptualisation, learning design process, teacher and learner roles and activities), the specific research questions addressed in this thesis, as detailed in chapter two, are as follows:

- 1 - What is a hybrid learning space?
- 2 - What is teacher practice in the design and implementation of learning activities in hybrid learning spaces?
- 3 - What are learner and teacher roles and activities in hybrid learning spaces?

1.3 Overview of the Studies

The empirical research involved two main studies

Each of these had a **design phase** (where the learning design process developed in chapter two was used to structure an activity) and an **implementation phase**, where the activity was carried out in the hybrid learning space with a number of learners. Study one was discussed in chapters four (design) and five (implementation) and study two was assessed in chapters six (design) and seven (implementation).

There are significant differences in both emphasis and population between the two studies. Study one features the development of a learning design process (chapter four) by the researcher prior to its implementation with a group of young learners in the hybrid learning space (chapter five). In study two, the learning design process is iteratively developed and refined by a group of teachers (chapter six). The resulting process is then implemented with a different group of students than in the first study, namely a number of PGCE students. Whilst design and implementation were integrated in each case, there were also significant relationships between and across the two studies. For example, the design and the implementation of study two was strongly informed by the findings of study one.

The studies addressed the research questions in different ways. Research question one (“What is a hybrid space?”), was addressed initially in chapter two, but also by both studies. The second question (“What is teacher practice in the design and implementation of learning activities in hybrid learning spaces?”) was answered primarily by the design part of the two studies, but was also informed to a smaller extent by the teachers’ experiences during the implementation part. The final research

question (“What are learner and teacher roles and activities in hybrid learning spaces?”) was examined mainly in the implementation part of the studies.

The studies were informed by two frameworks - one methodological (Interaction Analysis) and one analytical (Examining Shared Endeavours). The former was selected as it convincingly addressed the challenges inherent in using video as a data collection tool. The latter offered a strong degree of rigour in terms of categorising and making sense of the large volumes of data that video, as a data collection tool, resulted in.

1.4 Contributions of the thesis

The three main contributions of this thesis are listed below:

1 – A conceptualisation of a hybrid learning space

The thesis contributes to the field of educational technology by developing and setting out a particular and contextualised conceptualisation of a hybrid learning space. This conceptualisation is based on a learning design adapted from the Conversational Framework (Laurillard, 2007), and then implemented with two distinct populations. It was defined as an interaction space, where the interplay of the physical space of the classroom (or other formal educational setting) and the technology of a virtual world underpinned new types of learning practices. Whilst the definition developed in this thesis drew upon the existing literature on hybrid spaces, it also extended it to education by investigating how learners and teachers developed specialised activities, roles and interactions within the classroom setting. This conceptualisation offers a useful analytical tool for researchers to investigate relationships between the context of a hybrid space and learning and teaching practice. It also gives some insight into how innovative teaching practices emerged and evolved as mediated roles and interactions in the hybrid space.

2 – A learning design process to support teachers to develop hybrid learning activities

The thesis contributes to addressing a core challenge in educational technology, specifically, how to embed innovative technology and support the development of associated innovative practice into the everyday learning design activities undertaken by teachers. This was addressed by developing and refining a learning design process to support teachers to develop hybrid learning activities. The process integrated activity design informed by the Conversational Framework (Laurillard, 2002); with templated supports for learner collaboration and teacher intervention, both informed by the CSCL literature. Attempts to promote particular learner and teacher roles, mediated by the templated supports, did not work out in practice; with the envisaged roles frequently supplanted by learner defined ones, more closely aligned with the affordances of the hybrid space, and supported by the Conversational Framework aspect of the process. This was a challenge to the dominant position of scripts within the CSCL literature. It is argued in this thesis that support for particular interactions, closely aligned with the affordances of the hybrid space, is more effective at supporting collaboration than the outside imposition of specific roles. This allows learners and teachers to define, develop and implement specialised roles as appropriate.

Parallel to this, the thesis highlights the key role played by teacher perceptions of the usefulness of the hybrid learning space, and the nature of the roles and interactions in their willingness to implement the learning design. An example of this is in support for learner collaboration, where teacher perceptions of the space and interactions reduced the prevalence and scope of learner collaboration in the proposed activity, and moved it away from the real affordances of the space.

3 – A detailed description of learner roles within the hybrid space, which were found to support collaboration

Finally, the thesis contributes to the CSCL literature by examining how learners and teachers developed highly specific roles and interactions to support collaboration, whilst exploring how these informed novel learning practices in the hybrid space. The thesis shows that although clearly delimited roles existed, their nature changed over time. The two studies detailed the emergence and evolution of the roles, and examined how they were shaped by the hybrid space. The roles originated from differences in knowledge or awareness about the space between the learners, and how these developed in prevalence and complexity. Roles were influenced by factors such as the need to make sense of the fragmented nature of the space, and to perform complex tasks and negotiations within it. The main finding was that explicitly designing for learner and teacher roles was not as productive as allowing their organic emergence. Roles such as these were structured by the Conversational Framework, and by later researcher attempts to encourage interactions such as negotiation and verification in the learning activities. The thesis also explores how the roles and interactions informed new learning practices. These practices varied in their degree of complexity, and were used by the learners to achieve specific objectives.

1.5 Overview of the thesis

The thesis is structured as follows:

Chapter two introduces the idea of a hybrid space and situates it with respect to similar and alternative spaces. This is further conceptualised as a *hybrid learning space* through the application of the Conversational Framework (Laurillard, 2002). The remainder of the chapter develops a learning design process to support learner

interactions in the hybrid learning space, and explores how such interactions are mediated through learner roles and activities. In *chapter three*, the methodological decisions underpinning the thesis are set out. The practical, ethical and analytical contexts of the research are explored, with the rest of the chapter addressing how each of the research questions will be answered. *Chapter four* represents the design element of the first study, with the learning design process being used to develop an activity. Particular emphasis is given to the support of learner collaboration through scripts, and to examining the forms that teacher intervention in the activity might take. *Chapter five* discusses the implementation of this activity. A number of findings concerning learner roles and activities and teacher practice in the hybrid learning space are discussed. *Chapter six* examines in more depth the learning design practice of a group of teachers, representing the design element of study two. The extent to which they successfully use the learning design process in order to achieve this is critically discussed, and a number of modifications, drawing on the findings of the previous study, are then made both to their learning activity, and to the learning design process itself. Study two is concluded in *chapter seven*, as the activity is implemented by a different group of teachers. A more detailed set of findings concerning learner and teacher roles, activities and practice are discussed. Finally, *chapter eight* draws together the findings of the two studies and discusses them in the context of the research questions. The contributions and limitations of the research are set out and a number of proposals for future work are discussed.

Chapter 2

Learning design and collaboration in hybrid spaces

Introduction

This chapter sets the context of the thesis by introducing and situating the concept of a hybrid space, and by assessing how it can be used in formal education settings, in particular, with respect to the role of the teacher and to learner practices during collaborative activities. It will be argued that the learning applications of hybrid spaces, particularly in formal settings, have been underresearched; and that this poses three challenges: to begin with, the hybrid space does not represent a learning space per se: further conceptualisation and exploration of its perceived learning affordances (Oliver, 2005) is needed before it can be characterised as a hybrid learning space (HLS) (section 2.2). Secondly, it is not clear how educational professionals might design learning activities for use within the HLS. To this end, a multi-part learning design process is developed and justified throughout section 2.3. Finally, the contexts of the space and the learning design inform learner practices in the hybrid learning space. Section 2.4 examines the significance and mediation of these practices. Three research questions result from this analysis and are set out in section 2.5.

2.1 Learning spaces and technologies

This section provides background on the research into space:hybrid spaces, virtual reality, mixed reality, tangible systems. The concept of a hybrid space is introduced and discussed with reference to a number of examples. The concept is then developed in more depth and situated with respect to the three similar approaches, with the emphasis on the heritage and significance of the spaces concerned. The next section extends the discussion by interrogating how the space can be conceptualised as a Hybrid Learning Space (HLS).

2.1.1 Hybrid spaces

A hybrid space is created when physical and digital spaces merge. The term derives from ethnography and is used to explore a number of diverse situations, ranging from classrooms where the participants also interact online (Kazmer, 2005), urban “street” games in which competitors receive and swap clues and assignments via mobile devices (Crabtree and Rodden, 2008), through to Chinese Internet cafes where the customers simultaneously interact in the “*World of Warcraft*” virtual world (Lindtner and Nardi, 2008). Although different physical and digital spaces are used in the literature, there is a common interest in exploring how interaction occurs in and across both of the domains, or as de Souza e Silva (2006) puts it, “the action takes place simultaneously on the screen and in reality” (de Souza e Silva, 2006, P.1). More broadly, there is an emphasis on how the hybrid space can be both “constructed and co-constructed” (Rudstrom, Hook and Svensson, 2005, P.3) by the participants within; and on the social practices that are required in order to do this. In short, the focus is on socially organised interaction in combined physical and digital spaces. There are two

contrasting examples of hybrid spaces which are of particular interest to this discussion, and these are now set out.

In their earlier work, Crabtree & Rodden (2007) organised a number of “urban games” where the participants used mobile phones to interpret clues from physical artefacts and to send messages both to other players and to the organisers of the event. They described the mixed physical-digital space in which the games occurred as an example of a ‘hybrid ecology’ (ibid). The physical part of the space was a pre-defined series of street blocks in Manchester. The players had to find multiple postcards, each containing a clue to be decoded. The competing street players would occasionally come into contact with each other (as they were looking for the same cards and clues) and communicate face to face. The digital part of the space centred on the handheld devices that the street players carried with them. Whilst allowing messages to be sent, the devices also showed a simple map of the surrounding area along with the location of nearby players.

There was a significant interplay between the physical and digital parts of the space. The instructions and clues for the game were sent from the online players to the street ones. The latter’s action in the physical part of the space was based on the digital instructions. Where players got lost, they would ask for help, and so a series of navigation moves would begin. When a postcard was found, the contents had to be sent to the online players, who would interpret what these might mean and then send the street player to where they thought the next clue might be. All of this was complicated by players getting lost, falling out of contact with others, and misinterpreting messages. The emphasis of the study was on “fragmented interaction” (as discussed later in this

section) and on the strategies that the players used to deal with them. Crabtree and Rodden examine the importance of both “vulgar competences” (taken for granted rules) (Crabtree and Rodden, 2007, P. 29) and “articulation work” (ibid, P.31) in improving collaboration throughout the space. The study reflects a number of the features of the hybrid space that are discussed in depth throughout this section, such as the merging (and equality) of the physical and digital aspects, an emphasis on ‘breakdowns’ and on the interactional competences necessary to overcome them along with the moving of action back and forth between the physical and the digital parts of the space.

A contrasting example of a hybrid space is put forward by Lindtner and Nardi (2008). Their work studied the interaction between groups of *World of Warcraft* players who were co-located in a Beijing Internet cafe or *Wang Ba*. The aim of study was to examine the collaborative practices used in and across the two spaces. A further aim was to explore the longer term social culture that existed around the game, and to determine the extent to which it was shaped by interaction both on screen and in the physical world. Because of this, they used the term ‘hybrid cultural ecology’ to describe their choice of space (ibid)

The physical part of the space was the Internet cafe in which the players participated. Lindtner and Nardi spend much time discussing the social importance of such locations, particularly when compared with people’s homes or college dorms. They note how it is “one of the few places young urban Chinese can go to escape the pressures of school, work and their parents” (ibid, P.4). In other words, the players already attribute a strong social significance to the space. Although the players are seated in separate places in the cafe, they also walk around, mingle, shout and gesture to each other. Some of this is

related to the *World of Warcraft* game but much of it concerns broader recreational and social issues.

The digital part of the space is the *World of Warcraft* game. This is a virtual world where the players complete various quests, either alone or in “guilds”. The players do not have the power to modify the world (e.g. to create new artefacts or change the virtual space), although there is some flexibility beyond this. Whilst there are many features of traditional computer games (e.g. slaying monsters, fighting other players), there is also a strong in-game economy where the players can buy and sell weapons, clothes and other equipment.

The hybrid element in this study consists of the interactions that begin in one part of the space (either physical or digital) and then get carried over into the other. For example, the players walk around the cafe to get (and offer) advice on strategies, which they then implement online. Similarly, players often encounter each other in the game and discuss their progress. Upon discovering that they were in the same physical location, they would move their conversation to the *Wang Ba* before returning to the game itself.

Compared to the Crabtree and Rodden study, Lindtner and Nardi focus on longer term interactions (as opposed to what simply occurs while the game is in progress) and broader socio-cultural influences (hence their use of the term ‘hybrid cultural ecology’). To this end, there is much discussion of concepts such as trust and friendship between players along with cultural influences from players’ home towns. As before, the features of hybrid space are all present in this study. There is the strong interplay

between the physical and the digital, with interactions in one shaping what occurs in the other. There is less emphasis on ‘breakdowns’ here, but more focus on the bringing together of fragmented interactions.

The two studies presented here contrast somewhat with each other. The first presents a hybrid space with a strong degree of movement in the physical space, but relatively little verbal communication. It emphasises short term interactions, ‘breakdowns’ and the strategies used by the players to surmount them. The hybrid space is heavily orchestrated by the organisers of the activity. The second study is rooted more in the digital space (not that the physical one is neglected). The space is less orchestrated than before, and there is a greater focus on longer term social and cultural interactions. The players are co-located, and whilst there is less physical movement than in the first study, there is a greater degree of physical world communication through voice and gestures.

The concept of a hybrid space draws upon, and differs from, a number of similar spaces such as virtual reality, mixed spaces and tangible systems. The aim of the next three sub-sections is to introduce the features of each of these spaces. This is then used to organise the discussion which occurs in the section 2.1.5, where the hybrid space is compared and contrasted with each of the three similar spaces.

2.1.2 Virtual reality

Virtual reality (VR) is framed by a shared digital space, immediacy and interactivity (de Freitas, 2008), and it encompasses a variety of applications from collaborative computer games to virtual worlds. The emphasis is on ‘immersion’ as the action occurs solely in the digital world, and the real world is temporarily ‘put on hold’ (as Azuma (1997) puts it). VR applications allow learners to communicate in real time, and in many cases, there are also one or several shared digital artefacts that the learners can create, modify and share. Because of this, there is both real time digital communication and action between them. Spaces such as these can be represented in a variety of ways, and one of the more comprehensive classifications is put forward by Smith-Robbins (2011). Whilst she examines VR spaces in terms of factors such as their dominant media, users’ competitive and collaborative relationships with other users, and their broader relationship with the space (friendly, hostile or scenario based); her main emphasis is on the extent to which participants control and re-order the space in which they find themselves. These range from applications where both the scenario and the space are designed, and “locked down” from the outset and where little learner control is evident, through to relatively open spaces which can be modified by the participants.

Several studies in the literature examine how VR can be used for educational purposes. Some are wide ranging in their approach and identify several advantages of VR, whilst others emphasise one or two, more specific, affordances of the technology. de Freitas’ (2008) work represents an example of the first approach. She points to the importance of attributes such as “learner control, sharable and user generated digital content, and immersion” (ibid, P8) in determining how virtual reality can be used for learning, and underlines the extent to which VR applications can be used to realistically replicate

complex, inaccessible or dangerous environments. She then examines how the technology has been used for science education, and the training of emergency workers. As a contrast to this broad approach, Steinkuehler & Duncans' work (2008) on scientific discursive practices, using a VR environment, emphasises how such applications can be used to develop learner decision making. They assert that VR allows one to represent problems "of real complexity and genuine social import to those involved" (ibid, P.728). Their argument is that the realism and immersion inherent in virtual reality allow the learners to become stakeholders in solving scientific problems. They achieve this through following "simultaneous, overlapping and competing" (ibid, P.728) lines of research. Over time, in this study, the learners come to co-ordinate their enquiries and then aggregate what they have learned.

The Open University *Schome Park* project (Twining, 2009) is one example where the learners were offered considerable latitude in terms of modifying and developing the VR space. Based on the *Second Life* virtual world, it involved learners from a number of UK secondary schools, taking place over an 18 month period. Twining (ibid) examined the ways in which the learners improved their communication, leadership and creativity skills as the study progressed, but underlined that such success depended greatly on factors such as the design of the learning activity, the provision of adequate pedagogical and technical support, and the ethos of both the group of learners and the schools in question. In other words, the efficacy of virtual reality owed much to the pedagogical and social contexts in which it was implemented.

2.1.3 Augmented Reality and Mixed reality

An alternative means of representing a learning space is to allow for some blurring of the virtual and the real worlds. This is commonly referred to as “mixed reality”. The extent of this blurring depends on the technology at hand. Unlike virtual worlds, the user continues to see the real world, as digital objects are superimposed upon reality, or as Azuma (1997) asserts, “reality is supplemented rather than replaced ” (ibid, P.2). The aim is to ensure a more natural integration between the real and the virtual (Benford et al, 2000). Although there are a number of typologies of MR applications (eg. Billingham & Kato, 2002; Pan, Cheok et al, 2006); the emphasis remains on what occurs in the physical space - the virtual objects are of secondary importance. The term “augmented reality” (AR) is often used interchangeably with that of MR. It can be more accurately represented as a subset of mixed reality. Early work in this area focused on the use of goggles and head up displays to super-impose digital information onto real objects. The degree of virtual “augmentation” (of the real world) is therefore relatively light. There is an overlay of digital information onto the real world so that we perceive that information as being part of the world (Kirkley and Kirkley, 2004).

From an educational perspective, mixed reality applications take some of the features of virtual reality and merge them into the traditional classroom. The learners, therefore, are now co-located and interact with both the real world and with objects from the virtual one. This makes for an interesting range of educational projects, ranging from Brederode et al’s (2005) ‘*Powerball*’ (where a virtual world is ‘beamed’ onto a desk), through to Crabtree and Benfords’ (2004) ‘*Savannah*’ (where a series of geographic regions are overlaid onto a football field and the learners navigate through them).

One pertinent example is Moher's (2005) '*Roomquake*'; based on the idea that the classroom floor is the location of an active fault line. A series of tablet PC's (acting as seismographs) were left around the classroom and the learners used these (collaboratively) to help detect the location and magnitude of the on-going 'earthquakes' in the room. The classroom was depicted as a scaled down geographical region and over a period of some weeks, a total of twenty two such "roomquakes" occurred. On each occasion, the learners were able to use what they had learned from previous quakes to help determine its epicentre. A series of Styrofoam balls were then hung from the class ceiling to record the sequence of events. Over time, as Moher (ibid) put it, the "classroom fault line emerged" (ibid, P.1665). One of the concepts that underpins such work is the notion of "embedded phenomena" (Moher, 2005); where digital technology is used to recreate an imagined event or phenomena in the classroom. The teacher must then design a learning activity that includes student observation and investigation of the phenomena in question.

Later work by Moher, Uphoff, Bhatt et al (2008) extended this, offering two learning advantages compared to the virtual reality approach. Firstly, the multiple users could physically see each other, and cooperate in a more natural way than in virtual reality, or as Birchfield (2009) puts it, "there is direct face to face social exchange between the students" (ibid, P.502). In this sense, learner collaboration is "left to normal social protocols, rather than requiring mechanisms encoded in the interface" (Brederode, 2005, P.5). Secondly, the learners, in the later work could use a multitude of input devices (eg. laptops, smartphones) and were not restricted to the desktop PC as with most VR applications. The focus was therefore on "hands on computing" (Birchfield, 2009) with devices that can be simultaneously manipulated by several learners.

2.1.4 Tangible systems

Tangible systems aim to “augment the real physical world by coupling digital information to everyday physical objects and environments” (Fishkin, 2004, P.1). The emphasis is on physical and digital interaction through familiar objects, as this is argued to have a number of advantages for learners. In their early work on tangible systems, Price, Rogers and Scaife (2003), explain how “everyday artefacts, like bricks, balls and tools are physically manipulated to make changes in an associated digital world, capitalizing on people’s familiarity with their way of interacting in the physical world” (ibid, p.2). Such an approach, it is averred, moves computing away from the traditional screen and keyboard (or the ‘access bottleneck’ as Hornecker and Buur (2006, P.1) put it), and allows for new forms of learning and collaboration. By using familiar objects, there are additional opportunities and ways to participate in learning (‘multiple access points’ in Hornecker & Burr’s (2006) work). Moreover, the process of combining and recombining the familiar (objects) with the unfamiliar (the new things that the object can do) is held to promote new forms of experiential learning (Price, 2008).

Falcao and Price’s (2009) work on interactive tabletops represents one interesting example. This introduces a glass table which is illuminated by infrared LED’s. A number of plastic objects are used as input devices. These can be placed on, and then moved around, the tabletop. The aim of the tabletop is to demonstrate the physics of light (reflection, refraction, absorption) in a visible and practical way. Each of the plastic objects have different physical properties in terms of shape, material and colour and therefore will be affected differently by the light from inside the table. Apart from letting learners try out different configurations of objects in a risk-free way, the system

has the advantage of allowing them to participate whenever they want and not to be restricted by turn taking. Two broader issues emerge in this study. The first relates to the importance of “input / output coupling” for the learners; in other words, what do they perceive to be the link between action and effect as they move the objects around the tabletop? A second concern is that of participation, or more specifically, to what extent is it encouraged by the tangible environment, and in what ways is it manifest? To this end, Falcao & Price (ibid) describe in detail how the learners both observe and direct each other as the activity proceeds. In particular, they distinguish between “directing from the screen” (ibid, P.151) (a learner watching the tabletop would direct a learner with an object and tell them what to do) and “directing with the object” (ibid, P.151) (a learner with an object would ask a learner watching the tabletop to say what was happening in relation to their own movements).

Hornecker and Buur’s (2006) study of a shared smartboard being used for urban planning scenarios works in a similar way to this. It is based on a chessboard grid and registers RFID tags embedded in nearby objects. By placing the objects (‘tangible tokens’) on the board, learners simulate the effect of new bus or road routes across a city. Having detailed the route, they use the tangible tokens to plan locations for bus stops, car parks and other facilities. The board is used to calculate the space that a bus or road route might require, the distances between bus stops, and how far the road would be from important landmarks, amongst other elements. In learning terms, Hornecker and Buur (ibid) point to the importance of “meaningful configuration” in this system. In other words, the users can clearly see the result of what they do. One of the challenges that Hornecker and Buur faced was how to encourage collaboration between students. Their initial version of the smartboard offered a large number of

tokens (“access points”) so as to encourage learner participation. Over time, this resulted in students working alone. In later versions, therefore, they introduced a limited number of tokens, in an attempt to encourage the learners to work together.

2.1.5 Discussion

There is a wide range of literature on the learning applications of virtual reality, mixed reality and tangible systems. The same, however, cannot be said about hybrid spaces, as existing research emphasises technological, social and recreational contexts more than educational ones. More significantly, the use of hybrid spaces in formal education settings has not been explored. The thesis addresses this issue by conceptualising the space as a hybrid learning space (section 2.2), by examining how learning design by teachers using such spaces can be supported (section 2.3), and by assessing potential learner roles and learning practices that support collaboration in hybrid spaces (section 2.4). This results in the research questions presented in section 2.5. Before that, however, it is important to detail more closely the differences and similarities between the various spaces.

Shared heritage of the approaches

A shared interactional challenge in mixed, tangible and hybrid spaces is that communication between learners exhibits more nuanced complexity than in a traditional classroom environment. This is reflected in terms of “information, interaction and communication breakdowns” (Nielsen 1986). The terms used to describe these breakdowns, range from “fragmentation” (Crabtree and Rodden, 2007), through to “fragmented awareness” (Hornecker, 2005) and “collisions” (Ha, Inkpen et al, 2006). As communication spans the physical and digital parts of the space, learners use multiple media to interact. In tangible systems, for example, learners speak or gesture to each other in the physical space, whilst also manipulating objects in the

digital one. Learners are also prone to “connections, gaps, overlays and mismatches” (Rudstrom et al, 2005, P.2), in that the participant forges connections between previously unrelated pieces of information (“seeing coherence where it did not seem to exist before” (ibid, P.3)). The same participant also has gaps in their understanding of the activity (things that they do not know). Finally, they are prone to overlays (whereby they have learned the same thing from more than one source) and mismatches (where they uncover conflicting, and/or erroneous understandings of the same issues). Their interactions are informed by these factors. Therefore, much of the learners’ work consists of “making sense” of what is occurring in the space, and attempting to bring together information from several physical and digital sources.

The second theme, “awareness”, is examined by Hornecker in her work on shared multi-touch screens (2005). She again points to the difficulties learners have in making sense of their space, pointing to “clashes, collisions and breakdowns” as they attempt to do so (ibid, P.166). She proposes ‘awareness’ (“understanding of the activities of others, which provides a context for your own activities”) (ibid, P.168) to assess how learners might surmount these communication problems, and then explores the strategies they use to develop such awareness and to minimise breakdowns in the learning space. Her later work (2008) extends this, offering a briefer definition, namely, “can everybody see what is happening and follow the visual references?” (Hornecker and Buur, 2008, P.5)

The implication of both fragmentation and differences in awareness is that no one participant has full knowledge of what the space contains or how it works. This results in “communicative asymmetry” (Crabtree & Rodden, 2007), something which applies both to particular pieces of information and to broader conceptual knowledge about how the space is organised. Participants have different levels of understanding concerning the spaces' ground rules, objectives and uses. Their aim becomes one of attempting to reduce such asymmetry. In reality, there is more than one kind of asymmetry in such spaces, with more than one cause. Therefore to “communicative asymmetry”, we can add the concept of “functional asymmetry” (Billinghurst and Kato, 1999), occurring as learners have different levels of access to various physical or digital features of the space. For example, there may be physical spaces that learners are unaware of, or that they cannot reach within a given time frame. In digital terms, there may be items of hardware or software that are either unavailable or cannot be used by individual participants. In Lindtner et al's (2008), study of “*World of Warcraft*” players, functional asymmetries were evident amongst players who did not have access to software “plug ins”, whilst others were unable to purchase individual in-game items that would allow them to participate more fully in the quests. A final type of asymmetry is “social asymmetry” (Billinghurst and Kato, 1999), where the learners have unequal access to a range of conversational and interactional cues. Where they are co-located in both the digital and physical contexts, some learners take more notice of cues, gestures, and glances than others. Similarly, the same students may be unaware of equivalent cues that are offered in the digital space, such as “emoticons” and voice snippets. As with “fragmented interactions”, this asymmetry therefore exists both within a particular media and between the physical and digital media.

Whilst there are some differences between both mixed reality and tangible systems on the one hand, and hybrid spaces on the other; there is a shared emphasis on communicative problems and breakdowns and on how they might be overcome. Although, this is expressed in a number of ways by different researchers, the focus remains the same. The concepts of *fragmentation*, *awareness* and *asymmetries* have been underlined, as they offer a clear form of language for later discussion of what might occur in the hybrid space. Throughout the remainder of this section, hybrid spaces are situated more precisely and in more detail with respect to both mixed reality (and virtual reality is included as a subset of this) and tangible systems.

Mixed reality and hybrid spaces

The differences between mixed reality and hybrid spaces are conceptualised in this thesis in terms of *equality*, *complexity* and *time*, with each of these factors interacting with the others in various ways.

Firstly, the literature on hybrid spaces accords an *equal status* to both the physical and the digital. There is a ‘merging’ rather than a ‘blurring’ of spaces as Nova and Dillenbourg (2006) put it. Others (de Souza e Silva, 2006) express this in terms of the virtual being embedded in the physical space. In any case, student action is framed simultaneously by the physical space, the virtual space and the relationship between the two. This occurs in Kazmers’ (2005) CATS study of online learners where the interactions of the students owed as much to what happened in their (“idiosyncratic”) local environments as in the shared online space. In mixed reality, the spatial metaphor dominates. The emphasis remains on what occurs in the physical space. Studies based on this paradigm underline issues such as learner movement around the classroom (Moher, 2005), the optimal allocation and organisation of equipment in learning spaces (Moher & Bhatt, 2008), and student - teacher interactions in the physical space

(Birchfield, 2009). The virtual, meanwhile, is posited as something which is super-imposed onto the physical, as a “thin layer of computation” (Moher, 2005, P.1) is added. In hybrid spaces, the virtual space is embedded within the physical.

Secondly, the implication of this is a degree of *complexity* of interactions that is less evident in the mixed reality literature. Benford and Giannachi (2011) characterise this chiefly in terms of spaces and (participant) roles. They point to how participants forge connections between the physical and virtual parts of the hybrid space, summarising these as being ‘*adjacent*’ (with the participants moving in sequence between one part and another), *remote but connected* (with participants communicating between the two parts) and *overlaid* (where the participants experience both parts of the space simultaneously). The difference with mixed reality is one of emphasis, or as Benford et al posit, “it (hybrid spaces) reflect elements of mixed reality - but there is less emphasis on seamlessly overlaying the real and the virtual, but rather on establishing complex spaces that connect multiple virtual and physical environments in different ways” (ibid P.5). A further aspect of this complexity lies with the roles of the participants in the hybrid space. Benford et al (2008) underline how the space will contain bystanders, participants and orchestrators amongst others. None of this is static as the participants change roles (eg. from bystander to participant or from participant to orchestrator) as their experience with the space grows.

Finally, there is a strong emphasis on temporal aspects in the hybrid spaces literature. A distinction (Benford and Gianacchi, 2008) is made between ‘story-time’ (when the designer of the activity expects particular interactions to occur) and ‘interaction-time’ (when the participants are willing and able to undertake the expected interactions). Given that participants engage, disengage and re-engage with the activity, whilst making frequent transitions between the physical and virtual parts of the hybrid space,

the gap between these two times can vary enormously as an activity proceeds – something often characterised in terms of delays. This also connects with orchestration issues as the organiser of the space will need to take both variants of time into account, and attempt to speed up or slow down the activity of the participants as required.

Therefore, compared to mixed reality, the hybrid space is marked by *successive and complex transitions of participants* between its physical and virtual parts, transitions between participant roles, and temporal transitions as participants engage, re-engage and then need to catch up on missed action. This complexity is possible because of the equal and merged nature of the physical and virtual spaces.

Hybrid spaces and tangible systems

Turning to tangible systems, there are some differences compared to hybrid spaces. The most salient concerns the role of physical objects. Hornecker & Buur (2006) assert that tangible systems must involve “haptic direct manipulation” of material objects. It should be possible for users to “grab, feel and move the important elements” (ibid, P.4). Moreover, the objects should also provide recognisable feedback, through a small change in appearance (eg. light reflection in Falcao and Price’s example above), or through making a sound. In this case, the objects effectively take over the role of the mouse, keyboard and screen. They simultaneously become, “interface, interaction object and interaction device” (Hornecker & Buur, 2006, P. 4). There is some discussion of objects in the literature on hybrid spaces, but in a different sense to that portrayed here. One approach is to view objects in terms of specialised input and output devices as opposed to modified everyday items. The objects are physical, certainly, but they are used solely in the digital sense, as a means of sending and presenting data. Some examples of this include de Souza e Silva’s (2006) work with mobile devices, and Crabtree and Roddens (2007) study of street games where the phone is used both as

navigation and input device. The literature on hybrid spaces focuses on the desktop paradigm where input is, usually, through a keyboard and mouse and most output is from the screen (as in Lindtner and Nardi's (2008) *Wang Ba* study for example). This leads to the second use of the term 'object' in hybrid spaces, namely as a shared digital artefact that can be created and modified by the users. The object provides a focus for action, discussion and feedback. But none of this is in the tangible sense. The object remains on the screen. The differences are clear. In hybrid spaces, input and output are achieved either through the desktop or through a specialised (not modified everyday) device. In as much as objects are present, they are likely to be digital rather than physical.

Having explored each of its influences; it is now possible to present a more nuanced and detailed picture of what constitutes a hybrid space by revisiting some of the points made earlier, and examining them in the light of the discussion above.

The hybrid space re-examined

We can say that a hybrid space is characterised by the merging of a physical (e.g. a classroom or a public space) and a digital environment. The latter allows for real time communication between the learners, and offers a shared digital space or artefact that the learners are co-present and embedded in. This could range from a virtual world which the learners can modify and customise, through to a shared graphic artefact that they can contribute to. At a minimum, the learners can communicate face to face and / or through the digital artefact. It is possible that a greater range of communicative media might be available to them. Much depends on the 'creator' of the hybrid space, as they define not only the its physical aspects, but more importantly, the means and extent to which learners can communicate with each other; and also modify and customise the digital part of the space. In chapter 4 we define more precisely what the

learners can and cannot do in the hybrid space chosen for this thesis. The learner interactions in the hybrid space are likely to be “fragmented”, or distributed across both aspects of the space and between the various media on offer. This is accompanied by a degree of both “functional asymmetry” (differing abilities to use the various media on offer) and “social asymmetry” (differing access to social cues such as gestures, glances, emoticons etc.). Both of these themes (fragmentation and asymmetry) are reflected in terms of differing degrees of awareness on the part of the learners.

Thus far, the emphasis of this chapter has been on describing the specific characteristics of the hybrid space. Whilst learning applications have been considered in the cases of virtual and mixed reality and tangible spaces; there has been no discussion about how learning might be supported using hybrid spaces in formal education settings. The rest of the chapter addresses this issue.

2.2 Conceptualisation of a hybrid learning space

Having identified, in technical terms, the main characteristics of a hybrid space; our emphasis now shifts from technology to learning. The hybrid spaces examined in the previous section, whilst sharing common characteristics and heritage, took a number of forms or instantiations. In other words, they varied greatly in terms of their setting, their rationale, and the interactions between the participants, amongst other factors. If one uses a hybrid space to support learning, in the same way as others have done with mixed reality and tangible systems for example, then a similar degree of diversity can be expected. A hybrid learning space - that is, a hybrid space being used to support learning - can be used in formal or informal education settings. It can be used to support different groups of learners, in terms of age, curriculum or subject. Teacher and learner practice within the space can also vary widely. In short, there are several forms or instantiations that a hybrid learning space can take.

It is important, therefore, to narrow our focus both in terms of setting and learning practices. This thesis emphasises the use of hybrid learning spaces in formal education settings (such as a school), an area which is not presently examined by the literature. Within this specific setting, there are several aspects of learning practice that one could potentially examine. This thesis is concerned with two such aspects. The first of these relates to the role of the teacher and to the practice that they follow when using hybrid learning spaces. This points mainly towards learning design. We wish to examine how teachers carry out, implement and iteratively develop, learning design; and to identify the main challenges that they face in doing so. Closely related to this, is the second emphasis of this thesis, namely the roles, activities and practices of the learners as they follow the teachers' learning design.

This leaves us with three conceptual challenges. To begin with, it will be necessary to identify in more detail how the characteristics of the hybrid space can be used to support learning, and to assess the most effective way of carrying out this conceptualisation (sections 2.2.1 and 2.2.2). Secondly, there is the challenge of supporting teachers in their learning design for use in the HLS. One way of doing this is through the development and ongoing modification of a learning design process. This process is introduced, justified and elaborated in section 2.3. Finally, it is important to examine the CSCL literature more closely concerning learner practice, frequently mediated by roles and activities (section 2.4) – this provides a basis for the later examination of learner practices in the hybrid learning spaces in chapters five and seven.

2.2.1 Using a pedagogical framework to inform conceptualisation

At first glance, the extent to which the hybrid space can be exploited for learning is not immediately clear. Laurillard (2008) for example, points to the profusion of environments and technologies, which represent little more than “a solution devised for other requirements, in search of a problem it can solve in education” (ibid, P.12). Whilst the origins and features of the hybrid space have now been identified; it is also clear that, in itself, it does not represent an obvious educational space. To avoid a case where whatever learning that might occur within it is simply incidental; it is important to examine more closely what ones educational requirements are, and then to assess how the hybrid space might meet them. This can most effectively be achieved through the use of an appropriate pedagogical framework.

The framework in question needs to meet a number of criteria, relating to its rationale, emphasis and detail. In terms of rationale, the framework should ideally contribute both to learning design (as in section 2.3) and to the analysis of interactions once it is implemented. Given that the focus of this thesis is on teacher and learner practice, the framework should emphasise both of these factors, allowing us to examine them more closely. Lastly, it should allow us to do so with as much detail as possible – in a specific rather than an abstract way.

Given that no framework specifically addresses activity and learning in the hybrid space, it will be necessary to adapt an existing one to meet our ends. There are a multitude to choose from, but few meet all the criteria set out above. One possible approach would be the CIAO! Framework (Scanlon, Jones et al (2000)). This examines the context, interactions, attitudes and outcomes (hence the name) of a given learning activity, and particular focus is placed on examining the records of student interactions

along with the products of their work. To this end, the model sets out the rationale of examining each of these themes, the data that one might wish to collect concerning it, along with the appropriate methods that should be employed. The framework has primarily been used by its creators (and others) to examine a variety of CAL applications deployed on Open University courses. One drawback with this framework, however, is that it underlines learner interactions with the technology, rather than those with other learners and with the teacher. A further alternative, the Perspectives Interaction Paradigm (Squires and MacDougall, 1994) overcomes this by focusing more on learner interactions than the technology that supports them. It does this by distinguishing between the student, the teacher and the designer (as embodied in the software), and by examining the relationships between each of the parties. For example, there is an emphasis on how “teachers and students interact in the classroom in which the software is being used” (ibid P.46) and “how students learning can be improved using the software” (ibid P.46). Whilst this is promising, there is an issue of detail. The perspective does not allow us to characterise and examine these interactions in the ‘rich’ and detailed terms that we require, or in light of the intermediate steps that learners might move through in an activity. One approach that appears to meet each of our criteria, however, is Laurillard's (2002) Conversational Framework.

Laurillard makes a number of claims concerning effective learning, arguing that it consists of both a discursive element and an experiential component. The former examines the dialogue between the students or between the teacher and the student. The latter emphasises the work that the students carry out to produce some sort of output or production (eg. an essay, a model). The two levels (discursive and experiential) are inter-related and iterative. In other words, student discussions with each other and with

the teacher go to inform their interactive outputs, whilst the feedback that they get about these (from the teacher and from each other) go to influence what they discuss (again with each other and with the teacher). This cycle occurs not just once but a number of times whilst the learning activity remains in progress. From these principles (roles for both teacher and student, interrelated discursive and experiential levels, an on-going cycle of reflection, feedback and improvement), Laurillard puts forward her framework as shown in *figure2.1* below:

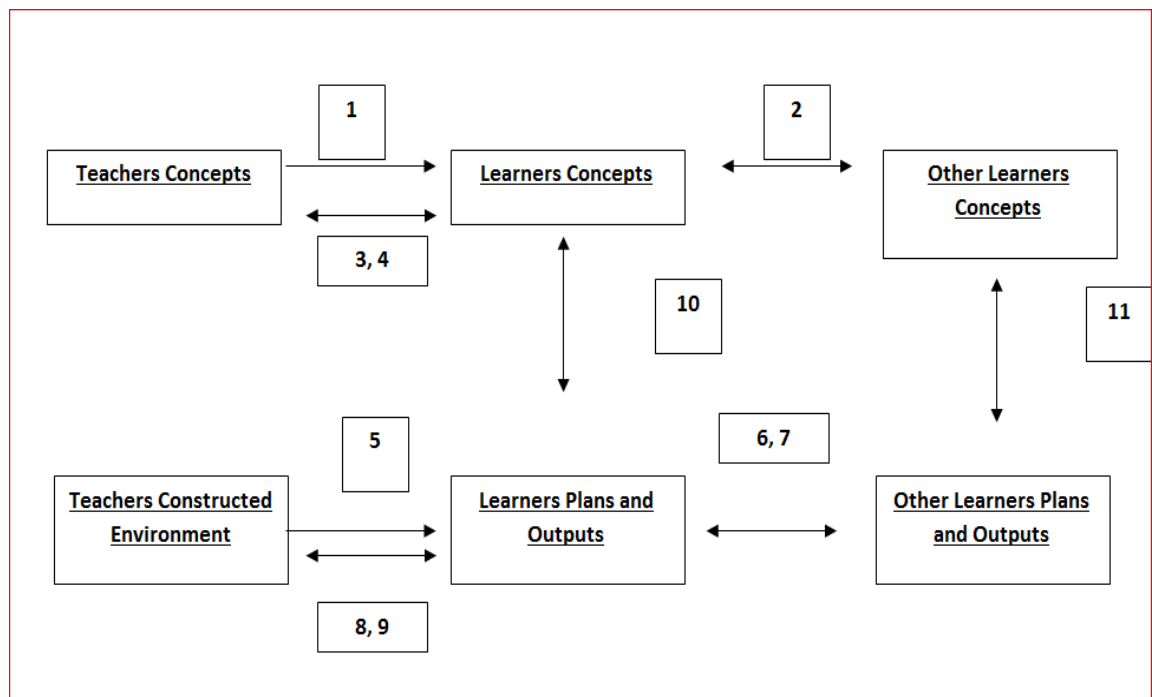


Figure 2.1 – The Conversational Framework for supporting the formal learning process (Laurillard, 2002)

The framework includes a large number of steps and linkages between its various components. Let us imagine that a teacher introduces (articulates) a concept to their students (step 1); the students might then discuss amongst themselves what it means (step 2). They might ask the teacher for further clarification (step 3) and then receive feedback from the teacher (step 4). At a later stage, the students are given a task to complete (preparing a presentation, for example) (step 5). The students work together

on the task (steps 6 and 7), and then present it to the teacher (step 8), who then offers feedback about how the output should be changed (step 9). As this example unfolds, the students draw on their conceptual knowledge (both personally and that of others) to initiate and improve their outputs (steps 10 and 11). These final steps are bi-directional in that the concepts and output shape each other. Whilst this example serves as an introduction to the framework, the elements within it that emphasise learner collaboration and the role of the teacher will be discussed in more depth in the next section. Laurillard (2002) posits that the conversational framework shows the “minimal requirements for supporting learning in formal education” (ibid, P.151). In later work she extends this assertion noting that the frameworks’ chief advantage lies in the fact that it focuses on the learner “as they are in the act of learning” (Laurillard, 2007, P.3), whilst placing less emphasis on issues such as the learning context or technology in question. The framework meets each of the criteria set out above, in that it focuses on the interactions and practices of the learners, whilst also allowing one to examine the role of the teacher in designing and implementing a given learning activity. Besides being pedagogically anchored, it provides sufficient detail so that one can both plan and evaluate such activities. It now remains to apply it to the specific case of the hybrid space.

2.2.2 The Conversational Framework and the hybrid space

The aim now is to use the Conversational Framework as a design tool, applying it to the contexts of the hybrid space. The previous section identified a number of possible interactions both between the learners, and between the teacher and the learners. What we do not yet know is how these interactions might be instantiated when the specific characteristics of the hybrid learning space are taken into account. The underlying question is: “in what ways does the hybrid space facilitate these interactions?” This will then form the foundation for the learning design in section 2.3. As the emphasis of this

thesis is on the role of the teacher in the space, and the interactions that take place between the learners, each of these elements can now be examined individually.

The Role of the Teacher

This is significant as the teacher is responsible for the choice of learning space; along with deciding what is to be taught, and how it is to be taught. In other words, their involvement starts with the selection of a given space and curriculum, the design of the learning activity in general and detailed terms, and then continues through their ongoing interactions with the learners until the activity has been completed. Laurillard (2002) distinguishes between the “teachers’ theoretical representation” (ibid, P.152) (what they choose to teach) and the “teachers’ experiential environment” (ibid, P.153) (the learning tasks and space that they offer to the learners). Our emphasis, at this point, is on this latter concept. In terms of the hybrid space, the issue is important in that the teacher is responsible for deciding what the boundaries of the space will be along with the features that will be available for the learners - and this is before the planning of the learning activity itself. The role of the teacher, therefore, becomes two fold - they must firstly define the space, and then design the activity that will unfold within it. In terms of figure 2.1, Laurillard (2002) observes the various loops that the learners follow as the activity gets under way. She posits that “good learners may take themselves around these iterative loops, given the means to do it; but poor, or unmotivated, learners need the teacher to construct their learning space in such a way that they can scarcely avoid being active learners” (P.151). As before, it is important to explore what roles the teacher is expected to perform in the conversational framework. Once identified, these can then be re-assessed in the context of the hybrid space.

Firstly, there is the communication (discursive level) that occurs between the teacher and the student. It should therefore be possible, according to the framework, for the teacher to present information, questions and feedback to their students. This communication, of course, goes in both directions. Moreover, at the experiential level, the teacher should be able to provide feedback (about outputs and productions) to the learners. The latter should then be able to reflect on their practice and then repeat and improve it before presenting the finished production to the teacher. In terms of figure 2.1, the emphasis is on interactions at the bottom left of the diagram, as the teacher develops and improves the practices and outputs of the learners.

If one assumes the same hybrid space as before, then we can perform a similar mapping of teacher roles onto the features available in the space as shown in appendix 2. It can be seen that some of the mappings are identical to before. The same features offer more than one use. There are noticeable differences in the cases of “offering information” and “providing feedback”. In both of these cases, the teacher can also use the shared digital artefact (eg. by building a feedback wall in a virtual world) as an additional means of communication. A similar situation applies in the case of the teacher assisting the learners to modify their output. Here, the teacher can intervene directly to modify the output, although the other physical and digital communication options again remain available. As for receiving the finished production; the teacher can again specify if they want the production to be delivered in the physical or the digital aspect of the hybrid space. More broadly, the same provisos as before apply also, in that the teacher can use more than one feature to perform a given interaction.

Learner Interactions

This is significant as the learners can interact with each other in a variety of ways. The advantage of the framework is that it gives us a means of examining and discussing these interactions with a reasonable degree of detail. There are several discursive and experiential interactions that occur between the learners. In *figure 2.1*, it can be seen that there are interactions between the learners at both the discursive and the experiential levels. At the discursive level, it is important that the learners in a given environment are able to ask questions, propose ideas, and then discuss them as a group. The environment must offer a means (or several means) of letting the learners question, inform and debate each other. At the experiential level, the learners should be able to share plans and outputs with each other (eg. a presentation, an artefact constructed on the screen). This rarely represents the finished version of the work, and therefore the learners will also need to jointly revise their outputs following feedback from their peers. When the final production is completed, they will also need to be able to present this to the other learners, typically, before it is given to the teacher. This analysis gives us an initial series of learner interactions that can now be examined in terms of the hybrid space.

In a hybrid space, these collaborative interactions can be carried out in various ways. One approach is to return to the basic features of the hybrid space, as discussed in section 2.1, and then consider how these might support the relevant interactions. In the physical aspect of the space, therefore, the learners can both speak and gesture to each other. In its digital aspects, they can communicate through text on the screen, whilst they can also modify and share outputs in the shared digital space. These outputs (termed here as ‘digital artefacts’) vary according to the digital space being used, and can vary from shared drawings and equations, through to online shapes, simulations

and programs. It is possible that a specific hybrid space might offer further features than this - what is discussed here represents a bare minimum to qualify as a hybrid space. Moreover, it is possible for learners to use more than one feature at the same time. If we put all of this together, we get a matching of interactions and features.

Therefore, interactions from the discursive level of the conversational framework can be undertaken in both aspects of the hybrid space. Those at the experiential level are slightly more complex. The output that the learners must create could be either on the screen (eg shared program code) or in the physical aspect (eg. a presentation). It would, of course, be possible, for the teacher to determine that the output in question must be presented in one or other of the two parts of the space.

The conversational framework places much emphasis on how the discursive and experiential levels drive each other. Therefore, the changes made to the digital artefacts do not occur in isolation. They are, to some extent, influenced by the asking of questions and sharing of ideas in the physical and virtual parts of the space. Similarly, this process of asking questions and sharing ideas is, in part, driven by the changes made to the digital artefact. Again, the idea that learners might use more than one feature in a specific interaction (eg asking a question across both aspects of the space) has already been mentioned.

2.3 Learning design in the hybrid space

Whilst conceptualisation of the hybrid learning space represents a start point, significant issues remain. Namely, how can teachers be supported to design learning activities for implementation in the space, and more broadly, how can we support teachers to embed these technologies in their everyday practice? Simply outlining the perceived learning affordances of the space, as in section 2.2, is unlikely to be sufficient. In short, to support teachers to design learning activities in the HLS, where should one begin, and how should one proceed? This section briefly reviews the issue of teachers embedding innovative technology in their everyday practice before developing, throughout the sub-sections, a process that allows them to design activities in the hybrid learning space.

2.3.1 Teachers embedding innovative technology in everyday practice

There are several reasons why teachers often find this difficult, ranging from their perceptions (correct or erroneous) of a given technology, their understandings or misconceptions of its' possible uses for learning, combined with the frequent lack of a viable and practicable means of designing learning activities for use with the technology. Several possible outcomes arise from this, ranging from failure to use the technology, using it in idiosyncratic or unproductive ways, or its' immediate or gradual abandonment in favour of older, and more established, technologies.

This arises from the fact that many technologies are originally designed for commercial and leisure interests, and then later 'repurposed' for educational uses (Laurillard, 2009). From a teachers' perspective, this points to three challenges, namely, how can one identify and provide 'what it takes to learn' (Laurillard, *ibid*) using the technology in question?; what additional degree of support for learning might be needed, and lastly, to

what extent can these supports be modified and built on in light of ones' experience and that of other teachers?

To begin with, Laurillard (2009) asserts, "they (teachers and lecturers) have too little help in addressing the issue at the heart of our educational problems: 'how to identify and provide what it takes to learn'" (ibid, P.3). Her seminal paper (Laurillard, 2009), examines how such learning design can be organised and structured, along with the challenges that teachers frequently face in appropriating and implementing it. She argues that learning design would be "more feasible if the teacher could work on the basis of an existing format, which captures a particular pedagogic form, and customise this to their context using their own texts, topics and digital assets" (ibid, P.8), before then proposing the Conversational Framework as a starting point for this process.

A second challenge is that a single 'existing format', (to use Laurillard's term), may not, in itself, be sufficient for successful learning design. Although fundamental, it may then be lacking in terms of detail or the meeting of specific learning criteria that the teacher might wish to support. What would be preferable would be a learning design *process*, made up of a number of complementary parts, with each of the various parts playing a particular role in the overall design. Teachers could then start with the initial framework and follow each of the successive parts of the process to finish with a robust learning design. The aim of this section is to set out and justify precisely such a process.

Finally, the learning design process should be adaptable in light of experience from implementation. Laurillard (ibid) again points to the importance of teachers being able to build on the work of others, averring that teachers need to "find, adopt, adapt, experiment, challenge in practice, redesign and share designs" (ibid p.5). The aim is

that teachers can reflect on their implementation experiences, share these with others and use this to iteratively improve the process.

The emphasis in this thesis is on the teacher as a *learning designer*. In this section, we start by revisiting the Conversational Framework and assessing the contribution that it makes to a learning design process for teachers, before interrogating how it can be complemented by the use of other techniques. It will be argued (section 2.3.2) that the Conversational Framework allows one to discern and specify rationale, content and potential learner interactions; but that a further degree of planning is required if one is to proscribe learner interactions and the role of the teacher in a closer, more detailed way. The broader collaborative context that underpins both of these concepts is explored in section 2.3.3, with the emphasis moving to how one can practically support learner collaboration in section 2.3.4. The discussion is informed primarily by the large body of CSCL literature. Drawing on this, the learning design process can then be elaborated, with the final part of the section (2.3.5) setting out, specifically, how learner interactions and the role of the teacher will be supported in study one (chapters 4 and 5). Where relevant, this will be discussed with reference to the findings of the studies and the conclusions of the thesis.

2.3.2 The Conversational Framework and learning design

A number of the frameworks' assumptions are of significance. It is assumed that the learners will think more about the theory involved if they have to use it in order to act in the learning space to complete some task or goal. It is also believed that they will reflect more on this experience if they are expected to produce some version of their work at the experiential level, or as Laurillard (2002) points out, "this would traditionally be an essay, report, or model, depending on the discipline" (P. 162).

Finally, in terms of both activity design and collaboration, it is claimed that the learners will improve their practice if they share their outputs with peers, and that they will improve both their practice and (conceptual) understanding, if they can reflect on their experience by discussing their outputs with their peers (ibid). Laurillard's expectation is that a suitable activity would facilitate most of these interactions in one form or another.

Many of these assumptions were inherent in our previous discussion of learner interactions and the role of the teacher. Some of the possible interactions are shown in *appendix 1 and appendix 2*. If we bring all of this together, however, it becomes easier to isolate some of the criteria that one might wish to see met in a given learning activity. The activity should have some theoretical or conceptual component. In this way, it can address the question of "what do we learn?" If one moves the emphasis towards how such learning might occur, then three further considerations come into play. Firstly, the activity should expect and allow learners to ask questions, debate and share ideas with each other and the teacher. Ideally, the learners should then proceed towards creating some sort of practical model or output in conjunction with other students. Finally, the finished product can then be presented to ones' peers and / or to the teacher for feedback and final assessment. The aim here is that the learners can then reflect on their experience. These core criteria of a learning activity are shown in *table 2.1*.

<u>Learning Activity Criteria</u>
1 - Learners can access theory and concepts
2 - Learners can ask questions, share ideas and debate with both teacher and other learners
3 - Learners use conceptual knowledge to achieve practical task / goal. The output of this is shared with teacher and other learners and the resulting feedback is used to improve performance at the task / goal
4 - Learners reflect on experience by presenting ideas & models to teacher and other learners

Table 2.1 – The main Criteria of a Learning Activity in the Conversational Framework

A simple example of this, using the hybrid space set out in the previous section (this becomes the teachers constructed environment) is appropriate. In our activity, the teacher expects two learners (A and B) to each produce a digital artefact in the hybrid space. This could be a simulation, a model, a game or something similar. The learners can collaborate if they wish, but it is expected that each will produce a working example of the artefact, and be able to explain and demonstrate how they made it, and the decisions taken for this, at the end, to the teacher. The conceptual knowledge resides in knowing how to do this, whilst the plans and outputs are represented by the attempts that the learners take to create and program the artefact. By examining this (theoretical) activity in terms of the four criteria, a number of ideas come to light. The teacher can use the various features of the space to set out the relevant concepts, through face to face explanations, text or demonstrations in the virtual world, amongst

other means. Similarly the learning material for this can be presented to the learners on book or paper (in the classroom) or through digital artefacts (eg. a learning wall, samples of script, working models). In terms of asking questions, debating and sharing ideas, the teacher and the learners can, again, achieve this through a mixture of voice and gestures in the classroom and through text and artefacts in the digital aspect. An example of the latter would be where learner A makes a practice simulation in the virtual world, and where learner B examines this and moves to where learner A is sitting to ask questions and suggest improvements that could be made to it. Similarly, learner B could again examine the simulation, and text either the teacher or learner A with a question about it. A final example of this might be where the learners discuss the model that they are working on with the teacher using a mixture of face to face and digital features, before then discussing it amongst each other. The third group of criteria extends this as the learners modify what they have built in light of feedback from the teacher and / or other students. An example of this is where learner B uses their new found knowledge to add new features to the simulation. This is then shared both with the teacher and with learner A. The former makes one suggestion about how to improve the simulation, whilst the latter proposes and then demonstrates how to add a new function to it. Learner B then modifies the simulation in light of feedback from both parties. Finally, at the end of the activity, both learner A and learner B present the completed output on the screen to the teacher and discuss it face to face. They also demonstrate how it works in the virtual world. This sample learning activity is not intended to be exhaustive, nor has it been discussed in terms of its broader educational rationale, but it does address most of the four criteria that we examined above. The main steps that such an activity might proceed through are set out below in table 2.2 below. It can be seen that the activity uses a range of the features of the hybrid space,

and results in a number of collaborative interactions. It also represents a starting point for the design of a specific and more detailed learning activity in chapter 4.

<u>Learning Activity Criteria</u>	<u>Example</u>
1 - Learners can access theory and concepts	<p>Learning material explained both face to face and in digital aspect by teacher</p> <p>Models / simulations / games / demonstrations are placed in the virtual world for study and modification by learners.</p>
2 - Learners can ask questions, share ideas and debate with both teacher and other learners	<p>Learner A discusses the task with the teacher using both face to face and text on screen.</p> <p>This is then discussed with learner B.</p> <p>Then both learners discuss the task with the teacher</p>
3 - Learners use conceptual knowledge to achieve practical task / goal. The output of this is shared with teacher and other learners and the resulting feedback is used to improve performance at the task / goal	<p>Learner B uses conceptual knowledge to design initial version of practical task / goal</p> <p>This is shared with both teacher and with learner A</p>

	<p>Both make suggestions on how to improve practical task / goal</p> <p>Learner B modifies the output in light of feedback from both parties</p>
<p>4 - Learners reflect on experience by presenting ideas & models to teacher and other learners</p>	<p>Both learners present final output</p> <p>Improvements are suggested by learners and teachers</p> <p>Learners draw up plan on how to run improved versions of output and will implement this in next version of learning activity.</p>

Table 2.2 - Learning Activity in the hybrid space based on the Conversational Framework

The Conversational Framework, therefore, allows us to initiate the learning design process. It does this by focusing our attention on a number of important initial criteria - challenging us to explain how these criteria will be met. This is useful in terms of a top level description of a learning activity. It is debatable, however, whether a teacher with no previous experience of a HLS would be able to immediately implement this. What is missing is detail. We would like to be able to specify both learner interactions and the role of the teacher in a more proscribed way. One way of doing this is to encourage the learners, through various means, to work with each other or collaborate (so as to encourage interaction between them), whilst examining more closely how the teacher

might productively intervene in the activity whilst it is in progress. Both of these issues are discussed in some detail in the CSCL literature. The aim of the rest of this section is to set out, more precisely, the meaning of collaboration as it applies to this thesis (2.3.2), before looking at practical ways in which learner interactions and the role of the teacher can be developed and specified in more detail (2.3.3 and 2.3.4).

2.3.3 What is meant by collaboration?

A simple definition of learners “working together” might represent a promising start point. Yet the exact meaning is an issue of much debate amongst researchers. Paavola et al (2004) for example, point to the use of words such as “coordination, cooperation and collaboration” (ibid, P.557) across the literature, each with its own definition and emphasis. There appears to be a consensus, however, that a loose form of cooperation amongst the learners is not enough – something more is required if learning is to be truly “collaborative”. Dillenbourg, Baker, Blaye & O'Malley (1995) set out the difference between the two concepts, explaining that, “collaboration is distinguished from cooperation, in that cooperative work is accomplished by the division of labour among participants, as an activity where each person is responsible for a portion of the problem solving; whereas collaboration involves the mutual engagement of participants in a coordinated effort to solve the problem together” (P. 2)

The concept has a long heritage, but it is Vygotsky’s pioneering work which underpins much of the research in this area. His work emphasises what occurs during the process of instruction, and examines the ways in which individual learner cognition drives, and is driven by, interactions with other learners and with the wider learning context. Central to his analysis is the idea of the ‘zone of proximal development’ (ZPD), which Vygotsky describes as the “discrepancy between a child’s actual mental age and the

level he reaches in solving problems with assistance” (1986, p. 187). As Crook (1996) argues, it points to a gap between actual developmental level as determined by individual problem solving, and their potential development as determined through problem solving under adult guidance or in collaboration with more capable peers; between what the learner can achieve through thinking and working on their own, and what they can achieve through collaborating with others. From our perspective, this is important as Vygotsky’s approach underlines “the rich possibilities of social interaction organised between individuals of varying expertise” (Crook, P.86). These possibilities are underpinned by important processes such as *scaffolding*, *appropriation* and *internalisation*.

Vygotsky argued that individuals who are expert in some domain will collaborate in distinctive ways with novices as they communicate their expertise. Whilst this can entail simple demonstration or direct explanation, *scaffolding*, implies a longer term collaborative encounter “with more participation on the part of the novice and more sensitivity on the part of the expert” (Crook, P.87). The term is used to describe tutorial assistance, where the quality and quantity of assistance offered to the individual learner is tailored to their current abilities and understanding of the subject matter being learnt. The novice completes the task alongside the expert, who may be judiciously steering or prompting. The encounter, therefore, is driven not so much by showing and explaining, but rather it encourages the novice’s full and joint participation in the act of problem solving. Later work by Wertsch (1988) examined how an adult and a child learner would distribute responsibility for the various elements of a learning activity. The adult would take responsibility for some of the moves that seem to be currently beyond the reach of the child. At other times, the adult might do and say things to prompt and mobilise a strategy that is within the child’s repertoire, but not spontaneously elicited by the situation alone. In terms of broader peer collaboration, socially organised

practices are central to the learning process. Luckin (2009), for example, notes how these are instantiated and framed by interactions such as articulation, conflict and the creation of shared knowledge by the learners. In all of this, there is *appropriation*, as learners observe and ‘borrow’ from the activities of their peers, behaving as if there is more common ground than there is in practice (Crook, 1996). Learning, therefore, becomes a joint interactional activity, based on productive encounters between the individual learners.

Parallel to this is a cognitive process of *internalisation* on the part of the individual learner. Instructional interactions ‘awaken’ the internal developmental processes of the learner, something which only operates when the child is interacting with other people in the environment (Luckin, 2008). There is a parallel between the external world of joint problem solving set out above and the internal world of mental functioning, or as Crook (1996) puts it, “what is performed in the arena of joint action gets internalised into the private world of the novice’s own mental life. Individual cognitive resources are first experienced on this public plane of collaboration, they are then adopted as private.” (ibid, p.88). In short, cognition is viewed as a social phenomenon, as the acquisition of new understandings becomes possible through participation in certain kinds of supporting social interactions.

Later work by Dillenbourg et al. (1999) built on these concepts. They assert, more broadly, that research on collaboration has passed through three distinct phases. Early work (labelled the ‘effects paradigm’) examined situations where learning as a group was considered to be more effective than learning as an individual. The overall results of these studies (eg. Slavin, 1983) was contradictory but broadly positive, giving way to

a second phase (the 'conditions paradigm') which sought to isolate and study the conditions required for effective collaboration. This concluded that the various factors examined interact with each other in complex ways, and that it is difficult to isolate the effect of a single variable. A third phase of study is characterised as the 'interactions paradigm', where the emphasis is on how specific interactions shape the overall collaboration between the learners. As such, it represents both a response to, and an extension of, the two previous phases. It emphasises the role of discontinuities in collaborative knowledge creation, such as “discontinuities between different stages of individual and group competency, between knowledge constructed in group interaction and that internalised by individual peers, or between online or face to face episodes of collaboration over time” (ibid, P.12). To this end, they suggested that such discontinuities could affect “meaning” (the ability of learners to construct and share information), “social structure” (the establishment and maintenance of social order and interactions) and “motivation” (the establishment and maintenance of motivation to communicate and cooperate). This “interactions paradigm” therefore, emphasises the methods that learners use to overcome such discontinuities, and to make group learning more successful and stable.

Stahls' work on “Virtual Maths Teams” (VMT) at Drexel University from 1992 onwards, is a good example of this. It explores how one could use a shared software environment (initially textual, graphics came later) to encourage students to solve maths problems as a group. As a minimum, this required that the learners develop a joint understanding of the problems at hand, before then collaborating to solve them. Stahl (2007) critiques what he considers to be the “traditional” approach to learning with its emphasis on human cognition at the individual level. To conceive of things

solely in this way (“a purely psychological phenomenon”), he argues, ignores the strong social components of learning that occur amongst groups of students. One alternative would be to focus on the more situated aspects of learning as they occur in a larger “community of practice” (Lave and Wenger, 1991). Whilst such an approach is useful, it still misses the point, according to Stahl. This is because it emphasises “the group’s situation in the larger industrial and historic context” (Stahl, 2007, P.3). Although this perspective might provide insights into the workings of the group; such insights arise as a secondary (and less important) outcome of the study. The focus remains on the broader social picture. Stahl’s underlying argument is that neither the individual (psychology focused) nor the community (social focused) approach is really sufficient to describe the ways in which small groups of learners collaborate. The “intermediate” level between the two extremes remains unexplored. His solution, therefore, is to focus on the small group as the preferred unit of analysis. The effect of this is to complement, rather than contradict the other two perspectives. To this end, he takes an example of learner activity from the VMT project noting that, “in online chat, the individuals interpret recent postings and design new postings in return, the group constructs, maintains and repairs the joint problem space, and the community evolves its shared methods of social organisation” (ibid, P.8). In other words, the same learning activity can be represented at different levels. Whilst this emphasises small group collaboration, the larger context is not neglected. Rather, the small group becomes an indispensable “bridge” between the individual and the community. The individual student learns as part of the small group, whilst the community is portrayed as being the ensemble of small groups. The emphasis is no longer on individual learning activities, but on group interactions such as sharing and negotiation; or as Stahl puts it, “collaboration becomes the result of a continued attempt to construct and maintain a shared conception of a problem” (Stahl, 2007, P.12).

2.3.4 Supporting learner interactions in the context of collaboration

The Conversational Framework allowed us to identify where learner interactions were both feasible and potentially productive, but offered no guarantee that such interactions would necessarily occur. In what other ways can we support such interactions? In the CSCL literature, this is characterised in terms such as facilitating, supporting or enforcing collaboration – something which is frequently mediated through the design of the technology.

In their study of collaborative storytelling, Benford, Druin et al (2000) put forward a continuum ranging from the simple facilitation of collaboration at one end through to its' enforcement at the other. The former refers to the technique of designing the software that the learners use so as to make it easier for them to work together. In other words, there is an attempt to design collaboration into the software itself. In this light, Dillenbourg (2002) reviews one application where the learners communicate via a series of pre-defined buttons. He notes how these form either a complete utterance (“do you agree?”) or open a sentence (“I propose to ..”) which the learner can then complete with free text. The aim is to make it easier for the learners to share their views with each other. Benford et al. (2000) extend this, proposing that the software should be more customisable than this. They argue that this constitutes an encouragement of collaboration (as opposed to its simple facilitation) and that in terms of their continuum, it represents a mid-point between the two extremes, or as they point out, “it is not so strict as to require users to work together, but rather it provides some explicit motivation for them to do so in terms of added benefit”. (ibid, P.7)

They present this approach in their KidPad storytelling project. The learners create drawings which they then explain to others - but the functionality of the software is tied to the willingness of the learners to collaborate. In other words, if they want to perform more complex functions with it, they will have to do so together; or as Benford et al put it, “a single child or two children working independently can create a fully functioning drawing, but two children collaborating can create an enhanced one, for example, with more colours” (ibid, P.4) . In a later iteration of the software, they add a number of actions that can be initiated by one user, but can then only be modified by more than one learner. In other words, collaboration is not required at the beginning of the learning activity (as the learners can work alone), but becomes essential later on as they need to modify and develop the existing work.

There are two concerns with this approach however. Firstly, whilst the option of collaboration is made available to the learners, there is little further attempt to help it occur. Whether it occurs or not continues to depend primarily on the software interface in question, rather than on the learning activity. Secondly, as Baker and Lund (1997) assert, the extent to which the interface can successfully shape collaboration remains an open issue. Concentrating on the interface frequently means neglecting the many other variables that influence collaboration. It also overlooks the role of the teacher in terms of the design of the activity, and their interventions whilst the activity is in progress. By taking into account the abilities and needs of the learners, the teacher can encourage interactions in a more personalised and detailed way than the software can. Moreover, the teacher can also intervene in a more dynamic way in the activity – again something which the software cannot do. A more promising approach would be to focus more

directly on the learning activity more than on the technology if we wish to encourage learner collaboration.

2.3.5 Templated supports and teacher interventions

Learner collaboration can be encouraged in several ways; concepts such as “scripting”, “role playing” and “orchestration” are frequently discussed in the literature. Dillenbourg’s (2002) work is particularly important in this regard, although a number of other researchers also address the issue in terms of scripting (Kollar and Fischer, 2006; Weinberger et al, 2005), enforcement (Battocchi, 2010) and activity planning (Lonchamp, 2006). To enforce collaboration, it is important to focus both on the planning of the learning activity and also on its longer term progress. In short, it should be possible both to initially design for collaboration and then to monitor and intervene in the activity as it unfolds. There can be a tension between these two concepts, as discussed in the context of ‘overscripting’ later in this sub-section. Dillenbourg (1999) puts forward a number of ways in which collaboration can be enforced. Three of these are examined here.

Firstly, it is important to “set up the initial conditions” (ibid). In other words, there are several factors inherent in the initial design of the learning activity which influence the likelihood that collaboration will occur. This includes issues such as who should be in the group, their similarities and differences in terms of what they know and more broadly, how they should be selected. Allied to this, is the composition of the learning tasks that they are expected to attempt. Dillenbourg (ibid) points to the notion that some tasks are more suited to collaborative processes than others, but also cautions that the various factors mentioned here interact with each other in complex (and not fully understood) ways. As a result, such attempts at picking the “right” participants and designing the appropriate mix of tasks are not always as successful as one might expect.

A second approach is to accord specific roles to each of the learners. The extent of this might vary, but generally, the aim is to specify and delimit what they can both say and do, something which is generally referred to as “scripting”. O’Donnell and Dansereau (1992, P3) define this as “a set of instructions regarding how the group members should interact, how they should collaborate and how they should solve the problem”. Two issues arise. The first is the rigour with which the scripts are to be applied, and the freedom that is offered to the learners to deviate from them – something which depends on the teacher. These positions can change markedly once an activity is in progress. In this thesis, the relevant scripts often conflicted with organic roles that the learners had taken on (chapter five). In other cases, the scripts frequently had to be abandoned due to technical problems or other pragmatic concerns (chapter five and chapter seven). More often than not, they had to be implemented in ways that were not envisaged when they were designed, again because the activity was going in a different direction than had been planned. The second concerns the desired uses of the scripts. Do they exist to determine simply what the learners say, or what they do, or something else? An example of this can be seen in Weinberger’s (2005) work. He distinguishes between epistemic, argumentative and social scripts. The former two of these are concerned with how the learners structure their discourse and arguments (this was the focus of his study), whilst the last one emphasises the ways in which they are expected and permitted to interact with each other. Such a list need hardly be exclusive, and, as before, the different types of scripts appear to interact with each other in complex ways. There can be tensions, with attempts to emphasise discourse alone leading to a breakdown of collaboration, whilst a renewed focus on the social scripts lead (in Weinberger’s work) to learners focusing on solving the problem at hand, but without elaborating the learning material. In this thesis, there was an emphasis on epistemic

scripts, based on the learners each holding different pieces of information. These were of some use in the early stages of the activity in chapter five, but became progressively less tenable, with the learners developing a wider range of organic, and unanticipated, roles as the activity progressed. As a result of this, scripts were eschewed for the learning design process in the later study (chapter 6)

A final means of encouraging collaboration is to “monitor and regulate the interactions” (Dillenbourg, 2002, P.6). This posits a more active role for the teacher, with the degree of such interventions varying enormously. Dillenbourg (ibid) takes a minimalist view, suggesting that the teacher provide a hint, for example, in order to redirect the group work “in a more productive direction, or to monitor which members are left out of the interaction” (ibid, P6). His central concern is to avoid disrupting the social dynamics of the group, hence the “light touch” approach to intervention. The advent of monitoring and regulation, regardless of its extent, raises a number of issues, such as who is to intervene, and specifically under which conditions. Jermann (2004) asserts, that such tasks are likely to prove difficult for teachers and that it is preferable to help the group to regulate itself by providing it with some representation of its own process. In study one (chapter 5), for example, there was a steady movement from teacher interventions as collaboration frequently broke down, towards encouraging the learners to represent and examine their own processes and ways of working. This proved to be a more successful way of avoiding breakdowns. In study two (chapter 7), this latter approach was pursued more broadly, with the learners frequently describing, interrogating and improving their processes, both to each other and to the teacher.

Attempts to encourage and enforce collaboration can be problematic. To begin with, each of the techniques set out above has its own inherent challenges. One general problem is that of complexity, as it is difficult to predict how the different steps interact with each other. If we keep our focus on the notion of enforcing collaboration through activity design, the designer of the learning activity is faced with a number of questions, ranging from the kind of collaborative interactions that they wish to bring about, to which of the three approaches they believe will be most successful - bearing in mind that they can use more than one.

At one extreme, a designer might want to go for a “light touch” approach. In this case, they would decide who was to participate in the activity and what would be the most promising tasks for them to complete. They might then give some general scripts to the learners, emphasising that these are simply guidelines – not to be followed too closely. Once the activity is in progress, the designer would then keep their interventions to a minimum, getting involved simply to provide hints and to ensure that the activity keeps moving. In planning the activity, the designer has set out a relatively unstructured role for “initial conditions”, scripting and regulation. The problem is that the desired collaboration might never materialise according to this scenario. In the second iteration of the learning activity, the designer responds to this challenge by moving towards the other extreme. Things are done differently this time, as the learners are assigned more detailed roles and are given scripts covering how they interact with each other and what they are expected to say (epistemic and social scripts to use Weinbergers’ terms). The activity is more heavily monitored and regulated, with the teacher intervening on several occasions, when the required collaboration did not appear to be occurring. In this thesis, there was an initial emphasis on relatively strict scripts during the first study

(chapter 5). As already discussed, these were rarely successful in achieving their objectives and were supplanted by the organic roles that the learners took on as the activity progressed. Complementing this was a strong emphasis on teacher interventions to avoid or minimise breakdowns. These were somewhat more successful, but imposed a stronger than anticipated workload on the teacher. Again, there was a move towards getting the learners to resolve the breakdowns themselves (by asking questions, getting them to explain their approach to others etc.), which proved to be more successful. The lessons from this were implemented in study two (chapter 7) where scripts were removed from the learning design process, and where a stronger emphasis was placed on getting the learners to sustain collaboration, rather than having the teacher intervene directly. From this perspective, therefore, there was a move from the more coercive to the less coercive approach between the two studies, with collaboration steadily improving. This posed something of a challenge to the dominant role of scripts in CSCL and is discussed further in the conclusion (chapter 8).

Dillenbourg (1999), notes how “choosing the appropriate level of coercion is the oldest educational design trade off” (P.19). His point is that some degree of enforcement is required if collaboration is to be guaranteed, but that this runs the risk of interfering with whatever (naturally occurring) collaborative (and other) processes that may already be in evidence. Moreover, there is the danger that a strongly coercive approach can reduce learner motivation. Dillenbourg developed these ideas over several years, leading to his seminal paper (2002) on the problems of “overscripting”. He identified a number of the problems that this might lead to. Two of these are of particular interest here.

Firstly, it disturbs both the “natural” interactions and problem solving processes that occur amongst the learners. Dillenbourg examines the case where a learner wants to undertake interaction A, but is only offered interactions B or C, by the script. The students’ options are either to do / say nothing, or to try out B or C, in the hope of changing it to A. In both cases, the collaborative process is damaged. Similarly, a learner may be given a script telling them to complete a particular task through a linear sequence of phases. The student finds a different way of completing the task, and again, must choose between following the script regardless and abandoning it entirely, or as Dillenbourg (ibid, P.21) puts it, “coercion becomes incompatible with the students cognitive processes”. This occurred frequently during study one (chapter 5) as the learners sometimes ignored or abandoned their assigned scripts – particularly when they had found better ways of performing the task in question. On other occasions, they followed the script in question to begin with, before then modifying it and implementing it in a different way – again, when they had found other ways of completing the task. Modification and abandonment of scripts was therefore commonplace.

A related problem concerns student motivation. Collaborative learning works well when it triggers natural interactions (Koschmann, 2001). When a co-learner asks a question, it is because they want to know the answer. Dillenbourg (ibid) argues that where an activity is heavily scripted, the teacher is asking questions for which they already know the answer. This is worrying, he asserts, because, “the learners know that these weird interactions are part of a didactic contract in which each actor plays its role. Interactions such as these are played like a game and hence miss the engagement that can be obtained when the listener really needs our explanation” (ibid, P. 24)

Dillenbourgs' broad critique is that the more one attempts to script and regulate a learning activity, the further away one moves from spontaneous and "natural" forms of collaboration. He finishes, indeed, on a pessimistic note, suggesting that research should be concerned not with finding the "golden script" (ibid, P.26), but rather with exploring why some scripts are effective and others are not. In this thesis, scripts were implemented with limited success in study one (chapter 5). They were frequently modified by the learners before being abandoned later on, particularly where they conflicted with organic roles that the learners had taken on as the activity progressed. Because of this, the use of scripts was avoided for study two (chapter 7), replaced instead with a new emphasis on encouraging learner interactions implicitly through the design of the activity, rather than explicitly in the form of scripts.

If we take a step back, this leaves us with a three part learning design process, comprised of the Conversational Framework (which sets out the initial rationale, learner interactions and the proposed role of the teacher at a top level), complemented by the use of learner scripts for collaboration (which can vary in terms of detail, degree of coercion and other factors) and a teacher examination or plan of how they might monitor and intervene in the activity and its interactions. Reliance solely on the Conversational Framework runs the risk that the desired learner interactions will not take place, whilst an over emphasis on the two latter parts of the process, runs the risk that "overscripting" or heavy handed teacher intervention will interfere with whatever interactions and problem solving processes that might already be in evidence. It would give us detail without an underlying rationale.

The emphasis, so far, has been on the conceptualisation of the hybrid learning space, and on the learning design challenges that teachers face when using it. In the final part of this literature review, we examine more closely the possible learner roles and activities that support collaboration in the space.

2.4 Roles and Activities in hybrid spaces

At its simplest, activity can be defined as something that a learner or group of learners say or do. Crook (1998) points to the importance of three activities, namely that the learners, “articulate their thoughts publicly, engage in productive conflict, and that there is the possibility of co-constructions”. The aim of all of this, he asserts, is to “support a creative process of converging upon a single object - a hypothesis, a prediction, a model, or whatever” (ibid, P.142). There is a range of work in the CSCL literature (eg. Marshall, (2007), Pinelle (2008), Roschelle and Teasley (1995), Sarmiento-Klapper (2009)), which takes such an approach, identifying what the learners want to achieve through collaboration and then unpacking the activities required in order to achieve this.

The concept of a role extends this, suggesting an activity or a series of activities that one performs more than once. This can either originate with the learner themselves (defined as a ‘spontaneous’ role by Strijbos, 2005), or be assigned by a teacher or another learner (‘scripted’ or ‘assigned’ in much of the literature). This conceals a number of more diverse definitions however. In their 1995 study, Mudrack & Farrell set out to study group cohesion in classroom learning. They identified three kinds of roles, which they described as “individual, task and maintenance”. The first two of these were concerned with completing tasks and activities, whilst the latter (which dealt

with attempts to make the group function better) was more social in nature. The study was based on self-report techniques (Lockhorst, 2004) and was made more complex by the fact that the learners could participate in more than one role at a given time. Later work attempted to extend this by obliging the learners to adopt (and stick to) clearly defined roles, and then examining what occurred in terms of group cohesion. The results were not always predictable. The learners in Cohen's (1994) work were given roles such as “artist, scriptwriter and manager”. This often had the effect of reducing group interaction rather than improving it as “each person worked quietly on their own task” (ibid). Taking this into account; Singley, Fairweather and Swerling (1999), asserted that relatively stable and predictable roles exist in collaborative learning (including “apprentices, specialists and leaders”) and that future research should focus on these only. Others (such as Strijbos, 2005) suggest that this is not feasible, and that instead roles should be seen as “functional” and determined by the perceived affordances of the software at hand.

The wide range of work on roles and activities (as part of collaboration) in the literature prevents us from examining each of them to the extent that one might wish. Nonetheless, it is possible to narrow the discussion in terms of three areas - one influenced by CSCL, another informed by a tangible systems approach, and a final one relating to non-collaboration. The first area is examined in the context of Stahl's (2006) seminal paper on ‘learning proposal bids’ where a learner suggests a course of action to the group, which can then be followed, modified or ignored. This concept figured prominently in both of the empirical studies in chapters five and seven. The thesis built on Stahl's work by outlining a series of roles and activities which were mediated by these bids, and which changed in character over time. The second area, relates to the intersection of physical action and discussion which characterises the tangible systems

approach. This was evident in both of the empirical studies as the learners used movement around the physical space as a means of establishing, advertising and developing their various roles. It was also inherent in activities such as passing, pairing and tussling as they appropriated other learners' laptops as a means of improving their awareness – something which in turn allowed further role development. The thesis builds on this work by examining how the development of roles and activities in hybrid learning spaces are informed as much by physical movement as by verbal discussion. The final area relates to non-collaboration. In the two empirical studies, this was often characterised by disagreement and argument. It sometimes paved the way for further collaboration, but frequently led to its' breakdown. The thesis builds on the work discussed here by examining in more detail the part that non-collaboration plays in the overall context of collaboration, and by describing why non collaboration would sometimes lead to later collaboration, and why it often lead to breakdown.

Roles and Activities I - Stahl and Learning Proposal Bids

In Stahl's VMT work, the learners would propose information, ideas or a course of action to the rest of the group - something which the latter were at liberty to accept, reject or ignore. A "learning proposal bid" was the name given by Stahl to one of these participant proposals, or as he puts it, "the learner bids for the groups work". The proposal itself could be a possible solution to a problem, a smaller piece of information that might contribute to solving the problem or, more significantly, a suggestion that the group adopt a different approach or course of action. At first glance, the group response to such a proposal might appear to be quite simple. They can choose to accept the new information or idea, ignore it, or reject it outright. The reality was not so simple. Often the proposal bid was initially accepted but then modified by others. In other cases, several competing bids were on offer with the group deciding which one (if any) to

choose. Where a bid was rejected, the (initiating) participant would sometimes modify its content or collaborate with other learners to create a later joint bid for the groups work. Few bids in the VMT study resulted in simple, immediate decisions. Often the group would provisionally accept ideas and “try them out” for a while, before making a firmer decision. Alternatively, a proposal would be accepted, and then “built on” over a long series of steps with contributions from other group members. Similarly, the argument over which out of a number of competing proposals to accept would often “drive forward the activity of the group for a significant period of time” (Stahl, 2005, P.5)

Later work by Toledo (2009), also on the VMT project, explored the broader significance of learning proposal bids. Toledo wanted to examine how learners decided which proposals to accept and which ones to ignore; in short, how would the group of learners assess the validity and appropriateness of a particular proposal? How would they choose between competing solutions? His work focused on how a small group of learners worked together to solve a geometry problem, and he observed that often a learner would put forward a particular approach in general terms, before somebody else would intervene to suggest how it should be carried out. The learners put much effort into observing and interrogating each other’s approaches. He concluded that the proposals were assessed based on a number of criteria; such as whether they would allow for contributions from a majority of the group members (this was viewed as being quite important), the extent to which similar proposals had been successful in the past (again, there was a preference for proposals that had worked well in the past), and the way in which the proposal was framed and described by its initiator. Where a number of competing proposals were on offer, effort was put into “interrogating” those

who were proposed them. The latter often “backed down” either revising their ideas or joining with others to make a new proposal. Toledo also observed situations where the learners “provisionally” took on a given proposal, but were careful to “build on” additional methods and criteria. Finally, he studied cases where the learners could not agree on any of the proposals at hand, but “moved on nonetheless”. In short, a proposal was likely to be accepted and advanced by the group if it was (reasonably) familiar, flexible enough to include (new) changes and contributions from others and inclusive (to some extent) of proposals made by others that had been “spurned” in the past.

Roles and Activities II - Fleck et al’s Collaborative Learning Mechanisms Framework

Fleck et al.’s work (2009) explores how co-located learners use a shared digital (multi touch) tabletop to plan the layout of a classroom. There is a mixture of physical action (on and around the tabletop) and discussion, in the learning space; and one of the motivations of the study is to examine how the physical and discursive elements of learning relate to each other. By observing the roles and activities in and around the space, they develop a “collaborative learning mechanisms” framework, in an attempt to isolate what they view as the most important mechanisms for collaborative learning in spaces such as these. The framework distinguishes between “mechanisms of collaborative discussion” and “mechanisms for coordinating collaboration”. A range of roles and activities form each of these.

In terms of collaborative discussion, Fleck et al. point to the importance of “making and accepting suggestions” and “negotiating”. These are achieved through a mixture of verbal and physical interactions. The former is somewhat similar to Stahls’ learning proposal bids in that the emphasis is on constructing and presenting ideas, clarifying them, discussing alternatives and then reaching a shared conclusion. As for physical aspects, there is a focus on gestures and demonstrations (by moving icons) on the tabletop. This is combined with the continuous watching of what the others do, along with ongoing requests for clarification (“why are you doing that?”) and the suggestion of alternatives (“why don’t you do this instead?”). Two additional types of interaction are added to this. The first draws on the verbal aspects of the space and is termed “narration”, as the learners explain to each other what they are doing and what they are about to do. Parallel to this, they use the physical aspect of the space to physically disrupt the actions of others (eg. knocking another students hand out of the way from the icon concerned) - something which informs the other learners of ones’ present and future intentions. As with Stahl’s learning proposal bids, the activity of the group is sustained by this ongoing process of suggestion, modification and negotiation over time. The two studies offer a number of shared contributions to our understanding of learner roles and activities. Both emphasise the importance of suggesting courses of action to other learners, and then having those suggestions modified, accepted and rejected by the others. Both review how this process can unfold over time and examine the uses that the learners put their suggestions to. They look at how the suggestions can be modified and built on over time. Moreover, they consider the ways in which the learners use the various features of the learning space in order to carry out this process. The studies differ in some subtle ways. Stahl (and later Toledo), offer an approach which allows for a more “close up” examination of how the proposals are revised over time. They emphasise more closely how an individual learner can set and modify the

agenda of the small group. Conversely, Fleck et al's work examines roles and activities in a wider focus. They note the important role played by physical action in the process. Because they do this, they are then in a position to explore how the verbal and physical parts of the learning space interplay with each other, thereby presenting a picture which might be closer to what may occur in the hybrid space.

Roles and Activities III – Non Collaboration - a different kind of collaboration?

Roles and activities also arise from non-collaboration, significantly when learners appear to obstruct others' learning through argument, disagreement and obstruction. In the CSCL and tangible systems literature, it takes a variety of forms, and is frequently labelled in terms of "interference" (Falcao and Price, 2009), "blocking" (Fleck, Rogers et al. (2009) and "conflict" (Morris et al. (2006)). Whilst these may appear to be outwardly negative in terms of their effects on collaboration, this is not necessarily the case.

The reason for this is that such interactions frequently signal original and unexpected patterns of collaboration. What occurs is not so much that collaboration stops or is reversed, but rather that the ways in which it is achieved have simply changed. Such a change can manifest itself in a number of ways. Fleck et al (2009), for example, compare how the various attempts at physical blocking are usually accompanied by a renewed exchange of ideas and negotiation efforts between the learners. It is the physical act of blocking or undoing which triggers verbal interactions. Non-collaboration (eg. by moving an item away, or preventing a learner from clicking on an icon), in this case; is best seen as something which encourages the other learners to explain their ideas more clearly, or as the authors assert, it "allows agreement and progress on the task" (ibid, P.5). Put simply, it should be characterised not as non-collaboration, but rather as an integral part of the ongoing evolution and negotiation of

ideas in the learning space. Falcao and Price (2009) situate these phenomena in a broader context, pointing to the role that the resolution of conflicts and the co-construction of ideas play in shaping learner interactions. As with Fleck et al., they too emphasise how non-collaboration allows learners to challenge their thinking and understanding by “prompting reflection through unexpected events” (ibid, P.2). They suggest, that rather than treating episodes of non-collaboration as being of equal significance; that we need instead, to examine the extent to which they “inhibit or encourage collaboration” (ibid, P.8). In other words, how productive is a given act of non-collaboration in terms of interaction? This, of course, requires that one examine any interactions that result out of such non-collaboration, and then assess their broader effects. Lastly, Hornecker and Marshall’s (2008) work on awareness, although it places less importance on non-collaboration, reaches a similar conclusion, noting that the interference evidenced in their study led participants to “interrupt their activity and renegotiate who does what and when”. (ibid, P.4)

Collaborative and non-collaborative roles and activities form part of the same context. The former are relatively clear and unambiguous, whilst the latter are to be assessed more closely on a case by case basis, in terms of any collaborative activities that they eventually appear to give rise to.

2.5 Research questions

This novel examination of learning design and teacher and learner roles and activities in hybrid spaces points to a several pertinent research questions.

2.5.1 RQ1: What is a hybrid learning space?

Thus far, the space has been defined and then situated with respect to a number of similar and different alternatives. Its heritage, nature and significance, particularly in terms of fragmented interactions and asymmetries have also been discussed. Moreover, through the use of a pedagogical framework, the space has been further conceptualised as an interaction space, characterised by its' affordances, and the likely learner and teacher interactions that one might expect to take place. However to fully answer this question, key issues remain.

Firstly, there is the practical challenge of setting up and orchestrating a hybrid learning space. Secondly, the space cannot be considered in isolation, but will also need to be discussed in the context of the learning activities that can be designed and implemented within it. Finally, it has been implied that the interplay of the physical space and the technology of the virtual world underpin new types of learning practices. This assertion can only be verified and developed through empirical study. Practices such as these are informed by the physical and virtual contexts of the space, and investigating them adds to our understanding of the hybrid learning space. Each of the three issues adds an additional, empirical, aspect to our resolution of the research question. If the question is to be answered in full, it is necessary to extend the development of the space using a learning design process, in conjunction with the design and implementation of the relevant learning activities, and then relate this back to the theoretical perspective presented in this chapter.

2.5.2 RQ2: What is teacher practice in the design and implementation of learning activities for a hybrid learning space?

The fact that there appears to be no existing learning design process for hybrid spaces was set out at the start of the chapter. Moreover, Laurillard's (2008) concept of the 'teacher as designer' and her discussion of the challenges that teachers face when attempting to design activities with innovative technologies has been discussed in section 2.3. Consequently, the Conversational Framework is being adapted to partly meet this requirement. The various ways in which learner collaboration might be supported, in a more proscribed manner (complementing the Conversational Framework), through scripts and teacher interventions; has also been set out. Taken together, these provide an early means of designing learning activities in the hybrid space. Nonetheless, several questions remain. The first relates to the general practice of activity design. An initial design process has already been set out. Further research is necessary to determine how this proposed three-part process might be developed, how it might work in practice, the extent to which it is successful when implemented, and also the extent to which the process can be generalised where the design work is carried out by other educational professionals (something which Laurillard characterises as 'the transfer of pedagogic design'). This points to the iterative development and refinement of the learning design process to support teachers. Closely related to this is the concept of practice transfer. This is reflected in the challenges that teachers might face, at various points in the design process, along with how they can be addressed. A final consideration, not frequently discussed in the literature on learning spaces, is the effect that pre-existing understandings and conceptions of technology in practice have on the learning design process. In other words, how is the design of learning activities influenced by ones present understandings of what constitutes a hybrid space, and its envisaged uses? These themes result in the main research question, set out above and

two sub-questions. The first of these is “**What are the challenges in developing learning design by teachers working with hybrid spaces, and how can they be addressed?**” It aims to identify and examine the design challenges and to assess how they can be resolved. The second sub-question is “**What part do existing perceptions of technology in practice play in shaping teacher design and implementation practice?**”, and examines how the existing ideas and understandings that teachers have about hybrid spaces and interactions, along with their perceptions of the usefulness of the space, can shape and influence their practice when they design and implement activities in such spaces.

2.5.3 RQ3: What are learner and teacher roles and activities in the hybrid learning space?

This question unites issues of context, collaboration and practices, in terms of how they relate to both learner and teacher roles and activities. Each of the three have been examined at various points in this chapter. Let us start with context. The initial discussion of hybrid spaces assessed how the physical and virtual contexts of the space influence the interactions that occur within it. This was particularly evident in terms of hybrid interactions, fragmented interactions and asymmetries. The later review of work from Stahl, and then Fleck et al. pointed, again, to how learner roles and activities are shaped by the contexts of the space. Parallel to this is the contribution that roles and activities make towards supporting collaboration. In the literature, the scale and significance of this contribution varies somewhat from study to study. Whilst roles and activities can support collaboration, the details of the relationships between the two elements are not always discussed in the literature. Finally, it has been asserted that the roles and activities inform not just collaboration, but also learning practices (some novel) in the hybrid space, more generally. In relating the roles and activities to context, collaboration and practice, one research question (set out above) and three sub-

questions emerge. The first sub-question being, “**How are their origin and evolution shaped by the physical and virtual contexts of the space?**”. This examines how roles and activities come into being in the context of the learning design process, and traces how they are influenced by the novel contexts of the hybrid space. The second sub-question moves the emphasis towards collaboration by asking, “**In what ways do these roles and activities support collaboration?**”, and examines how the two phenomena shape each other. Finally, the relationship with learning practices is discussed by asking “**How do these roles and activities inform learning practices in the hybrid space?**”, which represents the final sub-question.

This chapter has outlined the context, orientation and questions of the thesis. The next chapter examines how the research will be carried out.

Chapter 3

Methodology

This chapter sets out and justifies the methodological decisions that underpin the thesis. It begins with a short description of the two empirical studies undertaken, and explains why video was selected as the main data collection tool. Drawing on this, the choice of both methodological (section 3.2) and analytical (section 3.3) frameworks embodied in the thesis is then discussed. Emphasis narrows to the specific contexts of the studies, in terms of how sampling, validity and reliability were addressed (section 3.4), and how a number of ethical concerns were met (section 3.5), with the broader role of the researcher in the thesis being closely assessed. Finally, our focus returns to the research design, and the two empirical studies (section 3.6), which are then analysed in greater depth, in terms of their relationship to the research questions, their implementation, and the ways in which they relate to each other.

3.1 Introduction

The research questions were primarily answered by the design and implementation of two learning activities. Both of these were recorded using video and then analysed in some depth. Our initial aim is to describe the studies, and to set out the rationale for using video as a data capture tool. This provides a starting point for the methodological discussions to follow.

3.1.1 Description of the studies

There are two empirical studies in this thesis, and they are identified as ‘**study one**’ and ‘**study two**’ from this point on. Both of the studies consisted of a design phase (where the learning design process developed in chapter two was used to create and structure an activity) and an implementation phase, where the activity was carried out in the hybrid learning space with a number of learners. Study one is discussed across chapters four (design) and five (implementation) of this thesis, whilst study two is assessed in chapters six (design) and seven (implementation). There are some differences between the studies. In the first one, the learning activity is both designed and implemented by the researcher. In the second one, the design is undertaken by a group of teachers working with the researcher, before then being implemented by a further group of teachers. The basic design of the studies is set out in figure 3.1.

Whilst design and implementation are integrated in each case, there are also important relationships between and across the two studies. Both the design and the implementation parts of study two, for example, are greatly informed by the findings of study one. Although the contribution of each of the studies to resolving the research questions is discussed in more depth in section 3.6, some observations are pertinent at this stage. Research question one (“What is a hybrid Space?”), addressed significantly in chapter two, draws broadly on both of the studies. The second question (“What is teacher practice in the design and implementation of learning activities in the hybrid learning space?”) is answered primarily by the design part of the two studies, but also draws to some extent on the teachers’ experiences during the implementation part. The final research question (“What are learner and teacher roles and activities in hybrid learning spaces?”) is examined mainly in the implementation part of the studies.

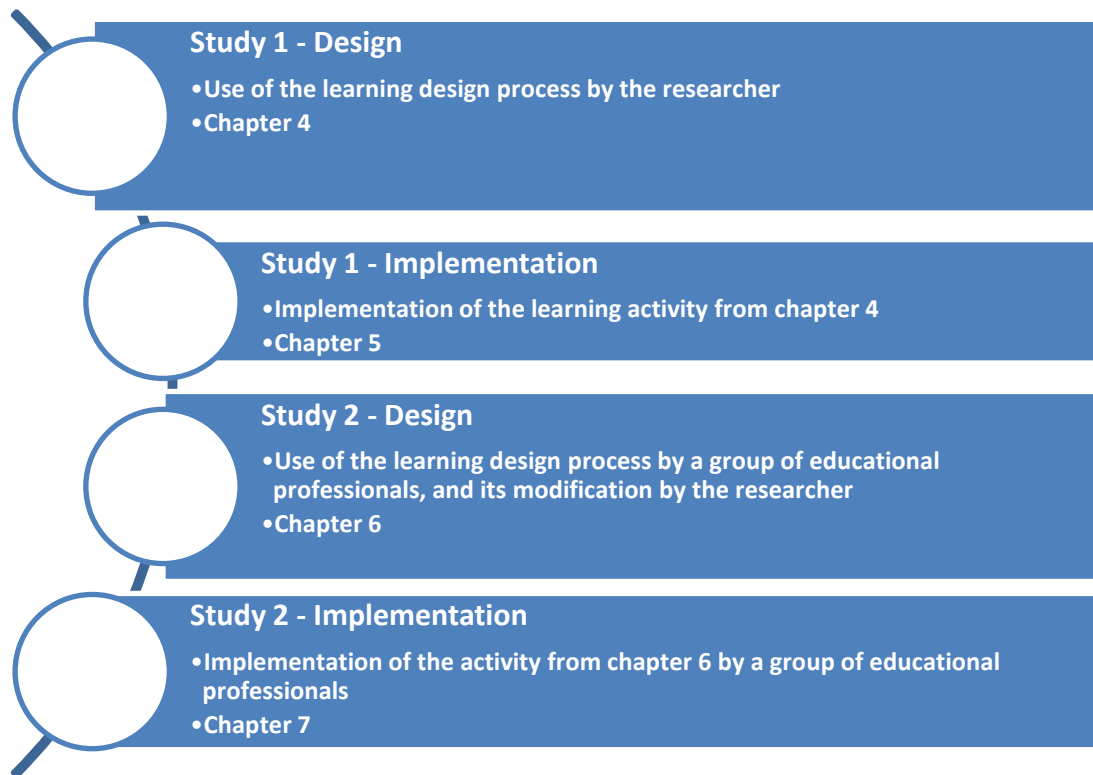


Figure 3.1 – Description of the studies

3.1.2 Rationale for using video

Video was used extensively in the two studies, for recording learner interactions in the physical and digital parts of the hybrid learning space (chapters five and seven), and capturing teacher discussions and work processes in the focus groups (chapter six). The rationale for using video emerged at an early stage in the thesis design. A number of pilot studies, based on the implementation of learning activities in the hybrid space with small groups of learners, were carried out. Data was collected through a mixture of screen recordings and note taking by the researcher whilst the activity was in progress. This approach had several shortcomings in terms of scale, detail and workload for the researcher. It was impossible to observe and capture all of the interactions that occurred between the learners. The researcher tended to focus on what the learners said, and less

so on their movement and actions. Much went unnoticed as a result. Secondly, the notes were not sufficiently detailed to trace complex interactions that moved between the contexts of the space. Finally, having to take notes as the activity was in progress hindered the researcher from intervening, supporting collaboration and resolving technical problems. The clearest alternative to this approach was to use video.

If we revisit issues of scale and complexity, the prime advantage of video was that it allowed the researcher to record the totality of interactions in the space, regardless of the media involved, or where the interactions originated. All speech and movement was captured via one or two cameras in the room and the (virtual) screen recording of each of the learners' avatars. Complex interactions encompassing the physical and virtual contexts of the space were examined by comparing the video records with the screen recordings. This allowed a second by second reconstruction of what the learners were saying and doing. The approach was especially useful for interactions involving negotiation and mutual adjustment. Typically, these would originate in the physical space as a learner would announce their intentions or proposals to others. They would then invite others to join them and complete a task in the virtual world. This led to process of 'constant comparison' (Glaser& Strauss, 2009), as the learner would verify (by asking questions, crossing the room to check their screens, sending texts in the virtual world) that the others were following the instructions correctly. The other learners would interact in a similar way, by asking questions of each other and by checking the progress of their peers in both contexts. Examining complex interactions such as these was only possible through using video, and through comparing in a detailed way the recordings from the physical and digital contexts of the space. In terms of workload, the use of video allowed the researcher to perform other important tasks

whilst the activity was in progress. This was especially important during the implementation of the first study (chapter five) as multiple interventions were required to prevent collaboration from breaking down. In the teachers' focus group (chapter six), it allowed the researcher to focus exclusively on helping the teachers with the learning design, posing questions to them, and interrogating their responses, rather than taking notes.

Flexibility was a further advantage of using video. A researcher taking contemporaneous notes has to narrow their focus, either implicitly or explicitly, and to concentrate on recording particular phenomena, whilst paying less attention to other factors. The problem is that it is difficult, at an early stage of the research, to know precisely what these 'particular phenomena' might be. This difficulty is compounded later on, as the emphasis of the research changes and moves in new and unforeseen directions. Frequent re-examination of the data, over time, is usually required. It is then problematic for one to re-examine notes, designed for a particular purpose, and to re-interpret them in light of the new emphasis. In this thesis, early examination of the data emphasised long run routines and practices that implicated large numbers of learners. Later reviews were more fine-grained, looking in more detail at the short term interactions between two or three learners. In short, the significance of the data only became evident following constant re-examination and re-interpretation, with the focus of ones' attention in terms of time, action and participants changing on each occasion. The permanence of the video record, along with the ease with which it could be viewed and interpreted as many times as necessary was therefore important. Additional benefits of video use in terms of collaborative viewing and the methodological rigour inherent in this are discussed in the next section.

The use of video as the primary method of data collection, is underpinned by the choice of appropriate methodological (section 3.2) and analytical (section 3.3) frameworks to guide the main decisions concerning the organisation and interpretation of the studies. Each of these frameworks can now be examined in some detail.

3.2 Interaction Analysis

Jordan and Henderson (1995) describe Interaction Analysis (IA from this point on) as “a method for the empirical investigation of the interaction of human beings with each other and with objects in their environment” (ibid, P.2). Put simply, it proposes the use of video as a means of recording participant activity, and their use of technologies and artefacts. These recordings are then examined and re-examined over time (both by the original researcher and by others) with a view towards identifying the routine practices of participants, and the various strategies that they might also use to solve whatever problems they encounter. In what follows, I will describe its’ origins and discuss a number of the ways in which it has been (and can be) implemented.

The origins of the approach lie primarily in ethnography, ethnomethodology and conversation analysis, and amongst its main assumptions is the belief that knowledge and action are social in nature, with Jordan and Henderson (ibid) asserting that, “technology sets up a social field in which particular activities become possible or likely whilst others become less possible” (ibid, P.14), and that it is therefore important to, “identify regularities in the ways in which participants utilise the resources of the social and material world in which they live” (ibid, P.14). Allied to this is an emphasis

on the achievement of social order in everyday settings, and in the ways in which participants might “make sense of each other’s actions as meaningful, orderly and projectable” (ibid, P.14). An additional assumption of IA, is the belief that observation (both during the activity and in later viewings, both as an individual and in groups) provides the best basis for knowledge about the outside world.

Jordan’s earlier work (1992), which formed the basis of IA, compared the interactions and practices of colleagues in a maternity hospital delivery room with those of an air traffic control centre. In both of these settings, there was a clear command structure in terms of the tasks that the various workers were permitted to perform. As her starting point, Jordan chose the notion of ‘authoritative knowledge’, namely instructions and information that came from more senior staff, and which were then passed on to the other participants in the work space. She wanted to examine the extent to which this sort of knowledge (as opposed to the ‘non-authoritative’ knowledge proffered by ones’ own colleagues) went on to shape practices such as division of labour, joint error detection, and group problem solving. Jordan used video to record how the workers performed their tasks and how they interacted with each other in both of these environments. This footage was initially used to develop a detailed account (and transcripts) of what happened. With later viewings, the main work practices of the staff were identified, and then elaborated upon.

IA, in various forms, has since been used in a number of other settings. Goodwin’s (2000) work, examining how school children use gestures to achieve coordination in a game of hopscotch is a good example of this. Goodwin (ibid) was critical of earlier studies which, he asserted, were overly focused on the role of speech in the coordination of such group activities such as the hopscotch game. He wanted, therefore,

to “move beyond talk and to deal with actions as well” (ibid, P.8). His approach was to video a number of games. In reviewing the video footage, he noticed how the children used both gestures and movement (eg. blocking, pushing, jumping into others’ way), either on their own (as a means of instructing other children what they wanted them to do), or to complement their speech.

Jordan and Henderson (1995) pay some attention to how the video recording might best be carried out, but they are at pains not to be over-prescriptive in their approach. For example, although they make proposals concerning how the video cameras can best be used during a study, they note that these are only suggestions, and that the final decisions would depend more on the specific context of the study and the immediate needs of the researcher. Later work by Goldman, Pea, Barron et al (2014), and Heath, Hindmarsh and Luff (2010) discuss such concepts in more detail however.

In terms of analysis, Jordan and Henderson (1995) put forward a more detailed series of steps that the researcher might follow. Much of this involves moving back and forth between individual and collaborative viewings of the video data. This emphasis on collaborative video viewing is significant in terms of analytical rigour, and underpins the choice of IA as the methodological framework for this thesis. Selwyn (2012) points to the importance of quality, rigour and appropriateness in qualitative research, arguing that “researchers should be making use of the methods of data collection and analysis that best fit their research questions of the moment, rather than methods that simply reflect personal convenience or habit” (ibid, P.218). Researcher bias can be reduced by the process of repeated and collaborative video viewing that Jordan and Henderson (1995) describe in their work. The researchers are encouraged to develop broad

agreement as to the meaning and significance of what they see. This is a particular strength in terms of developing validity (credibility of interpretation), and both inter-rater (agreement between the researchers) and intra-rater (having consistent interpretations of terms at different points in the study) reliability. How these were achieved through collaborative viewing in this thesis is discussed in sections 3.4.3 and 3.4.4.

In practical terms, Jordan and Henderson (1995) suggest that the individual researcher begin by viewing the video footage in its entirety, and by using this to set up a content log detailing the main sections and headings of the footage. The aim here is to get an overview of what is happening, and they therefore caution against proposing possible analytical codes and categories at this early stage. This is then followed by a series of collaborative viewings of the video. Jordan and Henderson (ibid) advise that such viewing should be followed by discussion sessions amongst the researchers where they can put forward their initial impressions of what is going on. Only after this (and several more viewings) should the researchers put forward some initial categories.

The focus then moves back to the individual researcher, who views the video again, and this time, develops a transcript of what the learners say and do. The detail of this can vary according to the context of the study, but Jordan and Henderson (ibid) suggest that as a minimum, “this needs to cover talk, nonverbal and object manipulation” (P.23). In the later stages of the analysis, there is a return (again) to collaborative viewing sessions, where the researchers refine the original transcript, and the original codes and categories that they identified earlier. The emphasis now is on identifying participant practices and routines, participation patterns and critical incidents. This process of

moving from individual to group viewings can continue, back and forth, for some time. Similarly, the researchers continue to refine their transcripts and codes until they consider that the data has been exhausted. Frequently, these steps are iterative and can overlap, or as Ruhleder (2000) puts it, “content logs generate potential tape sequences for analysis; tape analysis suggests further content logging and transcribing with emergent categories in mind. This, in turn, identifies new sequences for analysis” (P.4)

These strengths of IA concur broadly with those of using video. Frohlich (1993), for example, comments favourably on how video allows us to capture the complexity of interaction data, and asserts that “fieldwork notes do not capture the density of what occurs” (ibid, P.23). The advantage of IA, therefore, is that interactions in both aspects of the hybrid space can be captured, as can learner use of each of the modes of communication available. Much of this would be impossible to achieve using observation notes alone. As for flexibility, the existence of a permanent data corpus, which can be examined again and again as necessary, both by the original researcher and by others, allows for a progressive refinement of approach to the data. Ruhleder (2000), for example, argues that many forms of behaviour can only be identified through repeated viewings. It is therefore necessary for the researcher to return to the video records on several occasions, each time with a different question or focus in mind. Similarly, there are other, more complex behaviours that need to be ‘picked through’ (ibid) if their full complexity is to be understood – something which again requires repeated viewings. Finally, there are longer term practices and behaviours that can only be adequately analysed following several viewings of the records. Jordan and Henderson (1995), for example, point to the importance of “beginnings and endings, turn taking and structures of participation” (P. 21) in this regard. In a similar vein,

Frohlich (1993), in his comparison of IA with other forms of ethnographic fieldwork, suggests that the real benefit of IA lies in its ability to get to the underlying justification of activities and to examine their sequential development over time.

In broader methodological terms, the permanence of the video record serves as “a control on the limitations and fallibilities of intuition and recollection” as Heath, Hindmarsh and Luff (2010, P.11) put it. This relates, however, to some broader concerns about validity and reliability. Regardless of how data is captured, it will usually be necessary to ‘reconstruct the event’ (Ruhleder, 2000); to re-examine on several occasions what occurred during the study. This can often be a considerable source of researcher bias, as a number of writers point out (Derry et al, 2010; Maxwell, 2012). In reconstructing the event from paperwork (eg. observation or interview notes), there is the danger that one can “import meaning into the event, with secondary meanings contaminating the primary event” (Jordan and Henderson, 1995, P.15). In other words, the researcher emphasises their own interpretation of what has happened. Others such as Frohlich (1993) are more direct about this threat, pointing to the dangers of “post hoc rationalisations, ignoring things and leaving out tacit insights” (P.9) as one re-examines the data. This is not to say that all such bias is removed simply by using video. Derry et al (2010), for example, point to bias introduced through the location and positioning of the camera. This latter phenomenon, however, is consistent and can be controlled for, to some extent. Finally, researcher bias can be reduced by the process of repeated and collaborative video viewing that Jordan and Henderson (1995) describe in their work. The researchers are encouraged to develop broad agreement as to the meaning and significance of what they see. As outlined above, this is particularly useful for developing both validity and reliability.

The strengths of IA lie, therefore, in its ability to capture the complexity of the hybrid space and the possible interactions within it, in the degree of flexibility that it offers to the researcher, and in the extent to which it helps to reduce researcher bias (at least in comparison with other approaches). Having set out the underlying approach, we can now turn our attention to how the data resulting from the studies should be interpreted.

3.3 Analytical framework

The issues inherent in turning video records into useful data have been underlined by a number of researchers (Barron, 2000; Derry, 2010; Erickson, 2006). These issues are simultaneously practical and analytical, and result partly from the quantity and complexity of phenomena that can be captured by video recording; and partly from the need to develop “explicit strategies to focus the attention of the analyst” (Barron, 2000, P.2), if one is to make sense of these records. One way of achieving this degree of focus is to use an analytical framework. The immediate aim of this section, therefore, is to set out the precise rationale for using such a framework. Out of the many options available, a smaller number of potential frameworks are assessed and compared, with much of the remainder of the section given over to justifying the eventual choice. The objective is to present and justify. The implementation of the framework is examined in more depth in the relevant chapters.

3.3.1 Rationale for using a framework

The initial choice is between using an analytical framework to structure and focus the analysis of the records, and not using one. The latter path is certainly possible. As made clear by Derry (2010) and Plowman & Stephen (2008) amongst others, this would entail repeated viewings of the video and screen footage in question, followed by the initial identification of interactions that are deemed to be of interest, with respect to the research questions. In later viewings, a number of codes could be developed to better classify these interactions. Lastly, the findings of the study would then be discussed in general terms. There are practical and analytical reasons, however, why pursuing such a 'grounded' (Glaser and Strauss, 2014) approach might prove to be problematic.

The initial objection is practical, and relates to the difficulties involved in making sense of a mass of video records without some explicit guiding principle. Rourke and Anderson (2001), for example, point to the situation of the struggling 'Professor Jones', whose (CMC) research team becomes overwhelmed by the "mass of messages and threads" that her study has uncovered. This (hypothetical) study, results in about 900 messages, and takes the professor four days to read through, before any productive analysis can begin (ibid). In the absence of a clear framework, it is hard for her to know where to begin.

A further practical issue relates to the longer term organisation of the data analysis itself. Working without a clear analytical framework, it is possible that the researcher might fail to fully document and analyse their initial assumptions and the steps that they will follow as they assess the data in question. This occurs more often than one might

expect, as both Beers (2007) and Strijbos (2005) make clear in their respective papers. The former, for example, points to the “undescribed and implicit data analysis procedures” (P.3) of a variety of CSCL studies. This is not to say that such procedures do not exist or that they are necessarily defective, but rather that the researcher has not gone to sufficient lengths to make clear the steps that they are taking. Such an initial lack of clarity, then, makes it difficult to improve or refine ones’ approach as the study proceeds (as there is nothing evident to compare each step of the study with). Although this is partly an issue of researcher organisation; by referring constantly to a clear analytical framework throughout ones’ study, the researcher is encouraged to be more thorough and focused in terms of how they organise their data analysis. It provides a means of ‘scaffolding’ the data analysis process. Ongoing engagement with such a framework also helps the researcher to refine their approach to the data in the light of unexpected findings and incidents (Derry, 2010).

Working without a framework has serious analytical implications, also, in that it becomes difficult for the researcher to decide what is to be “brought into focus for deeper analysis”, as Derry (2010, P.16) puts it. One possible outcome of this lack of focus is that one presents a cursory and superficial overview of the data. Returning to the Rourke and Anderson (2001) example, we note how Professor Jones ends up with a ‘hodgepodge’ of decontextualised quotations and incidents, and then struggles to find any higher level explanations or causal links between all of these. In other words, without a framework, it becomes difficult to examine the data in any meaningful depth. A further possible consequence relates to the difficulty in ensuring rigour or consistency in terms of what one finds. Returning to the problems of Professor Jones, for the final time, it is noticeable how her team struggles to define and delimit a number

of data categories, and then continues to argue over what belongs and does not belong in each of them. The result is that they go on to develop a loose, but strongly contested, series of codes. There is ongoing argument over both the meanings of the codes and their prevalence in the body of data.

The rationale for using a framework for data analysis is therefore practical and analytical. Underlying this is the concept of rigour, in that having a framework encourages the researcher to be more systematic and disciplined both in the planning and organisation of the data analysis, and in the ways in which they interrogate the data itself. There are a range of suitable frameworks that one can turn to however, and a smaller number of these will be assessed in the next sub-section.

3.3.2 Which framework?

Given that there are several frameworks which examine learner collaboration in various learning environments (eg. de Wever's (2006) study of fifteen CSCL frameworks), it is imperative that we narrow our focus somewhat towards the ones which might be potentially most useful for our study. In this sense, Baker et al (2007) propose that a robust framework should meet a few minimum criteria. Namely, that it should emphasise the interactional aspects of learner collaboration, that it should allow one to examine the different types of learner environments (virtual, physical) and interactional data (face to face, virtual) available, and that it should lend itself equally to both descriptive and quantitative approaches to data analysis. The frameworks, discussed here meet each of these conditions. The initial aim is to set out their main features and advantages, before justifying our selection of the most appropriate one in the next sub-section

The ‘Rainbow’ Framework (Baker, Andriessen, Lund, Amelvoort & Quignard, 2007)

Although inspired by their earlier work in CMC environments, Baker et al assert that their framework is designed to be used in any CSCL environment. At its centre lies the notion of an “interaction”, which they define as “a series of actions that mutually influence each other” (ibid, P.5). They then go on to examine the various ways in which this might manifest itself by looking at the part played by speech, written communication and graphical modes of expression amongst others. The purpose of their framework is to examine the interactions that learners use as they attempt to solve problems collaboratively, and they put forward a number of analysis categories relating to “task management”, “argumentation” and “offering opinions”, as can be seen in **figure 3.2** below. Some of these categories relate to the organisation of the task, whilst others point to how the learners inform, argue and engage with each other throughout such a learning task. In their study, Baker et al examine the way in which learners interact and argue during a debate on GM crops in a CMC environment, with a more specific focus on how they 'broaden' and 'deepen' the debate. They examine what the students write in the environment and assign one or more of the analysis categories to it. They then use these initial findings to develop detailed sub-categories, before turning to a more general discussion, where they look for relationships between the various categories. Although their final results are represented through graphs and charts, they are at pains to point out that their framework (and its accompanying categories) lends itself also to rich ethnographic descriptions as well as to statistical 'counting and coding' approaches.

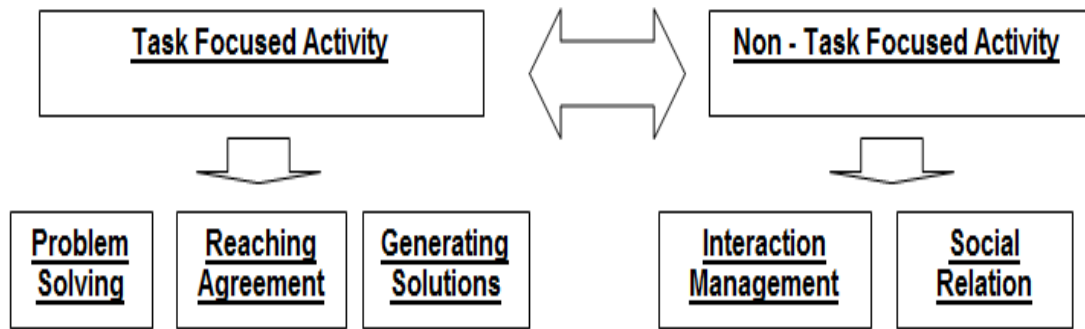


Figure 3.2 – Rainbow Framework (Baker et al, 2007)

Dual Interaction Spaces Framework (Lonchamp, 2009)

Lonchamp’s framework is based on the idea of a ‘dual interaction space’ - a CSCL environment which combines both a text based and a graphical component. As with Baker et al’s work, however, he also asserts that this framework can be used in any learning space. At the centre of his approach is a distinction between two levels of analysis, namely a dialog and a knowledge level. Both of these can be seen in **figure 3.3** below. The dialog level is fine grained and points to learner interactions in the dual interaction space. To this end, it introduces conversation categories such as “suggest, question, answer” (referring to what the learners say) and action categories such as “additive, change and destroy” (referring to what they do to shared artefacts in the space). The knowledge level emphasises longer term knowledge building processes, and introduces the ‘episode’ as its unit of analysis. These, in turn are categorised as ‘planning episodes’, or ‘argumentation episodes’ amongst several others. This split between dialog and knowledge levels reflects Lonchamps’ dissatisfaction with some previous work, which, in his opinion, emphasised one of the two aspects, at the expense of the other. The advantage of this approach, he contends, is that it allows one to examine how the fine grained interactions of the dialog level go on to influence the

longer term episodes of the knowledge level. As before, one examines the corpus of data for evidence of one or more of the various dialog level categories, before then attempting to identify longer term episodes. Again, the emphasis of the framework is on its flexibility, in that the categories can be used for descriptive or statistical explanations, or indeed combinations of both.

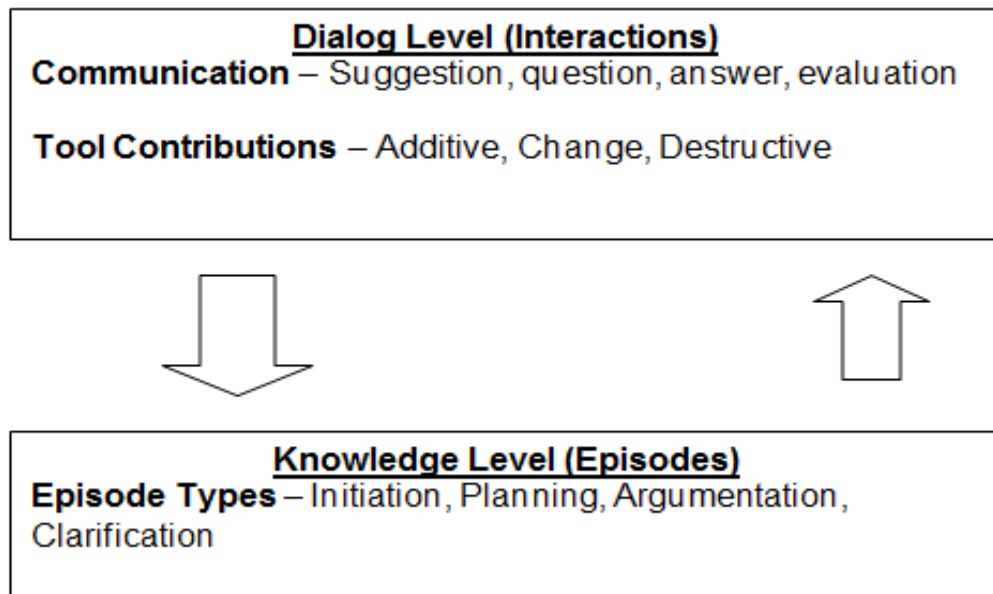


Figure 3.3 – Lonchamps’ Dual Interaction Spaces Framework (2009)

Examining Shared Endeavours (Angelillo, Rogoff & Chavajay, 2007)

This framework (referred to as ESE from here on), emerges from Angelillo et als (ibid) criticism of what they consider to be an undue emphasis, in some of the literature, on the part played by individual contributions in group learning contexts. In their view, because of this focus on individual acts, it becomes difficult for the researcher to capture the “dynamic inter-subjective aspects of emerging shared meaning and purpose in group interaction” (ibid, P.6). In short, what the individual says and does is removed from any meaningful interpersonal context. The framework that they put forward, therefore, represents an attempt to describe and analyse these interactions in a more

holistic and detailed way, moving beyond an approach which (in their view) simply counts individual acts and then uses this to make general inferences about group collaborative processes.

The framework draws upon aspects of both ethnographic and quantitative traditions. In terms of the former, there is a strong emphasis on the part played by rich descriptive accounts (defined as ‘cases’ by Angelillo et al. (ibid)) which aim to explore, in detail, the minute by minute collaborative interactions between the learners. The quantitative tradition, meanwhile, is represented in the form of increasingly detailed and rigorous coding categories derived from the descriptive accounts. The relationship between cases and categories is therefore mutual and iterative, with the researchers’ initial categories being derived from an early examination of the cases. These coding categories are then used to analyse later and similar cases in more depth - something which leads both to a more detailed discussion of the cases themselves and to an ongoing refinement of the categories. Such a process, where ethnographic cases give rise to coding categories, which in turn are used to further interrogate the remaining cases, can continue for as long as the researcher feels that it is productive, and that it is continuing to yield new insights. Finally, the overall findings of the study can then be discussed more broadly by reference to the totality of cases and categories. The main components of the ESE framework can be seen in **figure 3.4** below.

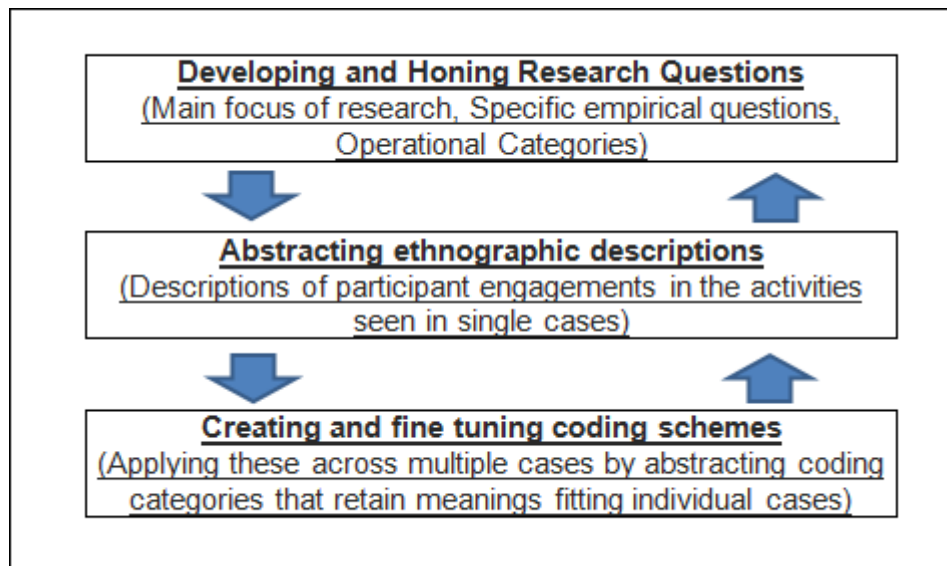


Figure 3.4 – Examining Shared Endeavors (ESE) – Angelillo et al. (2007)

In adopting the framework, the emphasis of enquiry, therefore, moves from the general to the detailed and then back to the general again. One begins by discussing the initial research question (“the main motivating question” as Angelillo et al (ibid) put it), and then refining it. In many cases, it can also be broken into a number of smaller sub-questions. The researcher is then invited to consider some of the possible interactions, or likely categories, that (if present) might successfully address each of these smaller questions. Angelillo, Rogoff and Tudge’s (1997) work comparing the teaching processes used by child and adult ‘experts’ represents a useful example of this. The main research question, in that study, is defined as “how does the teaching process differ with child versus adult ‘experts?’”. The researchers then derive six more specific and pointed questions from this. One of these is phrased as “how does the novice contribute?” and a range of initial categories including, amongst others, factors such as “obeys expert”, “explores on own” and “ignores expert” are identified. All of this is performed without recourse to the video records, but serves to hone and focus the scope of the enquiry. It clarifies what one is looking for, and sets out some initial guidance as to what one might find.

The analysis then moves to a more detailed phase as one begins to examine the records. The initial emphasis is on locating, in simple terms, descriptive accounts or cases that appear to concern each of the sub-questions. This need not be overly analytical. Indeed, Angelillo et al. (ibid), point to the advantages of “writing the descriptions in ways that someone not present could visualise the events that transpired, or even re-enact them” (P.8). Similarly, it is not necessary to identify all of the cases relevant to the sub-question at hand - a single relevant example can suffice. Once isolated, the single case is then re-examined in more depth with reference to the initial categories set out earlier. The role of the researcher, at this stage, is to refine the categories with respect to the single case, by removing those which do not appear to be relevant and by further developing (or sub-dividing) those which appear to be critical and prevalent. Once this occurs, the video records are then to be re-examined. By using the new categories, the researcher is expected to identify and then discuss further cases relevant to the sub-question (assuming they are present). In short, one moves from description (of a single case) to analysis (of multiple cases). Throughout this process, the coding categories continue to be refined and tightened, with respect to all of the cases, to ensure that they correctly portray what is occurring. Finally, once there are no further refinements that can be made to the categories, one is at liberty to analyse the cases as a cohesive whole and to relate this back to the original research sub-question. It is worth noting that the emphasis of this analysis need not necessarily be ethnographic in nature, and Angelillo et al (ibid) point to examples where researchers have used quantitative and graphical analyses at this point, according to the requirements of their work. By now the emphasis moves from the detailed back to the general, as analyses and responses from each of the sub questions are discussed in the light of the original main research question.

3.3.3 Justifying the choice of framework

Although each of the frameworks presented here offers their own advantages, it will be argued that there are a number of features specific to the ESE which makes it a more appropriate choice for the studies in question. Both Baker et al's and Lonchamps' frameworks, with their pre-existing data categories offer the advantage of simplicity. In the case of the former, these are quite broad and inclusive, and allow one to emphasise particular aspects of learner collaboration such as task management or argumentation, for example. Similarly, Lonchamps' framework, with its explicit distinction between short term interactions and longer term knowledge building processes, permits one to examine how each of these shapes the other. Whilst the two frameworks are comprehensive in these respects, they combine this with a high degree of flexibility. They both claim to be transferable to any small group learning environment, and they both claim to be applicable to qualitative, quantitative or mixed orientations. By not starting the analysis with some explicit concept of data categories (Baker et al), or levels of analysis (Lonchamp), the ESE would appear to be somewhat closer to the 'grounded' analytical approach set out at the beginning of this section. This is not a weakness, however, as will now be explained, by referring to the different stages of analysis where the framework is used.

The ESE offers a stronger and more explicit emphasis on the role of the research questions, in driving the analysis, than the other two frameworks do. The researcher is invited to explore their research interest in some depth before approaching the data. This requires that one focus on the issue at hand; dividing it into suitable sub-questions before proceeding further. Indeed, the move from one main question to a series of

smaller more detailed ones is essential according to Angelillo et al (ibid) if one is to “avoid the risk of trying to capture everything that happens or of examining arbitrary variables that do not address the purposes of the research” (P. 14). This also represents a first step towards developing viable and relevant coding categories, as the researcher considers the conceivable interactions and phenomena that might be required. In short, he or she must “articulate the corresponding video evidence required to address the questions” (ibid, P.14). This early exploration of the research questions, therefore, serves not only to focus the attentions of the researcher; it also allows one to set out the initial components of the framework. This is not to say that the other two frameworks considered here treat the research questions as being, somehow, of little importance; it is rather, that they do not posit an explicit role of allowing the questions to shape the framework in an ongoing way. They offer existing data categories, but the option of developing categories from scratch, based on the needs of the research questions is not considered.

As one moves beyond this ‘focusing exercise’ and begins to consider the video records themselves, the inherent rigour of the ESE framework becomes clear in other ways. It does not rely upon a single reading of the data. Rather, one is invited to describe the initial cases that one encounters, and then to analyse these in greater depth. This is achieved by a continuous fine tuning of the necessary coding categories. They are constantly assessed in terms of relevance and validity. As the research continues, ones’ focus broadens from the single case towards the totality of cases. Although, the process is iterative - in that closer examination of the cases gives rise to clearer and more productive categories, and that these evolving categories allow one to better analyse the cases; it also combines breadth and depth of analysis. The researchers’ focus moves

from one initial case towards the totality of such cases. Similarly, the level of analysis begins at a simple and descriptive level, becoming more intricate and detailed as one proceeds. The benefit of this recursive approach is that one can simultaneously examine both the individual cases along with the broader patterns that emerge from these descriptions. This recursive perspective is not incompatible with the other two frameworks, but rather, again, it is not made explicit. Both of them introduce what they consider to be the important data categories at an early stage, but have less to say on how these might change or be refined as the study proceeds. Such an approach could be interpreted as quite static in that it is assumed that the meaning of the data categories stays the same throughout.

Of the three frameworks, therefore, the ESE offers the additional advantages of flexibility and rigour. The former is evident in the way in which it allows the research questions to determine the data categories, as opposed to entering the enquiry with pre-existing ones. The latter is clear in the ongoing recursive and dynamic relationship between cases and categories, with each of these being refined and explored in more detail as the study proceeds. Neither of these features is necessarily incompatible with the other two frameworks. The real advantage of the ESE is that it makes each of these features explicit and explains to the beginning researcher precisely how to carry them out. It is to that task that we can now turn.

3.4 Context of the research

The approach taken here will be to set out the broad significance of each issue at hand, before assessing the specific challenges inherent in the individual studies, and then explaining how these were met in practice. A particular emphasis will be placed on researcher self-reflection and on closely examining the researchers' role and their relationships, both implicit and explicit, with those being observed.

3.4.1 Settings

The selected settings for the studies vary. For the first study, the setting was a South London comprehensive school in the secondary phase of UK education. The researcher was employed as an ICT teacher at the school, and the significance of this is explained in section 3.5.1. This setting was opportunistic, and was selected with a view to improving ease of access to participants, to reduce the amount of time required to implement and complete the study, and to benefit from an existing familiarity with the working context of the school. Whilst such familiarity has some disadvantages (again discussed later in this section), Atkinson and Hammersley (1994) support the use of such opportunistic research provided appropriate rigour is applied. The study itself was carried out at a nearby university, partly for technical reasons (as installation of the required software caused problems for the school network), and partly as a means of 'making the familiar strange' (Holliday, 2007) for both the participants and the researcher. The design element of study two (teacher focus groups), was carried out in a social setting, away from the normal workplace so as to encourage a more relaxed and open style of participation; with the implementation part of the study again located at the same university as in study one. Again, this reflected a move away from the everyday work environment of the participants.

3.4.2 Sampling

The overall approach was based on non-probability sampling. This was appropriate as there was “no intention or need to make a statistical generalisation to any population beyond the sample surveyed” (Robson, 2002, P.278). Whilst convenience sampling was initially considered (eg. recruiting from amongst colleagues, known ICT classes), it was soon rejected. Indeed, Robson (ibid) points to the approach as the “least satisfactory method of sampling”, noting that it “does not produce representative findings” (ibid, P.279).

It was decided instead to employ purposive sampling, whereby “particular people are selected deliberately in order to provide particular information” (Maxwell, 2012, P.82), or to “satisfy the specific needs of the project” (Robson, 2002). The specific needs, in the case of the first study, was that the participants had some existing experience of using the *Second Life* virtual world (or something similar in terms of online games), that they had some interest in using new technologies and that they were prepared to work as part of a team (*appendix 3*). The school ‘gifted and talented’ extra-curricular group ICT group represented an initial point of enquiry for the researcher. The students in this group were given a short survey to fill out, asking them to detail any previous experience that they had in either online games or virtual worlds. From this, a total of 10 students were invited to take part in the project. This consisted of the 8 necessary to take part in the learning activity, and a further two who were recruited as reserve members. The existing background of the students turned out to have positive and negative effects on the implementation of the activity. Although they had previous experience of using the virtual world, the nature and scale of this experience varied somewhat. This was reflected in the extent to which they were able to complete the various tasks, with some learners having little difficulty in building objects and finding

specific locations, whilst others struggled with anything more than simple movement of the avatar. Some of the students knew each other from the extra-curricular group. This made it easier for them to work together as pairs, to explain things to each other and to negotiate. This had the advantage of reducing the time taken for them to start and complete the tasks. It also had the effect of reducing teacher workload and interventions during the activity. Some of the students did not relate well with each other, and this was a contributory (though by no means an exclusive) cause of some of the disagreement and breakdowns of collaboration that ultimately occurred. Seven of the eight proposed participants turned up on the day, and their backgrounds are set out in *table 3.1*.

<u>Participant Identifier</u>	<u>Age</u>	<u>Previous virtual world experience in addition to SL</u>
A	14	<i>None</i>
B	16	<i>World of Warcraft, There, Club Penguin</i>
D	15	<i>World of Warcraft</i>
H	14	<i>Club Penguin</i>
J	16	<i>None</i>
M	15	<i>None</i>
R	14	<i>River City, There</i>

Table 3.1 – Study One – Background of the participants

The second study required participants with some degree of professional experience in the design of learning activities, with either children or adults. This was partly in the expectation that such participants would be able to draw on their experience during the design; whilst also reducing the time necessary to complete it. Given that the study was not restricted, in advance, to any specific curriculum area, the subject background of the

participants was left open. It was, however, expected that the participants would have basic IT skills combined with some interest in learning in mixed physical / digital spaces. To this end, a number of local schools, along with the teacher training division of a nearby university were approached. In order to get a wide range of experiences and backgrounds, it was decided to recruit two separate focus groups (*appendix 10* and *appendix 11*). The researcher had no previous connection with any of the participants or with the establishments in which they were employed. The first focus group, made up of postgraduate students from the local university, had four members. This was considered to be a reasonable number of participants, large enough so that productive discussions could occur, but not so large that individual members might feel inhibited or 'lost in the crowd'. The participants had not previously met in advance. It turned out to be quite a diverse group in terms of the backgrounds of its participants, in that two of them came from a primary school background, whilst one worked in a secondary school; with the final participant employed as a university lecturer. The two primary school teachers identified their main teaching interests as being art and design, and citizenship / pastoral education, respectively. The secondary school teacher was a specialist in history, whilst the university lecturer had a background in psychology. The teaching experience of the group members varied from 2 years to 15 years. The second group consisted of three secondary school teachers. It was somewhat more homogeneous than the first group, with two of the teachers specialising in mathematics and ICT, with the third being a scientist. The two maths teachers underlined their experience in teaching Key Stage 3 maths (students aged 11 – 14), whilst the science teacher pointed to his background in teaching A level physics and mechanics (students aged 16 – 18). The teachers all knew each other professionally, and had previously worked together to plan school events, lessons and documentation. The backgrounds of

the education professionals from both groups are set out in *table 3.2* and *table 3.3* below.

<u>Participant</u>	<u>Teaching Background</u>	<u>Teaching Experience</u> <u>(Years)</u>
1	Secondary – History	15
2	Primary – Art and Design	2
3	University – Psychology	4
4	Primary – Citizenship / Pastoral Education	7

Table 3.2 – Participants in Focus Group 1

<u>Participant</u>	<u>Teaching Background</u>	<u>Teaching Experience</u> <u>(Years)</u>
A	Mathematics – Key Stage 3	14
B	Science – A Level Physics	24
C	Mathematics – Key Stage 3	5

Table 3.3 – Participants in Focus Group 2

For the second part of the study, it was originally hoped to recruit some of these participants to implement the learning activities that they had designed. For pragmatic reasons, this was not possible, and it was therefore necessary to recruit an additional group of participants to both implement and participate in the study. A further approach was made to a nearby school, and from this the researcher was permitted to address a group of fourteen teachers. A brief survey of their IT skills and their knowledge of virtual worlds was carried out so as to assess their suitability for the study. A total of 7 trainees were then recruited. The researcher had no previous connection with any of the participants. The backgrounds of the seven participants are set out in *table 3.4* below.

<u>Participant Identifier</u>	<u>Gender</u>	<u>Teaching Experience (years)</u>	<u>Degree Background</u>	<u>Previous virtual world experience</u>
Sue	Female	5	Science	<i>Second Life</i>
Ruth	Female	2	Mathematics	<i>Second Life & World of Warcraft</i>
Tom	Male	3	Science	<i>World of Warcraft</i>
Aisha	Female	1	Languages	<i>None</i>
Baba	Female	3	Politics	<i>Second Life</i>
Pradeep	Male	2	Science	<i>Second Life & World of Warcraft</i>
Jane	Female	1	English	<i>Second Life</i>

Table 3.4 – Participants for study two (implementation)

3.4.3 Validity

This is defined as the “credibility of a description or an interpretation” (Maxwell, 2012, P.74). It figures prominently in the literature on methodology, with a number of researchers such as Robson (2002) arguing that, “writers make the mistake of talking about validity only in general, theoretical terms, and presenting abstract strategies” (P.

476). Others such as Maxwell (2012) go somewhat further in inviting researchers to spell out what they consider to be the main validity threats in a given study, and to propose how they intend to reduce them. It is generally accepted that many such threats are unavoidable, whilst the threat from others can only be reduced rather than eliminated.

In the case of this thesis, one specific validity threat was that of researcher subjectivity and bias. This refers to the possible tendency of a researcher to select data that fits ones existing theory or preconceptions. This is not something which can be easily eliminated, but it was reduced (in the two studies) by repeated viewings of the video footage over time and by asking a number of other research students to also view the footage and to provide critical feedback. This frequently led to changes in focus questions (as discussed in section 3.6) and the codes and categories of the various studies (as discussed in chapters five and seven). This concurs with Guba and Lincoln's (1994) appeal that validity be improved through "intensive long term involvement with the data based on repeated observations so as to remove spurious associations and premature theories" (P. 198).

A further validity threat comes from the influence of the researcher on those who are being studied. This was a particularly important concern in the context of the first study where there was a pre-existing professional relationship between the researcher and the participants. It can manifest itself in various ways, with Cohen et al (2011) emphasising how learners might "do something, or do something in a different way to please or placate the observer" (P. 192), whilst others such as Maxwell (2012) point to problems such as "artificiality and hesitancy" on the part of the learners. There are some who argue that its effect is over stated (Becker, 1990) and that the observer has less effect on the participants than the setting. Nonetheless, the threat had to be taken seriously. To

this end, I attempted to reduce it by recruiting students whom I did not teach (for study one), and participants that were not known to the researcher (for the later study), by changing the locations to those that were out of the workplace (for both studies), and by recruiting a student teacher (therefore not known to the learners) to work as an assistant during study one. Finally, for the two studies, the wording and language of the instructions for the various tasks was written, in co-operation with another research student, to be as neutral and non-directive as possible. The aim was to communicate instructions, but not to prescribe or control too closely how they might be followed. That said, the phenomenon is something that was more likely to be reduced because of these measures rather than eliminated. There are, according to Cohen et al (2011), a number of ways in which one can discern that it has been successfully reduced, such as “the patterns of interactions stabilising as the session continues” and “members of the group accept one’s presence and do not seek interaction” (P. 192).

3.4.4 Reliability

This concerns the extent to which the results of the studies would be replicated if one were to run them again with a similar group of participants and in a similar context. Whilst the term originates in, and applies quite strongly to, quantitative research; it is also relevant, albeit in a slightly different way, for qualitative studies such as this one. Cohen et al (2011) examine the debate between purists on the one hand (who view the concept as referring primarily to the quantitative tradition) and pragmatists (who believe that the issue still requires addressing in qualitative studies, again in a modified form). An example of the latter approach is represented by Denzin and Lincoln (2011) who assert that reliability in qualitative research can be addressed in terms of “stability of observations” (would the researcher make the same observations if the study were at a different time or place?), and “inter-rater reliability” (whether another observer with

the same theoretical framework and observing the same phenomena would have interpreted them in the same way). As with validity; the issue is to identify specific threats to the reliability of one's study; and then to set out some means of minimising the threats in question.

One threat, based on the discussion above, relates to intra observer reliability. This concerns the need for the researcher to identify and categorise what they examine in a consistent way, at different stages of the study. For example, if a particular interaction is categorised as "A asks B a question" at one point in the study, then it is important that this description is used at other points in the study where the same phenomenon occurs, and that it is not labelled as something else. In terms of IA, problems such as this are most likely to occur during the various stages of analysis. Whilst it is expected that the various data categories will change somewhat as the analysis matures, it is important that this is carried out in a planned and consistent way. In terms of improving intra observer reliability, Guba and Lincoln (1994) point to the importance of persistent observation and re-examination of the data, and outside audits (having others check through it). Much of this is inherent in the IA approach, with its emphasis on multiple viewings of the video footage, and on the collaborative discussion of the findings at each stage of the analysis. In the studies, therefore, I aimed to improve intra observer reliability, by reviewing the data on several occasions, over a period of a few weeks, and by endeavouring to approach it with a different focus each time. The footage was also reviewed by other research students, who frequently proposed small changes in the terms that were being used. An example of this occurred in study one, when it was observed that the learners tended to appropriate each others' laptops as a means of viewing the world from another avatars point of view. The researcher was unsure about how important this was. The co-analyst suggested that it was important and during the viewings pointed to the numerous times that it seemed to occur. The next challenge was

to decide on a name for this phenomenon, and a number of different categories were proposed. It was important that the eventual category included all of the components of this behaviour. After several revisions, the term ‘passing, pairing and tussling’ was agreed upon. A number of other examples similar to this are discussed in chapters five and seven.

A second, and related threat, is that of inter observer reliability. This points to the need for the various observers involved in the research to agree on the precise meaning of the data codes and categories involved, and to then use these in a consistent way. If we return to our example of “A asks B a question”, then it is possible that one researcher might categorise this as “asking questions” whilst another researcher might label the same phenomenon as something different such as “clarifies” or “finds something out”. Clearly if the researchers are working together, and aim to produce coherent findings, then not all of these categories can possibly be correct. Indeed, Robson (2012) points to this as being a particular issue in small scale observation based studies. In this thesis, the threat was reduced by working with a co-analyst through the video footage. An example of this was in study two (implementation) where there was some argument about the different categories of collaboration that appeared to be emerging. The co-analyst was encouraged to put forward their own interpretations and descriptions of what they saw. This then led to a process of questioning, argument and negotiation to ensure eventual agreement on the final data codes and categories. In this way, roles such as ‘subject experts’, and practices such as ‘simultaneous collaboration’ (where a pair of learners collaborate with two other groups of learners at the same time), were identified, critiqued and elaborated.

3.5 Ethics

There are several salient ethical concerns. Whilst discussed extensively in the literature, they are examined here as a means of identifying what was done. Parallel to these concerns, but just as significant, are a number of related ethical issues which are inherent in the use of video. Some of these issues will be reviewed. The emphasis moves from the general to the specific as I detail how each of the specific ethical concerns surrounding the two studies were addressed.

In much of the literature on ethics, concepts such as “openness”, “informed consent” and “anonymity” are frequently mentioned. Heath et al (2010), for example, point to the ethical importance of researchers explaining the rationale, purpose and requirements of their work to all who may be involved with it. Within educational settings, this includes the young people who may be participants, but also other stakeholders such as school managers, teachers and parents. They note (ibid) that it is not enough simply to state what the project is and how it will be carried out. It is important to explain to the stakeholders the importance and significance of the project, that it will only be used for research (and not commercial or other) purposes, and that it will be carried out according to established ethical guidelines.

If we move our interest from the stakeholders (in general) to the more specific case of the participants who took part in the studies; it was important that the latter were not placed under pressure to take part, and that they were told of their right to withdraw from the study at any point without having to provide a justification. In terms of such “informed consent”, they were also given the time and opportunity to ask questions and to raise any issues or concerns that came to mind. Cohen et al (2012) assert that

“informed consent” consists of four elements; namely, competence (on the part of the researcher to carry out the study), voluntarism (free choice on the part of the participants), full information and comprehension (where the participants understand at least the broad purpose of the research). Frequently linked to this are concerns about the anonymity of the participants. It should not be possible for the individual identify of one of the participants to be known. In practice, this usually results in the use of pseudonyms for the participants in written reports, and the blurring or blanking out of faces in video footage.

There is a growing body of literature which examines the ethical issues specific to the use of video (Derry et al 2010; McKay 1995). Whilst this has significant overlap with the broader concerns set out above, much emphasis is placed on the concepts of dissemination and inappropriate re-use of video footage. MacKay (1995), for example, points to cases where video footage that was initially captured for research purposes, was later disseminated to third parties unrelated to the research (often via the Internet), inappropriately re-edited (eg. by adding special effects) or later used for commercial or entertainment purposes. In most of the cases that she discusses, this was done without the consent of those initially involved. In such cases, the notion of “informed consent” becomes somewhat blurred. The participants might have given consent to take part in the study, but they were not informed about the possible later uses of the videos. There are a number of solutions to this problem. Derry (2010) suggests that one approach is to offer a two stage version of “informed consent”, one stage applying to collection of video data and the other stage focusing on its usage. An alternative to this is to adopt a checklist approach where the participants can choose the specific uses that the video is put to; although as Derry (ibid) points out, this may be difficult to organise in practice. In any case, the notion of who eventually views the video represents a further ethical concern, in addition to informed consent and anonymity.

Based on this review, the ethical steps undertaken are organised under three headings, namely, “informed consent”, “anonymity” and “confidentiality and dissemination” as set out below. In all of this, I followed the ethical guidelines of BERA (2011) who propose that all educational research should be conducted with respect for: the person, knowledge, democratic values, quality and academic freedom. With this in mind, I made sure that the aims, purpose, dissemination and potential benefits of the research to participants and the wider community were made clear and explicit. This was achieved by setting out a project plan and by means of an explanatory letter to the participants, and to parents and other stakeholders where appropriate

The notion of “informed consent” (the relevant forms are in the appendix) can be viewed both in terms of “consent from whom” and “consent to do what”. This was particularly pertinent for the first study, where the participants were aged 14, 15 and 16. As Cohen et al (2012) point out, getting informed consent for minors involves two stages, firstly from their parents and then from the children themselves. Once the study had been discussed with the school managers, and the initial sample of participants had taken place, a letter was sent to parents of the children in the sample group. This explained the nature of the project, its’ likely benefits, and how it would be carried out. Parents were given the contact details of the researcher, and invited to discuss any concerns that they might have had. In terms of “consent to do what”, the letter also explained the location in which the study would take place, the software involved, and the fact that the activity would be recorded on video (*appendix 4* and *appendix 5*). The parents were asked to provide consent to two things; firstly, that they would allow their child to participate in the activity, and secondly, that they would allow their child to be filmed during it. Out of the ten parents involved, nine provided consent for both participation and filming. Once this had been achieved, the nine remaining children in the sample group were approached with a second letter (*appendix 6*). This provided

further details about the activity and how it would be carried out. It also informed participants that they could withdraw from the study at any time and that they did not have to complete any parts of it if they did not want to. In short, they could ‘opt out’ of elements of the study and the data from this would be disregarded for research purposes. This, indeed, occurred on a few occasions during the learning activity and is discussed in chapter five. It was important that the participants did not feel compelled to participate. Consent, therefore, was sought from both parents and learners, in order to travel to the university, participate in the activity and, to be filmed during it. The participants in study two were all adults. Nonetheless, a number of procedures were followed. In both cases, the nature of the project, its’ expected benefits, and the proviso that participants could withdraw from the study at any time and did not have to complete any of the tasks they felt uncomfortable with were set out.

In terms of anonymity, it was also made clear in the studies that all details concerning the participants would be made anonymous. In practice, this meant that pseudonyms (identity letters) would be used instead of real names, and that the faces of the participants would be blanked out in the written report of the study. The aim here was to assure those involved (including the parents of the learners in the first study) that it would be impossible to identify individuals either from the description of the research or from photos taken from the video footage.

The final ethical concern related to confidentiality and dissemination. It was explained to the participants in each study that video footage of the learning activity or focus group would be encrypted and stored securely in line with ESRC data management guidelines, and would only be shared with the researchers’ supervisor.

3.5.1 The role of the researcher

This was a particular concern for the first study, where the researcher was also employed as an ICT teacher in the selected setting. This was beneficial in terms of access to participants, familiarity with working culture, and reducing the time required to organise and implement the study. There were, however, a number of important methodological implications that stemmed from this dual role. The aim of this section is to initially set out the nature of some of these implications, and then to reflect, in more depth, and across both studies, about the effect that they had, and the extent to which they were addressed.

The concept of researching those with whom one also works is commonly referred to as “researching in your own backyard” (Malone, 2003). Malone’s (ibid) seminal work, assessed the problematic nature of some of this research, by pointing to the prevalence of issues such as coercion and resistance, and, institutional power and relationships. This was allied with a concern about the extent to which considerations such as “informed consent” could be realistically upheld. Her main argument was that even if the researcher follows all of the established ethical procedures, there still remains an implicit and unseen degree of coercion upon the participants to take part in the study. She points, therefore, to cases of students who agree to participate in studies (run by their teachers) for fear of getting low grades; situations where learners feel drafted and coerced into taking part in research projects, not to mention ongoing issues concerning power differentials (eg. between adults and children) during the implementation of such projects.

In such cases, the notion of “informed consent” loses much of its meaning, where learners feel implicit pressure to take part in a study, or indeed, to complete parts of it that might make them feel uncomfortable. Similarly, Malone (ibid) points to how concepts of anonymity and confidentiality are harder to maintain where the researcher possibly interacts with the participants on a daily basis; focusing on her setting of a small university where the identities of those who participate in a particular study become apparent, over time to many of the participants colleagues.

It can also have a number of consequences in terms of validity and reliability. Robson (2002) examines a series of structured observations where the researcher and the participants already have a working relationship from another context. He describes the prevalence of “artificiality and hesitancy” in this setting, where those observed “do things differently to placate the observer” (ibid, P.472). More broadly, those being observed find it difficult to take on a new role, and to treat the person observing them in a different way from the previous context.

This is not to say that some of the more extreme concerns put forward by Malone (ibid) are somehow inevitable, or that “researching in your own backyard” is necessarily to be avoided. Indeed, Robson (2002) makes much of some of the pragmatic advantages of this approach, such as the already extensive knowledge that the researcher might have about the participants, along with the idea that “existing relations with individuals can short circuit developing trust” (ibid, P.471). Rather, it is an invitation to examine ones relationships with those being observed in a self-reflexive way, and to be honest about the possible effects (good and bad) resulting from this form of research. Where the effects are felt to be negative, (say in ethical terms) then it is important to look for ways to address them. Where there is the risk that they will distort the findings of the study in

a significant way (this time in terms of validity and reliability), it becomes important to assess the exact nature and scale of this effect, and, again, to find ways to reduce it.

In what follows, therefore, I will reflect upon this in more depth. The approach loosely follows that recommended by Maxwell (2012). He advises prospective researchers to reflect upon their existing relationships with the participants in the study, to consider how one might be viewed by the participants, to examine the explicit agreements and implicit understandings that one might have with the participants about the research and finally, to assess the broader ethical considerations of taking this approach.

3.5.2 Existing relationships with participants

This was primarily an issue for the first study. The sample was organised so as to exclude learners who were in my ICT classes at the time. This was mainly an attempt to reduce power differentials and to help me to be perceived as more of an observer than a teacher. There were two problems with this however. Firstly, I was the teacher of many of the participants in the past. Secondly, even where I had no previous working relationship with an individual learner, I was still likely to be perceived as being “the ICT teacher”.

On the other hand, it also meant that I could enter the study with background knowledge of many of the academic and social characteristics of the participants. In other words, I already had some idea as regards which learners were most likely to work together, which ones would be happy to teach others how to use the software, and which ones had already used the software in question. It was also helpful to know how some learners might behave in particular circumstances (eg. a large breakdown of

collaboration, tasks not going as planned). By using my existing knowledge of the participants, it was much quicker and easier for me to get particular learners to help their peers, or to pair up more knowledgeable with less knowledgeable ones, or to get a learner who I knew was very proficient at explaining things to act as a spokesperson to the others. This had the obvious benefit of saving time, and proved important in keeping the planned collaboration in progress.

The problem with this is that it brought some degree of researcher bias to the study, in that I entered with a number of implicit prejudices as to how the participants might behave in particular circumstances. For example, if learner X is already considered by the researcher to be “good at explaining things”, then it is more likely that this is what he or she will be encouraged to do during the activity. This runs the risk that many of the learner roles and activities are implicitly decided in advance. That said, I tried, during the activity, to base assigning roles and activities to the participants (where required) on the evidence at hand (eg. if learner X had appeared to be “good at explaining things” earlier in the activity, then it was more appropriate that s/he be given such a task later on).

In study two, there were no existing relationships between the researcher and the participants. It was important that they were comfortable in expressing their ideas, both to the researcher and to each other. Therefore, the instructions for the study were explained in a calm and patient way. Where possible, I used neutral and everyday language, and the participants were occasionally asked simple, informal questions to check their understanding. In study two the focus group was carried out in a social

setting, away from the normal workplace / college of the participants. Whilst much of the work consisted of discussion, argument and task completion, it was important for the researcher to step in from time to time, either to keep the discussion or task in progress, to encourage individual members to contribute, or to prevent one or more individuals from dominating the group. The researcher, therefore, had to balance their role between that of being an observer on the one hand and that of a facilitator / organiser on the other. Where possible, much effort was made to get the participants to drive the running of the group. Researcher intervention was, of course, required in order to explain terms, tasks and instructions to the participants and also to ensure that the group continued to run productively.

3.5.3 How I might be viewed by the participants

In each study, though particularly the first one, I was aware that I could have been viewed more as a teacher than as an observer by the participants. The distinction between the two can be quite substantial as a participant might expect the former to “do what teachers do” such as demand that tasks be completed, discipline ones’ peers, or help one to complete a task. None of these are things that an observer might normally do during the course of a study.

To this end, I took a number of steps so as to be viewed as less of a teacher and more of an observer both in the approach to and during the activity. In both studies, I attempted to introduce a degree of novelty by running them in either out of school or social settings. For the first study, I also arranged for a student teacher (and hence not somebody known to the participants) to accompany the group and to assist with some

of the technical aspects of the activity. She intervened to help the learners deal with minor issues.

One additional means of behaving less like a teacher and more like an observer, in each of the studies, was to get the participants to take on as much of the orchestration of the activity as possible. Certainly in the early stages a high degree of intervention was required in order to explain tasks and instructions to the participants. The aim, however, was to get the participants to take on more and more of these (and similar) functions as the activity (or focus group) proceeded. In many cases, it was only necessary to intervene where there was a large scale breakdown of collaboration, or where technical problems prevented the study from continuing.

3.5.4 Explicit agreements & implicit understandings with the participants about the research

Maxwell (2012) points to the possible differences that can exist between what one explicitly agrees with those being researched about how the study might proceed (and their part in it), and that which one might implicitly expect from them. In other words, what is the difference between what the researcher explains to the participants and what the researcher might expect from them (without ever making it clear)?

At the explicit level, it was expected that the participants would agree to take part in the study, that they would try and complete each of the tasks as best they could, and that they had the right to withdraw from anything that they did not wish to do. All of this has already been discussed.

If I look at this more closely, however, I am aware that there were a number of implicit demands that I made upon the participants in each study, in order to carry out the research. I expected them, in general, to collaborate with each other; and, in some cases, to work together in specific teams. This was inherent in both the design and the implementation of the studies. Secondly, moving on from collaboration, I was implicitly expecting the participants to complete the parts of the activity in particular ways. In many cases they found other ways of achieving the tasks set. Finally, I assumed that they would always respond positively to instructions (they did not have to, and they did not always) and that they would not ask too many questions about how to complete the tasks (for pragmatic reasons so that one would not be overwhelmed responding to their possible enquiries).

3.5.5 Broader ethical considerations

Considered as a whole, these concerns (existing relationships with those being researched, perceptions on the part of the participants, and the difference between explicit agreements and implicit expectations) relate back to the ethical requirements of the study as set out at the start of this section. Burman (1997), for example, notes how “particular research goals such as ‘relationship’ and ‘participation’ are easily co-opted into the existing power relationships” (P. 14). Their main effect is to make the concept of “informed consent” somewhat more complex to implement than one might have envisaged. It may be more difficult, for example, for learners to ‘opt out’ of doing particular tasks, or for them to question the ways in which such tasks are expected to be completed.

As set out above, I took a number of steps to try and reduce such power differentials, such as conducting the studies in non-school and work locations, employing an assistant for the first study, arranging for the participants to organise and run parts of the study and so on. Similarly, I am conscious that I brought a number of implicit assumptions with me about how the participants would behave. I am also aware that the measures set out here reduced the scale of the problem rather than remove it entirely. It was important, therefore, to adopt a self-reflective attitude and to continue to understand the complexity of one's dual role as facilitator and researcher.

3.6 Research design

The discussion of the studies, initiated in section 3.1.1, can now be detailed and extended. In what follows, three issues are central, namely the relationship between the studies and the research questions, the linkages within and between the studies, and the concept that some of the research questions be examined in a more detailed way through following a 'focusing exercise' (as described in section 3.3.3). We start by reviewing each of the research questions, and examining how they were addressed, before turning to the aims, content and context of each part of the studies.

3.6.1 How the studies address the research questions

The broad relationship between questions and the studies was set out in section 3.1.1. The aim here is to look more closely at the various *elements* of each of the questions, assessing the ways in which they were resolved by the studies.

The first research question ("What is a hybrid learning space?") consists of three elements, each addressed by the studies in various ways. Firstly, there is the design and

orchestration of a hybrid learning space. The design was examined in the early parts of both studies (chapters four and six), and was carried out by the researcher in the first study and by the group of teachers in the second one. The design with the teachers was informed by the implementation findings of study one, particularly concerning the efficacy of scripts and teacher interventions, and the desirability of getting the learners to orchestrate as much of the activity as possible. The orchestration element of this part of the question was examined by the implementation part of both studies (chapters five and seven). The implementation in the first study was carried out by the researcher, and by a group of teachers in the second one, although not the same ones who designed the activity. As before, implementation in the second study was informed by the experiences of the first one; with concepts emerging in the first study such as collaboration and fracturing being explored in greater depth. A second element of this question related to the emergence of novel types of learning practices, resulting from the interplay of the physical and digital contexts. This element was resolved in the implementation parts of the two studies, again with practices such as building challenges and solving complex problems being identified in the first study, and then assessed more closely in the second one. The final element of this question was a broader discussion around the theoretical perspective of chapter two with the empirical findings of the two studies. This meant examining the totality of the findings and relating them back to the literature review on hybrid spaces, and is carried out in chapter eight.

RQ	Question Detail	Study
1	What is a hybrid learning space? (Main)	
	Design and Orchestration of the space	Study 1 – Design (Chapter 4) Study 2 – Design (Chapter 6) Study 1 – Implementation (Chapter 5) Study 2 – Implementation (Chapter 7)
	Emergence of novel types of learning practices from the interplay of physical and digital contexts	Study 1 – Implementation (Chapter 5) Study 2 – Implementation (Chapter 7)
	Discussion of literature review and the findings of the two studies	Chapter 8 - Conclusion

Table 3.5 – The relationships between RQ1 and the studies

The second question (“What is teacher practice in the design and implementation of learning activities in a hybrid learning space?”) aligned closely with the design part of both studies in chapters four and six, again with a move from design by the researcher towards that carried out by the teachers. As before, design with the teachers was informed by the implementation findings in study one. However, the implementation parts of both studies also made a smaller, if still significant, contribution, allowing an examination of teacher implementation in practice, first by the researcher (study one) and later by the group of teachers (study two). When we move to the two sub-questions, other challenges emerge. The first sub-question (“What are the challenges in developing learning design by teachers working with hybrid spaces – and how can these be addressed?”) was addressed to a minor extent by the design part of the first study, in that the researcher uncovered several challenges relating to design such as the support of collaboration and planning for teacher interventions. The sub-question was

addressed in a more substantive manner in the design part of study two. Nonetheless, the researcher considered it necessary to break the question up into a number of more detailed ‘empirical questions’. The process by which this occurred is examined in section 3.6.3 below. A similar challenge applied to the final sub-question (“What part do existing perceptions of technology in practice play in shaping teacher design and implementation practice?”). This was, again, addressed substantively by the design part of study two, and as before, an empirical question emerged from the focusing exercise as set out in section 3.6.3.

<u>RQ</u>	<u>Question Detail</u>	<u>Study</u>	<u>Sections</u>
2	What is teacher practice in the design and implementation of learning activities in a hybrid learning space? (Main)	Study 1 – Design (Chapter 4) Study 2 – Design (Chapter 6)	4.4, 6.4, 6.5, 6.6
	What are the challenges in developing learning design by teachers working with hybrid spaces – and how can these be addressed? (Sub-question 1)	Study 2 – Design (Chapter 6)	6.4, 6.5, 6.6
	What part do existing perceptions of technology in practice play in shaping teacher design and implementation practice? (Sub-question 2)		

Table 3.6 – The relationships between RQ2 and the studies

The final question (“What are learner and teacher roles and activities in the hybrid learning space?”) relates closely to the implementation part of both studies, with the nature of the contribution varying between them. Some roles and activities were only evident in one of the studies (passing, pairing and tussling for example was mainly in study one) whilst others emerged in the first study and then evolved more comprehensively in the second one (such as subject experts and go-betweenes). Examining the three sub-questions allows us to assess the relationship with the studies

in more detail. The first one (“how are roles and activities shaped by the physical and virtual contexts of the space?”), required the researcher to identify specific roles and activities, and then to examine how they were being shaped by the contexts. Negotiation around the virtual teleporter was a good example of this in study one, with the process of negotiation being influenced by the ability of learners to find the teleporter in the virtual part of the space, and then to convince others to use it. The second sub-question (“How do the learner roles and activities support collaboration?”) was more complex. To make the sub-question easier to answer, it was broken into a number of empirical questions during the focusing exercise for the implementation part of study one. The process behind this is discussed in section 3.6.2. The last sub-question (“How do the roles and activities inform learning practices in the hybrid space?”), was resolved by identifying the roles and activities and then relating them to the learning practices. An example of this was in the implementation part of study two, where the part played by the activity of negotiation in the learning practice of solving complex problems was examined.

<u>RQ</u>	<u>Question Detail</u>	<u>Study</u>	<u>Sections</u>
3	What are learner and teacher roles and activities in the hybrid learning space? (Main)		
	How are roles and activities shaped by the physical and virtual contexts of the space? (Sub-question 1)	Study 1 – Implementation (Ch 5)	5.3.1, 7.3.1
	How do the learner roles and activities support collaboration? (Sub-question 2)	Study 2 – Implementation (Ch 7)	5.3.2, 7.3.2
	How do the roles and activities inform learning practices in the hybrid space? (Sub-question 3)		5.3.3, 7.3.3

Table 3.7 – The relationships between RQ3 and the studies

3.6.2 Study One

The aim of the study was for the researcher to design a learning activity using the learning design process developed in chapter two, and for the researcher to implement the same activity with a group of learners. The design part of the study took place in chapter four and the implementation part in chapter five. In this section, the aims and content of the study are set out.

Design (Chapter Four)

For the researcher, this was the first attempt at setting up a hybrid space and then designing a learning activity for implementation within it. The space was designed using the Conversational Framework in section 4.2.1. The learning design process based on the Conversational Framework and a series of templated scripts for collaboration was then developed throughout section 4.3, resulting in a three part activity. Finally, a plan for teacher interventions, based around potential threats to collaboration, was set out in section 4.4.

The design part of this study, therefore, set up both a hybrid learning space and an activity. In this way, it makes a minor contribution towards addressing question one (by setting up the space), and a significant contribution to question two (by designing a learning activity). For the researcher, this part of the study underlined the challenges in supporting collaboration and in anticipating likely threats to the orchestration of the hybrid learning space. This went on to influence the learning design practice with the teachers in study two.

Implementation (Chapter Five)

This part of the study made a small contribution towards resolving question one (by implementing the space and by identifying novel learning practices) and question two (by exploring teacher implementation practices, which varied greatly in their rationale and efficacy). It made a substantial contribution to addressing question three, by identifying a number of learner roles, activities and learning practices and then exploring how these related to the contexts of the space (sub-question one), to collaboration (sub-question two), and to how the roles and activities informed the learning practices (sub-question three).

One particular challenge related to how roles and activities supported collaboration. As the video records were reviewed with another research student, it was difficult to apply the sub-question (“How do learner roles and activities support collaboration?”), as it stood, to the emerging data. In line with the provisions of the ESE analytical framework, a focusing exercise was undertaken to break the sub-question into more manageable pieces. Discussion with the research student after early viewing of the records led to four initial empirical questions. These were:

- What examples are there of collaboration and non-collaboration? (EQ1)
- What roles & activities do learners use when there is collaboration? (EQ2)
- What roles & activities do learners use when there is non-collaboration? (EQ3)
- What does the teacher do to support collaboration during the activity? (EQ4)

Over time, the records viewed on successive occasions by the researcher and the co-analyst. It was decided that although EQ1 was a useful starting point, it added little to the enquiry, and it was therefore removed from the final series of empirical questions. The other EQ's proved to be useful as a means of examining the records. In later viewings, it became clear that a number of learner activities could influence either collaboration or non-collaboration depending on other circumstances. An example of this was with the activity of 'learners getting lost'. It often encouraged learners to collaborate, but sometimes had the effect of weakening collaboration that was already in progress. Therefore, a new EQ was added to the list, namely, "what other learner activities influence collaboration and non-collaboration?" This exercise was quite successful in allowing the researcher to examine the records in greater detail and to give a more considered response to the sub-question. A similar focusing exercise, again following collaborative viewing was carried out to further refine the codes and categories used in the study, and this is detailed in chapter five.

Finally, the implementation part of study one pointed to the relative inefficacy of both learner scripts (which were frequently abandoned by the learners in favour of organically emerging roles and activities) and to efforts to plan for teacher interventions (which failed to grasp the complexity of orchestrating the hybrid learning space, which were frequently ineffective, and which often diverted the teacher from more pressing tasks). This went to inform both the design and implementation of study two.

3.6.3 Study Two

The aim of this study was to support a group of teachers to use the learning design process to design and then implement a learning activity in the hybrid space. The design for this study took place in chapter six and the implementation in chapter seven.

Design (Chapter Six)

The design part of the study consisted of two workshops, each with a different group of teachers (the rationale for this was set out in section 3.4). Based on the findings of the previous study (particularly the implementation part), some small changes were made to the learning design process, with a greater emphasis being placed on the Conversational Framework aspect, and a reduced emphasis on templated scripts for collaboration and plans for teacher intervention. Once the teachers had designed the activity, they were then questioned by the researcher concerning their perceptions and understanding of the hybrid learning space, and their potential role within it. This part of the study made a small contribution to addressing research question one (it added to our overall understanding of hybrid learning spaces by setting up a second one), and a substantive contribution to addressing question two. This was achieved, in terms of the main question, by demonstrating teacher practice as they designed a hybrid learning space.

As with the earlier study, challenges emerged with the two sub-questions. In planning for this part of the study, it appeared to us that the sub-questions as they stood (“What are the challenges in developing learning designs by teachers working with hybrid spaces and how can they be resolved?” and “what part do existing perceptions of

technology in practice play in shaping teacher design and implementation practice?) might not yield detailed or considered responses from the teachers in the focus groups. What was required was something that would encourage the teachers to reflect more on their practice. Therefore, a further focusing exercise was carried out in advance of running the study. The aim was to express the sub-questions in a more practical and empirical form. The final questions resulting from the focusing exercise were:

- How do you (the teacher) perceive the term ‘hybrid learning space’ and what do you consider to be its’ main uses for learning? (EQ1)
- What is your (the teachers) understanding of the term ‘hybrid interactions’ and what part do these play in your completed learning activity? (EQ2)
- What do you envisage to be the role of the teacher in the hybrid learning space in terms of collaboration, orchestration and intervention? (EQ3)
- What broader challenges and concerns do you (the teacher) envisage in the design and implementation of activities in the hybrid learning space? (EQ4)

By expressing the sub-questions in this way, it was possible to examine teacher perceptions of their practice and of the technology in use in a more considered,detailed and self-reflective form.

Finally, the completed learning activities from this part of the study were reviewed with the same co-analyst who co-operated with viewing the records from the first study. This process pointed to a number of possible implementation problems with the activity, reflected in terms of tasks that could not be completed in the assigned time, tasks that were duplicated, and planned interactions that would likely be limited just one part of the space (and therefore less informative in terms of the research). Therefore, the activities were modified somewhat by the researcher, based on the findings of the implementation of study one.

Implementation (Chapter Seven)

In the final part of the study, the modified activity was implemented, for pragmatic reasons, by a different group of teachers than those who had designed it. This part of the study made a small contribution to addressing question one (a further implementation of a hybrid learning space and the emergence of novel learning practices), and question two (by further examining teacher implementation practices in the space). It made a substantive contribution to resolving question three. This was because during the implementation a further number of roles, activities and practices emerged. Some of these were novel (such as new forms of collaboration, new learning practices such as solving complex problems), whilst others were more detailed extensions of phenomena from the previous study (more complex forms of negotiation and verification, for example). There was no new focusing exercise (and no further empirical questions) in this part of the study, as the emphasis was on examining the same roles, activities and practices as in the previous study. However, a number of the (analytical) codes and categories were refined through collaborative viewing of the video records. The process through which this took place is examined in chapter seven.

This chapter has set out the methodological decisions underpinning the thesis. The two studies have been described in both elementary and detailed terms and their methodological, analytical, contextual and ethical backgrounds have been discussed. In the next chapter, the learning design process will be used by the researcher to design an initial hybrid learning space and learning activity.

Chapter 4

Study One – Design: Activity Development using the learning design process

This chapter addresses research question two (“What is teacher practice in the design and implementation of learning activities for a hybrid learning space?”) by developing an activity using the learning design process. The chapter make an initial contribution to resolving the first sub-question in RQ2 (“What are the challenges in developing learning design by teachers working with hybrid spaces – and how can these be addressed”) by examining a number of these challenges and assessing how they might be resolved.

It was argued in section 2.3, that the Conversational Framework, whilst useful for identifying potential learner interactions in an activity, does not proscribe these interactions in a more detailed manner, particularly in a way which learners can easily follow and appropriate. The framework is therefore complemented by a series of templated scripts for learner collaboration, based on the literature review in section 2.3.4. In order to focus the efforts of the teacher on supporting collaboration, there is also a plan analysing where teacher interventions in the activity are likely to be most apt and effective. These three elements represent a *learning design process*, and are followed in this order, with the Conversational Framework exploring potential interactions in the hybrid space; the support for collaboration providing further, more directive detail about how the learners should collaborate, and the teacher plan emphasising interventions likely to support learner collaboration. This chapter starts (section 4.1) with an overview of the instantiation of the Hybrid Learning Space and of the multi-part learning activity. In section 4.2, each part of the activity is developed

using the Conversational Framework and a series of scripts for collaboration. Section 4.3 details the final part of the process, emphasising the role of the teacher to support collaboration whilst the activity is in progress. Informed by the experience of carrying out the design process, a number of findings to research question two are discussed in section 4.4.

4.1 – Overview of the Hybrid Learning Space & Learning Activity

This section describes and situates the hybrid learning space that is used in this chapter. The literature frequently avoids distinguishing between the physical and virtual parts of hybrid spaces, preferring to discuss the concept in singular terms. However, such a distinction is carried out in this section so as to clarify and to facilitate discussion. In section 4.1.2 the parts of the activity are then described.

4.1.1 – Overview of the Hybrid Learning Space

The physical aspect of the space was the classroom that the learners occupied. This consisted of four laptop computers, arranged around a single oval table, along with a separate table which was used at the beginning (introduction), middle (consolidation) and end (review) of the learning activity. There was also a paper whiteboard which was used for one of the tasks in the activity, and a podium from which the learners could make presentations to the group. Although each learner sat initially in separate places, they could also walk around, talk and gesture to each other. Similarly, the laptops could be moved around. The space chosen here, had some initial similarities with Lindtner and Nardi's (2008) *Wang Ba* Internet cafe, where the participants walked around and discussed both their activities in the virtual space along with a range of other social and

recreational issues. It differed, however, in that the learners were expected to complete a specific learning task within a fixed time frame. It was also different in that there was a teacher and an assistant in the room, who could monitor and intervene in the activity.

The virtual part of the space consisted of the *Second Life* virtual world. In this, each of the learners had an avatar which they could modify. They could see the avatars of each of the other learners in the space, and could communicate with them by gesturing to them, or by sending either a public or private text. The former could be seen by all of the other learners whilst the latter was only visible to the person to whom it is sent. In this virtual part, the learners could walk, run and fly. They could also move (‘teleport’) from one space to another. Moreover, the avatars could be programmed to perform specific actions such as to dance or jump in a particular way. Compared to other virtual worlds such as *World of Warcraft*, it is possible to modify aspects of the content of *Second Life*. This meant that the learners could import shapes and then use these to set up buildings and other artefacts. As with the avatars, the shapes could be modified in terms of colour, position and appearance. They could also be programmed to ‘behave’ in particular ways. An example of this would be a door that opens when somebody walks up to it, or a loudspeaker which makes a text announcement once a learner comes within range of it. More specifically, the activity drew on the “International Spaceflight Museum” part of *Second Life*, where the learners explore each of the relevant planets and assess how they are similar and different from each other, their relative locations and orbits, and the extent to which they have been visited by space probes such as *Pioneer* and *Voyager*, for example, over the years. The screenshot below (*figures 4.1*) shows the overall appearance of the museum. In this part of the virtual world, the learners can move from one planet to another, whilst also visiting and finding out more about their various moons and other features.



Figure 4.1 - Nearest Stars

Jupiter's' Moons

The hybrid part of the environment consisted of the interactions that begin in one of the parts of the space and then get carried over into the other. For example, the learners walked around the classroom to get (and offer) advice on problem solving approaches, which they then tried out in *Second Life*. Similarly, the learners could encounter each other in the virtual world and discuss their progress. To solve a specific problem, they talked or gestured to each other before returning their attention to the virtual space. Again, there are similarities here with the work of Lindtner and Nardi (2008), in that the *Wang Ba* patrons would temporarily leave *World of Warcraft* and speak face to face to discuss what they should do next in terms of strategy in the game. Something like this is also evident in Crabtree and Rodden's (2008) study, where the players' searches for an individual clue involved a mixture of face to face and text interaction.

4.1.2 – Overview of the learning activity

The learning aims of the activity were derived from the Key Stage 3 Physics Curriculum in UK secondary education, and required the learners to develop conceptual knowledge of, and to design outputs relating to, the planets of the Solar System. The activity had three parts, as summarised in *table 4.1* below. Each part can now be described in more detail.

No	Summary	Rationale
1	Exploration – Learners coach each other on how to animate and move their avatars. They move between the physical and the virtual to do this.	<ul style="list-style-type: none">• To encourage the learners to communicate with each other• To familiarise learners with the technical features of the virtual world
2	Solar System to the Whiteboard – Learners research information on each of the planets in the virtual world. This is then communicated to another team for addition to a whiteboard presentation	<ul style="list-style-type: none">• To support collaboration by requiring the learners to assign tasks, teams etc.• To support collaboration by getting the learners to share what they find out• To support collaboration by getting the learners to create a single shared artefact
3	Building Competition – Learners build a model of the Solar System in the virtual world	<ul style="list-style-type: none">• To support collaboration by requiring the learners to assign tasks, teams etc.• To support collaboration by getting the learners to negotiation the relative positions, sizes etc. of the planets• To support collaboration by getting the learners to create a single shared artefact

Table 4.1 – The Parts of the Learning Activity

Part One -Exploration

The first task required the learners to initially work as pairs (one pair on each of four laptops) and to practice animating their avatars. This meant that they had to get the avatar to make particular movements (eg. running around in a circle, jump in the air) as chosen from a list. Once this had been mastered, they then had to get one other team (selected by the teacher), to animate and control their avatars with a series of commands from the list. This meant coaching the other team about what to do, by sending steps and instructions to them. At the same time, each team also had to respond to the incoming instructions from the others. The aim of this task, therefore, was to encourage the learners to communicate with each other, and help them become familiar with the technical and spatial aspects of the virtual space.

Figure 4.2 below, student B gets out of their seat and walks over to where students M and D are sitting. He shows them how to perform the animation in question. M watches and listens, whilst D does the work. Satisfied with the outcome, B then returns back to his seat.

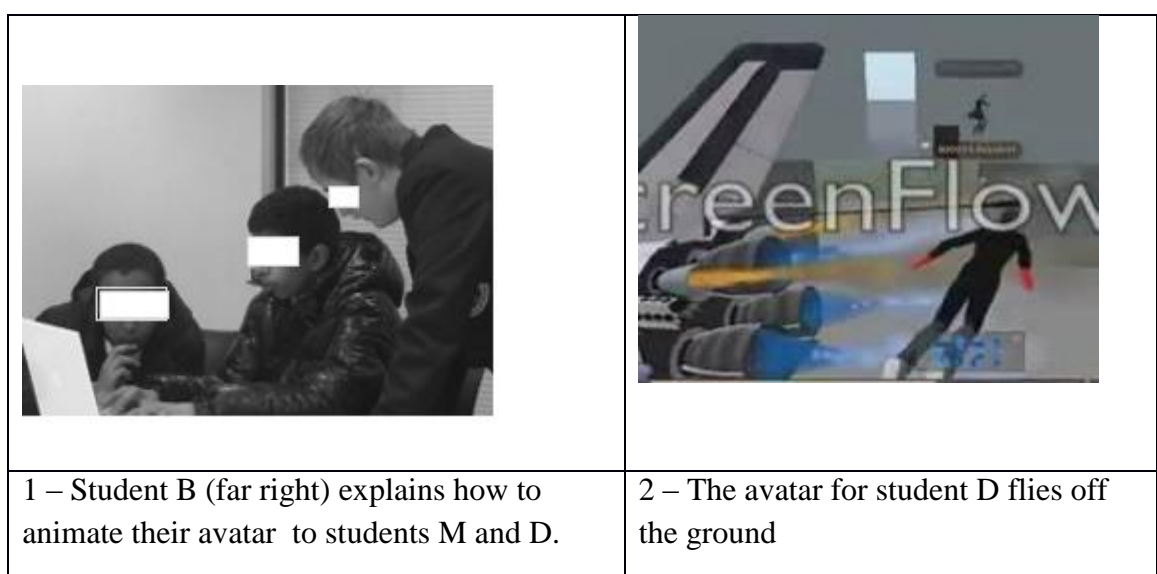


Figure 4.2 - Exploration

Part Two – Solar System to the whiteboard

The second task focused on the “Solar System” of the virtual world. Working again as pairs, the learners had to find out information about a number of planets (as assigned by other members in the overall group), and then pass this to a scribe, whose task was to get this information onto a paper whiteboard, and organise it in preparation for a later team presentation. The aim of the task, therefore, was to encourage collaboration between the various teams, in terms of assigning tasks to each of the pairs and then organising the communication of the findings to the scribe.

In the example below (*figure 4.3*), we see students D and H at the whiteboard. They are taking information both directly from the learners at the laptops and from other students who are acting as ‘go between’s’. We can also observe student A moving from planet to planet in *Second Life* in order to get more information. Finally, there is a broader shot of the teams at work.

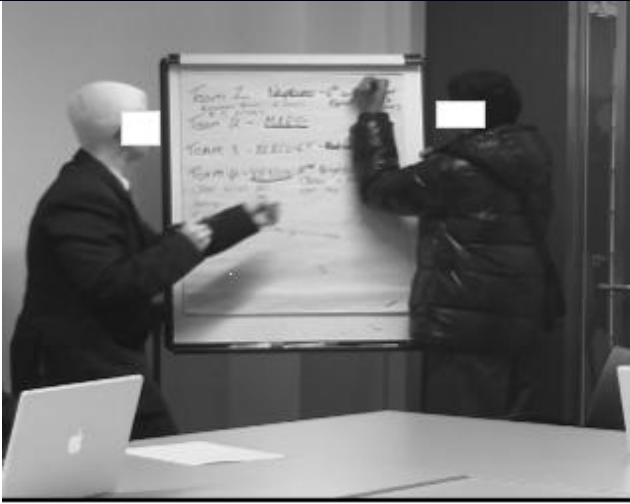


<p>1 – Students H and D are at the paper whiteboard. They are taking information about the planets from the other learners.</p>	
<p>2 – The learners use the virtual world to gather this information. This learner is orbiting around Neptune</p>	
<p>3 – A broader shot of the group</p>	

Figure 4.3– Solar System to the Whiteboard

Part Three – Solar System Building Competition

The final task was a building competition using the ‘build’ features of the virtual world. The aim was for each of the four teams (again working in pairs) to contribute to the building of a model of the solar system in the virtual world. As before, the learners had to work out the required sub-tasks and then divide them amongst themselves, deciding who was to be responsible for setting up which planets. They also had to collaborate in order to ensure that the planets were the correct relative sizes and were positioned in the right order.

In the example below (*figure 4.4*), we see how the learners make a start on the task by drawing out a variety of different shapes. Although they could usually see each other in the virtual world, the learners would often check what was occurring on the screens of others as a means of improving their awareness. The picture below shows student A checking what is happening on student J’s screen, for example.


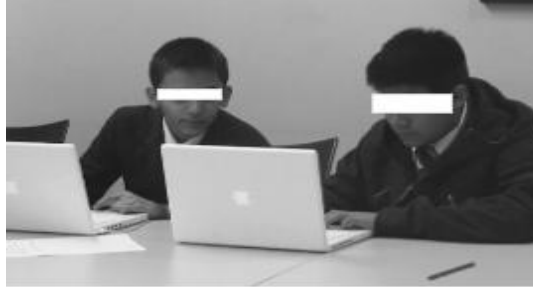
	
1 – The learners use the build features of the virtual world to construct a model of the Solar System	2 – Although visible to each other as avatars in the virtual world, they would also check on what each other were doing as a means of improving awareness

Figure 4.4 – Solar System Building Competition

4.2 Implementing the Learning Design Process

4.2.1 – Introduction

The aim of the learning design process, as shown in *figure 4.5*, was to allow a teacher or researcher to design, from the beginning, a learning activity for implementation in a hybrid learning space. The first two parts of the process (Conversational Framework and scripting for collaboration) are implemented in this section. The final part (teacher plan for interventions) is addressed in section 4.3.

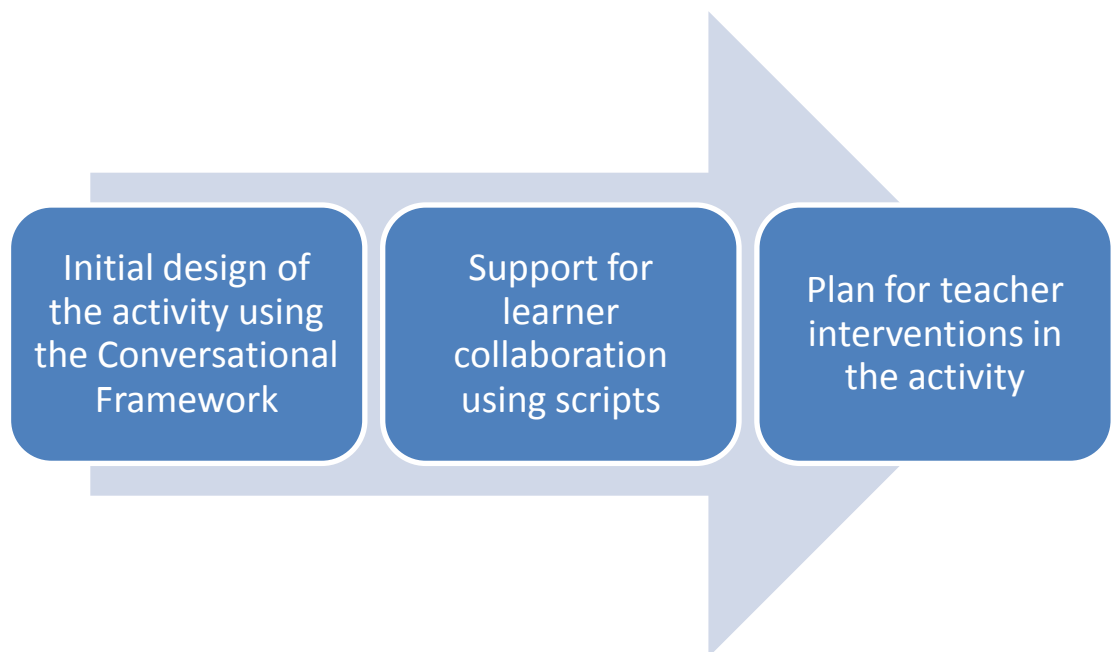


Figure 4.5 – The Learning Design Process for Hybrid Learning Spaces

The process began with the Conversational Framework being used to outline a number of possible interactions. In particular, we were interested in how learners could access theory and concepts, how they could ask questions and share ideas, and how they could use their conceptual knowledge to achieve a practical task or goal. The framework allowed one to develop and justify specific interactions, and to integrate them into an activity. In order to further prescribe the interactions and to increase the likelihood of

learners pursuing them, an additional degree of support for collaboration was also required.

In the long run, it would be desirable if the learners would drive the collaboration of their own accord, with the minimum of intervention or enforcement. The overall ethos of the activity, therefore, was to get them to “explore the possibilities of collaborating, and to discover that there are added benefits to working together” (Benford et al., 2006, P.12). If this was to occur, however, some initial degree of enforcement would have been required, and this had to be combined with techniques aimed at improving their desire and ability to collaborate over the longer term of the activity. Therefore, in this activity, a simple, but relatively non coercive, script was required in order to encourage initial participation in each part of the activity. Dillenbourg and Hong (2008) assert that these can be categorised in terms of their rationale (“the spirit of the script”, as they put it), their degree of coercion, and the ease with which they can be understood and appropriated by the relevant learners. The rationale of the script in this case, was to get the learners to take the “first steps” towards working with each other, in each of the phases and thereby to encourage them to collaborate. The degree of coercion was light, in that the learners had to perform particular tasks to begin with, and communicate with the others; but that they were able to change what they did once the initial needs of the script were met. Finally, the script had to be both clear and easy to understand - something which could be easily internalised by the learner.

4.2.2 - Part one - Exploration

The aim of this initial part of the activity was to introduce the learners to each other and to get them to explore the features of the hybrid space. It was expected that they would communicate at least once with each of the other learners (ideally in both aspects of the space). It was also hoped that they will move around both the physical and virtual parts of the space, know the identity of all of the other learners, and be able to perform simple tasks (such as animating an avatar) in the virtual world.

If one applies the four questions of the conversational framework to this part of the activity (as outlined in section 2.3), we get something like what is described in table 4.2 below.

<u>Learning Activity Criteria</u>	<u>Example of Possible Activities</u>
1 - Learners can access theory and concepts	The learners explain to each other how to animate the avatars
2 - Learners can ask questions, share ideas and debate with both teacher and other learners	This is done by using the perceived affordances of the space as in section 2.3
3 - Learners use conceptual knowledge to achieve practical task / goal. The output of this is shared with teacher and other learners and the resulting feedback is used to improve performance at the task / goal	The learners use their conceptual knowledge to animate the avatars, and then to show and explain what they have done to the other learners and to the teacher. This can be seen in the virtual world and from looking at the screens
4 - Learners reflect on experience by presenting ideas & models to teacher and other learners	There is no final artefact / output for this part of the activity.

Table 4.2 – Part one of the learning activity

The activity was, in itself, unusual in that whilst the participants were expected to cooperate with each other, they were not expected to create a shared artefact. It was felt that they would not have sufficient knowledge to do so at this early stage. Each of the groups was given a card with three simple functions that they were expected to perform. This included making a small change to the appearance of ones' avatar, sitting on a chair, or flying above the ground. In order to avoid repetition, each of the tasks (12 for the whole class) had to be distinctive. The pairs firstly had to complete the tasks themselves. As each task was completed, it had to be ticked off the card. The first group to finish the three functions then had to ask one of the other groups to perform one of the tasks, and check that it got done. Once this occurred, they were to ask a different group to perform another one of the tasks and so on. Throughout this time, the initial group also had to complete any task requested of it by the other participants. The means by which the learners might communicate the necessary requests was left to their discretion. The winning group was the one which successfully completed the three tasks and got each of the other groups to also complete one of the tasks.

<u>Part No</u>	<u>Part Name</u>	<u>Main Steps</u>
1	Exploration	<p>Each group takes a card with three simple Second Life tasks</p> <p>The tasks will be sufficiently different to avoid later repetition</p> <p>Each group must complete the tasks and tick them off the card</p>

		<p>They must then ask one other group to attempt one of the tasks and verify that they have successfully done so</p> <p>They then ask another group to try one of the remaining tasks</p> <p>Time permitting, they ask a final group to do the last task</p> <p>Whilst this goes on, the group must also respond to requests from other groups</p>
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Table 4.3 - Summary of Part 1 of the activity

Turning to the scripting part of the process, there were a wide range of scripts that one could turn to, but Aronson’s “Jigsaw” (1978) was the most promising. With this script, each of the learners had access to only a subset of the information needed to solve the problem. As a result, no individual could solve the problem alone, or as Dillenbourg (ibid) asserts, “it depends on complementarity of knowledge, no student can proceed without collaborating with their partners”. The underlying expectation was that the learner had to examine and process the information that they received, become an ‘expert’ in that area, and then share their newly acquired knowledge with the rest of the group. The attraction of this script lay in its simplicity and in the fact that it imposed relatively few demands on the learners involved.

In this first part (Exploration), the script required the learners to complete a list of tasks and then to request other groups to attempt the same tasks. It represented the most coercive and rigid script of the entire activity. It was coercive in that the groups had fixed tasks to perform combined with a strict prescription as regards who to communicate with, and what they were supposed to do. The rationale of the script was cooperative rather than collaborative in that it aimed to provoke the learners into communicating with each other, rather than getting them to construct a shared artefact. The main points of the script for this part are set out in *table 4.4* below.

Title	Modified Jigsaw script for part one (Exploration)
Resources	4 Role Cards each with three tasks to be completed in <i>Second Life</i>
Roles	None
Activities	Communicating, verifying
Component Distribution	Each group takes one task and requests another group to complete it. This must be verified. The group then takes a second task and asks a different group to attempt it. Finally, they ask the remaining group to take on the last task. The initial group must also address incoming requests whilst this is ongoing.
Sequencing	Each group must complete the tasks first before contacting any of the others. The sequencing is likely to be uneven as some groups will finish the tasks before the others

Table 4.4 - Script for Part One (Exploration)

4.2.3 - Part two – Consolidation (Solar System to the whiteboard)

The second part of the activity required the learners to use the Spaceflight Museum region of *Second Life* to locate information about each of four planets (Mercury, Venus, Mars, and Neptune) and to use this information to prepare a short paper based presentation on the classroom chartboard. The aim, in brief, was to get them to use the virtual aspect of the space to carry out research, and then to communicate the results of this to their peers via the physical part of the space.

As before, the four stages of the conversational framework were used to conceptualise this part of the activity, as shown in table 4.5 below.

<u>Learning Activity Criteria</u>	<u>Example of Possible Activities</u>
1 - Learners can access theory and concepts	The conceptual knowledge resides in the Spaceflight museum aspect of the virtual world. The learners can access this by moving their avatar to the relevant parts of the virtual world. They can also see what others are doing both by moving the avatar to them or from looking at what is on their screen.
2 - Learners can ask questions, share ideas and debate with both teacher and other learners	This is done by using the affordances of the space as detailed in section 2.3

<p>3 - Learners use conceptual knowledge to achieve practical task / goal. The output of this is shared with teacher and other learners and the resulting feedback is used to improve performance at the task / goal</p>	<p>The main output is the presentation on the classroom paper whiteboard.</p> <p>The conceptual knowledge to complete this comes from the virtual world as outlined in step one.</p> <p>The learners use the perceived affordances of the space to communicate this to others, who then write the information on the whiteboard. There should be a process of ongoing verification and feedback as those who write on the whiteboard check what they are being told by asking the learners.</p>
<p>4 - Learners reflect on experience by presenting ideas & models to teacher and other learners</p>	<p>The final output is presented on the paper whiteboard. This can be viewed by the learners in the classroom and by the teacher.</p>

Table 4.5 – Part two of the learning activity in terms of the Conversational

Framework

In terms of detail, this eventually led to the task summary in *table 4.6*

<u>Part No</u>	<u>Part Name</u>	<u>Main Steps</u>
2	Solar System to the whiteboard	<p>For each of four planets (Mercury, Venus, Mars, Neptune) the learners must present on the paper board information about its dimensions, moons (where applicable) and which spacecraft have visited it</p> <p>The groups need to assign four roles amongst themselves (preparers, dimensions, moons, spacecraft)</p> <p>The latter three groups need to find the relevant information and pass it to the preparer group</p> <p>The information must then be collected and presented on the paper board</p>

Table 4.6 - Summary of part two

In terms of scripting, for this part of the activity, the learners were split into four groups, and were asked to assign the (pre-written) roles amongst themselves. One of the groups was responsible for getting the information from the others and ensuring that it was written on the chartboard. Each of the remaining three groups then had to examine

a particular aspect of each of the four planets such as its dimensions and orbit, its moons (where applicable) and which spacecraft had visited it. Once they found the relevant information, they then had to find a way to communicate it to the lead group so that it could be added to the presentation. This part of the activity posed a number of challenges to the learners involved, not least, that of deciding which group was to perform which task, how best to communicate what they found, and finally, how to orchestrate their overall performance. This was less prescriptive than before, in that the task was specified, but with less detail than before about how the roles should be divided up between the learners. This partly represented an attempt to avoid “overscripting”, but was also a means of encouraging the learners to find their own ways of collaborating once the basic requirements of the script had been met.

Title	Modified Jigsaw script for Part Two
Resources	Paper Chart for drawing and writing the presentation
Roles	Preparer, Planet expert, Moon expert, Spacecraft expert
Activities	Researching, Communicating, Summarising, Selecting,
Component Distribution	The groups need to assign the roles amongst themselves. The Preparers are responsible for getting information from the others and for putting the presentation on the chart. How this gets done is up to the learners. The planet experts must find out the dimensions and statistics about four specific planets. The moon expert must find out information about the moons of the specified planets (where applicable) and the spacecraft expert must check which craft have visited the planets concerned.
Sequencing	The exact sequencing is to be left to the learners. The roles can run simultaneously with the preparers adding information to the chart as it is found by the others

Table 4.7 - Script for Part two (Solar System to the whiteboard)

4.2.4 - Part three – Construction (Solar System build)

The final part of the activity required the learners to use what they had learned in the previous parts to build a working model of the Solar System in the virtual world. To do this, they had to discuss, in advance, what tasks and sub tasks required completion along with who was to perform them. Then they could start building. The aim was to require a high degree of ongoing collaboration as the individual planets had to be built according to their relative size and then placed in the correct relevant positions. In terms of the conversational framework, the part was developed as in table 4.8 below.

<u>Learning Activity Criteria</u>	<u>Example of Possible Activities</u>
1 - Learners can access theory and concepts	<p>The conceptual knowledge to build this is developed through trial and error – by trying out the building in the virtual world.</p> <p>The learners share this knowledge in both the physical and the virtual aspects of the space.</p>
2 - Learners can ask questions, share ideas and debate with both teacher and other learners	<p>This is done by using the perceived affordances of the space as detailed in the sections 2.3</p>
3 - Learners use conceptual knowledge to achieve practical task / goal. The output of this is shared with teacher and other learners and the resulting feedback is used to improve performance at the task / goal	<p>The practical task is to build a working model of the Solar System in the virtual space.</p> <p>This can be viewed by the other learners both in the virtual world and by looking at the screens in the classroom.</p>

	Both the teacher and the other learners give advice about how the output can be improved. This is then implemented in the virtual world.
4 - Learners reflect on experience by presenting ideas & models to teacher and other learners	As above The final model is presented in the virtual world.

Table 4.8 – Part three of the learning activity

Again, by placing each of the steps of the framework together, we get the summary of the part as shown in table 4.9 below.

<u>Part No</u>	<u>Part Name</u>	<u>Main Steps</u>
3	Solar System Build	The learners must build a simple model of the Solar System. This requires drawing, shaping, colouring and naming each of the planets The relevant planets then need to be moved to one site and placed in sequence The relative distances between them need to be represented as best as possible. They will then need to be resized so as to be proportional. If time, simple hover and rotate scripts can be added

Table 4.9 - Summary of part three

By the time the activity reached part three (Solar System Build), the official roles were left out entirely (*Table 4.10* below), and the learners were left to break the necessary tasks into smaller parts and then to assign these parts to the various groups. The aim here was to leave a number of collaborative options open to the learners. One approach would have been for each group to be responsible for building a particular number of planets, and then to discuss their decisions with the other groups when they had to arrange them in sequence and resize the planets. This represented an approach where each group performed the same tasks and then coordinated their work with the others at the end. An alternative approach was for one or two of the groups to take on a leadership role. These ‘leader’ groups would have been responsible for assigning the building work to the others and then, at the end of the phase, taking what they have made and arranging it in the correct order. In practice, the learners chose a mixture of these two options.

Title	Modified Jigsaw script for part three
Resources	<i>Second Life</i> sandbox
Roles	None
Activities	Researching, Communicating, drawing, colouring, moving, judging
Component Distribution	No roles are specified for this script. The learners will need to draw, shape, size and name each of the planets. They will then have to assemble them in the correct order and modify the relative sizes and proportionate distances of the planets.
Sequencing	Left to the learners. The learners should construct the planets first and then arrange them collaboratively. It is possible, for one group of learners to take on this job and to accept what the others have built.

Table 4.10- *Script for Part three (Solar System build)*

4.3 The role of the teacher

The final part of the process was to develop a plan for potential teacher interventions. The issue was not as simple as ‘giving a hint’ to students as Dillenbourg (1999) asserts, but rather involved the degree of intervention that might be appropriate and the means through which it should be carried out. There was also the related issue of what exactly should “trigger” such interventions. A more detailed approach was required.

The solution chosen involved using Dillenbourg’s (2002) three-fold distinction between the way in which the learners communicate with each other (eg. verbal dialogues, gestures), the way and extent to which they complete the task in question (eg. problem solving, extent of completion), and the way in which they organise themselves (eg. how they divide tasks and regulate their activity). Since our interest was in the roles and activities that learners use, it was decided that this final factor was more important than the other two; in that if collaboration was to break down it was more likely to be evident here than elsewhere. A change in how learners communicate or a decline in the

extent to which they complete the activity, does not necessarily reflect problems with collaboration. Large and unexpected changes in how they organise themselves is more likely to point to problems in working together. This factor therefore was considered more deserving of teacher intervention than the others.

More specifically, it was possible to estimate in advance some of the likely difficulties that might contribute to changes in working together in each part of the activity and to suggest, from this, the sort of interventions that might be required. In the first part, for example, the students could find it difficult to complete the initial tasks. This would have consequences for their later collaboration, in that it would delay their progress to the communicative aspect of the part. Similarly, some of the students may not be aware of which group to address their request to. In the second part, collaborative challenges might result from learners “getting lost” and not being able to find and / or communicate the relevant information in the time required. Interventions, here, needed to focus on ensuring that each group knew what they had to do. One problem may involve the passing of information to the presentation preparers, and this would need to be closely monitored. The latter also had to coordinate the incoming information from the others - another possible source of collaborative breakdown. In the third part (Solar System build), the biggest challenge lay not so much in getting the learners to construct the planets, but rather in ensuring that the participants could coordinate putting them in order, and then modifying their relative size and positions. Again, close monitoring was required. A summary of some of the potential triggers for teacher intervention in each part (by no means exhaustive) is shown in *table 4.11* below.

<u>Part Number</u>	<u>Possible Problem</u>	<u>Proposed Intervention</u>
1	Lack of awareness of who to address requests to (which group)	Pointing out who is in each group and showing which group they need to talk to
2	Groups ‘getting lost’ in the virtual world and not being able to find the required information	Checking that learners are in the right part of the virtual world - pointing them towards the information where needed
3	Placing planets in order and modifying their relative sizes and positions	Intervening by questioning the relevant group as to what they are doing and whether they think it is right

Table 4.11 - Possible trigger points for teacher interventions

Taken as a whole, this left us with a three part learning activity design process. The Conversational Framework defined the rationale of the activity, along with potential learner interactions and the role of the teacher. These were further prescribed and detailed by introducing a modified version of Aronsons’ (1978) ‘Jigsaw’ script to encourage interactions in each part of the learning activity. Finally, this was accompanied by a light degree of intervention throughout. The overall emphasis was on non-coercion, and on the avoidance of “overscripting”. The learner instructions for implementing the activity can be found in ***appendix 7***.

4.4 Discussion

Although this process was developed at an early stage of the research, a number of the challenges that teachers face in developing learning design (research question 2) could already be discerned. Many of these emerged further and became more pressing as the study progressed. The discussion aims to identify these challenges and to relate them back to the literature review in chapter three, and forward to the implementation in chapter five, and the use and modification of the design process with teacher groups in chapter six. When the process had been carried out, three challenges already appeared pertinent. Firstly, there was the challenge of detail. In other words, to what extent and in what degree of detail should learner collaboration and teacher orchestration be supported? Secondly, there was the issue of distribution. In practice, how should support be distributed relatively across the three elements of the process? Finally, there were potential tensions between the elements, leading to the challenge of recognising and resolving this.

4.4.1 - Choosing the appropriate degree of detail

The process encouraged collaboration both implicitly (through the Conversational Framework) and explicitly (through scripting), and envisaged a degree of teacher interventions in order to support this. It became clear early on that the process could be carried out with various degrees of detail and rigour. What was not so clear was the ideal degree of detail necessary for a successful activity, marked by long-lived and self-sustaining learner collaboration (Stahl, 2000). There were considerable risks in moving to either of the extremes, with a loose, relatively unstructured activity running the risk that the desired learner collaboration would not occur. Conversely, an over detailed activity, with ‘overscripting’ in the broadest sense, would discourage natural learner

interactions - besides having an onerous teacher workload in terms of implementation. The approach in this chapter lies midway between the extremes, proposing a multi-part activity, with each part of that activity designed clearly with reference to each element of the process. There is a high degree of detail specifying what the learners are expected to do, characterised by objectives, activities and script components; yet the specific interactions that they might follow to achieve these goals are left open. The process, as applied here, emphasises what learners are expected to do, rather than how they should do it. It could have been applied in different ways. One approach would have been to apply the process in a more general, singular way to the activity as a whole, rather than in the multi-part way pursued here. This represents a move away from detail as only the broad aims of the activity are set out – leaving the learners left to detail the rest as the activity proceeds. This is precisely the approach in chapter six by the teacher focus groups. It proved not to be very successful as the activity had to be developed further by the researcher later on.

4.4.2 - Distributing support for collaboration

A further challenge related to how the broad support for collaboration should be distributed across the three elements of the process. The role that each element plays has been discussed at length. Dillenbourg and Hong (2008) seem to suggest that equal significance applies to collaboration support through activity design, scripting and teacher interventions. This implies that weak support for collaboration in one of the process elements can be compensated for by stronger support elsewhere. In reality, the Conversational Framework played a more significant role in supporting collaboration than the two latter parts. In applying the process in this chapter, there were occasions where tasks developed using the Conversational Framework offered less support for collaboration than desired. In these cases, it was difficult to ‘add in’ the necessary

support by scripting or teacher interventions at a later stage. In other words, the latter two parts of the process could improve and extend an activity that already offered clear support for collaboration, but they could not compensate for where that support was absent to begin with. This implies that the two latter parts of the process might not always be necessary; an approach which was implemented in the revised version of the activity late in chapter six. Such an approach places the full weight of supporting collaboration on the Conversational Framework. The activity had to be re-designed by the researcher with a more explicit promotion and support of hybrid interactions. None of this could be foreseen when the process was initially implemented. Therefore the three part process set out in this chapter, with the strong support for collaboration offered by the Conversational Framework being complemented by the other two elements represented a starting point. In chapter six, it is modified in light of the findings of the activity implementation in the next chapter.

4.4.3 - Tensions between the elements of the process

Although the relationship between the parts of the process was broadly complementary (as discussed above), there was also the potential for tensions. One area where this was particularly evident was between the collaboration scripts and the plan for teacher interventions. Whilst the teacher had a high degree of autonomy to act during the activity, there were limits to what they can be expected to do in terms of workload. An activity that emphasises detailed and coercive scripts requires much intervention and enforcement by the teacher. This reduces their time and ability to intervene in the activity for other reasons such as the support of collaboration more generally, the need to resolve technical problems, or issues with learner understanding, amongst others. It can also make it difficult to take advantage of unexpected opportunities to develop collaboration that emerge during the activity. Conversely, a more detailed plan for

teacher interventions than the one in this chapter, would make it difficult to effectively implement collaboration scripts.

Therefore, a number of challenges to learning design by teachers were already emerging. These included the extent and detail to which process need be applied in order to successfully support collaboration, the optimum distribution of such support between the elements of the process, and an awareness of potential tensions and trade-offs within the process.

Chapter 5

Study One – Implementation of the Hybrid Learning space

This chapter answers research question three (“What are learner and teacher roles and activities in the hybrid learning space?”) by implementing the learning activity from the previous chapter. It addresses each of the three sub-questions by examining the relationship between the roles and activities and the physical and virtual contexts of the space (sub question 1), collaboration (sub question 2), and novel learning practices (sub question 3). The chapter concludes that roles and activities arise as a response to the fragmented nature of the space, that they play an important role in the support of collaboration, and that they significantly inform novel learning practices. The chapter also has a number of implications for the learning design process, namely the relative inefficacy of scripts and plans for teacher intervention, and the emergence of hybrid interactions as discussed in section 5.3.4.

In section 3.6.2, research question three was represented as four empirical questions, to allow the findings to be more closely examined. This chapter extends the process, exploring how the categories and codes necessary to answer the empirical questions were developed and progressively refined. The findings of the study are analysed in section 5.2. The roles and activities found for each empirical question are introduced before being examined more closely through examples from across the activity. Finally, we relate back to the research question by discussing how these roles and activities informed and were shaped by contexts, collaboration and learning practices. A number of remaining challenges in terms of the learning design process are also described.

5.1 Organisation of the study

In section 3.6.2, research question three was divided into shorter, more pointed empirical questions (EQ's). These were progressively refined and narrowed. The final versions of the questions were:

- EQ 1 – What are learner roles and activities during collaboration?
- EQ 2 – What are learner roles and activities during non-collaboration?
- EQ 3 – What does the teacher do to support collaboration during the activity?
- EQ 4 – What other learner activities influence collaboration / non-collaboration?

This is a starting point. Angelillo et al (2007), suggest that a 'focusing exercise' be carried out in advance of reviewing the data from the study, and that this be used to describe what one considers to be relevant data categories and codes, to resolve each of the questions. Following later, repeated examination of the records, these categories and codes are progressively refined, before then assessing the findings. Parallel to this focusing exercise is the practical challenge of organising, collating and examining the large quantity of video records resulting from the study. In this section, the initial focusing exercise is set out in 5.1.1, whilst 5.1.2 describes, practically, how the records were categorised and examined. Finally, section 5.1.3 discusses the eventual categories and codes used to analyse the data. Each of the three stages was carried out collaboratively with the co-analyst, and the significance of this is also discussed.

5.1.1 Focusing exercise

This took place prior to reviewing the records from the study. The initial challenge was to suggest broad categories characterising examples of the phenomena (ie. collaboration) in practice, before proposing more detailed codes, with which one could then examine the data. The details of these are set out in the appendices, and our aim here is to summarise how the categories and codes were initially developed.

The first challenge was to identify a number of broad categories of interactions that might occur. The researcher put forward three such categories, titled '*roles and activities during collaboration*', '*roles and activities during non-collaboration*', and '*teacher support of collaboration*', respectively. These were broadly aligned with the direction of the literature review and the resulting research questions. The co-analyst, however, argued that this might not be sufficient, and that collaborative and non-collaborative practices might not be so easy to separate without more detailed examination of the records from the study. Therefore, a fourth category, that of '*collaborative and non-collaborative interactions*' was added to the focusing exercise. The next step, again prior to recourse to the records, was to develop a number of initial and more detailed codes where each of the four categories might be instantiated. The codes represented minute by minute interactions between the learners. A given code could be present in more than one of the four categories. In each case, the researcher put forward a provisional series of codes, which were then modified and refined by the co-analyst.

In terms of '*roles and activities during collaboration*', the researcher suggested that the learner *asking a question or seeking clarification from another learner* would be a good starting point. Similarly, the response or clarification in question represented additional codes. The co-analyst argued that these codes, whilst acceptable, emphasised speech more than action, and therefore suggested that two additional codes be added. These included '*learner helps other*' and '*learner proposes a course of action*'. The coding scheme was again examined by the researcher and the co-analyst, and it was decided that the specific case of a *learner assigning a task or role to another learner* should also be included as a separate code.

The co-analyst put forward three initial codes for '*roles and activities during non-collaboration*'. These were '*learner ignores instructions*', '*learner suggests alternative course of action*' and '*learner appears to be lost or detached from the task*'. The researcher, referring back to the literature review, argued that *learner interference and disturbance of other learners work* should also be taken into account. This was then added as a final code for the category. The third category of '*collaboration and non-collaboration*' simply merged the codes from each of the preceding two categories, although both the researcher and co-analyst recognised that this would probably be developed further once the records had been examined.

The category of '*teacher support of learner collaboration*' remained. The initial codes emphasised different means of teacher intervention in the learning activity and included, '*teacher explains to one or two learners*', '*teacher questions one or two learners*', '*teacher explains to all learners*' and '*teacher helps learners*'. This last code emphasised where the teacher helped the learner complete the activity, rather than simply responding to their questions. Further discussion with the co-analyst resulted in the addition of two further codes. Firstly, a distinction was made between cases where

the teacher explained concepts to the whole group without stopping the activity in question, and cases where the teacher stopped the activity so that particular points could be made. Moreover, the co-analyst suggested that sometimes the teacher might ask a learner to explain a concept to the others (rather than intervening themselves). This was therefore added as a final code (*'teacher asks learner to explain to others'*). The final categories and codes of this focusing exercise are summarised in **appendix 8**.

In terms of collaborative work with the co-analyst, three issues emerged. The first related to disagreement about what should be classified as a category and what should be seen as a code. It was often difficult to specify the difference between the two, and a process of dividing categories into smaller and smaller units ensued. Where something could not be further divided, it was finally labelled as a code. The eventual codes were generally applicable across several categories in that a learner asking a question, for example, related to several possible categories of collaborative behaviour. Secondly, although there was no attempt to prioritise the categories, there were several debates between the researcher and the co-analyst about the relative effect that one category might have upon collaboration or non-collaboration, and how this might be more significant than another category. For example, the co-analyst suggested that 'learners breaking into smaller groups' (in the final coding scheme for study 1, but not the original focusing exercise) might correlate with non-collaboration, whilst the researcher argued that this might not necessarily be the case. Finally, having the co-analyst help develop the categories meant that a wider range of potential findings were taken into account. For example, the co-analyst added an additional number of possible teacher interventions, beyond what the researcher put forward. This expanded group of categories turned out to be a better fit with what actually happened in the study, than what was originally proposed.

The aim of this focusing exercise was to provide categories and codes with which one could approach the data in an organised way. It was both initial and provisional, allowing for changes, merges and removals in light of the later findings.

5.1.2 Examining the records

Although lasting 90 minutes, the activity produced several hours of video footage. This came from the two cameras used in the classroom, and from each of the four avatars in *Second Life*. Two other issues quickly became apparent. The first was the need to match the classroom video record with what the students were simultaneously doing in the virtual world. This required constant checking between the video and the virtual world footage. A more analytical motivation was to relate the records to the questions, categories and codes developed above. Inherent in this was the notion of coding reliability; namely gaining outside verification about what one has viewed. Both of these considerations will be mentioned, where relevant, in the description that follows.

Initially, the video records and computer screen footage were broken into smaller file segments for technical reasons. Each of the six files (two from the classroom videos and four from *Second Life*) were divided into smaller sections of around five minutes duration each. Each of these segments were given an ID number and catalogued in a spreadsheet. They were identified in terms of which of the three tasks they covered. Therefore, all of the segments for task one were listed together for example, followed by those for tasks two and three.

Each of the segments was then viewed collaboratively a number of times, and a brief text description of what appeared to be happening was added to the spreadsheet. Where

the learners communicated with each other; then what they said was also transcribed. The movements of the learners (eg. when one learner would get out of their chair and go to another) were also captured. The video records were viewed first; and often, it became clear that what the learners were doing involved, and had some impact on, the virtual world. This was noted in the spreadsheet. When the virtual world footage was viewed later, the nature of the link between the video and the virtual footage was then examined more closely.

Similarly, when something significant occurred in the virtual world footage, this was then cross checked with the classroom video footage. Some of the later viewings were aimed more at clarifying what had been written earlier on the spreadsheet, than at finding out anything new. Other sessions consisted of printing and then examining the accounts on the spreadsheet, in preparation for more focused viewing later on.

There were long sections of footage (particularly in the virtual world) where not much appeared to happen, whilst other sections appeared to be more frantic and eventful. Once a number of viewings had been completed, it became easier to isolate apparent incidents of both collaboration and non-collaboration. These segments were marked with an asterisk in the spreadsheet, and then reviewed in more depth.

By relating these segments (collaborative / non collaborative) to which of the three tasks of the activity in which they had occurred, it became possible to write out an early description of apparent learner roles and activities in each task. These provided a descriptive background 'story' of what had happened. Each of these segments was then

reviewed, a number of times, both to analyse them more closely with respect to the other part of the space (eg. if physical, what happened at the same time in the virtual and vice versa). So far, the main incidents of collaboration and non-collaboration had been identified and described in simple terms.

Once this had been completed, the records were then viewed (again a number of times) in light of the codes and categories in the focusing exercise. As this continued, it became clear that several changes to the questions, categories and codes would have to be made. As already discussed in 3.6.2, one of the initial empirical questions was integrated with the others, whilst another question was expanded upon. Similarly, a number of the operational codes were deleted, revised or developed in more depth. The biggest changes were with the operational categories, a number of which were developed or clarified.

5.1.3 Refining questions and categories

Reviewing the records revealed that division of labour and the development of roles by the learners played an important role in supporting collaboration in the activity. These were not considered in the initial focusing exercise. Therefore, there was a process, for both the researcher and the co-analyst, of modifying the empirical questions, categories and codes. The aim of this sub-section is to look at this process more closely.

The initial emphasis of the study was on roles and activities during collaboration and this was reflected in the modified version of empirical question 1 (*‘What roles and activities do the learners use when there is collaboration?’*). It was observed during the activity that learner division of labour and the development of learner roles played an important part in sustaining collaboration. This was therefore added as a new category for the empirical question. Whilst the original codes from the focusing exercise were retained, a number of new ones were added to better explain what occurred during the activity. The learners frequently shared, but also argued over possession of the laptops during the activity. The researcher and co-analyst debated about how best to code this behaviour and agreed on the addition of three new codes, namely, *‘passing’*, *‘pairing’* and *‘tussling’*. Finally, it was observed, that learners would frequently *ask questions of others and then pass the answer on to the other learners*. This occurred several times during the activity. It was therefore also added as a new code.

The categories and codes describing non-collaboration (EQ2) were refined somewhat once the records had been examined. It was noted that a number of practices that were identified as strictly non-collaborative in the focusing exercise, resulted, in reality, in either collaborative or non-collaborative interactions between the learners. The categories for non-collaboration were therefore reduced to two, namely, *‘learners disagreeing about what to do or how to do it’* and *‘conflict and breakdown of collaboration’*. In terms of codes, the emphasis remained on the three initial codes of *‘learners ignoring tasks or instructions’*, *‘learners putting forward alternative courses of action’* and *‘learner interferes with or disturbs work of others without permission’*. It was recognised that learners either getting lost or otherwise becoming detached from the task, as originally coded in the focusing exercise, led in practice to collaboration as much as to non-collaboration, depending on the circumstances. This code was therefore

moved to the final empirical question (“What other activities influence collaboration or non-collaboration?”)

In terms of teacher support for learner collaboration(EQ3), it was observed that this changed in emphasis as the activity continued. Initially, it aligned reasonably closely with the codes and categories set out during the focusing exercise, in that the teacher regularly explained concepts to the small groups or to the entire group of learners. As the activity progressed, the emphasis shifted with the teacher intervening by making frequent changes to the groups and to the tasks in question. Initially, the researcher and co-analyst were unsure about how to operationalise these practices as codes. The scale of change ranged from reassigning a single learner to work with another team, through to recomposing the membership of whole teams. It was eventually decided to add new codes to this EQ, namely, *‘teacher changes team or reassigns learners’*, and *‘teacher changes task’*.

Finally, it was observed that many practices led to either collaboration or to non-collaboration, or to a combination of the two. Whilst this was identified as part of the focusing exercise, the more detailed codes were simply taken from the earlier EQ’s. In practice, it was noted that learners progressed through the activity with varying degrees of information, and that the nature of this asymmetry varied. Learners would be unsure about who they were meant to collaborate with or how they should complete an individual task, for example. Again, this had not been taken into account in the focusing exercise and required further examination by both the researcher and the co-analyst. It was therefore decided to add four new codes to take this into account. These were finalised as *‘learners getting lost by team’*, *‘learners getting lost by task’*, *‘learners not knowing how to complete a task’*, and *‘learners break into smaller groups’*. The final list of empirical questions, categories and codes for study one is shown in **appendix 9**.

Having the co-analyst review the video with the researcher was productive for building the credibility of the study. This was inherent in several ways. To begin with, they brought a fresh perspective, frequently identifying new categories that the researcher had not previously discerned, such as particular learner roles and the additional categories of teacher interventions. Secondly, there were a number of categories and codes forecast in the focusing exercise that were not manifest in the video records. It was difficult to tell if this assumption was accurate, and therefore, there was sometimes a degree of hesitation about removing them from the final version. Having a second person review the data and either agree or disagree (as they often did) with the proposed removal was quite useful. Finally, there was the issue of reliability. Terms to describe novel and unexpected behaviours such as ‘passing’ and ‘pairing’ only emerged following repeated discussion and examination. Certainty about the precise meaning and prevalence of such codes took time to develop. Codes were frequently modified or sub-divided following these repeated viewings. There had to be broad agreement that a specific term (ie. ‘tussling’) had the same meaning and significance across each of the cases where it occurred. It would have been difficult to develop this degree of reliability if the records were being examined by a solitary researcher.

5.2 Analysis

The four empirical questions can now be addressed in turn. For each question, there is an overview of the findings. Attention then shifts to more detailed descriptions of the findings, their significance and the ways in which they relate to each other. Where appropriate, they are examined with reference to specific examples, drawn from across the activity.

5.2.1 EQ1 – What are learner roles and activities during collaboration?

Overview

Learner collaboration was mediated through a number of roles and activities. These had the general effect of making the hybrid space more stable and of allowing collaboration to continue. The aim of this section is to identify what these roles and activities were, and to discuss how they related to each other, and to collaboration more broadly. The main roles were those of temporary experts and go-between, with the former subdivided, on the basis of the expertise in question, into subject, space, technical and task experts. The activities included questioning, mutual adjustment and argumentation, and verification, with the full list set out in the *table 5.1* below. The roles and activities were prevalent across the tasks of the activity, and therefore, it is not appropriate to say that ‘task X was dominated by activity Y’. Similarly, not every occurrence of every role or activity can be detailed, if only for reasons of space. Nonetheless, there are a number of seminal examples, arising out of specific tasks, which we can now detail. These are shown in *table 5.3*.

Role	Sub-type	Definition
Temporary Expert	Subject Expert	Learner has a good knowledge of the subject in question
	Space Expert	Learner is an expert on the various spaces in the virtual world and accessing them
	Technical Expert	Learner has a good knowledge of specific software features in the virtual world
	Task Expert	Learner has a clear understanding of the task in question and a plan to complete it.
Go-Between	N/A	Learner acts as an intermediary between individual and groups of learners. This includes advising, getting learners to collaborate, and helping them to complete

Table 5.1 – Roles during collaboration

Table 5.2 – Activities during collaboration

Activity
Questioning
Mutual adjustment and argumentation
Passing, pairing and tussling
Verification
Decision and action taking

Task	Expected Interactions	Role or activity example
1	Learners instruct each other how to animate virtual world avatars	N/A
2	Learners locate planets in virtual world and use the information to set up whiteboard presentation	Go-between (figure 5.1) Mutual adjustment and argumentation (figure 5.2)
3	Learners collaborate to build model of Solar System in virtual world	Passing, Pairing, Tussling (table 5.4) Verification (figure 5.3) (table 5.5) Decision and action taking (table 5.6)

Table 5.3 – Examples of roles and activities during collaboration

Roles I – Temporary Experts

Some learners were more proficient at performing tasks than others. They were able to divide up parts of the work between themselves, and to take on different roles. For example, some learners mastered individual technical features of the virtual world quite quickly, taking on the role of temporary (technical) ‘experts’ for the feature at hand. These roles were not specified as part of the learning activity, and were not imposed by the teacher. Rather, they came into being organically as the activity proceeded. The role was collaborative in that the experts had to question the learners as to what they were doing, and ask them the task questions. This started a process where the students

would explain each of these. The experts would then work briefly with the learner in order to complete the current task.

A learner was considered to be a ‘temporary expert’ if they explained the same task or piece of information to at least two (out of the three) other teams in the activity. This occurred several times, and frequently concerned use of a particular virtual world feature such as using gestures (task one), getting the teleporter to work (task two), and setting up and placing shapes together as part of the building competition (task three). In other cases, the expertise related to a specific location within the virtual world such as finding the teleporter or a suitable building sandbox (again tasks two and three). This was significant, as unless all of the learners were in the same virtual location, the task could not proceed. Five of the eight students involved were temporary experts at some point throughout the activity, with three of the five playing more than one role as it unfolded. The categories of temporary experts were subject (understanding the conceptual or theoretical knowledge of the subject), space (understanding the space / locations in the virtual world), technical (knowledge of specific technical features in the virtual world such as a teleporter or a building grid) and task (having a better understanding of the task and its requirements than ones peers).

The process would start with a learner making it clear that they had been first to perform the task or function within their own team. Frequently, they would walk to the nearest team and check if they had also done the task in question. Sometimes, they would be summoned by the other team, having declared what they had done. Once shown what to do, the team that had been offered assistance would then carry out the task, whilst the expert would proceed on to the next team and repeat what they had already done. This was interesting, as there were a few cases where the initial team that had been helped would then share their expertise with the others. In other words, the

teams would take whatever advice and help they could get from the expert, but were then reluctant to share this with the other learners. The weight of collaboration was placed mainly with the expert. On other occasions, the learners were called together as a group behind the screen of the expert.

Roles II – Go-betweens

An extension of the role was when some of the learners became ‘go-betweens’ or intermediaries between groups of learners. This required co-ordination more than technical expertise or virtual world knowledge. An example of this occurred during the ‘Solar System to the whiteboard’ task. Two learners took on the role of scribes, and were responsible for getting information about the planets from the others. At first this proceeded well, with the teams making several trips to the relevant planets in *Second Life*, and then shouting their results to the scribes, who promptly wrote them on the whiteboard. This way of working began to break down, when larger amounts of more detailed information (eg. the radius and atmospheric density of the planets) had to be passed from the screen to the board. The learners (perhaps realising that time was limited) shouted what they had learned, and the scribes quickly became overwhelmed and made mistakes in what they wrote down. This in turn made the learners more impatient. Eventually, two of the learners stood up and started to walk around from one team to another. These ‘go-betweens’ acted as intermediaries by taking the questions from the scribes, directing them to the relevant team (it was not always clear who was responsible for which planet, so a degree of checking and questioning was involved), and then passing the answers back to be written on the board. On other occasions, they helped clarify details that the scribes were unsure about, as in the **figure 5.1** below:

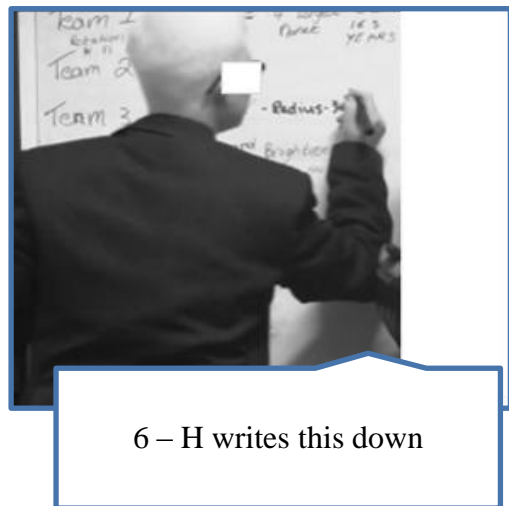
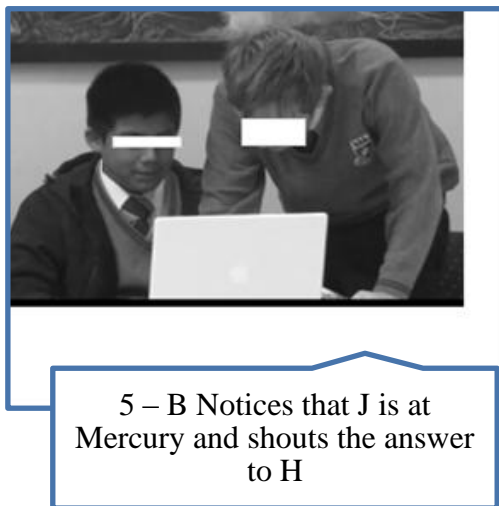
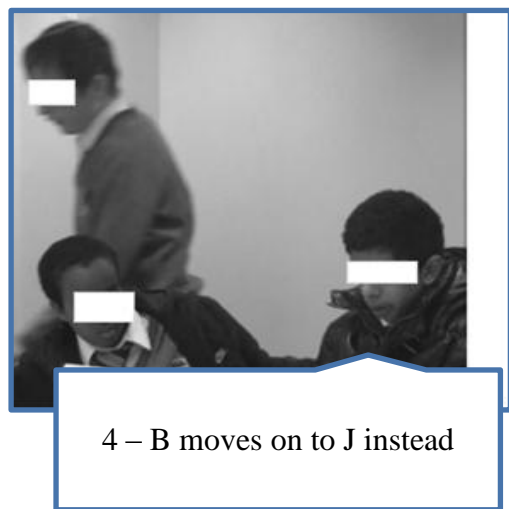
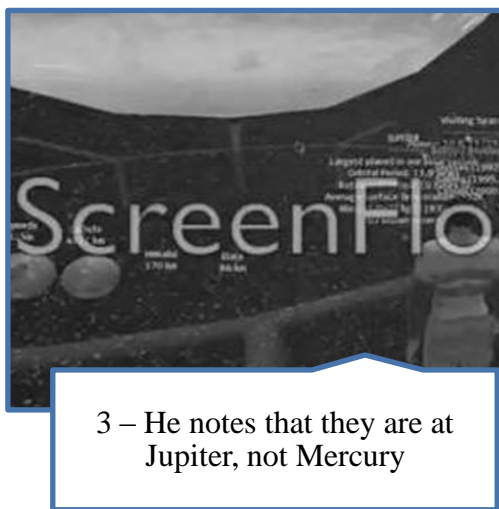
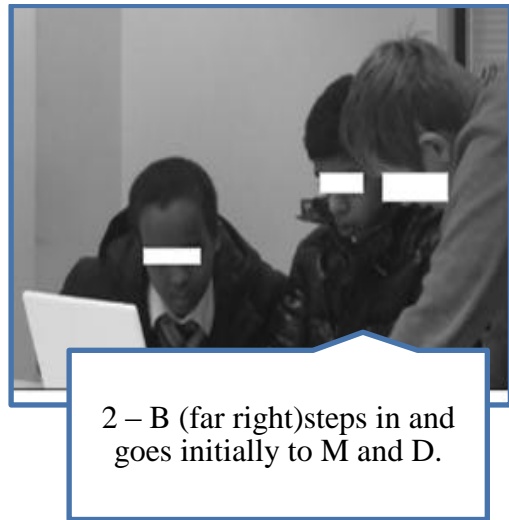
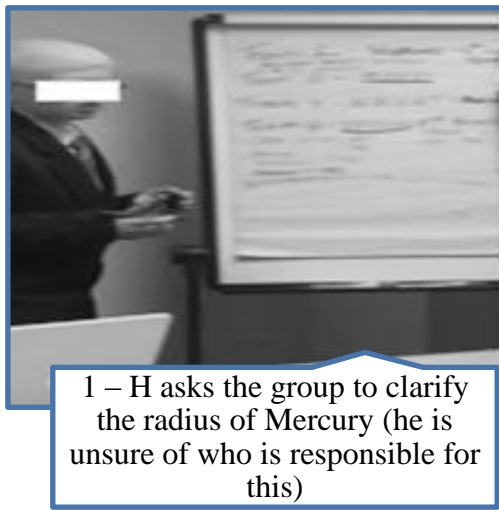


Figure 5.1 – ‘Go Between’s’

After several of these interactions, the learners began to volunteer information to the 'go-betweens'. The shouting died down as a two way process of communication started, whereby the learners would offer answers to the intermediary students, which would then get passed on to the scribes. Similarly, questions from the scribes were forwarded on to the learners for resolution and eventual addition to the whiteboard. This was part of a broader theme of clarification and verification, as initial details were checked one or more times before being added to the board.

Questioning

The learners began to ask each other questions shortly after the activity started. It was common, initially, for one student to ask questions solely of their peer. In task one, the move towards directing questions to other teams was triggered partly by cases where the peer could not offer an acceptable answer, and partly by the design of the learning activity, whereby the learners had to instruct other teams on how to move and animate their avatars. Throughout all of the tasks, the nature of the questions varied somewhat. The initial emphasis was on matching avatars with their owners (eg. which avatar was being controlled by which learner in the room?) and on verifying which team each of the learners were on. There were several questions inviting learners to identify themselves. A considerable source of confusion, involved learners getting 'lost' in the virtual world, and then having to ask the others to try and get them to a more suitable location. Once these concerns about learner identity and location were resolved, the emphasis moved to the task in question. The learners would ask others for help, and would check with the other students what they were expected to do. This was sometimes accomplished by staying put and shouting the question to another team, holding up and pointing to a task sheet, or by moving across the room to the other team. Another category of questions involved asking how to perform a particular task. This

was accomplished in several ways, such as by talking to another teams' avatar in the virtual world, or by moving over to another team in the classroom and verifying on the screen how the task could be carried out.

Mutual adjustment and argumentation

The learners frequently had to agree either about what to do, or how to do it. Whilst this occurred in parallel with learner division of labour and roles, it also provided the basis for it. In Dillenbourg's (2008) work, a distinction is made between negotiation based on "mutual adjustment or the refinement of the positions of each agent" and "competitive argumentation, where one agent attempts to convince the other to adopt his proposition" (ibid, P.5). Although both of these aspects of negotiation were in evidence, I concentrate on the first one, as it relates more closely to the collaboration observed. The second aspect, argumentation, is nonetheless important as it frequently led to periods of conflict and non-collaboration. It is therefore examined in the context of the next empirical question. The aim here is to examine cases of mutual adjustment, and to relate these to the previous category of division of labour and the development of roles.

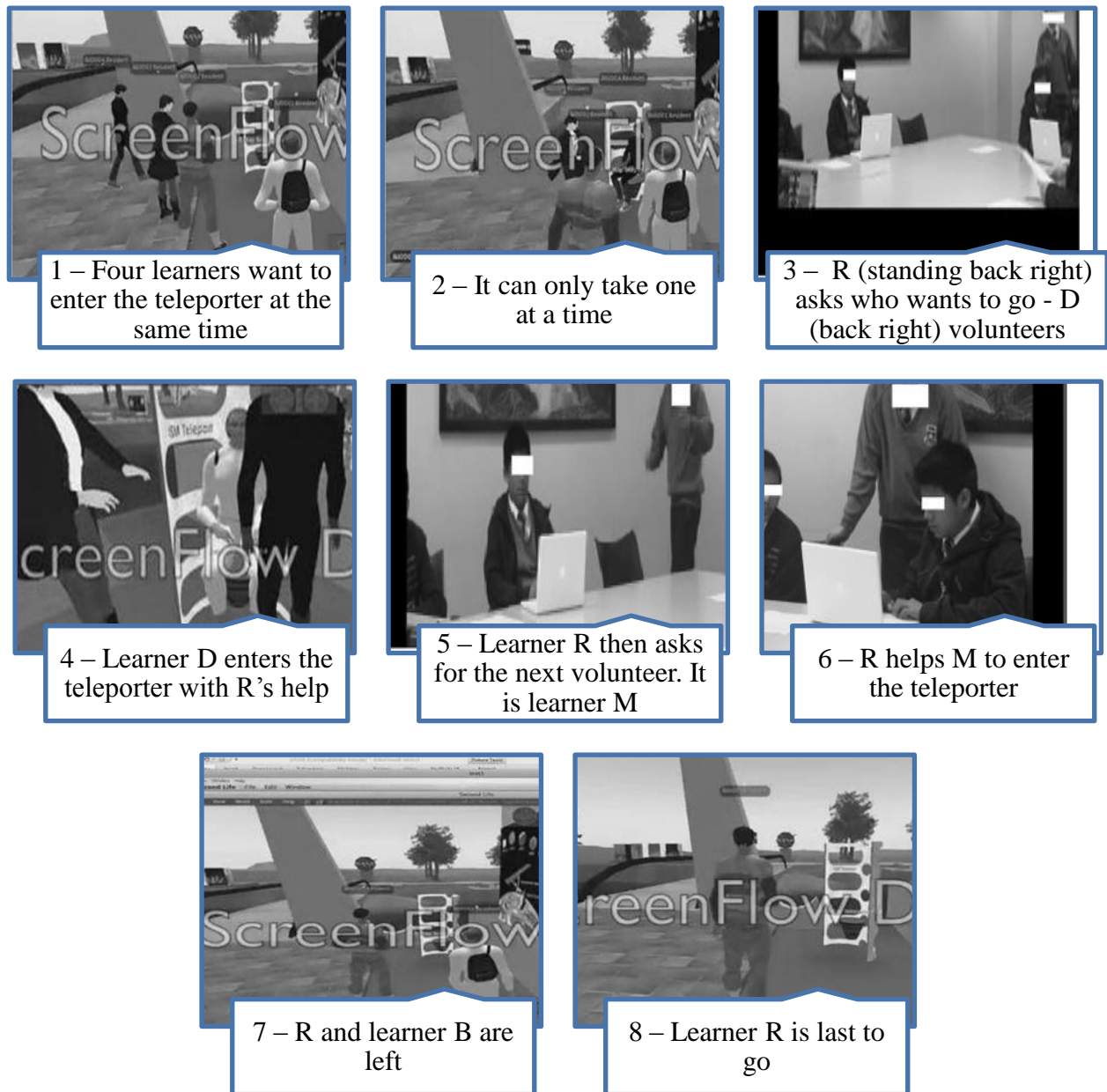


Figure 5.2 – Mutual Adjustment

Whilst such mutual adjustment was essential for keeping the activity in progress; it also made it easier for the learners to take on specific roles. This was evident in two ways - one direct and the other indirect. If one continues to focus on task two (researching the planets), it was vital during the task where the learners communicated with each other

using ‘go-betweens’. For this to work, it was important that the learners would take turns and would only speak when a question was put to them. Similarly, the ‘go-betweens’ had to be certain of consulting each of the teams and capturing what they had to say. The ongoing mutual adjustment (mostly achieved through pointing, calling names and sometimes moving to the relevant team) had to continue through several cycles of clarifying and changing what the students had to say. There were mistakes and misunderstandings and what had been written on the board only minutes before had to be changed. In an indirect (and more difficult to examine) sense, mutual adjustment served a secondary purpose as regards the appointment of temporary experts. It was a means of allowing learners to advertise their respective expertise. In the example, above, learner B showed to the others how much he knew about how to use the teleporter. This allowed him to become a temporary expert for this task.

Passing, Pairing, Tussling

The learners would frequently move their laptops around. The form of this varied, ranging from passing the laptop from one learner to another (often accompanied by pointing at the screen and explaining what they saw), pairing up with another learner behind the screen, through to arguing for possession of the laptop (tussling) so as to check what was happening. Two of these cases can be observed in **table 5.4** below:

<u>Step</u>	<u>Action</u>
1	<i>A wants to use the laptop</i>
2	<i>A slowly grabs it from M</i>
3	<i>A walks over to J</i>
4	<i>A and J pair up around the screen</i>
5	<i>J points to screen</i>
6	<i>A moves to keyboard and starts building shapes</i>

Table 5.4 – Passing, Pairing, Tussling

It was difficult to discern what this was about. However, it took on a new significance once one considered what was occurring simultaneously in the digital part of the hybrid space. This was essentially a means whereby learners could check on the progress of their peers, and was particularly evident in task three. The learners had to construct a model of the Solar System. This required the learners to collaborate (to design, measure, sequence the planets) in order to build the finished product. From watching the screens, it was clear that this was proceeding as expected. However, there appeared to be little interaction between the learners. This led to the question as to how they maintained awareness of what their peers were doing, and how did they then decide what actions to carry out? In short, how did collaboration occur with little overt discussion? The notion of passing, pairing and tussling provided a partial answer to this. Whilst the learners were active in the digital world and could see what the others were doing, it was not always clear in the physical world either who the other learner was or what they were doing. There was only partial awareness. One possible response

was to carry on anyway and build some planet or other without checking with anybody else (which occurred frequently). Passing, pairing and tussling represented an alternative way of improving ones' awareness. By either showing your own laptop screen to somebody else, or grabbing somebody else's screen (thereby seeing the view from their avatar) and pairing up with somebody else, it became possible to get a clearer understanding of the overall hybrid space - by seeing it from another learners point of view. This helped the initial learner both to understand more clearly what the peer learner was doing, and then to make a decision about what they themselves should do.

Verification

Passing, pairing and tussling concurred with broader forms of verification where the learners would frequently check what other students and teams were doing. Although prevalent when it was necessary to collaborate, it also occurred where observation of the activity of others was of less obvious relevance. This was often signified by the simple shouting of a question to another learner. Sometimes, it was demonstrated by a learner getting out of their seat and moving to look at what was happening on the other persons' screen. Sometimes, the two approaches were combined as in the **table 5.5**:

<u>Step</u>	<u>Action</u>
1	<i>Student J complains loudly that ‘M and D are not much help’</i>
2	<i>M responds ‘we sent you a message’</i>
3	<i>J briefly looks at screen</i>
4	<i>J walks over to M</i>
5	<i>M gets up and returns with J to where J was sitting</i>
6	<i>M points to J’s screen and shows him how to animate the avatar</i>

Table 5.5 – Verification

In the example above, the need to check what others are doing is clearly related to the task at hand (getting the other team to animate their avatar). The learners wished to improve their understanding and awareness of the task in question. This was evident when learners would enquire what others were doing, ask them questions, and get their opinion about how successful (or otherwise) this was turning out to be.

Verification was often mediated by other activities such as passing, pairing and tussling. By comparing the video records with the *Second Life* footage, therefore, one discerns a particular pattern of activity, something which becomes clear if we extend the example from *table 5.5*. This is shown in *figure 5.3* below:

A and M are unclear about which planet they are supposed to be building. They notice another avatar who is also doing something similar, but are unsure as to who this is. By taking the laptop and turning over to J, A confirms that this is the owner of the avatar and clarifies what J is doing (pointing at the screen). Informed by this, A then starts to build the correct planet, and eventually returns to his team partner.



1 – A and M are working together



2 - They are drawing the initial planet shapes in the virtual world



3 – A wants to use the laptop and slowly grabs it from M



4 – A turns to J to see what he is doing



5 – Having checked what J is doing he goes back to work



6 – A starts to redraw the planets based on what he has seen

Figure 5.3 - Verification

As with mutual adjustment, these two means of checking on what peers are doing, relate strongly to how the students used each other as learning resources. By knowing what the others were doing, it became possible to decide on what one needed to do. For example, to offer oneself as a temporary expert, it was important to understand what the other learners were doing. Similarly, by carrying out this verification over time, the learners built up an idea of the progress, strengths and weakness of their peers, something which made the appointment of temporary experts and intermediaries somewhat easier.

Decision and action taking

By verifying what their peers were doing, learners could then take related decisions or actions, ensuring that they were not duplicating the works of others. This was evident in the 'building competition' (*table 5.6* below) where student B constantly checked on what J is doing. Once satisfied that J knew what he was doing (drawing Mercury), he then proceeded to return to his laptop and start drawing the next planet himself (Venus).

<u>Step</u>	<u>Action</u>
1	<i>B checks what is on J's screen</i>
2	<i>B shouts across to M (clarifies the spelling of the sandbox that they must teleport to)</i>
3	<i>B returns to J again .. 'that looks like a semi-circle to me'</i>
4	<i>J responds .. 'I got Mercury'</i>
5	<i>B returns to laptop</i>
6	<i>B starts drawing in SL next to J ... positioning Venus</i>

Table 5.6 – Decision and action taking

Verification and decision and action taking informed each other. The former allowed learners to make a decision and to decide what to do next. Once they had committed to this, they would then use ongoing verification to ensure that what they were doing was successful, and to check if it was having any effect on the actions of others. Many hybrid interactions (such as use of the teleporter and the building competition) were driven by this mixture of verification and action taking, with learners repeatedly and successively moving between the physical and virtual parts of the space both to act and to check on what their peers were doing, with the process frequently mediated by both the temporary experts and the go-betweenes.

5.2.2 EQ2 – What are learner roles and activities during non-collaboration?

Overview

The learners disagreed, argued or broke into conflict. This was not always representative of non-collaboration, and often represented an intermediate step towards eventual collaboration. Our interest here is when activities such as these resulted in non-collaboration.

Minor examples of non-collaboration were expressed in several ways. Learners would frequently ‘detach’ from a task by ignoring an instruction, or by doing something else. At the individual level, these rarely impacted on the overall process of collaboration, and were often quickly resolved by other learners or the teacher getting the student back on task. In other examples, the ‘detached’ learner would work alone until the end of the task. Often, a learner would put forward an alternative course of action and try to persuade others to follow him. Although this sometimes led to the original learner detaching from the group when their proposal was not taken seriously, the most prevalent result was, again, that collaboration temporarily continued, with the learners agreeing to follow the new course of action. Finally, the learners would sometimes disrupt or interfere in the work of the others. This was done playfully, and again, with little effect upon ongoing collaboration.

For non-collaboration to develop, the actual flow of collaboration between the learners had to be disrupted. The severity of this disruption need not be great. It could vary from a brief delay to collaboration through to the premature ending of the task. Therefore, non-collaboration is organised in two categories here. The first, disagreement, relates to

when one or a number of the learners, disagreed with the present course of action. They then either stopped participating, or attempted to get others to do so. The second, conflict and breakdown, was when learners would break into competing groups whilst also attempting to interfere, distort and disrupt each other's work. It had more serious impacts on collaboration than the former category. How this related to the tasks is shown below.

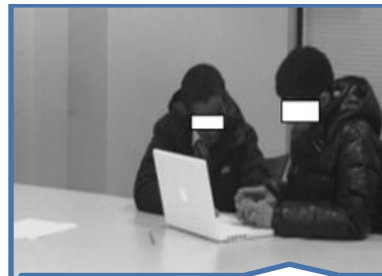
Task	Case Study
1	Disagreement(<i>figure 5.4</i>)
2	Conflict and Breakdown(<i>figure 5.5</i>)

Table 5.7 – Non Collaboration

Disagreement

Learners disagreed about the exact course of action to pursue, or how best to carry it out. The argument between team M and D and learner J, was a significant case of this (as can be seen in *figure 5.4* below). The former were expected to show J how to animate his avatar, yet there was little evidence of this occurring. When the teacher pointed this out, M and D claimed that they had tried to help J, but to no avail. J then complained that M and D had been of little assistance. Eventually D started to help to help out by yelling some of the relevant instructions to J. The collaboration continued. Three minutes later, J moved over to M and D to show a new way that he had found to animate the avatar in a particular way, by using shorter menu commands. M disagreed with this and pointed out to J that the existing way was just as good. There was argument over the best way to continue. J seemed to be offended that M and D were not following his advice and walked back to his seat. He stopped communicating with M

and D, and then announced to learners B and A that he would prefer to work with them instead. He went over to them and showed them the new shorter way of animating avatars, before returning to his seat. B and A seemed to have accepted this and then included him as part of their team, with A shouting to J the next sequence of instructions ('go to edit'). In this case, there was a brief case of non-collaboration in that the original team collapsed, and for a while the expected collaboration ended, before then recommencing with J changing teams.



1 – M and D (right) are meant to be working with J (off camera)



2 – The researcher points this out to them



3 – With the teacher they start working with J. The teacher verifies this with J



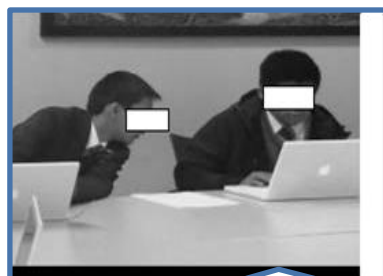
4 – J goes to M and D and shows them a new way of animating the avatars



5 – M and D disagree with him about this about this



6 – J storms back to his seat.

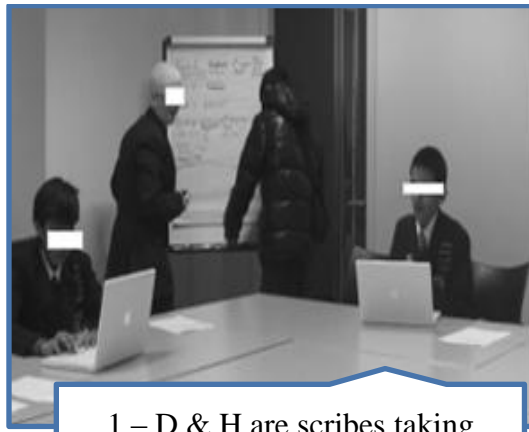


7 - J starts to work with A and B (on the left) instead

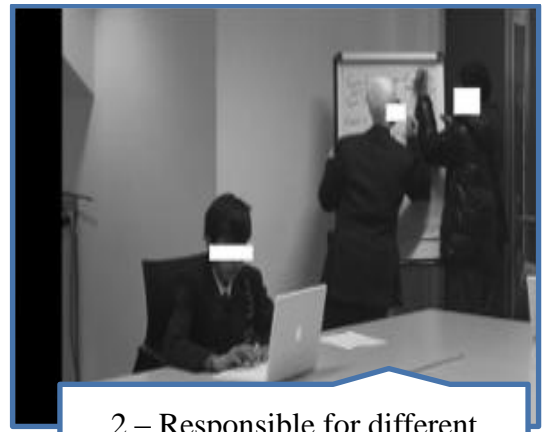
Figure 5.4 - Disagreement

Conflict and Breakdown

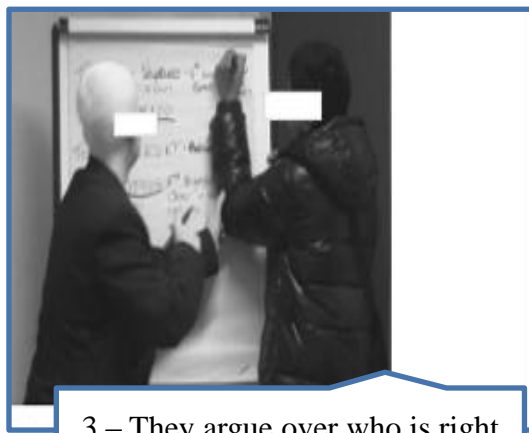
The extent of disagreement was often more pronounced and long lived. This led to arguments and an eventual breakdown of collaboration. This was evident during task two. The main elements of what occurred, in terms of the class breaking into competing groups, and a refusal to collaborate for the final presentation, are set out in *figure 5.5*.



1 – D & H are scribes taking information from the others to add to the whiteboard.



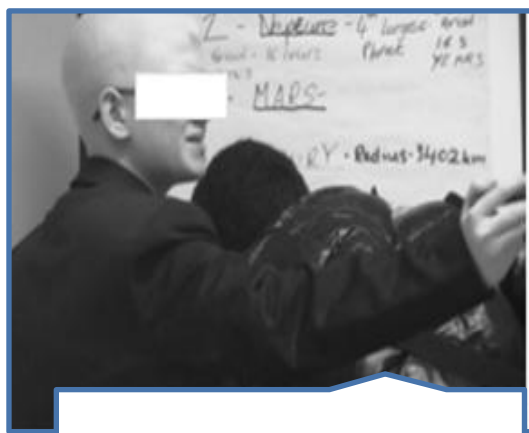
2 – Responsible for different planets and hence different areas of the whiteboard



3 – They argue over who is right and try to correct what the other has done



4 – As the argument develops, this goes in both directions



5 – Each of the two scribes try to get different learners on their side.



6 – Learner D eventually walks away

Figure 5.5 – Conflict and the Breakdown of Collaboration

Three points emerged. Firstly, the argument (initially between learners H and D) started as a means of improving the accuracy of the information being presented by the learners. One of the scribes (D) had made some mistakes by writing the data from one planet into the place reserved for another. Erasing what D had written and then posing the question again, directly to the learners, was H's way of pointing out and correcting the mistake. This was interpreted by D as unwarranted interference on his part of the whiteboard, who then claimed that H had (also) mistaken some of the numbers. The fact that this was not actually the case was not evident at the time, as D erased some of H's contribution, and posed the relevant questions again to the learners. Secondly, this had the immediate effect of both fracturing and duplicating the collaboration that had already been in progress, with both of the scribes now re-questioning the learners and the 'go-betweens' and either asking them to verify what they had said, or demanding that they return to the relevant planets in the virtual Solar System. Initially, they did this, but became frustrated about having to do so. One outcome was a 'competitive (or parallel) collaboration' with the learners working with the 'go-betweens' and the now competing scribes, but frequently having to provide the same information on two or more occasions, to different people. The 'go-betweens', who were playing the role of intermediaries between the learners and the scribes were not immediately aware of the conflict that had started at the whiteboard, and for a while did not notice that what they had said was often not captured as the scribes now preferred to question the learners directly. Once they became aware of this, they stopped acting as 'go-between's' and berated one or both of the scribes - collaboration had come to a stop. The final point is how impervious this non-collaboration proved to either learner or teacher intervention. Some of the learners took sides with the competing scribes, whilst others, detached themselves entirely from the activity. The teacher intervened at quite a late stage, but found it difficult to restart the collaboration. It was hoped that all learners would

participate in the final presentation of the data, but this proved impossible. Each of the competing scribes then ran short presentations of their own, which highlighted what they believed to be the correct versions of the Solar System data. The task had finally ended.

5.2.3 EQ3 – What does the teacher do to support collaboration during the learning activity?

Overview

The teacher intervened in the learning activity in a number of ways. Sometimes, this meant hinting to learners what to do next. Often, it involved stopping the activity and checking with the learners how they were proceeding, before explaining what they were expected to do next. Finally, more proficient learners were often moved from one team to another, to help weaker students to progress. The interventions varied significantly in terms of their rationale, form and effectiveness in support of collaboration. Five forms of intervention are discussed here. Those considered particularly significant (two) are discussed as examples.

Task	Example
1	Interventions to avoid breakdown (<i>figure 5.8</i>)
2	Initial conditions for collaboration (<i>figure 5.6</i>)
3	Initial conditions for collaboration (<i>figure 5.7</i>)

Table 5.8- Examples of support for collaboration

Setting up the initial conditions for collaboration

Explaining support for collaboration to the learners was a challenge. Moreover, a number of further interventions were required to clarify what had been said or to clear up points of confusion. The nature, and effectiveness of this intervention changed as the activity proceeded, moving through three stages.

This emerged at the very beginning. The learners had logged in and had made forays into the virtual *Spaceport Alpha*. The teacher walked around the room explaining what the learners were expected to do. This consisted mostly of statements about tasks, which teams they were in and so on. These were frequently repeated. The students continued to work on laptops and were not brought to a central point. The teacher spoke a lot, but did not demonstrate (eg. by moving around the virtual world) what was expected. This approach was not effective, as the learners soon started to get lost and to ask a number of questions. In an attempt to resolve this, the teacher eventually asked one of the learners to move around the table and to check how tasks were progressing.

Moving into the later tasks, the teacher took a different approach to setting up conditions for collaboration. He continued to state expectations, but made more use of demonstrations and of getting the learners to show each other what to do. This is in *figure 5.6* as the teacher introduced the teleporter to the learners. However, the focus and attention of the students remained split between what was on the screen and what the teacher was saying.

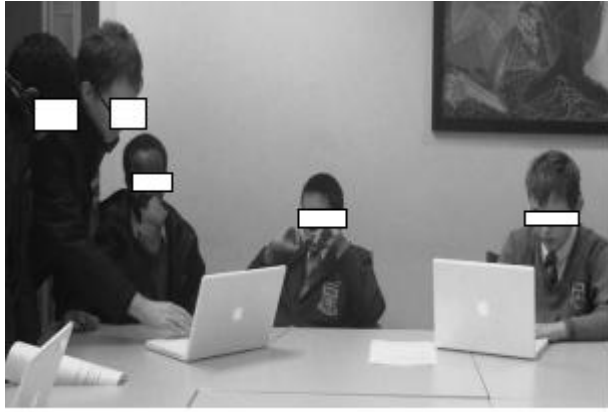


Figure 5.6 – Setting up the initial conditions for collaboration

A final, more effective, stage of this type of intervention was at the beginning of task 3 (*figure 5.7* below). The teacher stopped the activity, gathering the learners to a central desk. Instead of stating expectations, greater use was made of questioning the students as to how they felt they were progressing. This time, the students (not the teacher) were invited to demonstrate the task.



Figure 5.7 – Setting up the initial conditions for collaboration

Interventions to ensure collaboration continued

This type of intervention changed as the activity progressed. Early attempts relied on statements and explanations of the task. Later, the emphasis moved to questioning learners and getting them to demonstrate tasks to their peers. This shift was gradual, reflecting an attempt to leverage the fact that many of the learners were already proficient in their roles as ‘temporary experts’ and ‘go-betweens’. It was also an attempt to learn from previous occasions where collaboration had broken down. The effects were mixed. By moving to a more practical approach, the learners got off to a quicker start in terms of collaboration. However, it did not prevent problems and breakdowns from occurring later on.

The teacher made many modest interventions to keep collaboration going. This often involved directing from a distance, enquiring as to what the learners were doing, or providing short answers to simple questions. It frequently meant clarifying what the learners knew.

It was sometimes sufficient to explain again what the learners had to do. In the first task the teacher had to explain several times who was in which team, and what each student was expected to do. The emphasis then changed to explaining how to perform the individual tasks. One specific means of keeping collaboration going was to demonstrate to some learners how to do something, before then getting them to pass this on to someone else.

These techniques were accompanied by checking and verifying how learners were progressing. There were long periods marked by successful collaboration, where the role of the teacher was one of observation. This category of interventions was

essentially reactive and modest. It did not aim to change aspects of the activity, nor did it involve lengthy explanations to the learners.

Interventions to improve collaboration

Teacher interventions were frequently more ambitious. The rationale now was to improve and develop, more than sustain, collaboration. The means again varied. Instead of relying on explanations and asking questions, the teacher moved learners from one team to another, or changed slightly the tasks that they were expected to complete.

This often meant assigning roles to individual learners, frequently roles that the learners had already taken on (eg. as scribes, temporary experts). This represented a continuation of what they were already doing. In other cases, the roles suggested by the teacher were new. In the teleporter example, learner B had already emerged as a ‘temporary expert’. The role of the teachers’ intervention was simply to specify more precisely who he was to advise and what he was to say.

This was accompanied by moving learners from one team to another. Often, this was due to personal differences between the students. Much of the time, however, it took place mainly because one of the learners was lost, or had stopped collaborating with the others, for example. This occurred frequently during task 2, where the teams assigned to the different planets were changed by the teacher a number of times during the task.

Finally, aspects of the task were often changed. This meant removing jobs that were considered to be too difficult for some learners. In other cases, it was realised that some tasks were not as likely to support collaboration as had been supposed. This happened in task 3. Once the practice phase had ended, it emerged that much of the task could be

completed with little collaboration between the learners. Conversely, there were other occasions where a greater degree of collaboration than envisaged took place. Here, the task was extended slightly. This happened in the initial use of the teleporter during task 2. The teacher asked the learners to see what would happen if more than one learner got into the teleporter, and to explain back why this might have been a problem.

Interventions to avoid breakdown of collaboration

When collaboration was either clearly breaking down (eg. conflict between the scribes when getting details about the planets onto the paper whiteboard) or appeared to be in danger of doing so (eg. learners not knowing which teams they were on during task 1), the teacher intervened in other ways.

Of interest was when the teacher acted as a ‘go-between’ or performed part of the task for the learners. This occurred when some of the learners were lost and where collaboration was therefore unlikely to occur. An example of this (task one), is shown in *figure 5.8*. The teacher noticed that learners M and A (meant to be collaborating with learner J) were unsure what to do. To avoid breakdown, the teacher completed J’s task (animating the avatar) before returning to M and A, and then completing theirs. This was effective in supporting collaboration only for a short time. The learners completed one additional gesture once the teacher had moved on, before they stopped collaborating entirely.

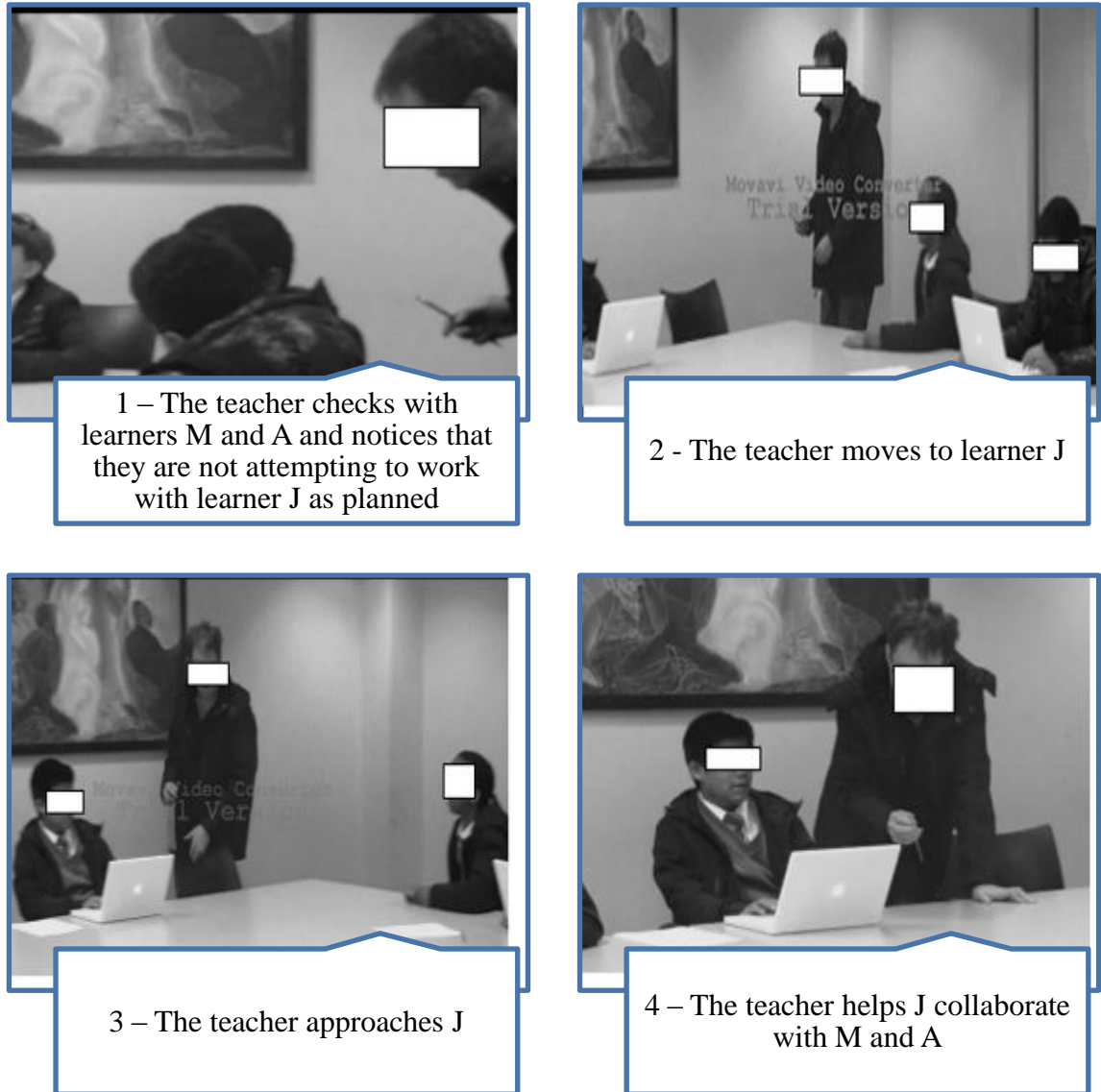


Figure 5.8 – Interventions to avoid breakdown of collaboration

At other times the teacher appeared to recognise that there was not much that could be done to avoid breakdown, and that it was better to ensure that the activity could instead be stopped with the minimum of chaos. During the conflict between the scribes (task 2), this was not easy. It took several minutes before order could be restored. The learners were logged out and moved to a central table. During task 3 when the sandbox

in the virtual world crashed (evicting the learners), the students were again moved to a central desk before being logged in again and moved to a new sandbox.

Interventions to recover from the breakdown of collaboration

A last category of teacher intervention was when the activity was restarted following a breakdown. Though this shared some features with the earlier category of ‘setting up initial conditions’; there were significant differences. It also drew on the other categories of interventions.

Following the breakdown of collaboration in task 2, the teachers’ priorities were to explain the requirements of task 3 and to ensure a breakdown would not recur. Firstly, the learners were separated from their laptops and moved to a central desk (like other types of teacher intervention). Each team was disbanded and reformed (again, a robust version of earlier interventions). As the task was explained, the learners were, this time, assigned roles one by one (something which did not occur in any of the previous interventions). Moreover, aspects of the task likely to cause breakdown were dropped by the teacher. Finally, the teacher took on many of the more technical roles such as logging the students back in, ensuring that they could teleport to the correct location, for example.

This was the strongest teacher intervention, aiming to restart the activity, minimise future breakdowns, and provide a basis for future collaboration. Although successful in getting the activity re-started, little could be done to avert the (technical) breakdown that later occurred. Whilst some collaboration took place during the next task, it was

little different from that which had happened in earlier tasks. In short, strong teacher intervention did not necessarily guarantee successful collaboration.

5.2.4 EQ4 – What other learner activities influence collaboration and non-collaboration?

Overview

There were long periods where the learners were unsure what to do. The nature and scale of this uncertainty varied; as did its susceptibility to outside intervention. As a category, this was labelled as ‘learners getting lost’. In the initial focusing exercise, it was identified in terms of non-collaboration. This view turned out to be over simplistic, as the effect on collaboration and non-collaboration sometimes turned out to be negligible. Frequently, however, it made supporting collaboration more difficult. It is discussed as an additional activity which indirectly influenced collaboration and non-collaboration, and related back to the role of the teacher – sometimes more difficult to resolve than others. This was when collaboration ended; or did not occur, as the learners become unsure about what they had to do or how they might do it. It was often resolved by the students asking others (such as temporary experts) or the teacher to help resolve the problem. In other cases (dropping out of the virtual world Solar System), it was fixed after a few minutes by the student themselves. The outcome was sometimes one of frustration and abandonment of the task, as the learner would walk away from the laptop until later, or would stay seated but go off elsewhere in the virtual world. The overall process of collaboration was weakened to various degrees, with the concept of ‘learners getting lost’ manifesting itself in various ways. This activity was prevalent in

all of the tasks. The example for this sub-section refers to ‘learners getting lost by team’ and represents task one (*figure 5.9*).

Learners getting lost by team

This was most evident early in the activity, with learners unsure about whom they were meant to work with. This confusion was twofold. Firstly, the learners had to match each of the on screen avatars with their classroom owners. Secondly, once this was achieved, there remained the issue of working out the composition of each of the teams. The effect of this was to slow down the envisaged process of collaboration, as additional time and effort were put into learners verifying who was on each team. An example of this is in *figure 5.9* below:

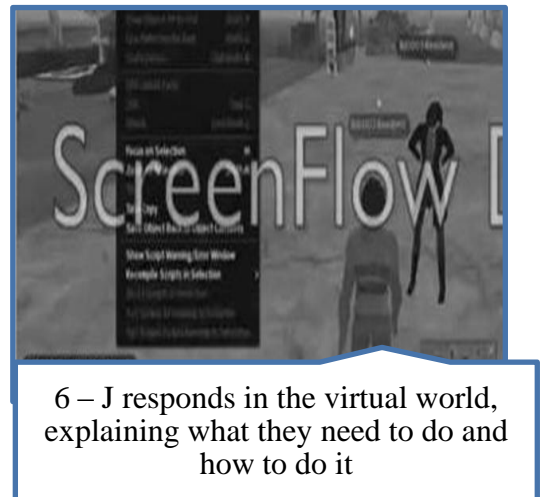
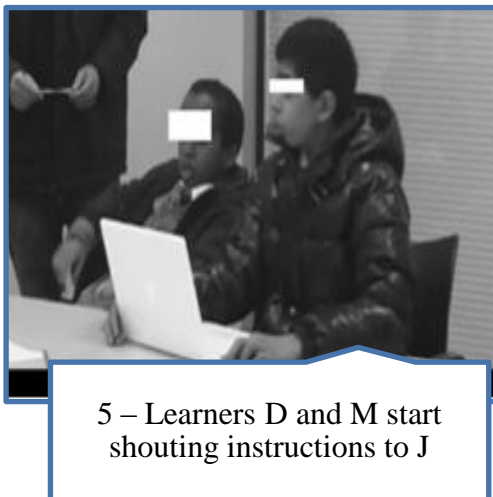
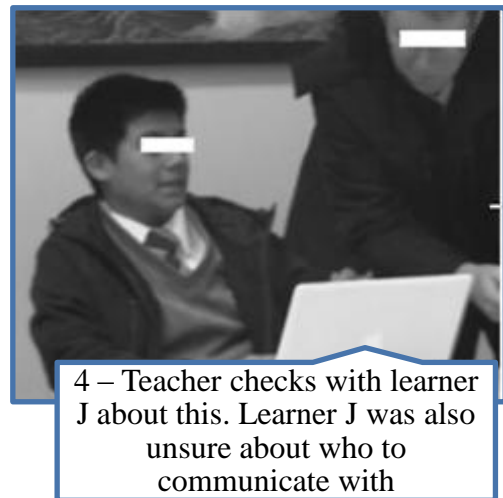
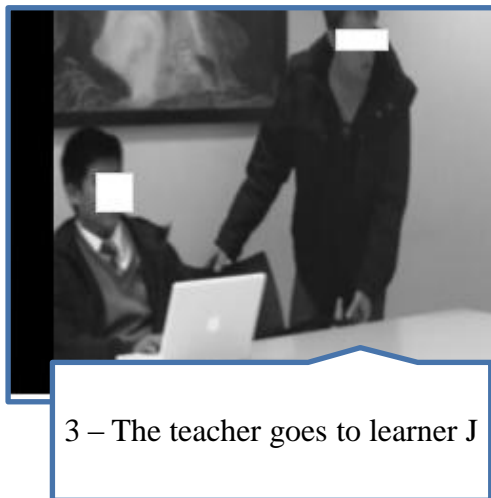
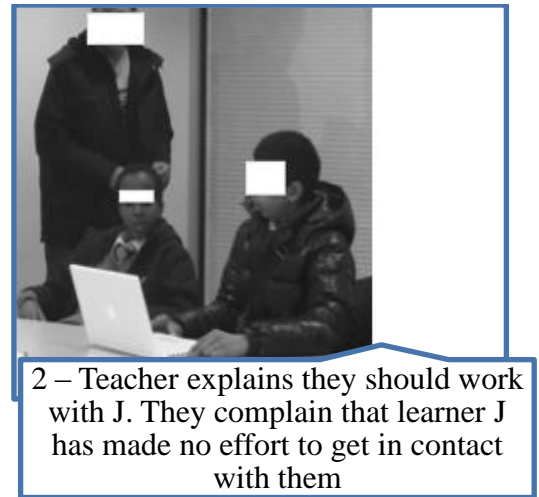
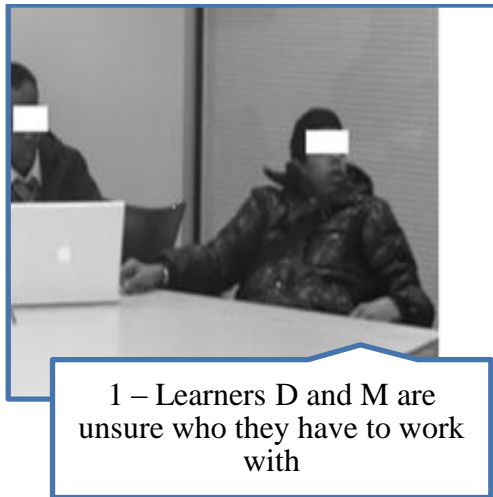


Figure 5.9 – Learners Getting Lost by team

Learners getting lost by space

As the activity progressed, problems of awareness and place in the virtual world emerged. To complete each task, students needed to move between several locations in *Spaceport Alpha*. Typically, they had to find the teleporter, transport themselves to the desired planet, move around, and then either continue to the next planet or leave the Solar System and return to the teleporter. As each team had to gather a large amount of information about each of their assigned planets, it was necessary to enter and leave the Solar System on several successive occasions. The complexity of this environment and the various shortcomings in its design (it was easy to accidentally drop out of the Solar System) were not taken into account. It took the learners some time to work out the location of the various features, and how to move confidently between them. Even then, there were multiple cases where they went to unintended locations or dropped out entirely. This had the effect of delaying or ending collaboration. In the building activity, it meant that fewer and fewer students were involved in the collaborative process as time went on.

Learners getting lost by task

A final manifestation of ‘learners getting lost’ was when they were unsure about the task they were expected to do, or how to carry it out. This was evident in the first (avatar animation) and final tasks (building competition), with learners often declaring that they ‘did not know what to do’. Placing the learners in pairs was intended to reduce this problem, and often was sufficient. Learners would then often ask other teams (by walking over to them), approach a temporary expert, or ask the teacher. This had a smaller effect in ending or inhibiting collaboration than the other two forms of learners

getting lost. It was more susceptible to being fixed by outside intervention, and was less likely to lead to a longer term breakdown of collaboration.

Revisiting each version of learners getting lost (unsure about who to work with, getting lost in the virtual world, unsure about which task do), in terms of how they influenced collaboration and non-collaboration, and in terms of their resolution; then a new picture emerges. Where learners were unsure about who to work with, the effect was to prevent collaboration from beginning. It was also difficult and slow to solve by learner or teacher interventions. Of the three, this was the most damaging for supporting collaboration. Where the learners became lost in the virtual world, or had other problems relating to awareness, the effect was primarily to slow down already existing collaboration. When left, it would eventually end, but the effect was gradual rather than immediate. It was also possible to resolve before becoming more serious. Finally, when learners were unsure about what task to perform or how to carry it out, this too could have the effect of either inhibiting or ending collaboration. This rarely occurred, and the effect was usually to delay collaboration. It again proved relatively susceptible to outside intervention.

5.3 Discussion

The aim of this section is to re-examine the findings of the study in the context of the sub-questions for research question three. Throughout the study, a number of learner and teacher roles and activities were identified and assessed. It now remains to assess how these related to the broader contexts of the space, collaboration and learning practices. The discussion here is extended in chapter 7 following the findings of study two. There are also a number of findings from the study with implications for the learning design process, and which will be discussed before proceeding to study two.

5.3.1 How the physical and virtual contexts of the space shape roles and activities

It was argued in chapter two that learner collaboration would be more complex and challenging due to the fragmentation of interactions between the different aspects of the space and different media, and due to differences in both awareness and knowledge amongst the learners. Inherent in this was the idea that a substantial degree of effort would be required from the learners and the teacher to avoid breakdowns in collaboration. In this study, the concept of ‘learners getting lost’ (in various ways) was a practical manifestation of these phenomena.

It emerged at an early stage, with learners struggling to reconcile their understandings of the virtual and the physical; as they tried to match screen avatars with their peers in the room, to locate various virtual locations, and to understand how the tasks of the activity might be implemented in the virtual aspect. They quickly needed to make sense of their environment and what they were meant to do in it. Though this initially led to argument and disagreement, it also prompted several learner roles and activities into

being. Roles such as go-betweens and experts were motivated by differing degrees of expertise and awareness amongst the learners. It was necessary for individuals to make others aware of ones' knowledge or skill. Learners would therefore announce to the others that they had been the first to complete a particular task, and would then volunteer to help others. The roles were facilitated through processes of verification and mutual adjustment. Both involved constant checking back and forth between the physical and virtual aspects, to establish and clarify what was happening, and then to use this as a basis for joint action. The cycle would run its course, resulting in agreement about a course of action, before then recommencing.

The dynamic of assigning learner roles accelerated as the activity continued; partially because the learners understood the qualities, strengths and weaknesses of their peers, and were more confident and fluent in assigning roles to each other, and partially because the teacher began to assign roles to various learners based on how they had performed earlier on. This contrasted with the fate of roles 'scripted' in advance, which frequently conflicted with the organic roles established by the learners, and were quickly abandoned.

Roles and activities, which emerged as a learner response to the fragmented nature of the hybrid space and as a means by which one could make sense of it, also played an important part in sustaining collaboration.

5.3.2 How roles and activities support collaboration

The roles and activities made the hybrid learning space more stable. They ensured that collaboration stayed on track for long periods, reducing the time required to complete tasks, and encouraged learners to continue working as a group. This occurred in different ways. The temporary experts played a short term tactical role, offering advice and information at important points in the activity, often just as collaboration was

heading towards breakdown. The strength of ‘go-betweens’ was linked to awareness, or to a clearer understanding of the aims of the activity, how to carry them out, and the relative strong and weak points of each of the participants. This was of more long term value, and played a strong part in shaping how the activity progressed. A similar trend concerned mutual adjustment and verification. The former usually applied to the solving of a specific problem, and was often concluded very quickly. The latter was slower, more measured and longer lasting. Both provided a basis upon which collaboration could continue, and the value of each of these became evident when small breakdowns or fractures in collaboration occurred. The learners would ask questions, demand clarifications, check the screens of others, amongst other factors. Phenomena such as ‘learners getting lost’ had a somewhat smaller impact on collaboration, delaying rather than ending it, because of how the learners used the various roles and activities. The overall result was one of resilience, with collaboration breaking down only due to strong personal disagreements amongst the learners, or following several significant setbacks or problems in quick succession.

5.3.3 How learning practices in the hybrid space are shaped by roles and activities

Novel learning practices, informed in various ways by the roles and activities, emerged as the study proceeded. The simplest one related to the learners relaying information from the virtual to the physical world. This was underpinned by a degree of mutual adjustment and questioning. There was little involvement of experts or go-betweens as the practice emerged when the activity was established, and where the learners had some understanding of the space and of what they were required to do. A further practice was when learners tried to overcome being ‘lost’ (as explained earlier). This usually meant comparing the virtual and the physical to get a complete picture of what was happening, or, as was more likely, to remove some degree of doubt as to what was

happening in the virtual world. This practice was often short lived. It was characterised by the work of temporary experts (filling in the gaps in learners knowledge), and by some degree of checking on what the others were doing (often by moving around, showing the laptop screens). A final practice was somewhat longer and more detailed, and required learners to negotiate to complete a complex task. The teleporter entry negotiations and the building competition were both examples of this. This practice relied on a strong degree of checking on other learners (through questioning, passing, pairing) and typically involved a process of ‘constant comparison’ (Glaser, 1967) of the physical and virtual, as the basis for future interactions in both parts of the space. Typically, these were both stable (requiring little teacher intervention) and highly productive in collaborative terms.

The discussion here represents a starting point with context, collaboration and practices re-examined in further depth in chapter 7.

5.3.4 – Remaining Challenges

An emphasis on scripts for learner collaboration and on proposed teacher interventions was inherent in the learning design process that underpinned this activity. Neither of these went as planned. There was a strong tension between the assigned scripts and learner defined roles. The former were observed for a time before being abandoned. The initial motivations for teacher interventions turned out not to be as significant as expected. However, it was necessary for the teacher to intervene for a large number of reasons that were not originally forecast. In short, there was a mismatch between the expected and the actual rationales for intervention. Finally, whilst many interactions took place solely in the physical or virtual part of the space, there were a significant number of hybrid interactions, involving both parts of the space. The aim of this section

is to examine each of these three phenomena more closely and to assess their importance for learning activity design in study two.

Scripts for collaboration

Three learner scripts, one for each of the tasks, were envisaged. They varied in terms of rationale and degree of coercion. The script for the first task required learners to exchange task cards, and to explain how to complete the task to each other. Its aim was to familiarise the learners both with their peers and with the features of the virtual world. The learners closely followed the scripts to begin with, but soon began to deviate. There were two reasons for this. The first related to them ‘getting lost’ in various ways as outlined in EQ4. More of their time and decision making went on resolving this problem than in following the task in question. The second reason was that, once the problems had been solved, the learners slowly became more confident, and adept at finding new ways to complete the requirements of the scripts. In short, they followed the scripts, but increasingly in their own ways in terms of roles, activities and assignments. The script for task two was both detailed and relatively coercive. It came at a time when the learners were already comfortable and stable in acting as temporary experts and go-betweens. This led to a strong tension in terms of the assigned roles and the ones which the learners had already developed. Whilst they listened to the teachers explanations about the former, they quickly went on to choose the latter. Initially, the teacher tried to enforce the assigned roles. This had the twin effects of increasing the teacher workload, and of disturbing the roles and activities that were already in place. This approach was quickly abandoned, with the teacher leaving the details of the scripts to one side and supporting the new learner defined roles. The script for the final task was relatively open in that no explicit roles were assigned to the learners. This proved to be more closely aligned with the practice of the activity, as

again the learners both defined and assigned the roles amongst themselves. Scripts for collaboration, therefore, did not play the part that was originally envisaged. Whilst useful as a means of starting of the activity, they were then either ignored or contradicted by the learners. They still proved useful as a means of adding an additional degree of detail, and of explaining in a more detailed way to learners, the task they were supposed to do. However, they were not successful as a means of telling them how to actually do the task. The issue, at the end of study one, was whether they should be retained, modified or dropped.

Teacher Interventions

Whilst not all justifications for teacher intervention could be set out in advance, it was argued that a number of factors were likely to have a significant effect on collaboration. Therefore, proposed teacher interventions (section 4.3) were motivated by the prospect of ‘learners getting lost’ by team or space, or having problems in sequencing tasks, amongst others. Again, the reality of the activity turned out to be different than expected. As discussed in section 5.2.4, the effect of ‘learners getting lost’ on collaboration turned out to be less important than envisaged. Similarly, issues regarding sequencing were generally solved by the learners using the roles and activities discussed above. But whilst these factors turned out to be less important than expected, there were several other issues that were not taken into account. Firstly, the original concept of intervening to support collaboration turned out to be quite narrow. In reality, intervention took place for a wider range of reactive and proactive reasons than expected, as outlined in section 5.2.3. Secondly, the threats to learner collaboration were also wider than expected. It was frequently disrupted by conflict and argument between the learners, technical problems, and multiple unexpected events. Thirdly,

teacher interventions to support collaboration varied enormously in effectiveness, again as discussed in 5.2.3. Finally, the need to intervene, even on a modest scale added greatly to teacher workload. The issue here was similar to that of scripts for collaboration. Given the extent of the mismatch between planning and practice, combined with their relative inefficacy, we were left with the question of whether such intervention plans should be retained, modified or eschewed in favour of something else.

The nature of hybrid interactions

Whilst many interactions took place solely in one part or another of the space, there were a significant number of interactions that encompassed both parts. These were broadly reflected in the novel learning practices detailed in section 5.3.3. Hybrid interactions were underpinned by one of three learner motivations. These included the need to convey information from the one part of the space to another (as in task 2), the need to overcome ‘getting lost’ (which occurred to varying degrees in each task), and the need to complete a single, complex task requiring a significant degree of mutual adjustment (getting learners to enter the teleporter in task 2 and building the Solar System model in task 3 were examples of this). Each of these required the learners to constantly compare what was happening in both parts of the space, and what their peers were doing as a basis for action and decision taking. The three categories of hybrid interactions were mediated by the learner roles and activities to various extents, as discussed in section 5.3.3. This was significant, as it opened the possibility of specifically supporting such interactions in the context of learning design. It moved the emphasis from the support of collaboration (which might have resulted in hybrid interactions) to the support of the interactions themselves.

Implications for study two

The findings from the study had important implications for the learning design process. To begin with, there was a strong case, in the next iteration of the process, for modifying or removing collaboration scripts and the plan for teacher intervention, based on their relative inefficacy in this study. Secondly, the identification of broad categories of hybrid interactions, meant that it could now be possible to support such interactions directly in the activity design, and not just in the context of broader encouragement for collaboration. This formed the basis for the next study, which was designed and implemented, not by the researcher, but by groups of educational professionals.

Chapter 6

Study two – Design: Learning activity design by educational professionals

This study resolved research question two by implementing the learning design process with a group of educational professionals. A number of challenges that teachers faced in working with hybrid spaces were discussed in section 4.4. This chapter extends the analysis, exploring these challenges in greater depth, whilst also emphasising the part that existing perceptions of technology in practice play in shaping teacher design and implementation practice. The design, outputs and analysis of the study are discussed in this chapter, with the resulting activity being implemented in chapter seven. The rationale for examination of teacher practice is set out in section 6.1, whilst the version of the learning design process used is justified in section 6.2. The outputs, findings and discussion of the study are discussed in sections 6.3, 6.4 and 6.5. The activity resulting from the study had to be modified by the researcher, with the rationale and detail for this being assessed in section 6.6. Finally, this had a number of implications for our use of the learning design process, and these are discussed in section 6.6.5. The analysis from chapter four is extended here. Several challenges from the implementation of the learning design process (by the researcher) were identified. These related to the appropriate degree of support for collaboration, the distribution of this support, and the extent and means through which hybrid interactions could be encouraged. This provided a number of initial answers to research question two (“What is teacher practice in the design and implementation of learning activities for a hybrid learning space?”). However, further examination was required. The rationale for this is discussed in terms of teacher practice (6.1) and the transfer of the learning design process (6.2)

6.1 The rationale for examining teacher practice

The rationale for implementing the learning design process with groups of teachers derived specifically from the requirements to resolve the sub-questions in RQ2 and more generally from a wish to develop the credibility and reliability of the study.

Both of the sub-questions required examination beyond the sole researcher, and beyond the single activity in chapters four and five. The first sub-question (“What are the challenges in developing learning design by teachers working with hybrid spaces?”) could only be adequately addressed by researching the design, in practice, of groups of teachers. It pointed to the planning and design of one or more learning activities from beginning to end. Whilst the second sub-question (“How do existing perceptions of technology in practice shape teacher design and implementation practice?”) can be addressed solely through the use of interviews or surveys with groups of teachers; a more reliable approach was to support them to design a series of learning activities, to encourage them to reflect on their perceptions and experiences, and then to examine their responses. These twin research demands aligned with the broader agenda of developing the credibility and reliability of the study. This was evident in terms of concepts and process. A number of concepts around the hybrid learning space were identified and discussed in the preceding chapters. Undertaking a further study with outside groups of teachers allowed us to assess how these concepts could be applied beyond the confines of the first study. In terms of the learning design process, we wished to examine the extent to which it was effective when transferred to other groups.

The challenge was to represent research question two (including its sub-question) in an operational way, so as to examine the data from the study with a greater degree of detail. In what follows, the ESE analytical framework is again used to express RQ2 as a series of four empirical questions.

6.1.1 EQ1 – How do the teachers perceive the term ‘hybrid learning space’ and what do they consider to be its’ main uses?

The concept was discussed in some depth, and situated with respect to similar and different environments in chapter two. Although strongly grounded in theory, much of this discussion has been influenced by the academic and practitioner backgrounds of the researcher. The aim of this question, therefore, was to examine what others might understand by the concept ‘hybrid learning space’, in terms of its’ structure and role; and to explore how they might compare it with other spaces. Parallel to this, was the need to assess, more broadly than before, the potential learning uses of the hybrid learning space. By discussing these two terms with the participants of the focus groups, a wider appreciation of both concepts was developed.

6.1.2 EQ2 – What is their understanding of the term ‘hybrid interactions’ and what part do these play in the completed learning activity?

Our understanding of a ‘hybrid interaction’, thus far, was based upon an application of the Conversational Framework, the design of the learning activity, and a post-activity analysis of some of the interactions that were observed. Whilst useful, this reflected the design and outcome of a single learning activity. Again, there remained the danger that our interpretation of the term was too narrow. The point of the question, therefore,

wasto examine what the participants considered to be a ‘hybrid interaction’; again, with the aim of getting a more rounded and diverse view of the term. Similarly, the process of activity design that was followed earlier in the thesis reflected one possible way of supporting such interactions. By getting several participants with different backgrounds (rather than just one researcher) to collectively design their own activity, in a different context than before; it was anticipated that further fresh perspectives would emerge.

6.1.3 EQ3 – How do the participants envisage the role of the teacher in the hybrid learning space in terms of collaboration, orchestration and intervention?

Whilst the Conversational Framework represented an important part of the learning activity design in chapter 4 it was not, in itself, sufficient. Much effort was put into assessing the role of the teacher in terms of supporting collaboration and intervening, more generally, in the activity in order to prevent breakdown, amongst other issues. If only due to limitations of time and space, the single learning activity in chapters 4 and 5 considered just some of the potential roles of the teacher in these contexts. A further activity, less influenced by the background and viewpoints of the researcher, allowed us to examine other possible roles, and thereby, gain a more complete picture of how the teacher acted in the running of the activity.

6.1.4 EQ4 – What broader challenges and concerns do they envisage in the design and implementation of activities in the hybrid space?

It is in this area that a more distant and critical perspective than that of the researcher was most beneficial. This question was concerned more with the learning design process, and its complexities and challenges than with the space or interactions *per se*. The question was posed to the participants towards the end of the focus group, after they had completed the practical tasks. It allowed them to reflect upon their experiences

of the study, in general terms, and to offer their own interpretations about what they had learned. As with the preceding questions, the emphasis was on encouraging the participants to generate new ideas and perspectives about the learning design process.

6.2 Learning Design Process

The previous version of the learning design process proposed a significant degree of templated support for collaboration, combined with a list of possible teacher interventions. However, the results of the first study indicated that neither of these elements of the design process was very successful. The learners rarely accepted or followed the envisaged roles, preferring instead to develop and assign their own. Similarly, the range and scope of teacher interventions went somewhat beyond what was planned. Both of these aspects of the design process were useful in planning the activity, in getting the researcher to reflect on how to support learner interactions and teacher interventions, but were less helpful in practice. It was argued in section 4.4, that removal of these latter two parts of the process might be productive.

The version of the design process set out here took this into account, by eschewing learner scripts for collaboration. However, the teacher plan for intervention was maintained as a conceptual aide, as a means of helping the professionals to examine how they might intervene in the hybrid learning space. This was also useful for both the researcher and the teachers for addressing the four empirical questions. The learning design process in this study therefore consisted of the Conversational Framework (as before), combined with a plan for teacher intervention, and a refinement stage at the end, as shown in *figure 6.1*. To ensure rigour, the overall approach was iterative with each stage building upon or refining the output of the preceding one(s). In what follows, the details of each of the stages are examined. This is evident in terms of their

rationale, the exact steps that the participants were expected to follow, and the final output that was required at each point.

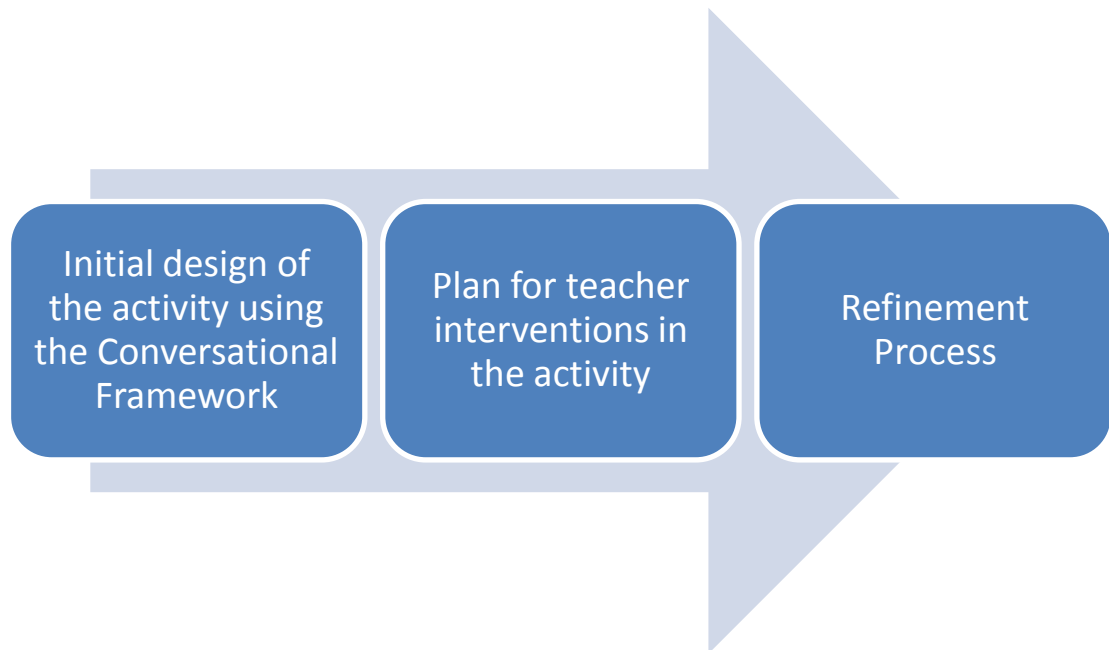


Figure 6.1 – Representation of the Learning Design Process for study two

6.2.1 Stage one – Design of the initial learning activity

The aim of this first stage was to introduce the participants to the concepts of both a hybrid learning space and a hybrid interaction, before guiding them through a number of steps that resulted in the design of a provisional learning activity. There were two underlying challenges. The first related to familiarity. It was expected that the participants would have had little (if any) exposure to, or explanation of, the relevant concepts. It was therefore important to offer not just top level descriptions, but also practical examples that they could understand and use. Given that the final output required them to apply the concepts in a concrete manner, this was especially significant. The second issue related to rigour. The activity that the participants

designed had to be sufficiently detailed and rigorous for implementation (with little modification) by other educational professionals.

These challenges were resolved both by breaking the stage into several smaller sub-parts, and by then using the Conversational Framework as a design tool to help the participants organise and structure their work. To begin with, a short video exploring some of the educational uses of the *Second Life* virtual world was shown. By means of a guided discussion, the participants were led towards the related concept of a hybrid learning space. The idea of an interaction encompassing both the physical and virtual parts of the space was introduced. The group was then invited to identify, write out, and discuss as a team, possible examples of hybrid interactions that might occur. The emphasis here was on setting out the main concepts and on ensuring that the participants were able to generate relevant examples of hybrid interactions in practice.

A scenario, describing a hybrid learning space with a small group of learners, was presented. The participants were then asked to identify a viable curriculum and age group focus for the eventual learning activity. Once this was achieved, the Conversational Framework was used to guide the design of the activity, based around the scenario. The framework was particularly useful in terms of helping the group to define the activities' theoretical concepts, opportunities for the learner to ask questions, and the presentation of the finished learner product to the teacher, amongst other elements.

Throughout the task, therefore, there was a process of movement between the theoretical (introducing concepts such as hybrid interactions or the Conversational Framework), and the practical (where the participants attempted to apply what they learned). By the end, the participants had designed their provisional version of a learning activity for implementation in the hybrid learning space. This was refined in the two latter stages.

6.2.2 Stage two – Teacher interventions

The issue of how and why the teacher might intervene in the hybrid learning space was discussed at some length in earlier chapters. It remained significant. If the learning activity was to be rigorous, robust and applicable, then it was important that the participants proposed in advance what they considered to be the main justifications for teacher intervention along with some idea of how this could be carried out, ideally, without further disrupting the flow of the activity. This was useful in two other senses. Firstly, it offered the researcher an insight into participant perceptions and understandings of the hybrid learning space. In short, what did they consider to be the most likely potential problems and concerns, and what did they consider to be appropriate in terms of intervention? Secondly, it was helpful for the participants in practical terms as it encouraged them to examine more closely their own assumptions and ideas concerning the activity, its design and its implementation.

The discussion began in general terms, with the participants considering generic and theoretical situations where teacher intervention might be both justified and productive. Some emphasis was placed on the notion of prioritising between different interventions. With the main issues debated, the emphasis of the stage then moved back to the practical. The group revisited the learning activity and identified areas where teacher

intervention was required, for whatever reason, in order to keep the activity in progress. They then put forward how they proposed to intervene along with what they considered to be the relative importance of each of the intervention areas.

It was accepted that one could not easily predict, in advance, all that might occur as the activity was implemented. Moreover, one could not be certain that every proposed intervention would necessarily be carried out. Nonetheless, the practice of re-examining the activity in some detail, and of locating what one considered to be its' potential challenges and concerns, allowed one to develop a clearer understanding of both the space and the interactions that could occur within it.

6.2.3 Stage three: Refinement – Putting it all together

The emphasis, at this point, was on reviewing and refining the outputs of each of the preceding stages, with a view to integrating them into a single coherent learning activity. From a participant viewpoint, this was helpful as it allowed them to reflect on the part that each of the individual components of the activity played in the whole. The earlier, tentative, version of the activity from stage one was now made more specific and conclusive by adding the later material on the role of the teacher. This, however, was more than an act of integration. It was also to help the participants to explore the linkages between the various parts of the activity.

The outputs of stages 1 and 2 were looked at again. This gave the participants an opportunity to make further changes in light of what they had learned.

Although the final output of the study was the learning activity, a number of other documents were completed by the group as they proceeded through the planning tasks. Some of these were relatively informal such as the results of ‘brainstorming’ sessions, or cards and post-it notes, amongst other items. Others were more structured and theoretically informed such as the initial activity design (based on the Conversational Framework) for example. The main documents that the participants produced can be seen in *table 6.1* below. Having discussed the content and broad organisation of the focus group, we can now turn to its context.

<u>Stage No.</u>	<u>Focus</u>	<u>Expected output documents</u>
1	Initial design	Chart with activity as per Conversational Framework
3	Role of the Teacher	Priority list showing potential teacher interventions
3	Refinement	Completed activity integrating all tasks, as per Conversational Framework.

Table 6.1 – Summary of expected output documents

6.3 Outputs from the study

The two focus groups followed different paths in designing their learning activities, something which was evident in their approaches, decisions and outputs. In this section, the progress of each of the groups is explored in terms of the main stages of the study. The aim is to examine how they designed the learning activity, and what they envisaged

as the role of the teacher in running the activity. The emphasis here is partly descriptive and partly discursive.

A video was shown at the beginning of each of the focus groups explaining how the *Second Life* virtual world is used in a variety of learning contexts. After this, the participants were given a scenario involving six co-located learners and one teacher, each of whom could access *Second Life* from a laptop. They were then asked a very general, open question – namely, how might the virtual world be employed for learning in this scenario? From this point on, the focus groups had started, with each of them taking different routes.

6.3.1 Design of the learning activity

Focus Group one

Following a number of ‘brainstorming’ sessions, the first group was able to identify a learning area (citizenship / pastoral education) and age group (11 – 13) for the activity. They suggested that primary to secondary school transition, a problematic time for most children, might be a useful starting point. The participants felt that the hybrid learning space would provide a safe and non-threatening roleplay space for the learners, allowing them to try out different personas, and to ask questions both of each other and the teacher. The initial activity started with an icebreaker in the classroom, where the group discussed the concepts of changes, life transitions and the responses that one can take to them. This was then followed by a series of scripted biographical role plays in the virtual world where the learners played the part of individuals who have managed specific life events, such as moving from one country to another, or a long term illness. Each of the learners simultaneously acted out their assigned persona (using a script answering many of the questions they might be asked) whilst also asking questions of the others. The activity then moved successively between the physical and virtual

spaces; with the learners using their return to the physical space to discuss what they have learned and to refine the questions that they would ask of the others when they go back to the virtual space. The teacher left a series of notecards in the virtual world which the learners could use as prompts to develop their questions. The activity therefore had elements of both a role play and a scavenger hunt. At the end of the activity, they completed the role play and used what they have learned to create a poster in the classroom for presentation to the teacher. In *table 6.2*, the main aspects of the learning activity as per the Conversational Framework are set out.

<u>Learning Activity Criteria</u>	<u>Example</u>
Learners can access theory and concepts	Concepts of change, transition and responses are embedded in the role play scripts and in the notecard material in the virtual world
Learners ask questions, share ideas and debate with peers and teacher	Several question sessions in classroom Ongoing role play question / discussion sessions in virtual world
Learners achieve practical task / goal. The output of this is shared and improved	Practical goal is to develop questions to ask in the role play – to ask the questions – study the answers and use this to refine the questions over successive role plays

Learners present ideas & model to teachers and other learners – used for discussion & reflection	Learners use what they have learned to create poster in classroom – this is then used for discussion and reflection
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Table 6.2 – Learning activity (initial) as per the conversational Framework – Focus Group 1

As the study proceeded, the participants made a number of changes to the sequencing of the activity. They felt that it would be wise to separate the scavenger hunt from the role plays. The former, therefore, became, a means for the learners to gain experience in using the virtual world, whilst gathering possible questions and answers for the later role play. This is followed by a teacher led planning session in the classroom, where they developed the questions that they would ask the others, along with the answers that they would give when they were in character. For the role play, the learners worked as individuals. They then collaborated in the classroom to improve their questions before returning to the virtual space to complete the role plays (again as individuals). The learners used online notecards in order to store the answers that they got, and then combined them with what they found in the initial scavenger hunt to create an individual portfolio. At the end of the activity, they collaborated to create a poster in the classroom. The learners needed to move between the physical and virtual spaces in order to get the relevant information from the notecards and suggest how it might be useful for addition to the poster. Parallel to this, the learners needed to assign roles in terms of ‘who does what’ to design and complete the poster. The main steps and rationale of the final version of the learning activity for focus group one are set out in *table 6.3*.

<u>Part No</u>	<u>Title</u>	<u>Organisation</u>
1	Icebreaker	Teacher introduces the concept, activity, and the hybrid learning space to the learners.
2	Scavenger Hunt	Learners work as individuals and collect notes, photos and other items in the virtual world. The learners can also ask questions, compare notes and discuss ideas in both parts of the hybrid learning space
3	Developing Questions	Teacher guides classroom discussion where the learners are given the roles that they will play. They use this to develop the questions that they will ask as well as the answers that they will offer when in character.
4	Role Play 1	Learners work as individuals and conduct role play in the virtual world. Each learner is expected both to play their role and to ask questions of the others – results are stored in the individual portfolios along with the findings from the scavenger hunt.
5	Refining Questions	Collaborative (learner driven) activity in classroom. The learners discuss the questions

		that they asked. Throughout the session, they refine the questions and develop new ones.
6	Role Play 2	Return to the role play in the virtual world – the aim is to apply the new questions and to interrogate any of the learners that they did not speak to earlier.
7	Designing the Poster	Learners design a poster in the classroom. They will need to move between physical and virtual worlds in order to access information from the portfolios, and propose it for inclusion in the poster. The learners will also need to collaborate to assign roles in terms of the poster design and creation.

Table 6.3 – Learning activity (final) – Focus Group 1

Focus Group two

The second group proposed that the hybrid space might be useful for finding things out, verifying information learned from elsewhere, and for testing hypotheses. Again, following some discussion, they suggested that it could be used for a Key Stage 3 (ages 11 – 14) maths lesson looking at the relative heights of buildings, and assessing how these could best be measured. The activity started with the learners using a website to identify some of the tallest buildings in the world and, where possible, to note their heights in metres. The learners then moved to the virtual space and to the maths learning zone where a number of these buildings (designed in advance by the teacher)

were present. The buildings were constructed to scale, but their exact measurements were not revealed. The learners' initial objective was to locate the buildings, before considering how one could measure their heights. This was achieved in a number of ways such as through using an in-world measuring tool, amongst others. As with the first group, the learners moved between the physical and the virtual to confirm what they have learned and to ensure that the task is progressing and can continue. As a group, they constructed a league table in the virtual world identifying the 10 tallest buildings in the world and showing their relative heights. The activity finishes with a discussion and presentation in the classroom. As before, the main elements of the learning activity are set out below in *table 6.4*.

<u>Learning Activity Criteria</u>	<u>Example</u>
Learners can access theory and concepts	Concepts of relative and actual height – this is accessed through measuring buildings in the virtual world. Some of the concepts are accessed via web searches throughout the activity.
Learners ask questions, share ideas and debate with peers and teacher	Question sessions in classroom Question / discussion in virtual world as learners locate information for practical task
Learners achieve practical task / goal. The output of this is shared and improved	Practical task to develop league table of buildings showing relative and actual heights in the virtual world. Modified and refined as the activity proceeds.

Learners present ideas & model to teachers and other learners – used for discussion & reflection	Learners present contribution to the league table to each other – final output is presented to the teacher to scaffold
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Table 6.4 – Learning Activity (initial) as per Conversational Framework – Focus

Group two

Compared to the first focus group, the participants in this case did not make as many changes to the format and sequencing of the activity. Instead, they used the tasks to discuss teacher interventions in more depth. The remaining time was given over to clarifying what they expected the learners to do during each part of the activity. This resulted in the final version as set out in **table 6.5** below.

<u>Part No</u>	<u>Title</u>	<u>Organisation</u>
1	Icebreaker	Teacher introduces the concept, activity and the hybrid learning space to the learners.
2	Web Search	Learners work as pairs and run web searches to identify the top 10 tallest buildings in the world. They make brief notes about what they find.
3	Find the Buildings	They are directed to a zone in the virtual world. They continue to work as pairs and their first priority is to find as many of the relevant buildings as possible. They should note their locations and relative sizes.

4	Developing Ideas	Teacher led discussion in the classroom - how do we measure the height of buildings in the virtual world? (using a prim, using an in-world measuring tool etc.) – How do we know how accurate this is – The teacher assigns different methods to each of the three pairs of learners
5	Measuring Heights	The learners (still in pairs) carry out the measurements using the tools prescribed above. These are stored in their portfolios in the virtual world.
6	Designing the League Table	Learners collaborate to decide on location and appearance of virtual league table. They also collaborate to decide how to get the information to the league table from the various groups of learners.
7	Presenting the League Table	Learners present the virtual league table – the presentation occur in the classroom – again the learners are expected to collaborate to decide on assigning roles and working out how best to communicate details from the virtual world to the classroom

Table 6.5 – Learning activity (final) – Focus Group 2

Discussion

By comparing tables 6.3 and 6.5, we can now point to a number of similarities and differences between the two learning activities. It can be seen that whilst they address different concepts and theories (life transitions compared to maths and measurements), they had more in common than one might expect. In terms of asking questions and debating ideas, for example, both activities moved between the physical and virtual spaces, with the former often being used to reflect, check what has been learned, and to ask questions, and the latter being used to find things out. There were differences too. In the first activity, the virtual space was used as a role play space, whilst the learners used the physical space to refine their questions, check their scripts and to generally make changes to their approach, prior to re-entering the virtual. In the second activity, the physical space was used to find out information and to develop working hypotheses; both of these were then tested in the virtual space – it became a space for verification. The finished outputs of both activities also reflected different approaches. The first activity required that the learners aggregate what they had learned from asking questions in the virtual, by creating a leaflet in the classroom, whilst the second required construction of a league table in the virtual, partially based on what they had learned from web searches in the classroom. The final reflection and discussion for both activities took place entirely in the classroom. However, in both cases, there remained the challenge of how the learners communicated what they had learned from the virtual to the physical space. The significance of all of this is discussed at more length in section 6.4

6.3.2 Role of the teacher

The participants were then asked to set out what they envisaged as being the likely role of the teacher as the activity proceeded. This was a useful (although somewhat hypothetical) exercise, as it encouraged the group members to ‘step back’ from the learning activity, and to consider the hybrid learning space in more general terms, prior to considering what interventions the teacher might need to make within it. As before, there were a number of common points and differences between the groups.

Focus Group one

Inevitably, one likely role of the teacher was to intervene in response to some problem occurring in the hybrid learning space. The first group identified a diverse range of such potential problems ranging from learners not understanding what they had to do, through to learners bullying each other. Interestingly, one of the participants (with primary school experience) suggested that there might be a credibility issue in that some of the learners could have difficulty in distinguishing between what was ‘real’ and what was ‘virtual’. Her point was that some children might interpret what they were told in the virtual world as being a sort of fantasy, and that the teacher would have to go to some lengths to explain that the virtual world was an integral and valid part of the lesson, and by extension of the classroom. Another participant pointed to the possibility of mistaking engagement for learning – in that the learners might appear to be busy and productive, but were, in reality, deviating from the learning activity. A number of proposed teacher interventions were suggested to resolve these problems, ranging from giving lots of playtime to the learners, through to an online behaviour board (another extension of what would occur in the classroom), and the appointment of some of the learners as ‘administrators’ or ‘enforcers’. Another participant viewed

the virtual part of the space as being inherently chaotic, and that, therefore, the prime role of the teacher would be to use the “physical space to balance out the chaos of the virtual”.

Focus Group two

The second group shared a number of these concerns, especially those concerning learner motivation and potential confusion and, therefore, again viewed the teachers’ role as that of intervener in order to keep the activity in progress. The group added a number of other issues however. They suggested that some learners would find themselves more comfortable in the hybrid learning space than others, and that there would be somewhat different levels of progress between the learners. The role of the teacher would be to stop the activity now and again to ensure that those who were lost would have a chance to catch up. Whilst the first group underlined the importance of teacher interventions to solve problems, the second group took a more pragmatic approach, by proposing that more of the ‘intervention work’ could be borne by the learners in the form of peer help and the organised pairing of learners. They also suggested that many of the proposed justifications for teacher intervention should actually be used as learning opportunities – as something which the learners might be able to solve of their own accord. In other words, the second group set a somewhat higher threshold for teacher interventions.

Discussion

As with the two previous themes, therefore, there were a number of similarities and differences concerning the likely roles of the teacher in terms of intervention. Both groups shared a concern about learners getting lost, not knowing what to do, or otherwise going off task. One of the groups worried more about issues of credibility and bullying; whilst the other was more interested in how the students might worry or feel about their own progress. By combining the interventions proposed by the two groups into a single list, a singular picture of the teachers' role came into view. Before the learning activity, the role of the teacher was to set up the ground rules (group one), clarify how collaboration was expected to occur (both groups) and build in lots of break points to allow any problems to be ironed out (again both groups). Throughout the activity, both groups emphasised that the teacher should have an online presence (rather than simply monitoring the classroom), and should integrate somewhat into the learning activity (as opposed to watching it and waiting for any potential problems). Finally, both groups proposed tailoring the virtual world software, where possible, in order to minimise learner confusion and to make any necessary teacher interventions more effective. An example was the provision of teleports and 'help points' (proposed by the second focus group) so that lost students could return to where they were supposed to be.

6.4 Analysis

6.4.1 EQ1 – How do the teachers perceive the term ‘hybrid learning space’ and what do they consider to be its main uses?

It took some effort, on the part of the researcher, to move the emphasis and interest of the focus groups from the virtual world (which was relatively easy to isolate, examine and identify) towards that of the hybrid learning space. As the development of the activity proceeded, this challenge became somewhat easier, as one could guide the participants around the space and invite them to make connections between its two parts. There was therefore, something of a distinction between the participants’ initial (first) impressions of the space, and the later uses to which it was put. Both shed significant light on their interpretation of the hybrid learning space.

At the start of the focus groups, the concept of a hybrid learning space was introduced, and the participants were invited to identify what they considered would be suitable learning uses for it. They offered answers such as “*making things*”, “*examining real world things close up*” and “*solving mysteries*” amongst others. When probed further, and asked to suggest what would be good curriculum areas for this, they suggested subjects such as history, maths and science, amongst others. The idea of mixing subjects, or cross curricular work, was mentioned at an early stage with pairings such as maths and history and geography and history being most prominent. This was often reflected in the early activity proposals of the groups. The second focus group, for example, initially looked at the idea of building a town from 1900 (history), and then using this to examine the role played by maths in the construction techniques at the time.

By moving on from these high level scenarios, and examining the activities developed by the groups, a more nuanced picture emerged. The physical (classroom) part of the hybrid learning space was primarily used for tasks such as icebreakers, reflection, and refining ones approach; whilst the virtual was used more for tasks such as finding things out, testing hypotheses, and as a tool for collaboration in terms of scavenger hunts and building objects, amongst others. Where the teacher needed to direct the group or to consolidate what had been learned, then the classroom was the preferred environment. Conversely, the virtual was seen as better for confirming (or denying) what has been learned elsewhere, for making things or for encouraging the learners to work together. This appeared to relate strongly to the previous empirical work, in terms of how the features of the space were used.

There were also some significant differences. One emphasis of the previous work was on using the virtual space to find things out, and then presenting this to the other learners in the classroom. What the participants planned in focus group one was both more detailed and better ‘scaffolded’ than in the previous work. For example, they advocated using a ‘scavenger hunt’ approach whereby the learners gather objects containing relevant notes and information. This was not proposed before. Similarly, in both activities, there was a focus on the learners saving objects, notes, photos and other virtual world artefacts to their individual portfolios, before using these to present to present to the other learners. Again, this was not considered in the previous work.

Conversely, the idea of getting the learners to build objects in the virtual world was only put forward in one of the activities, and this was at an elementary level. The participants suggested that this might be time consuming, and that the learners might benefit more by explaining and discussing what they had done instead. It was viewed as

a lot of work for little reward. If the focus groups were reluctant about getting the learners to modify the virtual world, however, they were less hesitant about doing the job themselves. A series of proposed modifications were put forward by the groups including behaviour boards (activity one), buildings which the learners had to provide information about (activity two), and signposting tools such as markers and teleports (both activities). Compared to the previous work, therefore, there was a new emphasis on using more detailed and specific features of the virtual world to scaffold student learning. Modifications to the world, by the teacher, were aimed at encouraging this.

6.4.2 EQ2 – What is their understanding of the term ‘hybrid interactions’ and what role do these play in the completed learning activity?

As with the space, a similar issue emerged concerning participant understanding of hybrid interactions. In the initial versions of the learning activities, there was a tendency for the interactions to be “in silos”, to the extent that they would occur entirely in the physical or the virtual space. There was little opportunity for crossover between the two. It was necessary to return, on a number of occasions, to the initial ‘brainstorming’ exercise, so that the participants could re-examine the idea of a hybrid interaction and then seek to integrate them into parts of the activity. In other words, this required much more researcher intervention than was initially expected. Again, such interventions were required less and less as the activity developed. The participants began to come up with their envisaged hybrid interactions. One outstanding issue is that what they developed was a design rather than an implementation. In the previous activity, many of the hybrid interactions only became clear during its implementation.

It appeared that hybrid interactions were most likely to occur in four areas. The first of these was where a question or task was posed in the classroom, and the virtual world

was then used to research, find something out or role play the issue in question. An example of this was in activity two, where the learners use the classroom to set up a list of the world's tallest buildings before moving to the virtual world to confirm or deny that the list was correct. A second case, usually later in the activity, was where the classroom was used to refine ones' approach or questioning, based on what one had already learned in the virtual world. In other words, the learners had to communicate what they had learned from the virtual to the classroom. When the refining exercise was complete, they then returned to the virtual world to apply their new approach. An example of this was in activity one where the learners developed the questions that they would ask as part of the role play. A third area where hybrid interactions occurred was where the basic principles of a task were set out in the classroom, but the more concrete details and complexity of the task, along with how collaboration could be structured were decided in the virtual world. There was therefore a need to refer constantly between the two parts. An example of this was in activity two, where the concept of the league table that the learners built was set out in the classroom, but the more specific terms of organisation were decided shortly afterwards in the virtual world. Finally, both activities finished with the learners needing to communicate what they had learned / created in the virtual back into the physical. In the case of the first activity, this meant using their individual portfolios and the responses from the role play to create a classroom poster. In the second activity, the learners needed to communicate what they had written on the virtual league table to the teacher in the classroom.

Compared to the previous study, there were, again, a number of similarities and differences. Firstly, the notion of using the virtual world to find something out

wassimilar to before. In both of the activities here, however, it was being done in a different way. One of the activities used a role play, whilst the other got the learners to use the virtual world to confirm or deny what they had learned in the classroom. Neither of these were part of the previous study. Secondly, in the previous activity, the distribution of roles (what is to be done, who will do it etc.) amongst the learners was organised entirely in the classroom, before being implemented in the virtual world. In the activity from focus group two, the planning of the building task was split between the physical and the virtual, with initial introductions occurring in the former and the specific details of the collaboration being organised in the latter. This concept of splitting role distribution was quite new. Finally, in terms of the final output and production, there was a significant difference. The output of the previous study was entirely in the virtual world, where the learners built a working model of the Solar System. In both of the new activities, the final outputs occurred in the classroom (one as a poster, the other as a talk), but drew heavily on what the learners created in the virtual. In short, therefore, there was a more focused and structured use of the virtual world, a split in role distribution between the classroom and the virtual world, and a move towards having the final presentation in the classroom.

6.4.3 EQ3 – How do the participants envisage the role of the teacher in the hybrid learning space in terms of collaboration, orchestration and intervention?

The main reasons for teacher intervention in the two learning activities involved learners getting lost, going off task for various reasons, or otherwise falling behind their peers. To this end, a series of possible interventions for before, during and after the activities were put forward by the participants. These included having lots of break points in the activity to deal with problems, giving the teacher a clear online presence, and, in many cases, modifying the virtual world to fit with the needs of the teacher.

Compared to the previous study, there was, again, much in common, and many of the reasons for intervention (eg. learners getting lost by task, place and role) were again present. There was also a broad similarity in terms of the possible teacher interventions (eg. stopping the activity, break points). What was different was that the participants suggested a number of additional reasons for teacher intervention than before. These included problems with learners bullying each other (focus group one), issues amongst students in distinguishing between physical and virtual parts (focus group one again) and learners being unable to solve some of the problems (focus group two).

However, the range of suggested teacher interventions was also more diverse than in the previous study. For example in activity one, there was a stronger emphasis on modifying elements of the virtual world, in terms of replicating tools that one might find in the classroom, such as a behaviour board, for example. Both focus groups proposed a stronger online presence for the teacher, to the extent of following the learners between the two parts of the hybrid space. The second group, for example, committed much effort to discussing where in the virtual world the teacher should be situated and how their avatar should appear to the learners. They were also proposing, at one point, to get the teacher to deliver a mini lecture in the virtual world, but chose not to due to time restrictions. The biggest difference compared to the previous study, therefore, was in the enhanced role of the teacher, either to modify the software or to project a stronger virtual presence. In either case, there was more of an emphasis on steps that the teacher could take both before and during the activity than before.

6.4.4 EQ4 – What broader challenges and concerns do they envisage in the design and implementation of activities in the hybrid space?

At a number of points during the focus groups, the participants were asked for their opinions on what they felt were existing issues in the design and eventual running of the activity, along with what they considered to be other possible concerns. Indeed, they offered their opinions on a number of occasions other than this. The aim here is to take the more salient of these issues and to examine them in more depth, relating them, where applicable, to the previous study.

The participants frequently pointed to the likely time required in order to adequately design and run a learning activity in the hybrid learning space. This was especially the case with the second focus group. More specifically, they considered that much time would have to be given to finding (and / or designing) appropriate locations in the virtual world, preparing accompanying learning resources, and then assessing how effective the activity had been. The first focus group took a similar position, observing that although many of the techniques they used (scavenger hunts, role plays etc.) are meant to be learner driven, they require, in reality, a significant time investment on behalf of the teacher.

If one stays with focus group one, it will be remembered that one of the potential learner problems that they identified related to credibility – how the learners might perceive the virtual world and how they could take it less seriously than the physical. A further issue related to this, and underlined by both groups, related to the problems with virtual skills and etiquette for both learners and teachers. When asked to elaborate, the participants pointed to possible learner problems with “*knowing what to do*”, “*knowing*

who is who” and *“knowing what is available and possible”*. All of this related strongly to the theme of learners getting lost as explored in the previous study. Focus group two, in particular, described the problems that they could foresee in this regard, and suggested that a significant amount of time would need to be given over to training those involved in identifying and resolving the possible problems.

Finally, both groups suggested that the hybrid learning space most lent itself to cross curricular uses, in that it provided teachers with an opportunity to go beyond traditional subject boundaries. Both groups offered practical examples of this throughout the study, whilst pointing to the challenges that it could incur within a schools context. In short, the challenges to designing learning activities in the hybrid learning space included the already established ones of bringing together the physical and the virtual parts, along with the more novel ones of time, virtual etiquette, and the issue of activities that encompassed more than one curriculum subject.

6.5 Discussion

The findings from this part of the study were then used to address the two sub-questions of RQ2. Where necessary, reference is made back to the earlier work in section 4.4, and to the experiences of the researcher in the implementing the activity in chapter five.

6.5.1 – Challenges in developing learning design by teachers working with hybrid spaces

A number of learning design challenges, relating to the degree of detail and the distribution of support for collaboration, were discussed in chapter four. Both of these were again evident in the present study.

The degree of detail in each of the learning activities was inconsistent. In broad terms, it was significantly less than in the previous study. Teacher expectations of the learners were set out, but less consideration was given to how the learners might achieve the goals. It can be argued that this allowed flexibility to the learners, letting them define the ways in which the tasks can be carried out. The problem with this argument, however, is that it also assumes a high degree of understanding on their part, both in terms of the rationale of the activity and the technical features of the hybrid space. In practice, neither of these factors can be taken for granted. In the earlier study, the teacher frequently had to intervene, explaining in detail how the learners could complete a task. This was in spite of the availability of scripts and instruction sheets. The lack of detail was mainly due to the way in which the process was applied. It was used to define the activity in a top level way, with the broad aims being set out, before then converting these into more discrete tasks. Once these tasks had been set out, there was no further attempt to use the process to define the interactions in a more detailed way. In other words, development stopped once the tasks had been established. It would have been more productive to use the process a second time to then define the

interactions within the tasks. This is not to say that the activities were unviable. It means that they had a number of shortcomings. These are addressed in more detail in section 6.6. Compared to the previous study, support for collaboration came solely from the Conversational Framework. Again the consistency of this support varied somewhat. In a few cases, it was significant, resulting in proposed learner roles and sub-tasks. It was interesting that these emerged out of the Conversational Framework, as explicit support for roles and scripts was eschewed in this version of the framework. The downside of relying on the Conversational Framework, therefore, was one of consistency across the parts of the activity. This was evident in terms of both detail and the degree of support for collaboration. Whilst learner scripts did not work well in practice, they would have been useful in this case as a form of quality control, and as a means of encouraging teachers to define precisely how collaboration would be supported. Modifying the process in this study did little to address the challenges of detail or support for collaboration.

6.5.2 – How existing perceptions of technology in practice shape teacher design and implementation practice

Teacher perceptions about hybrid spaces had a significant effect on their design practice, shaping the resulting learning activities in three ways.

Firstly, they perceived that each part of the space was ‘useful’ for particular learning purposes. They viewed the physical part as being good for activities such as issuing instructions, reflection, refinement and consolidation of existing learning, and the virtual part as being productive for finding things out, testing hypotheses and for collaborative enquiry and building work. This had two effects. Since some of these activities would be required at particular points of the learning activity (eg. Issuing instructions, refinement), it meant that the focus of the activity tended to move from the

physical to the virtual and then back to the physical as the activity went on. This set the scene for a series of tasks that were restricted to one part or other of the hybrid learning space. This accentuated the divide between the physical and the virtual and significantly reduced the potential for hybrid interactions.

Secondly, it meant that the envisaged hybrid interactions consisted of single and discrete moves between the two elements of the space, rather than the fast sequences of successive back and forth movement that often occurred in the first study. In other words, teacher perceptions favoured a particular type of hybrid interaction, one which was not dissimilar to the interactions in the previous study that involved communication or passing information from one part of the space to the other. This was evident at various points in the activities that the teachers designed. For example, a task would be assigned to learners in the physical space, and they would then move to the virtual space to initiate it. In other cases, the direction of movement was reversed with a building task being completed in the virtual, and with the learners moving back to the physical to discuss their progress. Whilst the researcher made a number of efforts during the study to move the teachers away from this conception of hybrid interactions, it was not very effective, and eventually led to the activity having to be modified in section 6.6.

Finally, their perceptions revealed a stronger emphasis on the role of the teacher than expected. This differed in two ways from the teacher interventions in the first study. Firstly, they envisaged the space as something which they could easily and quickly modify, particularly in terms of its virtual part, and saw such modifications as a means of encouraging learner interactions. This viewpoint is similar to that of Benford et al. in section 2.3.3, where they proposed that support for such interactions can be primarily offered through the software design of the learning space. For pragmatic reasons, this

approach has not been undertaken in this study, where the emphasis has been on ready-made virtual spaces. A second difference related to teacher presence. Whilst the researcher made a number of interventions in the first study; all orchestration came from the physical part of the space. There was never a permanent presence in the virtual part of the hybrid learning space. Nor was it used for direct teaching. The teachers in this study had other ideas. They suggested that some degree of virtual presence was essential to have a clear idea of what the learners were doing, and that simply observing them from the physical space was ineffective. Given that that the activity in study one was primarily learner driven, there was no great need for this. Lastly, they also viewed the virtual part of the space as somewhere from which they could issue instructions and support learner interactions. Again, they argued that support offered from the physical part of the space would not be as effective. There was no evidence of this in either of the two studies however.

Therefore, existing teacher perceptions of the hybrid learning space had a significant effect on their design practice. Their learning activities emphasised interactions occurring solely in one part or another of the space, punctuated by single hybrid interactions as the learners moved as a group from one part to the other. All of this was in a context of strong teacher presence in the virtual part, both in terms of design and orchestration.

6.6 The learning activity revisited

It was hoped that the groups who designed the learning activities would also implement them. For pragmatic reasons, this proved to be impossible, and it was necessary to get a different group of professionals to carry out one of the activities. Before reaching this stage, a number of challenges remained. Some of these were technical, in the sense of selecting one of the activities to implement, and modifying it to fit in the confines of a 90 minute time slot. Others were more serious, and related to whether or not the activity was likely to support the desired hybrid interactions. What follows, therefore, is a critical assessment of one of the activities, and by extension of the learning design process. The initial pragmatic evaluation is in section 6.6.1 whilst section 6.6.2 assesses the activity in terms of its support for hybrid interactions. The learning design process is critiqued and developed in section 6.6.3. A modified version of the activity is outlined in section 6.6.4, prior to its implementation in the next chapter.

6.6.1 Initial evaluation

An initial choice had to be made between the two learning activities. Following two practice sessions and further discussions with my supervisor and a small number of education professionals, it was decided to select the maths based activity created by the second of the focus groups, and described in more depth in *table 6.5*

The practice sessions also showed the activity both to be too lengthy (in terms of the time it required for implementation) and to be repetitive (in that many of the same steps occurred on more than one occasion). Given more time, such repetition could be justified in terms of helping learners to consolidate their knowledge. In pragmatic terms, where time and resources were limited, it made sense to remove some steps of the activity, whilst merging some of the others. For example, the web search for the 10

tallest buildings (task 2 in table 6.5) was abolished. It was considered easier to let the students find the buildings themselves in the virtual world. Conversely, the discrete tasks related to the learners measuring the buildings, and then discussing their findings (tasks 3 and 4 in table 6.5) were merged together. It was faster for the learners to discuss their findings whilst they carried out the measuring work.

Secondly, the original version of the activity was strongly teacher led. It was proposed that the teacher should intervene frequently in order to explain the various steps, and to instruct the learners on what they should be doing at different points. This partially reflected the school education background of those who designed it. Whilst this might be appropriate for groups of younger learners, it was not an ideal prescription for the eventual adult participants of the activity. Moreover, such a prescriptive approach ran the risk of ‘overscripting’ (Dillenbourg, 2002), in the sense of distorting possible collaborative interactions amongst the learners. Therefore, parts of the activity that were considered to be overly directive for adult learners, were again either removed (‘developing ideas’ in task 4 of table 6.5) or merged with other tasks (such as ‘icebreaker’ in task 1 of table 6.5)

The result of these modifications was a learning activity that was somewhat shorter and simpler than that of *table 6.5*. The modified version of the activity, along with the main changes can be seen in *table 6.6*.

<u>Part No</u>	<u>Title</u>	<u>How this relates to the initial activity</u>
1	Icebreaker	This replaces part 1 (“Icebreaker”) of the original activity. The focus of the activity is moved from the teacher to the learners.
2	Finding and Measuring	This is a merger of parts 2 (“web search”), 3 (“find the buildings”), and 5 (“get the heights”) of the original activity. Whilst some of this requires use of the virtual world, it is up to the learners to decide where and how to perform each of the task requirements. Part 4 of the original activity (“developing ideas”) has been removed
3	Designing the league table	Similar to part 6 (“Designing the league table”) of the original activity
4	Presenting the results	Similar to part 7 (“Presenting the results”) of the original activity

Table 6.6 – Learning activity (final version) – how this relates to the previous version

The organisation of the activity, in terms of what the learners were expected to do, is shown in **table 6.7** below. There was an “icebreaker” task which required the learners to communicate with their peers and to show each other how to perform a variety of virtual world tasks. The second part of the activity required the learners to locate a number of tall buildings, and to find out their relative heights. They were only given minimal support as to where these were located. The learners were also expected to

communicate their intermediate findings to the others, through whatever means they chose. In the third part, they were expected to use a ‘sandbox’ in the virtual world to construct a league table of the tallest buildings. How they achieved this was, again, left open. Finally, the learners presented their completed artefact to each other and to the teacher. Although a number of resources (paper sheets, whiteboards, virtual) were provided for this, the learners had to collaborate in order to decide the most appropriate way of explaining what they had done.

<u>Part No</u>	<u>Title</u>	<u>Organisation</u>
1	Icebreaker	The learners complete a series of jobs that require them to show others how to navigate around the virtual world and use its features.
2	Finding and Measuring	The learners attempt to locate the world’s tallest buildings as represented in the virtual world. They must share their findings (as they go along) with the other learners, and keep records of what they find. They must also find out and store whatever data they can about the buildings.
3	Designing the league table	By using a sandbox in the virtual world, the learners construct a league table showing the relative heights of the buildings in question.
4	Presenting the results	Presentation by the learners of the completed artefact - explanation of how they constructed it.

Table 6.7 – Learning activity (modified version) – organisation

6.6.2 Encouraging hybrid interactions

Whilst these modifications made the activity easier to implement, the issue of supporting hybrid interactions remained. A closer examination of the activity pointed to several concerns.

Firstly, there were parts of the activity where no support for hybrid interactions was envisaged. This led either to tasks that were explicitly designed to be carried out entirely in one part or other of the space; or indeed in tasks which nominally had some hybrid component, but where the outcome was likely to be the same as the other kind of task. An example of the former can be found in the ‘icebreaker’ (task 1). Here the learners were expected to receive initial instructions from the teacher, entirely in the physical part of the space. A similar pattern was evident in task 2, as the learners carried out a web search, again completely in the physical space. Immediately after this, they move to the virtual world to locate suitable buildings. In this second case, there is some potential for hybrid interactions (by communicating the details to learners in the physical space), should the teacher or learners desire it, but it was not clear how this might be realised. The outcome was likely to be a task which was carried out solely in the virtual world.

A second issue concerned tasks which were designed to be hybrid in nature, but which may prove less than ideal when implemented. In chapter 5, a distinction was made between simple and more complex hybrid interactions. The former were short lived and frequently unstable. The latter were more complex, but also more stable. In general, the former often involved tasks that required the simple passing of information from one part of the space to the other, whilst the latter was made up of richer tasks that required the learners to collaborate and negotiate on open ended problems over a longer period of time. As it stood, the activity offered many of the former types of hybrid

interactions, and few of the latter kind. An example of this can be seen in task 4, where the learners were expected to present their findings in the physical space. Given that they were drawing on the virtual league table from the previous task, it was likely that this task when implemented would simply consist of them transferring their findings from the virtual to the physical. Something similar was evident in task 2, when the learners measure the virtual buildings. The results could be stored entirely in the virtual world (with no hybrid interactions), or could be passed to the physical space (which again indicates the sort of simple hybrid interaction that we were concerned with in chapter 5). In either case, the outcome was not ideal.

Finally, there were some envisaged hybrid interactions which fitted the description of ‘complex’ as developed in chapter 5, but which could be both better described and possibly improved upon. An example of this occurred in task 3, where the learners collaborated to build a shared artefact (‘league table’) in the virtual space. It was likely that they would have to communicate considerably across both parts of the space in order to complete this. This was promising, but the fact remained that the task could still be improved upon, so as to better exploit the context.

<u>Part No</u>	<u>Title</u>	<u>Support for Hybrid Interactions</u>
1	Icebreaker	<u>None</u> – All instructions are given in the physical world by the teacher
2	Finding and Measuring	Web Search (old task 2) – <u>None</u> – The entire task is completed in the physical space Find Buildings (old task 3) – <u>Minimal</u> – The learners are directed to a particular location in the virtual space– but there is little attempt to go beyond this and to move towards richer interactions Measure Buildings (old task 5) – This is <u>simple hybrid</u> where learners just transfer data from the virtual to the physical.
3	League Table Design	Based on chapter 5, this will produce <u>complex hybrid</u> interactions. However, the task can be improved so as to take full advantage of this.
4	Presenting the results	Again, this is <u>simple hybrid</u> with the transfer of information from virtual to physical.

Table 6.8 – How the activity supports hybrid interactions

The picture was far from ideal. Several tasks offered little or no support, whilst others only promoted a simple and short lived version of such interactions. Where more promising hybrid interactions were planned, there remained room for development or refinement, even if only to render the anticipated workings of such interactions more explicit.

6.6.3 Development of the learning design process

The version of the learning design process used in this chapter did not provide sufficient support for hybrid interactions.

To begin with, hybrid interactions resulted from activities (in study one) that were open ended in terms of teams and tasks. The learners were left relatively free to define their own teams (and to change between teams where possible), and to complete the tasks in whatever ways they thought were viable. This had a number of advantages. It reduced what the learners have to remember in terms of instructions, thereby letting them concentrate on the activity itself. It allowed them to make decisions quickly, and more naturally, in light of emerging conditions. Rather than closely following a specific script (as in chapter five) or attempting to replicate a particular outcome, they instead found imaginative and often unexpected solutions and paths towards completing the activity. By having ownership of the tasks, they were more likely to persevere and find ways of solving them. Most of the complex hybrid interactions in the first study developed out of these conditions, rather than from teacher led instructions to perform the task in a given way.

Allied to this, was the ability of learners to define and take on various roles as the activity progressed. The nature of these varied, but roles such as ‘go-between’ and ‘expert’ figured quite prominently in the first study. In some cases, typically for the earlier stages of the activity, these roles were chosen by the teacher in advance; whilst in others they were both defined and developed by the learners as the activity went on. These roles contributed to complex hybrid interactions, partly because they offered a degree of instant expertise to the learners as they attempted to overcome phenomena such as ‘getting lost’ and partly because they provided a broader vision or agenda to the

learners about how to complete the various tasks. In short, they kept the learners involved and informed at points where they might have been tempted to give up.

Thirdly, complex hybrid interactions frequently arose out of mutual adjustment situations. In the previous study, the detailed negotiations to enter the teleporter represented an example of this. This was also evident in the various contingent negotiations to ensure that all of the learners went to the same virtual location, and then proceeded to attempt the relevant tasks. It was tasks such as these that forced the learners to bring together their understanding of what was happening in both the virtual and physical spaces. It required them to use the features of both parts of the space in order to successfully complete the task at hand, and to frequently move between the virtual and the physical. Inherent in this was the concept of the learners verifying each-others activities, usually in an attempt to check that a particular request had been properly completed. In study one, it was evident that negotiations could only continue (step by step) once each learner was able to verify the degree of compliance of the other learners. Again, this required the learners to be fully involved in both the physical and virtual parts of the space, to move between them, and to ensure that they could make clear sense of what was happening in both of them. The complexity of the hybrid interactions arose out of this forced movement and understanding.

These factors (giving the learners a high degree of control, emphasising and encouraging learner roles, integrating mutual adjustment and verification into the activity) represented an addition to the learning design process, complementing the part played by the Conversational Framework, whilst replacing the scripts of the previous version. This new version provided us with a viable means of supporting both hybrid interactions *per se*, and of encouraging the sort of complex hybrid interactions that were in evidence in the last chapter study.

6.6.4 Refining the learning activity

In the previous version of the first task, there was no explicit support for hybrid interactions. The aim of the ‘icebreaker’ was for the teacher to give instructions to the learners in the physical space. One approach was to make the task (slightly) ‘more’ hybrid by suggesting that some of this initial instruction take place in the virtual world. The problem with this, however, was that there would still be no guarantee of hybrid interactions occurring. Indeed, such a change met few of the criteria that were discussed earlier in terms of learners having more control and developing roles, for example. A more productive solution was for the teacher to give only very basic introductions about the activity (in the physical space), and for the learners to then continue with a number of ‘icebreaker’ tasks in the hybrid space. In the modification set out below, the learners become responsible for teaching each other how to use the various technical features of the virtual world. A series of cards were given to each pair, and their mission was to firstly try out the specified parts of the task, and then to show how to perform this to at least one of the other pairs. The main parts of this modified task are set out in table 6.9

Task	Original Version	Modified Version
1 – Icebreaker	Teacher explains instructions to learners in the classroom / physical space	Simplified instruction process in classroom followed by: Learners work as pairs and must use technical features of virtual world to program / move / animate their avatars They must then select at least one other pair of learners and show them how to perform the same steps

Table 6.9 – The modified version of task one

Returning to the framework set out in the previous sub-section, then there were a number of further additions to be made to the version of task one. To begin with, the responsibility for organising the task was effectively given over to the learners. This meant that they now had to work out who the other learners were, along with their intentions and levels of expertise. These are difficult things to do through observation alone, and the learners will therefore had to constantly check what their peers were doing. Similarly, some degree of mutual adjustment was required to get other learners to perform the requisite steps of the task. Finally, two of the learners were given the roles of ‘go-betweens’ by the teacher at the start of the task. This was not to prevent others from taking on such roles as the task proceeds; it simply afforded an extra (imposed) degree of encouragement for hybrid interactions. The final version of task one, including the various supports for such interactions is set out in table 6.10.

Task	Learner Control	Roles	Mutual Adjustment	Verification
1 – Icebreaker	The learners are responsible for: Moving to the correct virtual location / for assigning steps to others / for ensuring that their own pair completes the task / for encouraging others to perform the necessary steps	Teacher picks two go-betweens at the start of the activity Other roles to be determined by the learners as the activity proceeds	Required – to ensure that the task is being completed / to get learners to the correct location / to encourage other learners to attempt the task / to get them to change what they are doing etc.	The learners need to check that other pairs are in the correct location / using the right tools / following the correct steps etc.

Table 6.10 – How task one now supports more complex hybrid interactions

The second task was longer and more detailed than the first. It proposed a number of steps, and already included some degree of support for simple hybrid interactions. The challenge, here, was not so much to make radical revisions to the task, but rather, to look at some modest changes that encourage more complex hybrid interactions. Some initial changes to the task included the removal of the ‘web search’ (which offered no hybrid component and could be completed within the virtual world instead), getting the learners to find out for themselves where the relevant buildings were located (as opposed to directing them there) and adding a proviso to the step that they must take a virtual ‘photo’ with one other group once they arrive there (again, in an attempt to encourage hybrid interactions). Finally, when they measured the relevant buildings, the decision about how to communicate this information (and to whom) could be left open. The learners were simply told that they must share the information, but the exact modalities were left open. Both the original and modified versions of task 2 can be seen in *table 6.11* below.

Task	Original Version	Modified Version
<p>2 – Finding and Measuring</p>	<p>This is a merger of parts 2 (“web search”), 3 (“find the buildings”), and 5 (“get the heights”) of the original activity.</p> <p>Part 4 of the original activity (“developing ideas”) has been removed as it was quite similar to other parts of the activity</p>	<p>2 - Removal of the ‘web search’</p> <p>3 - ‘Find the buildings’ modified so that the learners must firstly work out the virtual location before going there. They must take a ‘photo’ of at least one other group every time they find a relevant building. To do this, they must invite the others, ensure that they arrive in the right place in time etc.</p> <p>4 – Removal of ‘developing ideas’</p> <p>5 - ‘Get the Heights’ – This is made more open ended with no instructions about how / where the learners should communicate what they find</p>

Table 6.11 – The original and modified versions of task two

If we now review task two in its broadest sense, then the significance of the proposed changes become clearer. As before, the learners are now responsible for finding the appropriate virtual locations, and for ensuring that the other learners reach these in good time. Similarly, the learners had to decide amongst themselves how to divide up the work. Responsibility was again distributed. Hybrid interactions were better supported through mutual adjustment (in that the learners had to collaborate in order to reach the same virtual location), verification (they had to check what the others were doing) and the assignment of roles in advance (as the teacher was expected to select two learners as ‘go-between’ in advance of the task). The degree of support that task two offers for complex hybrid interactions is shown in *table 6.12*.

Task	Learner Control	Roles	Mutual Adjustment	Verification
2 – Finding & Measuring	Learners have to pick location – look for appropriate exhibits – divide work between themselves – agree on how to complete the task – compared to the earlier version it is up to the learners to decide how and where to perform each of the sub-tasks	Teacher assigns two learners as ‘go-between’ at the start of the task	The learners must agree on a single virtual location and ensure that the others are able to reach it / there must then be further negotiation concerning finding the buildings, getting the others to go there / negotiation about how to share and store information about what they find etc.	Required – to ensure that learners are in the right place – or moving towards it – then that they are in the right part of that place – taking a picture, that they are getting the details about the correct buildings, that they are communicating this to the others etc.

Table 6.12 – Support for Complex Hybrid Interactions in task two

In task three, the challenge was not so much to modify the task, as to explain why it was likely to support complex hybrid interactions. It required the learners to construct a shared artefact in the virtual world, with the relevant information from this originating from both parts of the space. A similar task in study one, led to a number of stable and long lived hybrid interactions. As before, the responsibility was on the learners to organise both each other and the various parts of the task. The degree of mutual adjustment required by the learners was more detailed than in the previous tasks as they had to negotiate not only where to go (as in task 2), but also the best ways of performing the task, along with who should complete which parts of it. Again, all of this required a high degree of verification. One difference compared to before, was that role assignment was left open, and not imposed by the teacher. The main supports for hybrid interactions in task three are set out in *table 6.13*.

Task	Learner Control	Roles	Mutual Adjustment	Verification
3 – Designing the league table	As with the earlier tasks, the learners must decide on a useful virtual location, on task division and sharing, on collaborating to build the shared artefact etc	Open – This will be decided by the learners during the task (should they wish to)	Similar to task 2 – but more developed – the learners have to agree on a location, on assigning tasks, on coordinating and putting together the various parts to make a single artefact	Required – to ensure conditions of negotiation are met – that they are in the right place – that they are building what they are supposed to be building – that we know where they are and what they are doing – that they are putting it all together – and correctly

Table 6.13 – Support for Complex Hybrid Interactions in Task three

It was argued earlier, that the fourth (and final) task was most likely to lead to simple hybrid interactions. This was because it emphasised the transfer of information from the virtual to the physical world. Such interactions remained simple, as all the learners had to do was to decide how best to communicate this information from one place (namely the league table) to another. In study one, this often resulted in a single learner reading out what they saw in the virtual and the others simply copying it onto a whiteboard in the physical space. It was therefore desirable to encourage more complex hybrid interactions in the design of this task. One way of doing this was to preserve the original idea of presenting the results on a whiteboard in the classroom, but instead asking the learners to gather their information from a number of virtual locations instead of just one. The effect of this, again, was that they had to negotiate issues of virtual location, division of labour and role assignment. The learners were responsible for ensuring and verifying that others had completed their instructions. The aim of all of this was to change the nature of support in the task from that of simple hybrid interactions towards the more complex ones evidenced in the previous study. Both the modified version of the task, and the support that it now offers for hybrid interactions are set out in *tables 6.14* and *6.15* respectively.

Task	Original Version	Modified Version
4 – Presenting the results	Learners present their findings as a group in the classroom / physical space. To this, they will need to summarise what they have found in the virtual world (on the league table) and communicate it to a whiteboard in the classroom	Presentation to the whiteboard, but the information comes from several sources in the virtual world. The learners need to find a way of bringing all of this together before communicating it to the classroom.

Table 6.14 – Modifications to task four to encourage complex hybrid interactions

Task	Learner Control	Roles	Mutual Adjustment	Verification
4 – Presenting the results	As with the earlier tasks, the learners will need to divide the task up, decide on the best ways of attempting it, ensure that others remain on task etc.	Open – This will be decided by the learners during the task (should they wish to)	Required to get the learners to find and summarise the information, to modify it where necessary, to present it when required etc.	Required in order to make sure that the negotiation conditions are met

Table 6.15 – Support for complex hybrid interactions in task four

The outcome of all of this was a learning activity that was significantly modified so as to better support the more complex type of hybrid interactions manifest in parts of the previous study. Typically, this was achieved by focusing on aspects of the activity that forced the learners both to negotiate with each other and to verify what the others were doing. An emphasis on roles (even when initially assigned by the teacher); and on moving responsibility for organising the activity from the teacher to the learners, ran parallel to these issues. We are left, therefore, with a vision of the anticipated hybrid interactions that one might expect to arise throughout the activity. The learner instructions for the modified activity can be found in *appendix 13*.

6.6.5 – The Learning Design Process – Implications

Compared both to chapter four and the beginning of this chapter, there were a number of changes to the learning design process. This was evident in terms of content and implementation. The content moved from a strong and explicit support for

collaboration through scripts, combined with a plan for proposed teacher interventions (chapter 4) towards a weaker support for collaboration based around the Conversational Framework (early in this chapter), and finally onto an explicit support for hybrid interactions, rather than collaboration more generally, through the design of the activity (as in the previous section). Compared to the start, both learner collaboration scripts and the plan for teacher interventions were eschewed. The final version of the process is shown in **figure 6.2** below. Moreover, the process was *implemented* in a different way at the start of this chapter (with the teachers) compared to in the previous study, with the Conversational Framework part being used in a looser, less detailed way. It was used to set out the expected interactions for the activity as a whole, rather than for each of the individual tasks as before.

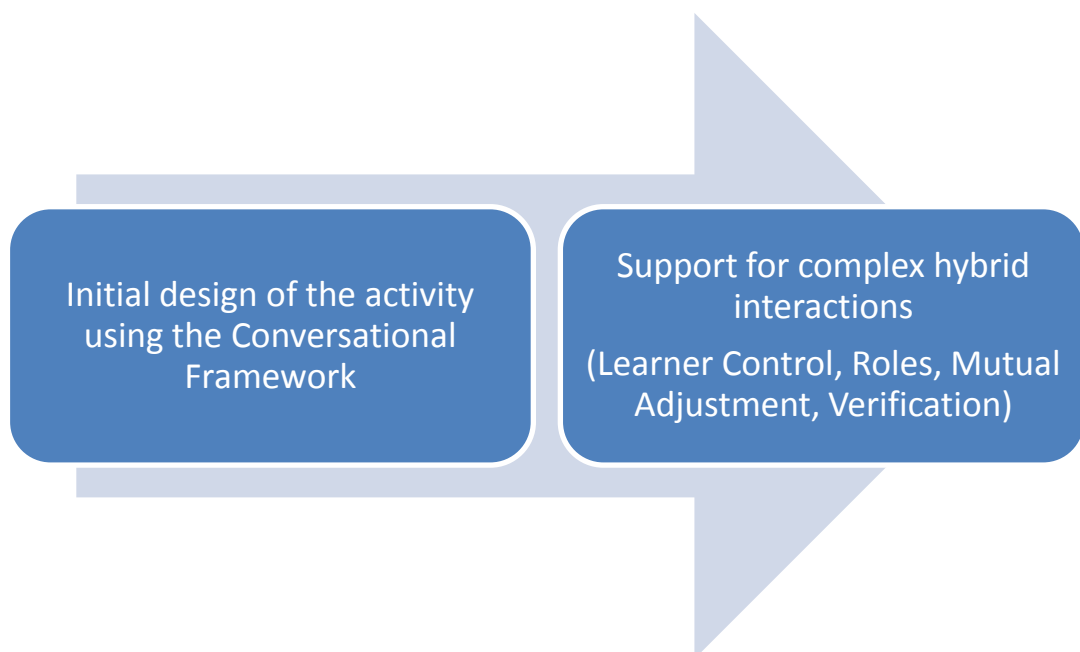


Figure 6.2 – *Version of the learning design process as used for the redesigned activity.*

This pointed to an initial failure to apply the findings of the first study, and to turn them into a generalizable tool for the teachers to support hybrid interactions. A number of the findings from study one would have been relevant. These included the specialised learner roles of temporary experts and go-betweens, novel practices supported by the hybrid learning space such as solving complex problems and task assignment, and the finding that some forms of hybrid interaction (such as those requiring negotiation and / or verification) were more detailed and complex than others. Whilst an understanding of the findings informed the running of the teacher workshops, it was not applied in an explicit way as part of the design process. The result was that the teachers did not have the opportunity to apply these findings, and they therefore struggled (more than one might have expected) to address the challenges of supporting collaboration. The resulting learning activities fell short of expectations and then had to be modified by the researcher.

Chapter 7

Study Two: Implementation of the hybrid learning space by educational professionals

This part of the study addresses research question three in further depth. It extends our earlier analysis, arguing that the relationships between collaboration, practice, and the contexts of the space are more complex than expected, with learner roles and activities again playing an important part in mediating these linkages. There are some differences in how the study was organised compared to before, and these are detailed in section 7.1. Whilst the relationship between research question three and the four empirical questions is identical to that in the previous study, the findings point to several novel forms of collaboration and teacher intervention, as discussed in section 7.2. Finally, the new findings are related more broadly to research question three, and to the discussion in chapter five (5.3).

7.1 Organisation of the study

The aim was to extend the analysis in section 5.3, examining in a deeper way the part played by learner and teacher roles and activities in the hybrid learning space. To ensure consistency of approach, research question three was characterised in terms of the same four empirical questions as in study one. However, there were two important organisational differences compared to the previous study. Firstly, the activity was implemented by a different group of educational professionals to the ones who had designed it (in chapter six). Secondly, as the records from the study were being examined, a number of changes were made to the analytical codes and categories.

7.1.1 Implementation by educational professionals

The teachers who implemented the activity were not the ones who had designed it. This occurred for pragmatic reasons as detailed in section 3.4.2. It was therefore important that the teachers had time to examine the activity in advance, ask questions about it, and then discuss how they would implement it. The activity was presented to them by the researcher around 30 minutes before starting, and they were invited to examine its main aims and then assess how these could be implemented. Whilst the learners were again expected to work in pairs, there was no attempt to suggest or enforce who might work with whom, and to what extent. Therefore, the initiation and minute to minute orchestration of the activity was left entirely to the learners. It was explained to the learners that the researcher would only intervene in the activity to prevent breakdown or to resolve significant technical problems. The reality of the implementation turned out to be somewhat different as explained in section 7.2.3. At this early point, the learners were already putting forward a number of competing proposals about how the tasks could be completed, making notes about how they planned to carry out the tasks once the activity started.

7.1.2 Collaborative viewing and the refinement of categories

The process of storing and reviewing the records from the activity was broadly similar to study one. The researcher now had an additional degree of experience and was able to complete tasks such as comparing physical and online video footage, identifying turning points, and tracing hybrid interactions across the parts of the space, more quickly than before. Collaborative viewing was carried out with the same co-analyst as before, with the existence of a previous working relationship having advantages in terms of reliability (as before) and convenience. As with the previous study, there was a process of refinement of the analytical categories once the video records had been

examined. Therefore whilst the empirical questions remained the same as before, the categories used to resolve them changed slightly, for three of the four questions.

The first empirical question examined the roles and activities that the learners used during collaboration. As the records from the study were reviewed, it became clear that the nature of collaboration was somewhat different from that of the previous study. It was less stable and was marked by a constant succession of pairs both entering and leaving whole group collaboration at short notice. At the same time, it was not unknown for a pair to work simultaneously on two different tasks with two different groups. To this end, two new categories labelled '*entry and exit of pairs*' and '*simultaneous collaboration*' were introduced. The co-analyst noted that there were several occasions during the activity where the learners appeared to be duplicating the same work as separate pairs. This also occurred during the previous study, but was not considered as a category in itself, as it was not very prevalent. There was some argument between the researcher and the co-analyst as to whether this should be included as a category. The co-analyst underlined the many points where this occurred, often for long stable periods, in the activity. Further examination showed how it was successfully mediated by the various roles and activities. It was therefore decided to add '*simultaneous collaboration*' as a new category.

The second empirical question, assessing non-collaboration, was originally portrayed in terms of both disagreement (usually with small effects on collaboration) and conflict or breakdown (which had more significant effects). Although, both were evident here, it was noticeable that where collaboration broke down, it was frequently following a number of successive setbacks, which would often divert the attention of the learners. In terms of collaborative viewing, a significant amount of time was spent on identifying

such setbacks and examining their overall effect on collaboration. The word ‘fracturing’ was used briefly in the previous study to describe these setbacks. Given their increased prevalence this time, the term has now been added to the framework. Compared to before, the learners made a number of efforts to reverse non-collaboration, and this theme was therefore incorporated into the new version of the framework. The two new categories, therefore, were ‘*fracturing*’ and ‘*learner efforts to reduce non-collaboration*’. Both of these were suggested by the researcher, and then supported by the co-analyst.

The issues surrounding teacher support for collaboration (empirical question three) were less clear cut. It was envisaged that little active intervention would be required. This turned out to be incorrect. Instead, the researcher worked to encourage pairs to communicate with each other, to join the broader group collaboration and to resolve incidents of breakdown, amongst others. Some of these themes were covered by the existing categories, whilst others were less well covered, and to this end, the existing category of ‘recovering from breakdowns’ was retained. It was felt that many of the other existing categories did not capture the detail and rationale of the researcher support that was offered, and were therefore removed. In their place, were added the new categories of ‘*helping individuals and pairs to get involved*’, ‘*encouraging pairs to enter group collaboration*’ and ‘*bridging parallel collaboration*’. The first of these was identified by the co-analyst, whilst the latter two were proposed by the researcher.

Conversely, the categories for the final empirical question (activities that influence collaboration and non-collaboration) were left essentially unchanged, although the relative part played by these activities was somewhat different than in the previous study. In the initial viewings, it seemed that the work of some of the go-betweens

frequently had a negative impact on learner collaboration. In many cases, they did not have much understanding of the features of the software. Therefore, they sometimes gave the wrong advice to learners and this often damaged existing collaboration. The idea of adding an additional category ('go-betweens disrupt collaboration') in this empirical question was therefore proposed by the other research student. However, later collaborative viewings showed that the effect of this sort of go-between activity on collaboration was not that significant. Moreover, it was not clear that this small effect could be traced specifically to the go-between, or to other factors. The category was therefore not added. The final version of the focusing exercise for the activity can be found in *appendix 14*.

7.2 Analysis

The approach from study one was again used, starting with an overview of the findings. Attention then shifts to more detailed descriptions, their significance and the ways in which they relate to each other. Where appropriate, they are examined with reference to specific examples, drawn from across the activity. There is also a significant degree of discussion referring back to similar and different examples from study one.

7.2.1 EQ1 – What are learner roles and activities during collaboration?

Overview

The collaboration that occurred in this study was of a different character compared to that of the earlier one. Then, the underlying theme was one of stability, with the learners collaborating as a whole group for relatively long periods of time. This is not to overlook the importance of teacher interventions, and the part played by non-collaboration; but simply to underline that the participants collaborated as a group to complete each task in sequence. In this study, a similar sort of stability was less evident.

The activity was marked by short, unstable phases of whole group collaboration. Three themes were evident in all of this. The first concerned the frequent entry and exit of pairs and individuals into and out of whole group collaboration. Typically, a pair or an individual would collaborate with the rest of the learners for a short time, before then leaving the group for various reasons. Sometimes, they would then return later during the same task and contribute further. In other cases, they did not. Secondly, on other occasions, the group would break up into smaller units, each trying out different solutions to a specific task. Often such an approach later resulted in a single solution, which the learners as whole would then try to implement. In other cases, there was

duplication of effort and approach, and little attempt at reaching a whole group consensus. Lastly, there were cases where a pair would work simultaneously with two other groups, usually on different tasks. This resulted in whole group collaboration as the emphasis shifted from one task to another. The overall picture of collaboration was now one that was less stable and more nuanced, then in the previous study. The aim is to examine each of these emerging themes before exploring their underlying roles and activities in more depth.

Activity
Entering and leaving whole group collaboration
Parallel collaboration
Simultaneous collaboration
Questioning and verification
Mutual Adjustment
Temporary Experts
Go-Betweens

Table 7.1 – Roles and activities during collaboration

Task	Expected Interactions	Role or activity example
1	Learners teach others how to navigate around the virtual world and using its features.	Entering and leaving group collaboration (figure 7.1) Parallel collaboration (figure 7.2) Simultaneous collaboration (figure 7.3)
2	Learners locate the world’s tallest buildings as represented in the virtual world. They must share their findings (as they go along) with the other learners, and keep records of what they find. They must also find out and store whatever data / measurements they can about the relevant buildings.	Simultaneous collaboration (figure 7.4) Questioning and verification (figure 7.5 and figure 7.6) Mutual Adjustment (figure 7.7) Temporary Experts (figure 7.9) Go Betweens (figure 7.10)
3	Using a virtual world sandbox, learners construct a league table showing the relative heights of the buildings	Mutual Adjustment (figure 7.8) Go Betweens (figure 7.11)
4	Presentation to the whiteboard with information from several sources in the virtual world. The learners need to find a way of bringing all of this together before communicating it to the classroom.	N/A - This task was not completed

Table 7.2 – Examples of roles and activities during collaboration

Entering and leaving whole group Collaboration

In the first few minutes of the activity, the learners made strong efforts at locating and identifying each other in the virtual world. They then quickly started on the first task (where they had to teach each other how to animate their avatars in various ways). Sue and Mama's pair, however, remained detached from this. In the virtual world, the pair situated themselves a small distance away from the others, and spent minutes trying out the animation techniques on their own avatar. Their efforts remained visible to the others in the virtual world.

The pairs' isolation ended as Aisha invites them to work with the rest of the group. This required getting the pair to move closer to the others, and there was a degree of negotiation between Aisha and Mama, with the latter asking Aisha to 'come forward'. Aisha's avatar did this, and this encouraged Sue and Mama to move their avatar closer to the others. The rest of the group noticed the approach of Sue and Mama, and asked them to confirm who they were and how their avatars appeared. Jane, for example, pointed to screen whilst looking at Sue across the desk and asked 'Sue, is that you?' Mama responded to this by pointing out that 'we are the ones in the white'.

Having clarified all of this, the rest of the group now wanted to know what the newcomers could contribute. Ruth shouted to Sue and Mama that 'you can show us how to jump for joy' (one of the requirements of the task). Mama assented to this and started to explain the instructions (across the desk) to the others. There was a long cycle of both explanation and verification in the virtual and the physical aspects of the space as Mama explained the individual steps to Ruth, who then tried them out. All the while Mama was checking that Ruth was actually doing what she claimed to be doing. At the same

time, the remaining learners were simply following Mamas' instructions, and quietly completing the task.

Ruth, however, was still struggling to get things done, and she temporarily ignored Sue and Mamas' group. She turned her attention to the rest of the learners and repeated her question to them instead ('how do I jump for joy?'). This time, she seemed to act upon the instructions a little better and successfully finished her part of the task. Sue and Mama, who were watching this, noted Ruth's success by shouting, 'yes, I see you doing it'. The pair, realising that the task at hand has been done, again withdrew from the rest of the learners, and returned to experimenting with their avatar. In the space of about two minutes, they both entered and left the whole group collaboration. The sequencing of this entry can be seen in *figure 7.1* below.

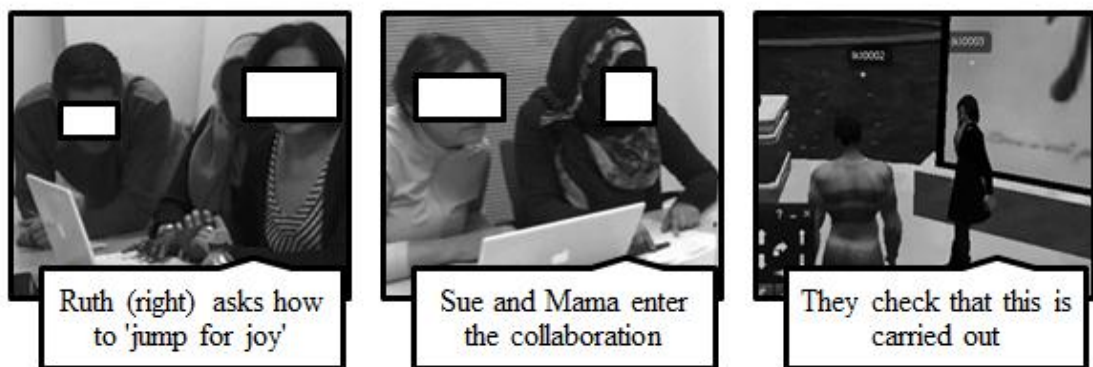


Figure 7.1 – Entering into collaboration

Parallel Collaboration

There was some duplication of effort throughout the activity, with the learners frequently performing as pairs, tasks that they were expected to do as a whole group. This ‘parallel collaboration’ was frequently unintentional. Often, there was little mutual awareness between the pairs, with the result that they did not know that the others were doing, effectively, the same things. This could be ended by the intervention of one or more of the learners. Conversely, the rationale was sometimes more deliberate, with the whole group purposely dividing into pairs in an attempt to try out different and competing solutions to a specific task. Where this was successful, the pairs were brought together, with their efforts contributing to an eventual single solution. Sometimes, however, this did not occur, and the pairs would continue to work separately.

Towards the end of task one, for example, two of the pairs were doing the same things, albeit in slightly different ways. Neither was aware of the others actions. This was noticed by Tom who then played the role of a ‘go-between’. Initially, he did not say anything, preferring to move between the pairs and observing what they were doing. He then started making suggestions for action to each of the pairs, based on what he had seen the others do. The process became more overt as he explained to each pair what their counterparts were doing. Finally, the curiosity of the learners was provoked, and they started to communicate directly with each other. The two pairs stopped duplicating their efforts and began to collaborate to complete the task. Each of the stages of this can be seen in *figure 7.2* below.

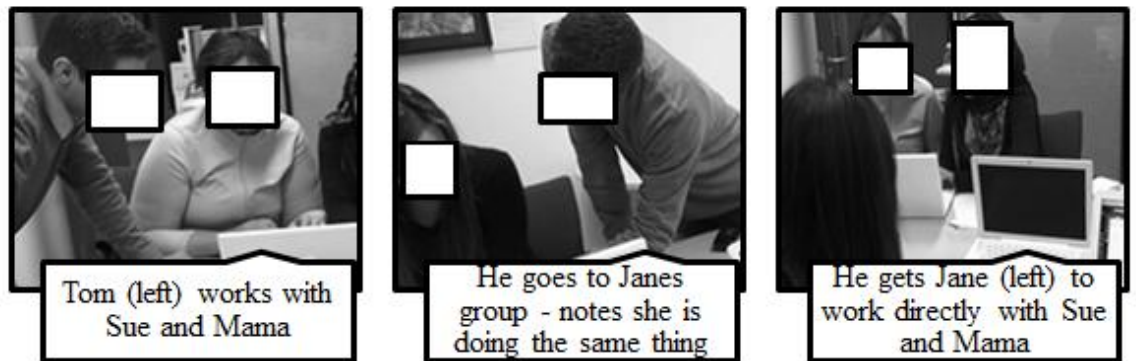


Figure 7.2 – Parallel Collaboration

Simultaneous Collaboration

Some of the pairs moved more quickly through the tasks than others. Frequently, a pair who had already completed a task would return to help others who had yet to reach the end. They would then discover that the remaining pairs were at different stages of the task, and would find themselves simultaneously working with two groups, but helping each of them in different ways. The dominant group was forced to quickly shift its' focus between each of the other two; in terms of asking questions, explaining and clarifying things, and checking that instructions were being followed. The outcome of this 'simultaneous collaboration' varied somewhat. Frequently, the other pairs would 'catch up' with the dominant one, thereby allowing whole group collaboration to proceed. In other cases, one of the weaker pairs would encounter a problem that could not be immediately resolved by the dominant pair. They would then fall further behind and become isolated as collaboration between the other pairs continued apace.

In the example below (*figure 7.3*), Sue and Mama collaborate in separate ways with two other pairs. Whilst Mama explains to Ruth (by shouting the instructions across the table) the various stages of how to make her avatar ‘jump for joy’, Sue is working in the virtual world to show Jane and Baba how to get their avatar to ‘laugh out loud’. Both Sue and Mama check how each of the others is getting on. When the two tasks have been completed, they detach from the other pairs and work separately for a time.

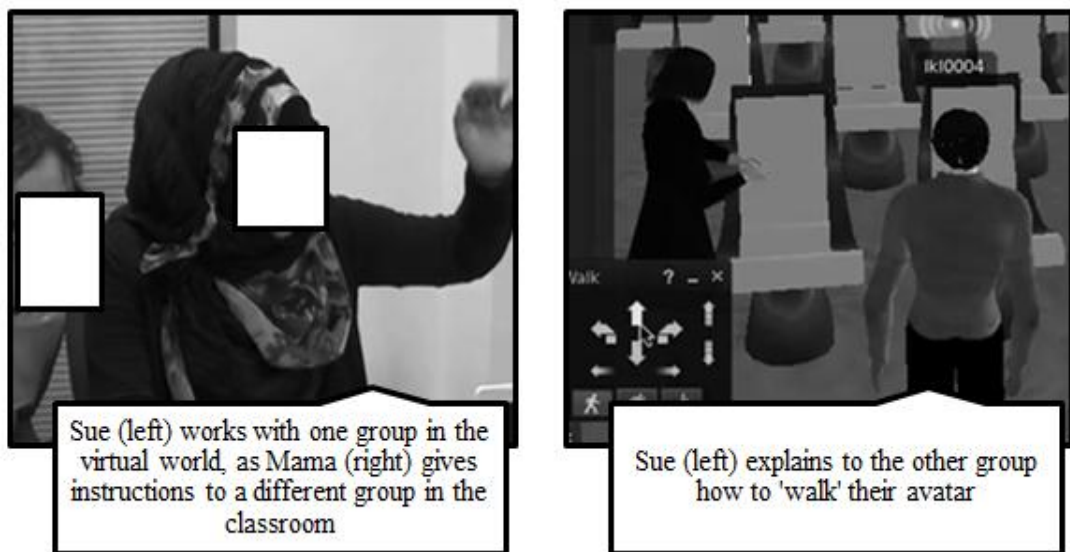


Figure 7.3 – Simultaneous collaboration 1

In the slightly different example below (*figure 7.4*), Jane and Baba are trying to get both of the two other pairs into the same virtual location. They do this by passing the relevant co-ordinates to each of them, and by then guiding them into and around the virtual world as they appear. One of the pairs successfully arrives, whilst the other one struggles to complete the task. Baba moves away to the pair concerned to help them out, whilst Jane continues to collaborate with the pair that has already arrived.

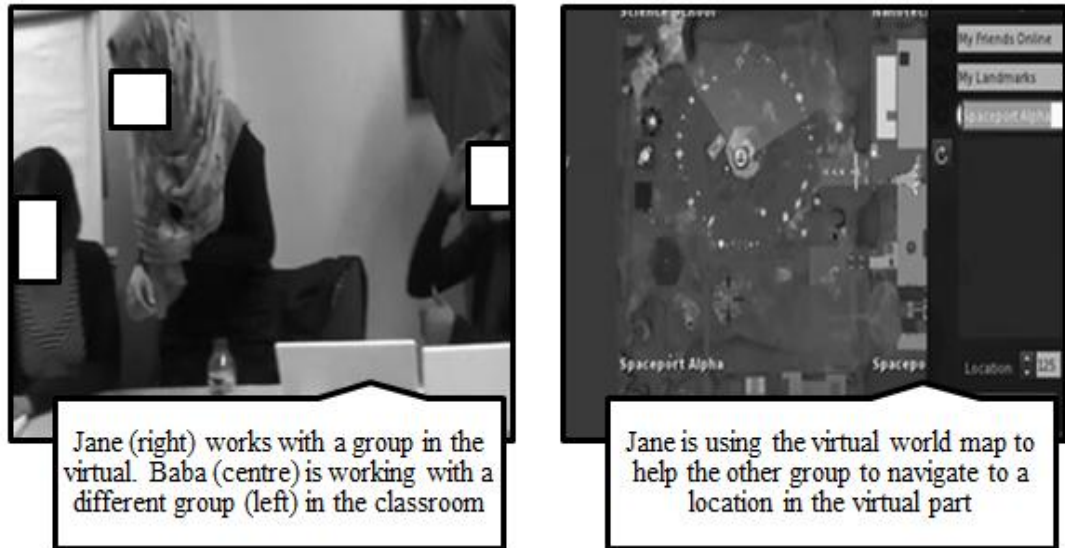


Figure 7.4 - Simultaneous collaboration 2

The nature of collaboration, then, was somewhat more varied in this study than in the previous one. Instead of being stable and relatively long lived; whole group collaboration was made up of several short incidents into which pairs of learners would enter and then exit. It was marked by an emphasis on both parallel and simultaneous collaboration. Having described the scene; the aim of the rest of this section is to explore in more depth the specific roles and activities that shaped the three themes set out here, and to assess why they sometimes led to whole group collaboration, and why they often did not.

Questioning and verification

The learners began to question each other from an early point; and themes familiar from the previous study quickly re-emerged, with participants using questions to find out what the others were doing, where they were, or how they were performing a particular task. There were several long sequences of questions and answers, with questions

becoming more detailed and specific in response to the answers offered by the other learner(s).

These questions provided the basis for learners verifying, and checking on each other's actions. This differed from questioning in that learner A no longer simply asked learner B what they were doing, but instead, physically monitored and checked on their activity. The questions, themselves were frequently used by one learner to develop an initial idea as to where the other learner was located, and what they were doing. Once this basis had been established, it was then possible to physically check on the other learners' progress and then to use this to inform ones' own progress. In the previous study, this often took the form of one participant grabbing a laptop screen from another and seeing what was on it. In this activity, it was more usual for the learners to walk over to the other pairs' screen, briefly analyse what was happening, and then quickly return to ones' own screen to carry out some action. After a few more seconds, the learner (having completed the action) would then jump back to where they had been, check for some further details and then return, again, to the their initial location. An example of this can be seen in *figure 7.5* below as Baba moves back and forth between her own desk and that of Ruth. She is helping Ruth to take a picture (in the virtual world) of Baba's group. This means that she must first position her avatar in a convenient location, before checking to see how the virtual world looks from Ruths' standpoint. She must also explain to Ruth how to operate the camera in the virtual world. None of this can be satisfactorily completed simply by asking questions. It was necessary, therefore, for her to move back and forth several times. Each time she had a greater awareness of how the avatars lined up in the virtual world. What she did was informed, minute by minute, by what she saw from checking Ruths' screen.

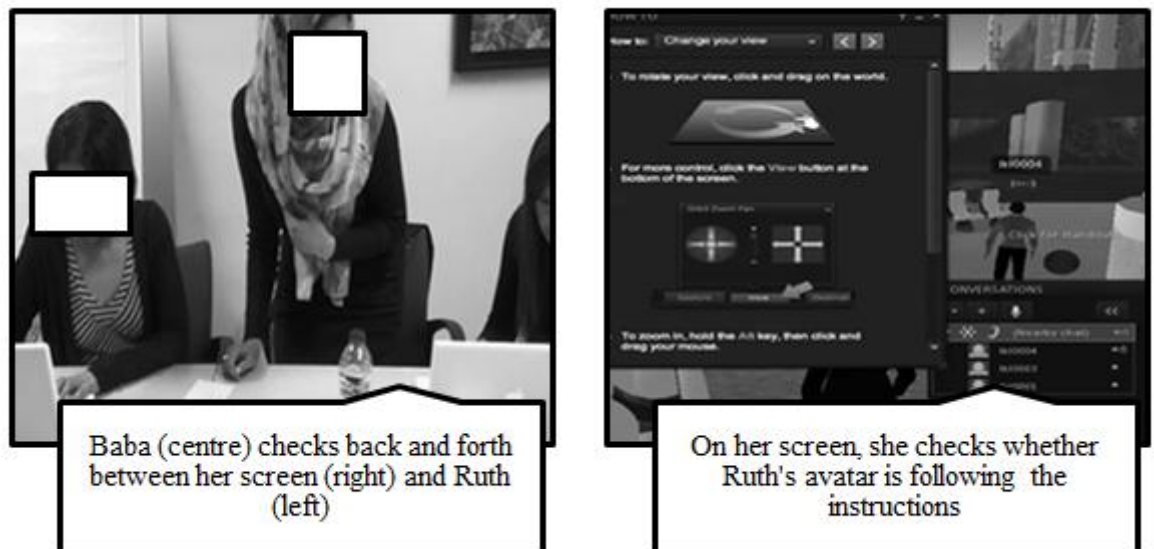


Figure 7.5 – Verification 1

This process of verification would start within a pair, where one learner would check what their partner was doing. They would try a number of different approaches towards completing a task (again within the pair). Once they were satisfied with what they had done, they would start asking another pair to do the same task. Where more than one pair was doing this, there was a degree of reciprocal verification, with two pairs performing different tasks, and both checking what the other was doing. An example of this can be seen in *figure 7.6*. Initially, there was verification within the two pairs. The group on the left (Ruth and Aisha) are trying out different approaches to changing the appearance of their avatar (as part of the task). Generally, Aisha performs the task, and Ruth checks that it is acceptable. The group on the right (Jane and Baba) are performing a different task, namely collecting items to put into their profile. In this case, Jane tries out the various approaches and Baba checks that they work. Each of the pairs complete their tasks at about the same time. They then want to get the other pair to repeat what they have just done. A cycle of questioning and verification begins, with each pair asking the other where they are, moving them to the right virtual location where necessary, and instructing them about what they should do. There is a constant checking

as each pair assesses the progress of the other whilst simultaneously trying to perform a task themselves. This points to a more complex and balanced form of verification than was evident in the previous study.

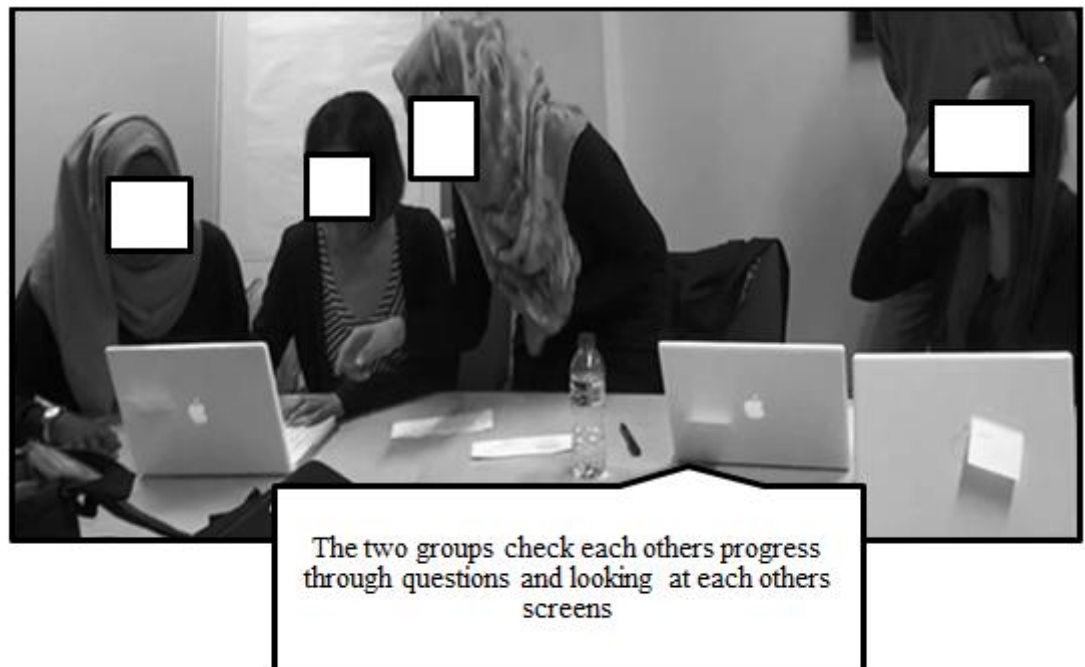


Figure 7.6 – Verification 2

Mutual Adjustment

A similar complexity applied to mutual adjustment, where learners needed to complete a shared task. In the previous study, for example, they had to agree on the order in which they would enter the virtual world teleporter and then carry out their plan. The task, in that case, was relatively simple. On this occasion, there was a greater degree of what we have termed ‘contingent negotiation’. This meant that achieving task Y was dependent upon the learners firstly completing task X. A number of challenges were inherent in this. To begin with, the learners were not always aware of the complexity of the tasks at hand. They were not necessarily aware that X had to be achieved before Y, for example. In other cases, they were aware of the complexity, but did not adequately

ensure that all of the learners had completed the earlier task. This often resulted in the groups breaking into smaller (sometimes competing) units, or becoming lost (by place, task or team). It often made future learner negotiation more difficult to carry out.

Some contingent negotiations were successful. In task two, for example, the learners (*figure 7.7*) needed to negotiate their move to a single virtual location (the science Exploratorium), before arranging for all of the avatars to enter the same building for a group photo. The latter task could not be achieved without the former. The pairs began by each declaring their current virtual location. One of the pairs discovered the coordinates for the Exploratorium first, sharing this with the others. They went through a process of constantly (and loudly) declaring where they were to the others. Each time they moved it was to get closer to where they all needed to be. As this proceeded, two of the groups could now see each other in the virtual world. By heading towards the Exploratorium, they have entered the second phase of the negotiation. Ruth noticed, however, that the third pair was nowhere to be seen. The missing pair (checking on Ruth's screen), realised that they were not in the right location. They had made some mistakes. They started asking Ruth, again, for the coordinates. She gave the information, and soon the missing pair arrived. All three pairs now entered the second phase of the negotiation. They started checking who the others were and what they intended to do. Again, through a mixture of questions, verification and negotiation, they began to enter the correct building. Already, there was argument about how they should position themselves for the group photo.



Figure 7.7 – Contingent Negotiation 1

In other cases, the challenges of contingent negotiation were too much. In task 3, the learners (*figure 7.8*) again had to agree on a single virtual location to visit, before negotiating who would build which parts of the league table. As before, this could not be attempted without getting all of the participants into the same place. Initially, things went well, with the pairs declaring their locations, reading out their coordinates, and arranging to go to a ‘sandbox’ in the virtual world, at the suggestion of Tom and Pradeep. This is where the negotiation began to break down. They did not make it clear which ‘sandbox’ they wanted the others to go to. Moreover, not all of the learners were able to use the ‘world map’ feature in the virtual world that would allow them to go to the sandbox. It took a few minutes before the participants became aware of this. Tom and Pradeep moved around to check what the others were doing, and noticed that they are all now in different locations. The mistake was realised and the group started negotiating again, this time agreeing on a common location to move to. They slowly moved there, but then had problems in visually locating each other in the expanses of

the virtual world. There were no obvious landmarks to refer to. They continued to shout out coordinates, but this was of little use. Part of the negotiation had been achieved, in that they were in the same location. But there was a lack of awareness, they could not locate each other, and this prevented moving to the second part of the negotiation.

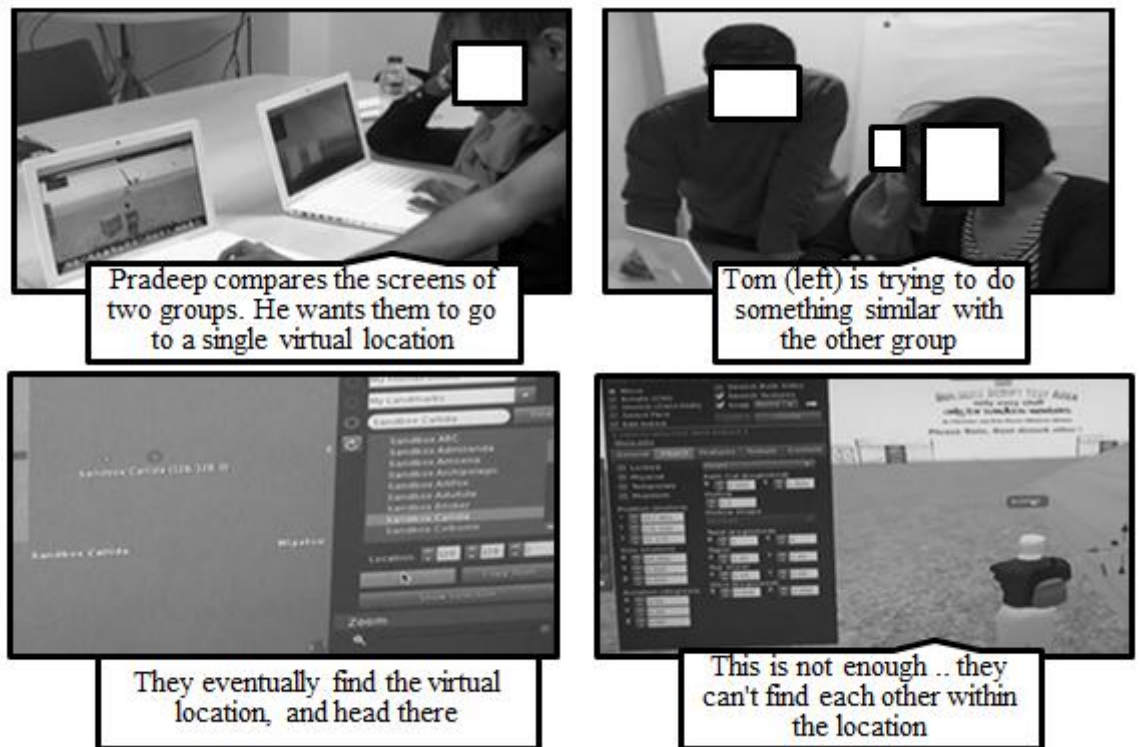


Figure 7.8 – Contingent Negotiation 2

Roles I – Temporary Experts

The part played by experts in shaping collaboration was just as important as in the previous study. The nature of the expertise that they offered was also similar, and was again usually concerned with how to navigate to particular locations in the virtual world or how to operate specific features and tools within it. The way in which the experts operated was somewhat different however. In the previous study, the experts tended to be individuals rather than pairs, and they would usually walk around amongst the other learners quietly showing them what to do, usually without being asked, or indeed

without requesting anything obvious in return. Their contribution, however, was somewhat detached from the broader minute to minute communication between the learners. In this study, the experts usually operated as pairs. Rather than move quietly amongst the participants, they would generally announce their expertise to the others. They would then say what they expected from the learners in return for sharing what they knew. In other words, there was a stronger emphasis on the equal sharing of expertise. Advice was offered in return for something else.

The uses that this expertise was put to also differed. Frequently, offering expertise to the others was one way in which a pair could enter broader collaboration. By declaring what they knew, and what they were good at, they would be brought into the group effort. Similarly, it offered the pairs a means of contributing to negotiations, and also a way of shaping the verification of what the other pairs were doing. Each of these themes can be seen in *figure 7.9* below. Baba and Jane's group have been outside of the group collaboration. They know, however, how to use the camera feature in the virtual world (which the learners need to use to record their progress). Baba announces this to the others, and is called over by Ruth. She talks Ruth through the use of the various controls, constantly checking back both to her own screen (to make sure she has it right) and to Jane (with whom she keeps checking the details). Whilst this is happening, Jane continues to research the camera and how it works. As she finds out new features, she shows them to Baba (who then shows them to the other learners). When this is not possible, she shouts them directly to the other pairs. They try out the new features as soon as they hear of them.



Figure 7.9 – Temporary Experts

Roles II – Go-Betweens

In the previous study, go-betweens would find one individual or pair who was performing better than the others at a particular task, and then encourage the other learners to view (and then emulate) what that pair was doing. In other cases, they would simply note what the higher performing pair was up to, and try to explain it to the other participants. In this study, they played a similar part, and were particularly effective in helping pairs to enter whole group collaboration and in bridging incidents of parallel collaboration. In the first task, for example, Tom noted how several of the pairs were working separately to solve the same task in slightly different ways. He started off by noting what each pair was doing and then started to explain the actions of each one to the others. There was no initial effort to get the pairs to work together; instead, he simply brought ideas from one pair to another. As time went on, he then encouraged individuals in the pairs to ‘go and see’ what the others were doing. The task of supporting collaboration slowly shifted from the go-between to the pairs themselves.

The work of the go-betweens was significant in two other ways. Firstly, they played a stronger, more long-term role in sharing practice between the various pairs. This differed from the previous study, where their interventions were shorter and more limited. This can be noted in *figure 7.10* where Tom moves between two pairs for just over six minutes. He spends much of the time studying what Jane and Baba are doing, before moving to the neighbouring pair of Ruth and Aisha. He examines what they are doing, and only makes some small suggestions about how they could improve. He then returns to Jane and Baba and explains to them what he saw the other pair doing. Over the rest of the task, he continues to bring ideas and suggestions between the two pairs. Towards the end, he then moves to Sue and Mama's group, who have thus far been outside of the collaboration. He checks where they are and shows them how they can help the others. They then start to collaborate with the rest of the participants. Staying with this example, it is interesting to note the dynamic between the go-between and the experts in the individual groups. Tom, in this case, started with little knowledge of the features of the virtual world, but he is successively 'coached' by Ruth (camera features) and by Jane (world map). In the other sense, the experts built on what they know by asking the go between and were frequently able to later use what they had learned in order to enter collaboration.

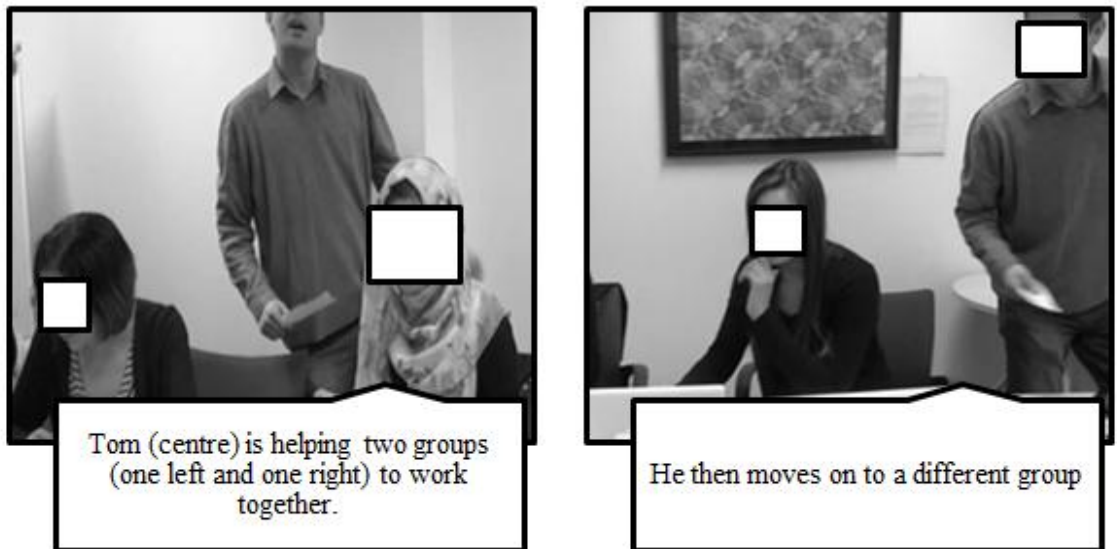


Figure 7.10 – Go Betweens 1

Finally, in this study, there were incidents where the go-betweens collaborated. This is something which did not occur much before. In *figure 7.11*, both Tom and Pradeep divide their attentions between the three pairs. They begin by questioning each other, and by trying to work out the relative strengths, weaknesses and progress of each of their charges. They discuss this for just under a minute before deciding on what to do. Rather than work as a duo, they split in two and divide the pairs up, with Pradeep going to Ruth and Aishas' group (who are struggling with teleporting) and Tom working with the other two groups.

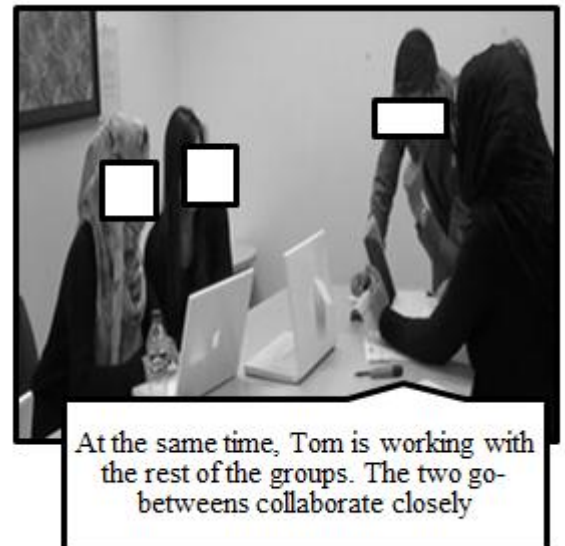
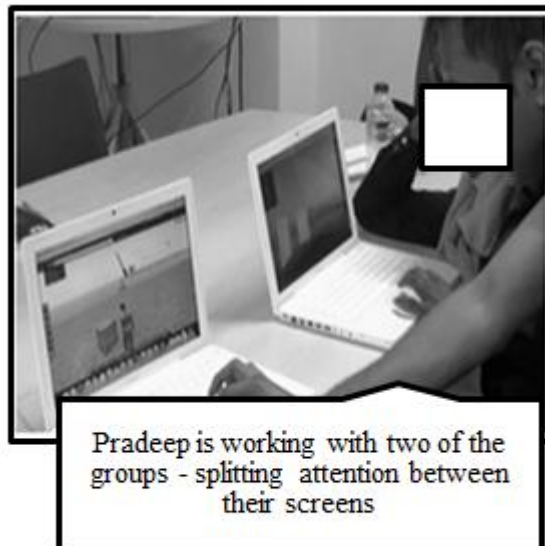


Figure 7.11 – Go Betweens 2

7.2.2 EQ2 – What are learner roles and activities during non-collaboration?

Non-collaboration also differed somewhat compared to the previous study; and this provided a useful opportunity to study several of the roles and activities surrounding it in more depth.

Overview

In the first study, non-collaboration was marked by a (reasonably balanced) prevalence of both disagreement and conflict. The former applied to incidents where the learners argued and disagreed about a particular course of action, whilst the latter was more aggressive in nature. Both led to a weakening, or ending of collaboration. Moreover, there were few attempts on the part of the learners in the earlier study to attempt to reverse such moves towards non-collaboration. The onus of support fell largely on the teacher.

Things were different in three ways. Firstly, there remained a strong emphasis on disagreement and argument between the learners. This rarely led, however, to outright conflict or to the sudden breakdown of collaboration that was evident before. There was much disagreement, but little conflict. Secondly, the outcome of this was frequently an initial break or ‘fracture’ of collaboration, rather than its’ sudden collapse, with the learners continuing to work towards a single goal, but in parallel groups. Over time, these groups would again come together (possibly with the help of go-betweens), and return to the original group collaboration. Finally, the participants made strong and continuous efforts to overcome non-collaboration as the activity proceeded. This was often a difficult thing for them to do.

At a deeper level, the biggest difference between the two studies concerned how non-collaboration could best be described. In the first study, it was generally portrayed as a single incident or event where learner collaboration seemed to suddenly end. An approach such as this was less representative of the present study. Instead, it was more productive to view non-collaboration as a longer term process, as something which the learners moved either towards or away from throughout successive interactions and activities. It was also something which the learners had great power to reduce or reverse. Our interest, therefore, was in examining the on-going fractures which moved the group towards non collaboration, and in the persistent efforts made to overcome it. Task three, which required the learners to collaboratively build a number of items, was a particular case of this.

Task	Expected Interactions	Role or activity example
3	Using a virtual world sandbox, learners construct a league table showing the relative heights of the buildings in question.	Fracturing (<i>figure 7.12 and figure 7.13</i>) Efforts to reverse non-collaboration (<i>figure 7.14</i>)

Table 7.3 - Non-collaboration – Examples in task 3

Fracturing – Moves towards non-collaboration

The envisaged task was never really started, let alone completed. Yet, it began promisingly enough, with the learners collaborating as a whole. It finished ten minutes later with some of the individuals and pairs working alone on the task, and with others lost, distracted or detached from the remainder of the group. How did this happen?

One objective was for all participants to move to a single sandbox, prior to assigning tasks and beginning to build. Tom got the task started (*figure 7.12*) by proposing to the group that ‘we should go to the first sandbox on the world map – that’s sandbox ABC’. As they did this, two challenges emerged. Firstly, not all learners knew how to use the world map. Secondly, because of how locations were named in the virtual world, it was not clear precisely which sandbox could be considered to be ‘sandbox ABC’ – there were several locations with this name. There was already an initial fracture in the collaboration, as one of the pairs went to the intended location (Tom and Pradeep), whilst another went to the wrong location (Jane and Baba) and a final one (Ruth and

Aisha) was unsure of how to find the world map. Tom and Pradeep, in the correct location, were not immediately aware of what had happened, and continue to experiment with the building tools of the virtual world – alone.

Jane and Baba (in the wrong location) were aware that not all was well. Baba walked around to Tom and Pradeep'. She noticed that they were in a different location. Ruth chimed in (she had since mastered the world map) pointing out that 'we need to agree on the coordinates for sandbox ABC'. The group tried to get to the same location, as they checked, shouted and verified that entering the relevant coordinates brought the desired results. They were finally in the same location. But given the size of the sandbox, they could see where they were in relation to the others. To complicate matters, the sandbox was populated with a number of avatars from outside of the group of learners. This both confused and distracted the participants. Did the avatars belong to somebody in the group or to someone else? The learners found each other and started to practice with the building features. But there was then a second fracture in collaboration as some of the outside avatars interrupted the work of the learners. They needed to change location again.

At this point, the teacher intervened and sent the participants to a single location. Tom and Pradeep worked as go-betweens to help the others move there. The learners again collaborated as they drew simple objects and look for ways of combining them into a larger build (*figure 7.13*). Some of them struggled to use the building tools, whilst others were not sure how to move objects around. By asking questions and checking on others, they solved these problems one at a time. They frequently did this within their pairs. As they did this, however, they had less and less involvement with the collaborative task they were meant to be doing. There was a third fracture in

collaboration as Sue and Mama moved away from the others into a corner of the sandbox and started building there.

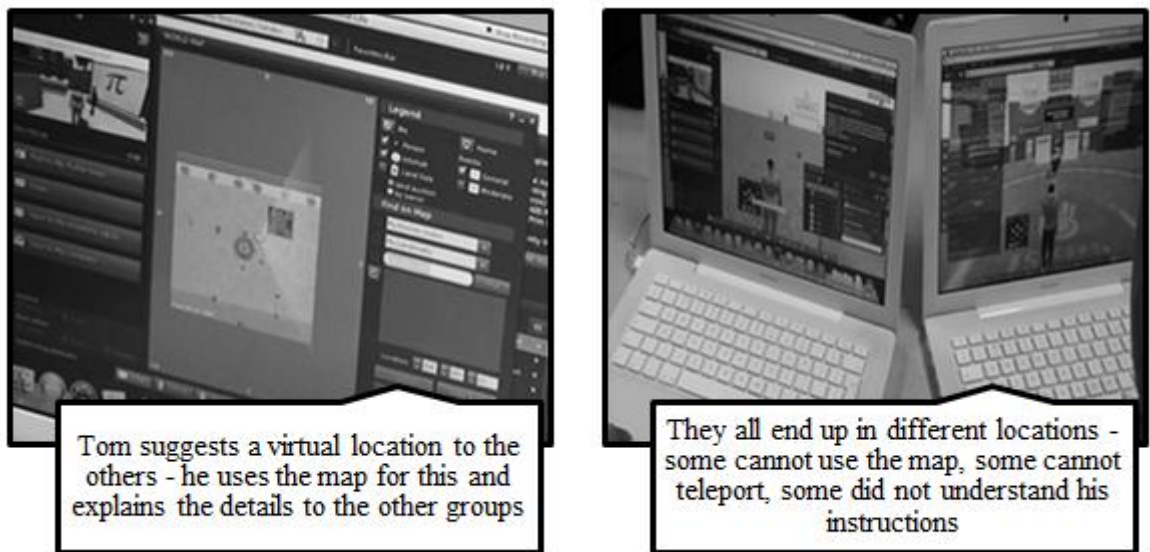


Figure 7.12 – Fracturing 1

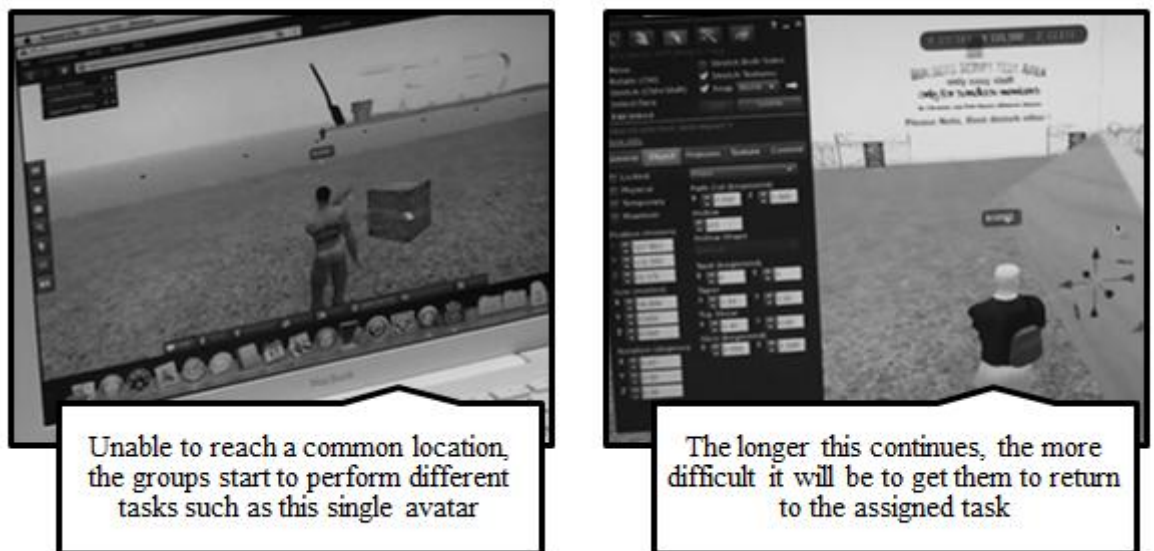


Figure 7.13 – Fracturing 2

Learner efforts to reverse non-collaboration

By the end of the task, one of the pairs (Sue and Mama) was building, another was playing (separately) with the building features (Jane and Baba), whilst a third was in a

different sandbox and had started building - exhorting the others to come and join them (Ruth and Aisha). This hardly constituted successful collaboration. Yet the learners made successive efforts both to collaborate and to get back to collaborating as problem after problem emerged.

Following the first fracture, the learners worked together to check the world map and to clarify the actual locations of the available sandboxes. They explained the working of the virtual maps to each other and continued to shout out and verify the coordinates until all were again in the correct location. For example, in *figure 7.14*, Jane and Aisha check that all of the groups have made it to the new sandbox. By checking the world map, they note that one of the pairs has arrived, but has yet to meet the others. They note (checking their screens) that it is Ruth and Baba. They describe the scene and landmarks to them ('we are waiting for you guys to join us .. its with the spinning floor') to lead them in.

The second fracture, and the imposition of a new sandbox meant that the learners had to start their collaboration again. They continued to ensure that everybody was in the right place, with Tom and Pradeep, for example, clarifying the spelling of the box, whilst explaining the building features to the other pairs. Aisha, who was temporarily lost, asked for their help and re-joined the others. Ruth joined in, offering more information about how to get there.

As collaboration restarted (for the final time), the learners were explaining the different ways of how to build an object to each other, and there was talk about how to move

objects and how to link them together. When Sue and Mama moved away from the others to start their own building, they were challenged by Baba, who pointed out, ‘we are meant to be building it together’. Mama tried to get her partner, Sue, to move back towards the others as she suggests, ‘why don’t you bring the object over to Ruth’. Ruth was proving hard to find, so Mama went to check what is on her screen. She was in another sandbox entirely. Sue asked for the coordinates, whilst Tom and Pradeep were trying to organise putting the build objects together. Right until the end, the learners strive to collaborate.



Figure 7.14 – Learner efforts to re-establish collaboration

A more nuanced picture emerges from this. Far from being the product of a single breakdown, non-collaboration was something which the learners moved towards following successive difficulties and setbacks. Each of these was marked by a fracture point which disturbed the previously existing collaboration. This is not to suggest that collaboration ended at this stage, but rather that it became more difficult to sustain. In response to each fracture, the learners made various efforts to re-establish collaboration.

Where the fractures were both few and minor, it was not difficult for the learners to

reverse their effects. When this was not the case, and where the fracture points were both stronger and frequent, more and more of the learners efforts were given over to solving the problem. Less and less effort could go on collaboration. The result was a gradual weakening of collaboration over time. It was also something which became more and more difficult to overcome.

7.2.3 EQ3 – What does the teacher do to support collaboration during the learning activity?

Overview

Several efforts were made by the teacher to support collaboration. This was not originally envisaged. The rationale, scale and success of these efforts varied somewhat. The plan was to keep teacher attempts to support collaboration to a minimum. This was due to the different background of the participants (adult as opposed to young learners), and partly from a wish to avoid disturbing whatever natural collaborative interactions might occur. In short, it was assumed that teacher intervention would be both unnecessary and undesirable.

In practice, a number of interventions were made, albeit on a somewhat smaller scale than in the first study. Much of the support, back then, consisted of resolving various technical problems and explaining how to use the software. The rationale, on this occasion, was to take advantage of possible opportunities for improved collaboration (eg. where groups in parallel collaborations were brought together), or (as before) to avoid or overcome imminent breakdowns of collaboration. One common point with the first study was the case where the collaboration had to be restarted following a larger scale breakdown. The scale of the various support efforts varied somewhat, ranging from simple explanations and suggestions, towards more muscular interventions, where the activity was temporarily stopped, before being restarted under different conditions.

The account below considers four salient types of teacher support. It begins with the ‘light touch’ support efforts set out above and moves steadily towards more direct and decisive interventions. How these interventions relate to the specific tasks is shown in table 7.6.

Task	Expected Interactions	Role or activity example
2	Learners locate the world’s tallest buildings as represented in the virtual world. They must share their findings (as they go along) with the other learners, and keep records of what they find. They must also find out and store whatever data / measurements they can about the relevant buildings.	Bridging incidents of parallel collaboration (figure 7.15)
3	Using a virtual world sandbox, learners construct a league table showing the relative heights of the buildings in question.	Recovery from breakdowns (figure 7.16)

Table 7.4 – Researcher Interventions in the activity - Examples

Helping individuals and pairs to collaborate

The most elementary support for collaboration was simply encouraging an individual or a pair to work with somebody else. This did not have to be with the whole group, but could just be with the person sitting next to them. At the early stages, it often consisted

of showing individual learners what was possible or permissible within the confines of the technology and the activity. Given that the participants were adults, it was useful to be quite subtle about this sometimes, by pointing out that a specific task was indeed possible, or that it might be preferable to use a different feature to achieve an intended objective. An example of this was in task one, where the teacher was asked by Ruth and Aisha about the best way to animate their avatar. They suggested picking the correct animation from a list on the screen. The teacher pointed out that this was possible, but that it might be better to program the avatar to do the movements by using the dialogue box. In other cases, the advice was aimed more generally at all of the learners, and this often consisted of repeating instructions several times or of summarising to the group what they appeared to be doing at a given moment ('you are moving the avatars into the right location, and you are mostly doing this by using the world map and typing in the coordinates') before either adding one extra piece of information that might be useful ('the coordinates are'), or suggesting another alternative action that some of the learners might want to try ('you know that you are allowed to try out the features in the exhibits'). In other words, support like this was aimed partly at those who might be struggling, and also at those who were doing well and might be impatient to know what else they could do.

Another way of getting a particular learner more involved was to make their plight known to others (especially the go-betweens) and to encourage the participants to approach them. Sometimes, this was performed quite explicitly ('Pradeep, could you check how Aisha is getting on'), but more typically it was done through simple pointing gestures and reminders to the other pairs.

Bridging incidents of parallel collaboration

A more intricate support for collaboration was to bring together or ‘bridge’ pairs of learners who were performing (or duplicating) the same tasks and to encourage them to work as a group. This was sometimes proactive (in that it was considered beneficial for the pairs to collaborate with each other), and other times reactive (where the pairs had previously been collaborating prior to a fracturing, and this support represented an attempt to get them to collaborate again).

Compared to before, this form of support placed additional demands upon the teacher. Firstly, awareness was a bigger issue, in that it was necessary to know that the various pairs were doing similar work. Secondly, there was the issue of how to actually bring them together. The former was achieved by constantly walking and checking what was occurring both in the room and in the virtual world, and by several short conversations with the learners and especially the go-betweens as the activity progressed. Getting the pairs to work with each other was often achieved by simply pointing out to a pair that somebody else was doing essentially the same work and that it might be a good idea to see what they were up to. This frequently led to one member of the original pair walking over to the others. What mattered was whether their work was of use to the original pair. There was, therefore, a process of checking what they were doing, and of reporting back to the other person in the pair. The outcome of this would vary. Sometimes, they would decide that the work of the others was worth investigating further, and this would result in an invite by the original group to join them. Soon they would assign tasks to them. On other occasions, they would ask for further information, and a cycle of questions and verification would then result. Frequently, the original

group would conclude that there was little business to be done with the other pair, and that it was not really worth collaborating with them. This might have been because they were not seen as being at a similar stage of the task as the other group, or more generally, that were they were doing was not felt to be of direct use to the original pair. The individual would then return to their pair. The two pairs would then continue with their separate efforts until something else happened. The example shown in *figure 7.15* below represents a more successful example of the bridging of parallel collaborations. The two groups are looking for information to present as part of the presentation. It has been noted by the researcher that they are in the same virtual location, and looking at essentially the same features and exhibits there. The researcher moves around the desks, and then suggests to Tom's group that they should check what Ruth and Aisha's pair are doing. He does this and begins a sequence of questions and answers with Ruth and Aisha.

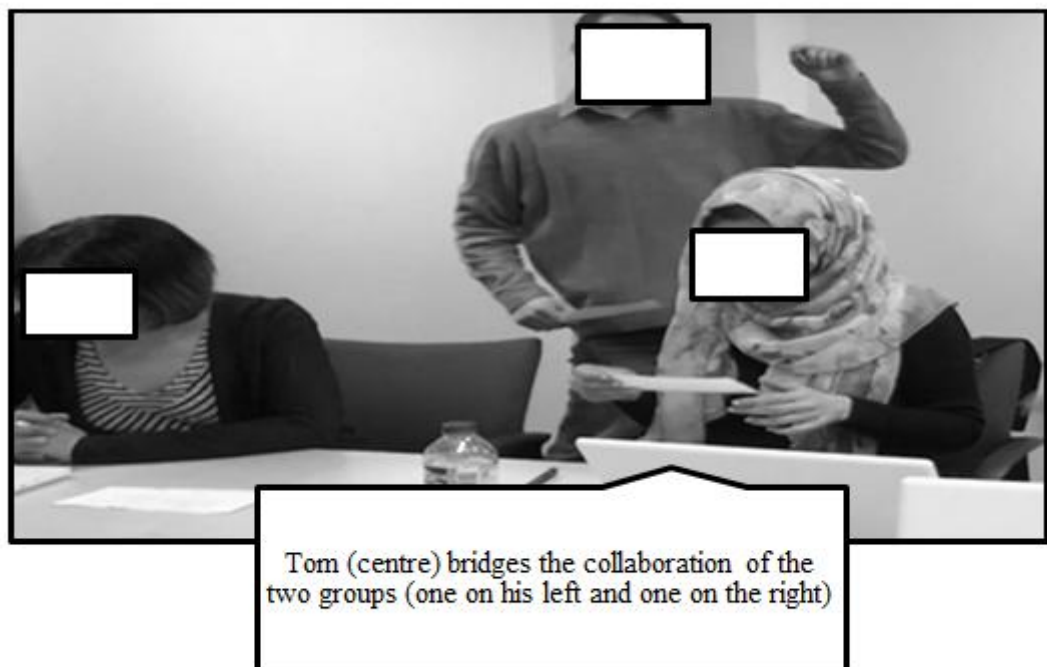


Figure 7.15 – Bridging incidents of parallel collaboration

Supporting pairs to enter collaboration

In this case, the whole group (apart from the pair in question) are already collaborating, and frequently, the pair that is outside of the collaboration has (separately) made a discovery or an advance that might be of use to the others. The aim, therefore, is to get the pair involved, not simply because they were outsiders to the collaboration (as above) or because they were duplicating what the others do (also above), but because they know something that could have a strong effect on the collaboration of the others. They have a significant contribution to make, and have not of their own accord attempted to share this with the others.

Much of this support related to learners who managed find a virtual location in advance of the others, or who discovered how to use particular features of the virtual world ahead of the others. Often, they were not always aware that they had made a significant discovery, assuming that everybody else had already done the same thing. In any case, they had expertise that they could now trade with the rest of the learners.

The way in which support was offered here was subtly different to the other cases. Rather than get the other learners to invite the pair to participate, it was more productive to approach the pair and to help them appreciate what they had done. In general, there would be a short conversation, with the teacher pointing out what the pair had achieved and how useful it might be to everybody. The aim was to encourage the pair to participate, but, if possible on their own terms. This was frequently what occurred, as the pair would announce to the others what they had done. The latter would then bring them into the collaboration. On other occasions, the pair would converse with the

teacher, but would not seek to collaborate with the others. This was because often they saw what they had done as being part of a larger task, and they did not want to get involved until they had completed each of the other related tasks as well. They wanted to be able to make a larger contribution to the group collaboration – and at a later stage.

Recovery from breakdowns

Finally, this was then there was an imminent danger of breakdown, or where a breakdown had already occurred. Typically, this occurred because of an unexpected problem (the presence of participants from outside the group in the virtual world) or a problem that the learners were unlikely to overcome in a sensible period of time. Task three, for example included both of these elements. At an early stage, the teacher had to impose a sandbox on the group. The learners had become distracted by the behaviour of outsiders in the virtual world. The teacher spent around 30 seconds identifying a suitable location, before shouting its coordinates to the participants. They then passed the details on to each other. This was quite a successful intervention in that the disruption to collaboration was short and relatively small. Once in the new location, they were quickly able to resume what they had been doing.

A less successful intervention was at the end of task three. Non-collaboration had gone so far as to be difficult to correct. The learners were working separately in different groups, with some of them in the wrong locations. In spite of this, they were making some efforts to get collaboration back on track. The aim of intervention was to leverage what some of the learners were already doing. This can be seen in *figure 7.16*. The

researcher approaches Sue and Mama, who have been successful in building. They are trying to work with Ruth, but are unsure as to where she is in the virtual world or what she is doing. The researcher acts as a go-between, bringing information back and forth. Once this appears to have had some effect on their collaboration, the teacher then moves to another group (Tom and Pradeep's). This pair has also been building, but again they are detached from the others. Their work is more advanced than the others, and therefore getting them to share their expertise by collaborating with the others would be beneficial. They are reluctant to do this at first. The researcher manages to talk them into helping out the others. They then find that they are unable to solve the problem of moving their work from one location to another. They detach from the other pairs as they try to solve the problem. This turns out to be quite difficult. The attempt to support collaboration has not succeeded.

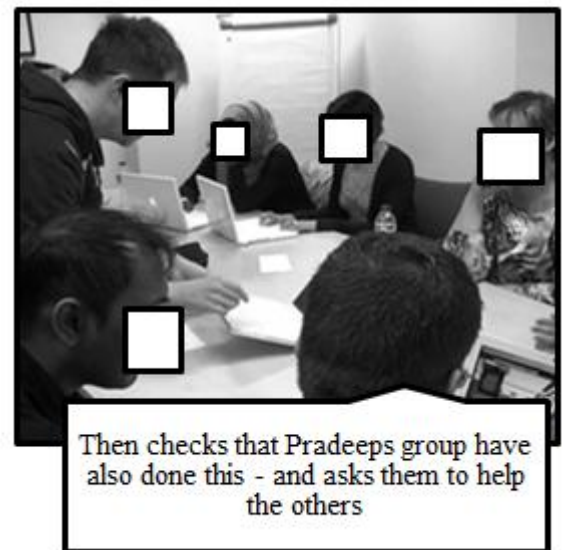
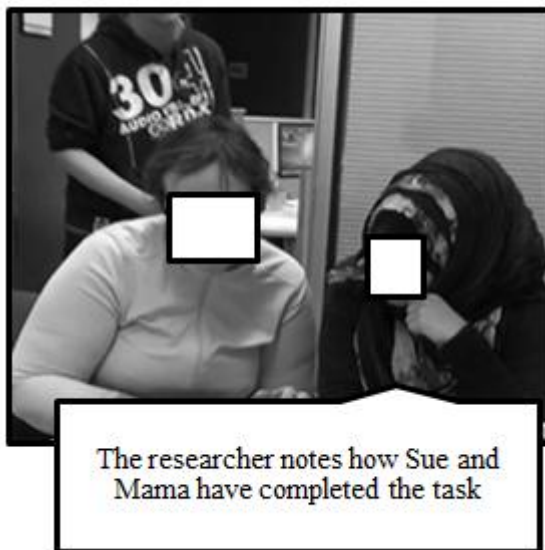


Figure 7.16 – Recovery from breakdowns

7.2.4 EQ4 – What other learner activities influence collaboration and non-collaboration?

Overview

In study one, learners getting lost had a significant effect on collaboration. This was both in the sense of weakening existing collaboration, and sometimes, of encouraging collaboration as the learners attempted to resolve the problem at hand. The overall effect depended on the relative balance of these two factors. The example in this case is taken from task two.

Task	Expected Interactions	Role or activity example
2	Learners locate the world's tallest buildings as represented in the virtual world. They must share their findings (as they go along) with the other learners, and keep records of what they find. They must also find out and store whatever data / measurements they can about the relevant buildings.	Learners getting lost by place

Table 7.5 – Learners getting lost

Learners getting lost by team

This occurred where learners had difficulty in identifying each other in the virtual world. As a result, they would sometimes not collaborate, as they could not find who they were meant to be working with. The result was often confusion as time had to be spent either clarifying the identity of others, or in trying to find the relevant individual. In the previous study, it was the most damaging of the three phenomena in terms of its negative effect on collaboration. Its main effect was frequently in stopping it from beginning. It often proved immune to teacher and learner intervention.

This time, it was quite rare. Where it did occur was often at specific turn points where the learners would move from one task to another. Its effect on collaboration was negligible as the learners moved quickly to verify each others identity, frequently by asking several questions until they were satisfied. An example of this was in task one, where it was not clear who was the owner of one of the avatars. One of the learners (Jane) started loudly describing the avatar in question. It was Sue who responded that she fitted this description, and she then started to tell the others how she looked and where she could be seen. This formed the basis for her pair becoming involved in the collaboration, as the others then invited them to move closer.

Learners getting lost by task

This was when learners were unsure about how to do something, often the use of a particular feature of the virtual world. In study one, it was prevalent; but also susceptible to resolution, and therefore, its effect on collaboration was greatly reduced. A similar picture emerged in the present study. It occurred at broadly the same points as before, such as at the beginnings of tasks. Unlike before, the learners were generally quick to admit to not knowing how to do something. They would ask questions of the others, or simply look at their screens in an attempt to get ideas. Sometimes, they would ask the teacher or one of the go-betweens. The effect on collaboration was again modest. One difference compared to the earlier study was that the bulk of the support and intervention work was undertaken by the learners rather than by the teacher. The learners were more proactive. The nature of this intervention varied, ranging from asking questions, through to verification, and to sending go-betweens to move around and explain.

Learners getting lost by place

This was more prevalent in this study than in the earlier one. It refers to when learners find it difficult to collaborate or to complete a task because they have not, or cannot, reach the appropriate location in the virtual world. Its effect on collaboration was not significant, because learners made stronger efforts than in the earlier study to overcome it.

This was evident in task two. The learners had to teleport to a single location to get more information about a series of buildings. Although they knew the name of the location, the task was complicated by their different levels of knowledge about how to use the relevant features such as the teleporter and the world map. One pair teleported to

the wrong location. This was quickly corrected by the others. With all of the pairs in the same virtual place, it was still necessary for them to visually locate each other. This could best be done by using the world map which shows the relevant location of all of the participants in a world. In this case, the learners used a different approach and took to loudly describing whatever landmarks and features they could see around them. Over about 90 seconds, they slowly moved each of the avatars closer and closer to each other. They were then ready to move to the next part of the task.

Where this had a negative effect on collaboration (such as in task 3), it was because it was accompanied by other problems at the same time. For example, when some learners got lost at the start of task 3, it was because of doubts about which sandbox to go to. Similarly, the process of having to move from one sandbox to another led to a number of participants getting lost. The more factors involved, the less susceptible the issue was to teacher or learner interventions.

7.3 Discussion

The findings allow us to address the sub-questions of research question three in more depth. As before, the emphasis is on the context of the space, collaboration and learning practices. This also extends the discussion commenced in chapter five, and where necessary, significant reference is made back to this earlier work.

7.3.1 Physical and virtual contexts – how they shape the origin and evolution of roles and activities

Although the physical and virtual contexts of this study were similar to the previous one, they had less of an effect on the evolution of roles and activities. This was primarily due to the modified learning design process. Compared to before, this study

eschewed explicitly assigned roles, concentrating instead on the support of learner interactions, through tasks requiring negotiation and verification. This shaped many of the roles that then emerged, with tasks requiring learners to locate a virtual location (navigation experts), before then consulting others about going there ('go-between's), assembling learners into one place ('go-between's again) and negotiating the transport of each of them to the location (feature experts). Tasks aimed at creating a shared output or model, encouraged the emergence of a similar series of roles. Therefore, whilst the origin of the roles and activities again owed much to the contexts of the space, their evolution after this was shaped more by the learning design process, than in the previous study. Examples of this include the roles of experts and go-betweens, the various stages of contingent negotiation, and the cycles of negotiation.

7.3.2 Roles and activities – how they support collaboration

At first glance, collaboration in this study appeared to be less stable and predictable than in the previous one. It was marked by phenomena such as the rapid entry and exit of pairs into and out of group collaboration, along with parallel and simultaneous collaboration. It was made up of many short incidents rather than long stable processes. Nonetheless, collaboration proved to be quite robust. A number of reasons help to explain this apparent paradox. Firstly compared to the previous study, more of the learners took part, acting as experts and go-betweens and frequently changing roles. Secondly, they were more likely to take an interest in the actions of the group as a whole, rather than just one or two other people they had already worked with. This was frequently evidenced by experts and go-betweens working in groups, compared to as individuals in study one. In this sense, their expectations were higher, as the various pairs emphasised trading information and expertise. Thirdly, verification was both more

persistent and more detailed than in the previous study. In other words, experts and go-betweens were less likely to give up, and would continue to work at a problem until they were sure that they had solved it. Finally, the learners made stronger and more sustained efforts to avoid breakdowns in collaboration than in the earlier study. Because of this, individual ‘fractures’ had a less significant effect on collaboration than one might have expected, with learners quickly looking for ways to resolve them. The overall effect was that roles and activities again supported collaboration, and in a stronger, more resilient way than before.

7.3.3 How learning practices are informed by roles and activities

The roles and activities informed new learning practices to varying extents. This was evident in four cases, with some of the practices examined in a shorter form in study one. The ‘weight’ of informing these practices, was shared with interactions such as negotiation and verification as discussed above. For example, practices such as passing information between the aspects of the space had little need for ‘experts’ or ‘go-betweens’, due to the simple, delimited nature of the task. It was something that the learners felt competent to carry out on their own. A minimal degree of negotiation and verification were required. Similarly, when the learners needed to make sense of the space and the activity, there was only a minor requirement for roles. The learners often needed to clarify points and to ask questions of the others (experts), but the emphasis was on checking what others were doing and on then negotiating with them. Other practices had a greater need for the learner roles. The completion of a single, complex task required significant involvement from ‘go-betweens’ (in terms of directing learners), and a secondary part for ‘feature’ experts (showing learners how to use particular software features). Finally, learning practices where the learners

orchestrated the activity, assign tasks and divide labour, were most susceptible to the intervention of 'experts' and 'go-betweens'. It was frequently the latter that would define and modify instructions and ask others to carry them out, usually because they had a fuller picture of the activity than many of the other participants. This usually opened the way for a degree of negotiation (asking them to do something and getting their consent) and verification as they checked on the progress of their peers. There was also interplay between the 'experts' and 'go-betweens', with the former identifying themselves to the latter to as to be picked to attempt tasks. In other cases, the latter would simply select the former, based on their earlier experiences.

Chapter 8 - Conclusion

This chapter concludes the thesis by reviewing its rationale, contributions and limitations. Starting with a retrospective analysis of the motivation and purposes of the research, the contributions of the thesis are then discussed. Drawing on this, limitations and future work are then examined.

8.1 – Rationale

This thesis was motivated by my interest in understanding learner and teacher practice in the design and implementation of hybrid learning spaces. As the research progressed, this was examined through the novel conceptualisation of a hybrid learning space, the iterative development and evaluation of a learning design process for use by teachers, and the analysis of learner activities, roles and interactions that were found to support collaboration within these spaces. The emphasis of the thesis, therefore, moved from theory (conceptualisation) through to methodology (design, use and evaluation of the process) and, finally, to the empirical (learner roles and interactions, and also the design practice of the teachers).

My initial motivation was to define what constitutes a hybrid learning space by drawing on the existing literature on hybrid spaces and extending the field of application to education. A hybrid space was conceptualised as an interaction space where learner and teacher activities and interactions were shaped by the physical and virtual contexts of the space. This was significant, because it allowed me to explore, at an early stage of the research, how the context of the space supports learning and teaching practice. The empirical work examined how learners and teachers used the affordances of the space in practice, and how innovative practices – informed by the context of the space – originated and developed. The conceptualisation also provided a basis for further

discussion of how practice related to other factors such as the learning design of the activity. Once the space was defined, the challenge of supporting teachers to embed innovative practice into everyday learning activities was addressed. This challenge was made more formidable by the lack of a pre-existing design process specifically for hybrid spaces, which meant that one had to be developed, drawing upon the variety of available design frameworks. An original learning design process, based on the Conversational Framework (Laurillard, 2002), and on a series of templated supports for learner collaboration and teacher interventions was therefore proposed. The process was iteratively refined through successive studies, and through ongoing implementation with the teachers. This was important because it improved the quality and application of the process, whilst also identifying a number of the perceptual and practical barriers and constraints surrounding its' implementation. Finally, learners and teachers developed a number of highly specialised roles and interactions in the empirical studies. This was significant, as the roles changed in both nature (becoming more diverse and more complex), and importance (playing a greater part in sustaining and shaping learner collaboration), both within and between the studies. Moreover, these roles contributed to novel learning practices in the hybrid learning space. It was important to examine both how and why this occurred. Finally, the extent to which this related to the evolving learning design process became of greater interest as the research progressed.

The three strands of research detailed above interacted in several ways. The early conceptual work, with its exploration of possible learner interactions supported by the hybrid learning space, provided a starting point for the learning design process and offered the researcher an initial means of structuring the interactions. Further support for collaboration and teacher intervention were then added. A similar link existed between the initial learning design and the emergence of learner roles, with the Conversational Framework aspect of the process informing many of the roles. In both of

these cases, the relationship between the themes was one of contingency, in that progress in one area was dependent upon previous accomplishments in an earlier one. The hybrid learning space had to be conceptualised so that a learning design process could be instantiated, with this then informing the roles and interactions that emerged. The themes also interacted in more complex ways. The roles and interactions identified in the early empirical work, for instance, developed the researchers' understanding of each of the two earlier themes, both by providing further detail about learner practices, and by allowing refinement of the learning design process. Similarly, evaluation of the process with the teachers and the identification of barriers and constraints surrounding its implementation contributed to the ongoing conceptualisation of the space. Refined versions of the process were then implemented, again strongly shaping the learner roles that emerged. By examining how these informed innovative learner practice, a further, final contribution was made to the theme of conceptualisation.

8.2 Contributions

This thesis has developed a particular conceptualisation of a hybrid learning space, which was defined as the interplay between the physical space of the classroom (or other formal educational setting) and the technology of a virtual world. A hybrid learning space was, therefore, an *interaction* space, where physical and virtual contexts supported learners and teachers to develop highly specific roles and interactions, which were dependent on the affordances of the physical-virtual space to mediate new forms of learning practices. The research undertaken extended existing work (mainly from the subfield of HCI) on hybrid spaces more generally and, by integrating this with research from the CSCL community, the thesis showed how learning design, appropriately

informed by and aligned with, participants' roles, was crucial to embedding innovative technology in teaching practice.

The main contributions of the thesis are:

1. A conceptualisation of a hybrid learning space
2. A learning design process to support teachers to develop hybrid learning activities
3. A detailed description of teacher and learner roles within the hybrid space, which were found to support collaboration

This section, then concludes with a generalizable overview about how learner roles and practices in hybrid spaces might be further examined by future researchers.

8.2.1 - A conceptualisation of a hybrid learning space

The thesis contributes to the field of educational technology, by developing and setting out a particular and contextualised conceptualisation of a hybrid learning space. This conceptualisation is based on a learning design adapted from the Conversational Framework (Laurillard, 2007), and then implemented with two distinct populations. This was defined as *interaction* space, where the interplay between the physical space of the classroom (or other formal educational setting) and the technology of a virtual world underpinned new types of learning practices. The definition developed in this thesis drew upon the existing literature on hybrid spaces, but extended it to education, investigating how learners and teachers developed specialised activities, roles and interactions within the classroom setting. This conceptualisation offers a useful analytical tool for researchers to investigate relationships between the context of the hybrid space and learning and teaching practice. In particular, a conceptual underpinning is provided to develop new understandings of learner and teacher use of

the affordances of the space in their practice. The conceptualisation also offers an insight into how innovative teaching practices originate and evolve, as mediated roles and interactions in the hybrid space.

8.2.2 - A learning design process to support teachers to develop hybrid learning activities

The thesis contributes to addressing a core challenge in educational technology, namely, how to embed innovative technology, and associated innovative practice into the everyday learning design activities undertaken by teachers. This issue was addressed by developing and refining a *learning design process* to support teachers to develop hybrid learning activities. This was motivated by a wish to help teachers navigate the variety of learning frameworks and resources that exist. The process integrated activity design informed by the Conversational Framework (Laurillard, 2002), with templated supports for learner collaboration and teacher intervention, both drawn from the CSCL literature. Attempts to promote particular learner and teacher roles, mediated by the templated supports, did not work out in practice. The envisaged roles were often supplanted by learner defined ones, more closely aligned with the affordances of the hybrid space, and supported by the Conversational Framework aspect of the process. This challenges the dominant position of scripts within the CSCL literature, arguing that support for particular interactions, closely aligned with the affordances of the hybrid space, is more effective at supporting collaboration than the external imposition of specific roles. Learners and teachers can then define, develop and implement specialised roles as appropriate.

With respect to the implementation of the learning designs in practice, the thesis brought to the fore the key role played by teacher perceptions of the usefulness of the hybrid learning space, and the nature of the roles and interactions in their willingness to implement the learning design. One key example is their approach to the challenge of supporting learner collaboration, where their perceptions of the space and interactions reduced the prevalence and scope of learner collaboration in the proposed activity, and moving it away from the real affordances of the space.

The learning design process developed in this thesis is particularly useful in offering key insights into the practical difficulties and complexities involved in developing learning design with emerging technologies that support new learning practices such as collaboration in hybrid spaces. Much research remains to be done in this area but the findings present here offer a productive starting point. Implementation of the learning design process also highlighted the importance of the part played by existing perceptions of technology-in-practice in shaping teacher implementation practices.

8.2.3 - A detailed description of learner roles in the hybrid space, which were found to support collaboration

This thesis contributes to the CSCL literature by examining how learners and teachers develop highly specific roles and interactions to support collaboration, whilst exploring how these inform novel learning practices in the hybrid space. The thesis shows that although clearly delimited roles exist, their nature changes over time. The empirical work details how the roles come into being and then evolve, and how they are shaped by the affordances of the hybrid space. Originating from differences in knowledge or awareness about the space between the learners, they developed in prevalence and complexity, and were motivated by factors such as the need to make sense of the fragmented nature of the space, and to perform complex tasks and negotiations within it.

The main finding was that explicitly designing for learner and teacher roles was not as productive as allowing their organic emergence. These roles were structured by the Conversational Framework aspect of the learning design process, and by later researcher attempts to encourage interactions such as negotiation and verification in the learning activities. Moreover, this thesis explores how the roles and interactions inform new learning practices.

8.2.4 – Learner roles and activities in hybrid spaces: Start points for future researchers

This final contribution is relevant for both researchers and teachers. It allows the former to better understand how learner roles and interactions are supported by the physical / virtual contexts of the space, whilst assessing their contribution to innovative learning practices. By identifying a number of delimited and specialised roles, the thesis adds to teacher knowledge of learner practices in the hybrid learning space, thereby contributing to their activity design practice.

Besides identifying and tracing a number of learner roles and activities, the thesis also points to a number of underlying issues of possible interest to future researchers. These concern how roles and activities relate to context and learning design, learning practices, and collaboration, respectively.

In each study, learner roles and activities were informed by the specific relationship between the physical and virtual contexts of the space and the learning design in question. This was particularly evident in study two which emphasised the support of learner interactions through tasks requiring negotiation and verification. This sets an important question for future researchers – namely, how should the ‘weight’ of support of roles and activities be distributed between the design of the hybrid space and the

design of the learning activity in each case? The extremities on this continuum are risky, and reflect established debates within the CSCL perspective. A singular emphasis on design of the space, for example, whilst creating clear conditions for the development of learner roles and activities, runs the risk that these may not actually emerge. Conversely, placing most of the weight on the learning design aspect, risks having an over-regulated activity and leaves little room for the emergence of learner-driven and more spontaneous roles and activities. By setting out two studies with the same space and with different approaches to learning design, the thesis makes an initial contribution to addressing this issue.

The thesis examines how the roles and activities are instantiated in the form of various learning practices, namely, passing information between aspects of the space, making sense of the space and the activity, completion of a complex task and learner orchestration. From the perspective of future researchers, this suggests a number of possible questions. To begin with, what other learning practices might the roles and activities examined in this thesis go on to inform – and, as before, what relative part do each of the roles and activities play in the new learning practices? More broadly, what new (thus far unexamined) roles and activities might emerge in hybrid spaces to support collaboration; and what additional learning practices would these then go on to inform?

Finally, there is the broader issue of how roles and activities support collaboration. The two studies in this thesis offer contrasting portrayals of collaboration in hybrid spaces, with the first consisting of a small number of long stable processes, and the second marked by shorter lived, sporadic and less predictable patterns of collaboration. The latter, however, was more robust than the former. The ways in which this was shaped by the varying roles and activities was examined in section 7.3.2. For researchers, this poses an interesting question, namely, how does one define ‘good’ collaboration, and

how is it to be distinguished from other kinds of collaboration? In reality, it is not always easy to identify correctly. For example, when seen from the outside, the collaboration in study two appeared to be unstable and short lived. When viewed close up, it proved to be more durable than in the previous study.

8.3 – Limitations

A significant limitation of the thesis relates to the content and implementation of the learning design process. Multiple shortcomings with the teacher designed activities constrained their implementation. Whilst some were minor (duplication of tasks, ambitious activity timings), substantial difficulties remained. These were characterised, primarily, by simple hybrid interactions with learners using the affordances of the space mostly to communicate between the its' physical and digital parts, as opposed to the more complex hybrid interactions evident in the earlier study. The activities supported learner collaboration chiefly within specific parts of the space, rather than between them. This was far from what was envisaged. Whilst part of this can be traced to teacher perceptions and understandings of the hybrid space and interactions (as discussed in chapter 6), it owed more to limitations in the design and implementation of the process.

Broadly, there was a failure to translate the findings of the first study into a practical and generalizable tool that could have been used by the teachers to support hybrid interactions. A number of the conceptual findings of the study would have been relevant. These include the specialised learner roles of temporary experts and go-betweens, novel practices supported by the hybrid learning space such as solving complex problems and task assignment, and the finding that some forms of hybrid interaction (such as those requiring negotiation and / or verification) are more detailed and complex than others. Whilst an understanding of the findings informed the running

of the teacher workshops, it was not proposed or applied in a practical or explicit way as part of the learning design process. The outcome was that the teachers did not have the opportunity to apply these findings, and they therefore struggled (more than one might have expected) to address the challenges of supporting collaboration. The resulting learning activities fell short of expectations and then had to be modified by the researcher.

Moreover, there were limitations with the way in which the process was implemented. The Conversational Framework part of the process was applied in a different way (with the teachers) in the second study than in the first (with the researcher). This contributed to the more limited nature of the supported interactions. In the earlier work, the framework was used to develop each task in the activity ‘from the ground up’. This meant defining the pedagogical rationale of each task, identifying possible interactions that might contribute to this task, and then setting out how these related to the affordances of the space. The individual tasks, planned in some detail, were then sequenced to form the overall activity. With the teachers, a different approach was taken. The conversational framework was used in a more ‘top down’ fashion, setting out the overall rationale and outline of the activity. The individual tasks, along with their anticipated interactions, were then developed primarily from the outline and with minimal reference to the framework. The latter was applied in a more superficial way than before, as a means of checking that the interactions met basic pedagogical standards, rather than to specify their detail. The result was a series of interactions that were either insufficiently detailed to be implemented, or which demonstrated the shortcomings that were discussed earlier. The change in approach was motivated by pragmatic reasons, to make the framework easier to implement by the teachers, and to

avoid them becoming immersed in the details of planning individual learner interactions at an early stage.

8.4 - Future Work

Future work should focus on three areas; namely, addressing the limitations of the learning design process, exploring the challenges of integrating the process into everyday classroom practice, and examining learner perspectives of the hybrid learning space.

The limitations of the process relate both to its content and its implementation. Future work would use the final version of the process, with its emphasis on the support of hybrid interactions as a start point. The aim would be to assess in more depth how successful this is, and to identify further potential practices that support hybrid interactions, integrating them into a more refined version of the process. A further option would be to develop and add additional stages to the process in an attempt to make it more robust. As for implementation, the Conversational Framework aspect of the process would be applied in a more rigorous form, being used to develop each of the sub-tasks of the activity in more detail than during chapter six.

Parallel to this lie the broader challenges of teachers as learning designers, and more specifically the integration of the design process into everyday classroom practice. The thesis has identified a number of these challenges, relating to teacher perceptions of the hybrid space, their role within it, and learner interactions. Future work, derived from this research, would work with teachers over a longer time period than was possible for this thesis, and would examine the changing relationships between design and implementation, again over a longer time frame. In short, how do teacher perceptions of the space and the interactions within it, evolve, and what effect does this have on the

learning design process? Conversely, what effect does successive development and implementation of the design process have on teacher perceptions of the hybrid learning space?

This leaves the issue of learner perspective. What are their understandings of hybrid spaces and hybrid interactions, and what do they perceive as being the main issues and challenges inherent in designing and implementing them? The concept was briefly explored with the learners as part of the sampling procedure for the first study. Nonetheless, the emphasis of the thesis remained on their interactions. There are several directions that a future researcher could take. One approach would be for a teacher or researcher to implement an activity and to then to examine the resulting roles and interactions in concert with the learners. This would provide an initial means of exploring their perceptions. Productive next steps could then include researcher and learner co-design of a further activity, prior to its implementation by the learners. To some extent, this follows the approach taken for examining teacher design practice and implementation. The rationale in all of this would be to examine what learners think and understand about hybrid spaces, and to explore how they might apply this.

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APPENDICIES

Appendix 1 –Sample learner interactions in the hybrid learning space

<u>Learner Interaction with peers</u>	<u>How this can be carried out in the Hybrid Space chosen for this study</u>
Ask Questions	Learner runs across the room to ask a question about something they have seen on the screen
Offer Ideas	Learner takes a laptop and shows the screen to another learner to give information about one of the planets in the virtual world
Debate Ideas	The learners can text each other in the virtual world, and then discuss the results in the physical aspect of the space
Share Outputs	The learners work together on a model of the Solar System in the virtual world
Modify Outputs	They make modifications to the model
Present the finished production	The final output consists of the working model in the virtual world and a presentation on the paper whiteboard giving further information about the relevant planets.

Appendix 2 –Sample teacher roles in the hybrid learning space

<u>Role of the Teacher</u>	<u>How this can be carried in the Hybrid Space chosen for this study</u>
Ask Questions	The learners cannot perform a function in the virtual world and ask the classroom teacher to help with a solution
Offer Information	The learners find some information in the virtual world. They shout this to the teacher, and ask if it is correct. There is then a process of verification as the learners use the virtual world to check again if it is correct.
Present Feedback	The teacher gathers the learners around one of the laptop screens to give feedback on completed outputs by the learners in the virtual world
Assist learners to improve outputs	The teacher intervenes in the virtual world to help the learners with their model of the Solar System
Receive the finished production	The learners use information from the virtual world to make a presentation on a paper whiteboard. This is then shown to both the teacher and the other learners.

Appendix 3 –Study 1 – Participant Survey

This survey asks some simple questions about your use of virtual worlds. It will only take a few minutes to complete.

The answers that you give will remain confidential (secret) and anonymous (nobody will know who you are). If there are questions below that you don't want to answer, then leave them blank. This will not affect your overall participation in the research. If you have any questions about this, contact me at ddarcy@sjc.ac

You have used Second Life as part of the gifted and talented ICT group. The point of this survey is to find out what other virtual worlds you might have used outside of school.

Q1 – Which of these have you used? -

- World of Warcraft
- River City
- There
- Club Penguin
- Secretbuilders
- Whyville
- Other

Q2 – If you ticked 'other' – what is the name of the virtual world that you have used?

Q3 – If you ticked any of the boxes in Q1 – What, in your own words, do you use the virtual world for?

Appendix 4 –Study 1 – Project Introduction Letter

03 October 2011

Dear Parents / Guardians

As you may already know from the recent parents evening, I will be co-ordinating the gifted and talented learning group in the ICT department for year 10 this year. Over the next few weeks, I will be contacting you again with further information about some of the trips, lessons and speakers that the college will be organising.

This is also a useful time to inform you that I am presently carrying out a PhD study in conjunction with the Institute of Education at the University of London. My work there examines how virtual worlds are used in classroom environments, along with the strategies that teachers use to develop learning activities for them. This is an exciting area of research, and I would hope that my thesis will have a number of beneficial effects for my students, the school and the community in general.

It is likely that one or more of the gifted and talented lessons / trips will be carried out in the context of my research, and I hope to give you more information about this nearer the time.

Until then, should you have any questions concerning either the gifted and talented group or my PhD work, then please do not hesitate to contact me at ddarcy@sjc.ac

Thanking you in advance for your co-operation

Yours faithfully

Appendix 5 –Study 1 – Consent Form - Parents

10 November 2011

Dear Parents / Guardians

Year 10 ICT – Gifted and Talented Group

As part of the College's provision for gifted and talented students in ICT, we are proposing to take a group of year 10 students to the London Knowledge Lab at the University of London for one day on Friday 18 November.

The lab (www.lkl.ac.uk) examines how virtual worlds, game design software and other new technologies can best be used for educational purposes. The group will have two lessons at the lab and will learn how to build both virtual worlds and games using the latest software.

As explained in my earlier letter, this visit will also be used for the research purposes of my PhD, which examines how lessons can best be designed for implementation in virtual worlds. The research has gone through the standard procedures of ethical approval at the Institute of Education. It will follow the guidelines of the British Educational Research Association which may be consulted at www.bera.ac.uk

To this end, student participation in the study will include being recorded on video during the visit. Please note that all records from this study will be safely stored and will not be shared beyond my supervisor and one other IOE researcher. The identity of the students will be concealed when the research is written up. The records will be destroyed once the study has been completed. The students have the right to withdraw from any aspect of the study (or all of it) at any time. Should they do this, it will not affect them in any way. This has also been explained separately to them.

If you would like your son to participate in this opportunity, please complete the consent slip below and retain the remainder of this letter for your reference. If you have any questions, I can be contacted at ddarcy@sjc.ac

Year 10 ICT – Gifted and Talented Group Trip – Friday 18 November

I have read this consent form and I agree to the following (tick as applicable)

For my son to travel on the trip to the London Knowledge Lab

That the visit will be filmed as part of my PhD research project

I have had the opportunity to ask, and I have received answers to, any questions I had regarding the study. I understand that if I have any additional questions, I may contact the researcher as set out above.

Student Name:

(Parent / Guardian):

Date

Appendix 6 –Study 1 – Consent Form - Participants

When we go to the London Knowledge Lab, we will be using a virtual world in order to complete the assignments. By taking part in this, you will be helping me complete a research project at the university. There are a few things that you need to know about this.

1. You will be filmed during the visit. This will be to help me examine how students learning using virtual worlds, and to help design good lessons for the future.
2. Anything that you do online in the virtual world will be recorded too. This is for the same reason as above.
3. The film from this will be kept safe and it will only be shared with my supervisor and one other researcher at the university.
4. It will be deleted when the project is finished.
5. Although, it will be used to help me write up the project, nobody will be able to know who you are. Your face will be covered over and your name will never be used. The video will be made anonymous, in other words.
6. Your parents have given permission for you to take part in this. But if there is anything on the day that you do not want to do, or if you want to ‘opt out’ of the visit altogether, this is fine, and it will not affect you in any way. You should not feel under any pressure to do this.

Thank you again for taking part! If you have any questions, please ask.

Please sign below if you have read all of this; if you understand it; and if you are happy to take part.

Your Name

Signed

Appendix 7 –Study 1 – Learning Activity Task Instructions

Task One – Exploration

Mission:

To find out what you can do in the virtual world, where everything is, and who else is there

What you need to do:

Using the instructions below, you need to teach the group how to do the three things on the list. You will need to work out who the people are, and then make sure that they have done what you have asked.

At the same time, you will need to do a number of tasks for others. Both listening and talking will be required!

You can communicate with the others in any way that you think appropriate!

Time allowed:

20 minutes

Task One - Instructions

Team A

Get team B to make their avatar run around in a circle and say something funny, then ...

Get team C to make their avatar jump up and down and say the names of its owners, then ...

Get team D to make their avatar do five separate things from the behaviour drop down list

REMEMBER – HOW WILL YOU KNOW THAT THEY HAVE DONE IT?

=====

Team B

Get team A to make their avatar change colour to blue and to say who its owners are, then ...

Get team C to get their avatar to put on some extra clothes (Hint: inventory), then ...

Get team D to make their avatar run around in a circle and say something funny

REMEMBER – HOW WILL YOU KNOW THAT THEY HAVE DONE IT?

=====

Team C

Get team A to make their avatar do five separate things from the behaviour drop down list, then ...

Get team B to get their avatar to put on some extra clothes (Hint: inventory), then ..

Get team D to make their avatar jump up and down and say the names of its owners.

REMEMBER – HOW WILL YOU KNOW THAT THEY HAVE DONE IT?

=====

Team D

Get team A to make their avatar run around in a circle and say something funny, then ..

Get team B to make their avatar do five separate things from the behaviour drop down list, then ...

Get team C to make their avatar run around in a circle and say something funny

REMEMBER – HOW WILL YOU KNOW THAT THEY HAVE DONE IT?

Task Two – Solar System to the Whiteboard

Mission

Using the virtual world to get more information about the planets and then putting all of this together into a single presentation on the whiteboard.

What you need to do:

Search for 'Spaceport Alpha' in the virtual world. Go there. Make sure that everybody else in the group goes there also (find a way to get them there).

Locate the planets, and then decide who is going to get which information about each of them.

You will then need to pick people to do the writing on the whiteboard. Work out how to get the information to them. Make sure everybody contributes and that everybody stays on task to get the presentation finished.

Time allowed:

30 minutes

Task Three – Solar System Build

Mission

Build a model of the Solar System by using the build tools in *Second Life*

What you need to do:

Start by practicing using some of the tools. You will then need to decide who is going to do which parts of the tasks. Remember that the planets need to be in the right order and they should be correctly sized.

How will you deal with moons, planet rings etc? Who will do what exactly, and how will they do it?

Time allowed:

20 minutes

Appendix 8 –Study 1 –Focusing Exercise – Initial Version

<u>Broad Focus of Research</u>	<u>Empirical questions</u>	<u>Operational Categories</u>	<u>Operational Codes</u>
<p>What examples of collaboration and non-collaboration occur in the hybrid space?</p>	<p>What examples are there of collaboration and non-collaboration?</p>	<ul style="list-style-type: none"> • Learners talking to each other about the task • Learners contributing to the task • Learners contributing to a single artefact (eg. a virtual building, a paper chart) • Learners helping each other to complete a task • Learners not collaborating when expected to • Sudden ending of collaboration • Arguments and disagreements about how to proceed • Learners breaking into smaller groups 	<ul style="list-style-type: none"> • Learner explains to other • Learner asks question to other • Learner helps other to perform task • Learner ignores instruction / task / role – goes off the does something else • Learner puts forward alternative course and encourages others to follow this • Learner seems to be lost / detached from others

	<p>What roles and activities do the learners use when there is collaboration?</p>	<ul style="list-style-type: none"> • Learners taking charge of each other or of a particular task • Negotiation between learners about what to do and how to do it • Learners checking on what others are doing 	<ul style="list-style-type: none"> • Learner asks question to others • Learner explains to others • Learner seeks clarification • Learner clarifies • Learner helps others to perform task • Learner puts forward idea / proposal • Learner gives role / task to other to do
	<p>What roles and activities do the learners use when there is non-collaboration?</p>	<ul style="list-style-type: none"> • Learners disagreeing about what to do or how to do it • Conflict and breakdown of collaboration • Learners not knowing what to do 	<ul style="list-style-type: none"> • Learner ignores instruction / task / roles – goes off and does something else • Learner puts forward alternative course and encourages other to follow this • Learner interferes / disturbs others work without permission • Learner seems to be lost / detached from others
	<p>What does the teacher do to support collaboration during the learning activity?</p>	<ul style="list-style-type: none"> • Setting up the initial conditions for collaboration • Interventions to keep the activity moving • Interventions to avoid breakdown of the activity 	<ul style="list-style-type: none"> • Explains to one or two learners • Questions one or two learners • Helps learners to complete task • Explains to all learners without stopping the task • Explains to all learners whilst stopping task • Gets learners to explain to each other

Appendix 9 –Study 1 –Focusing Exercise – Final Version

<u>Broad Focus of Research</u>	<u>Empirical questions</u>	<u>Operational Categories</u>	<u>Operational Codes</u>
<p>What examples of collaboration and non-collaboration occur in the hybrid space?</p>	<p>What roles and activities do the learners use when there is collaboration?</p>	<ul style="list-style-type: none"> • <u>Division of labour and the development of learner roles*</u> • Negotiation between learners about what to do and how to do it • Learners checking on what others are doing 	<ul style="list-style-type: none"> • Learner asks question to others • Learner explains to others • Learner seeks clarification • Learner clarifies • Learner helps others to perform task • Learner puts forward idea / proposal • Learner gives role / task to other to do • <u>Learner asks question of others and passes on answer to other learners (NEW)</u> • <u>Passing (NEW)</u> • <u>Pairing (NEW)</u> • <u>Tussling (NEW)</u>
	<p>What roles and activities do the learners use when there is non-collaboration?</p>	<ul style="list-style-type: none"> • Learners disagreeing about what to do or how to do it • Conflict and breakdown of collaboration <p>(OTHER CATEGORIES MOVED TO NEW QUESTION)</p>	<ul style="list-style-type: none"> • Learner ignores instruction / task / roles – goes off and does something else • Learner puts forward alternative course and encourages other to follow this • Learner interferes / disturbs others work without permission <p>(OTHER CODES MOVED TO NEW QUESTION)</p>

	<p>What does the teacher do to support collaboration during the learning activity?</p>	<ul style="list-style-type: none"> • Setting up the initial conditions for collaboration • Interventions to keep the activity moving • <u>Interventions to improve collaboration as the activity is in progress (NEW)</u> • Interventions to avoid breakdown of the activity • <u>Interventions to recover from breakdown (NEW)</u> 	<ul style="list-style-type: none"> • Explains to one or two learners • Questions one or two learners • Helps learners to complete task • Explains to all learners without stopping the task • Explains to all learners whilst stopping task • Gets learners to explain to each other • <u>Teacher changes team members / reassigns learners (NEW)</u> • <u>Teacher changes task elements (NEW)</u>
	<p>What other learner activities influence collaboration and non-collaboration? (NEW)</p>	<ul style="list-style-type: none"> • <u>Learners getting lost (NEW) – Moved from non-collaboration question</u> 	<ul style="list-style-type: none"> • <u>Learners not knowing which team (NEW)</u> • <u>Learners not knowing which task (NEW)</u> • <u>Learners not knowing how to do task (NEW)</u> • <u>Learners break into groups (moved from non-collaboration question)</u>

Appendix 10 – Study 2 – Project Introduction Letter

12 June 2014

Invitation to Participate

Dear Sir / Madam

I am a PhD student at the Institute of Education. My research looks at how teachers design learning activities when they use virtual worlds in the classroom, and I would like to invite you to participate in a group workshop.

This would require you to design a number of learning activities in conjunction with other teachers, with a view towards implementing them with students in the weeks to come. The workshop will give you exposure to some of the latest classroom technology, and allow you to network and share ideas with other teachers.

To take part, you will need to have a minimum of one years teaching experience. This can be at any level and / or in any subject. It would be useful if you have some existing experience in working with virtual worlds, but this is by no means essential. The most important qualities for this are enthusiasm and a desire to try out something new!

If you would like to take part in this exciting opportunity, please complete the attached survey, and I will get in contact with you shortly.

Yours faithfully

Damien Darcy

Appendix 11 – Study 2 – Initial participant survey

As you may already know, the workshop forms part of my research at the Institute of Education. This survey asks a small number of simple questions about your teaching background and will be used to help organise and run the workshop. It will only take a few minutes to complete.

The data collected will remain strictly confidential and anonymous and will only be used for the purposes of the present study. The data will be destroyed as soon as the study is complete. You have the right to withdraw from the study at any time. If there are questions that you do not wish to answer, then simply leave them blank. This will not affect your overall participation in the research. If you have any questions about this, please do not hesitate to contact me at ddarcy@sjc.ac

=====

1 – What is your current job title?

2 – How long (in years) have you been teaching for?

3 – At what level, does most (or all) of your teaching take place? (circle the most appropriate figure)

Nursery / Reception

Primary School

Secondary / High School

FE College

University

Other

4 – What is the main subject (or subjects) that you teach? If you teach more than one subject, then list what you consider to be your THREE most important subjects.

5 – Have you ever used a virtual world as part of your teaching?

Yes

No

6 – If YES, which one(s)? – List as many as you need to

7 – Have you ever used a virtual world in your time outside of the classroom?

Yes

No

8 – If YES, which one(s)? – List as many as you need to

Thank you

Appendix 12–Study 2 – Participant Consent Form

Thank you for agreeing to take part

When we go to the London Knowledge Lab, we will be using a virtual world in order to design a number of learning activities. By taking part in this, you will be helping me complete a research project at the university. There are a few things that you need to know about this.

1. You will be filmed during the visit. This will be to help me examine how students learning using virtual worlds, and to help design good lessons for the future.
2. Anything that you do online in the virtual world will be recorded too. This is for the same reason as above.
3. The film from this will be kept safe and it will only be shared with my supervisor and one other researcher at the university.
4. It will be deleted when the project is finished.
5. Although, it will be used to help me write up the project, nobody will be able to know who you are. Your face will be covered over and your name will never be used. The video will be made anonymous, in other words.
6. If there is anything on the day that you do not want to do, or if you want to ‘opt out’ of the visit altogether, this is fine, and it will not affect you in any way. You should not feel under any pressure to do this.

Thank you again for taking part! If you have any questions, please ask.

Please sign below if you have read all of this; if you understand it; and if you are happy to take part.

Your Name

Signed

Appendix 13–Study 2 – Learning Activity Task Instructions

Task One – Icebreaker

Mission:

To find out what you can do in the virtual world, where everything is, and who else is there

What you need to do:

Using the instructions below, you need to teach the group how to do the three things on the list. You will need to work out who the people are, and then make sure that they have done what you have asked.

At the same time, you will need to do a number of tasks for others. Both listening and talking will be required!

You can communicate with the others in any way that you think appropriate!

Time allowed:

20 minutes

Task One - Instructions

Team A

Get team B to make their avatar run around in a circle and say something funny, then ...

Get team C to make their avatar jump up and down and say the names of its owners, then ...

Get team D to make their avatar do five separate things from the behaviour drop down list

REMEMBER – HOW WILL YOU KNOW THAT THEY HAVE DONE IT?

=====

Team B

Get team A to make their avatar change colour to blue and to say who its owners are, then ...

Get team C to get their avatar to put on some extra clothes (Hint: inventory), then ...

Get team D to make their avatar run around in a circle and say something funny

REMEMBER – HOW WILL YOU KNOW THAT THEY HAVE DONE IT?

=====

Team C

Get team A to make their avatar do five separate things from the behaviour drop down list, then ...

Get team B to get their avatar to put on some extra clothes (Hint: inventory), then ..

Get team D to make their avatar jump up and down and say the names of its owners.

REMEMBER – HOW WILL YOU KNOW THAT THEY HAVE DONE IT?

=====

Task Two – Finding and Measuring

Mission:

Now that you know how to use *Second Life*, we can do some serious work!

The worlds TEN tallest buildings are all in Second Life. The problem is that they are not all in the same places, so it is necessary to:

- Move around to find them
- Prove to others that you have found them

This is not a job that you can do on your own – and you will need the help of the other groups

The big question is ... who will do what?

What you need to do:

- Find the worlds 10 tallest buildings. You will need to do some searching for this – you will also need to use the maps and teleporters very carefully to get to the right places.
- Prove that you have found it by inviting another group to the location and taking a picture showing both you and them in it.
- You will need to store the basic information about the buildings that you find – this can go into your inventory as you will need it for the next task

Time Allowed:

30 Minutes

Task Three – Building the League Table

Mission:

So you know something about the ten tallest buildings

But how do you get this information across to others?

One way is be to build a league table that people can easily read

Again, this is not something that you can do alone.....

So you will need to decide where it should go, how to build it, what it should look like ..
and lots of other things

Good luck!

What you need to do:

As a group, you will need to decide on several things

Then start building!

Get as much of this done as you can in the time

Time Allowed:

30 Minutes

Task Four – Presenting your results

Mission:

Now that you know all this ... only one challenge remains ..

How would you present this information in the physical space that is the classroom?

It needs to be accurate and easy to understand!

What you need to do:

Using the details about the buildings from the league table – and your inventories, organise a short presentation to go on the classroom whiteboard

Again, you will have to work as a team but how you do this is up to you!

Time Allowed:

10 Minutes

Appendix 14 – Study 2 – Focusing Exercise – Final Version

<u>Broad Focus of Research</u>	<u>Empirical questions</u>	<u>Operational Categories</u>	<u>Operational Codes</u>
<p>What examples of collaboration and non-collaboration occur in the hybrid space</p>	<p>What roles and activities do the learners use when there is collaboration?</p>	<ul style="list-style-type: none"> • Division of labour and the development of learner roles (RETAINED) • Negotiation between learners about what to do and how to do it (RETAINED) • Learners checking on what others are doing (RETAINED) • Pairs entering / leaving group collaboration (NEW) • Parallel collaborations (NEW) • Simultaneous collaboration (NEW) 	<ul style="list-style-type: none"> • Learner asks question to others • Learner explains to others • Learner seeks clarification • Learner clarifies • Learner helps others to perform task • Learner puts forward idea / proposal • Learner gives role / task to other to do • Learner asks question of others and passes on answer to other learners • Passing • Pairing • Tussling
	<p>What roles and activities do the learners use when there is non-collaboration?</p>	<ul style="list-style-type: none"> • Learners disagreeing about what to do or how to do it (RETAINED) • Conflict and breakdown of collaboration (RETAINED) • Fracture Points (NEW) • Learner efforts to reduce non-collaboration (NEW) 	<ul style="list-style-type: none"> • Learner ignores instruction / task / roles – goes off and does something else • Learner puts forward alternative course and encourages other to follow this • Learner interferes / disturbs others work without permission

	<p>What does the teacher do to support collaboration during the learning activity?</p>	<ul style="list-style-type: none"> • Supporting learners to communicate • Helping pairs to enter / join group collaboration • Bridging pairs in parallel collaborations • Interventions to recover from breakdown (RETAINED) 	<ul style="list-style-type: none"> • Explains to one or two learners • Questions one or two learners • Helps learners to complete task • Explains to all learners without stopping the task • Explains to all learners whilst stopping task • Gets learners to explain to each other • Teacher changes team members / reassigns learners • Teacher changes task elements
	<p>What other learner activities influence collaboration and non-collaboration?</p>	<ul style="list-style-type: none"> • Learners getting lost by Team • Learners getting lost by task • Learners getting lost by place 	<ul style="list-style-type: none"> • Learners not knowing which team • Learners not knowing which task • Learners not knowing how to do task • Learners break into groups

Again, background argument continues over orbit period of Neptune	Learners checking on what others are doing	Negotiation between learners about what others are doing	X			
J can be heard saying 'it here' to somebody						X
Scene 103*						
D and H are working at the whiteboard	Division of labour and the development of learner roles		X	X		
Quite a lot seems to have been written B goes to Z - what the hell are you doing - stop changing your appearance					Conflict and learners breakdown disagreeing about what to do	X X
Note how two parallel questioning streams have started - with H getting information from A and D mostly writing - He is getting moved to the edge of the board					Conflict and breakdown of collaboration	X X
H calls out to A for the radius ... Note how the board is structured according to team 1, team2 ..					Learners disagreeing about what to do	X
H and D are discussing	Division of labour and the development of learner roles	Negotiation between learners	X	X		
D is checking what has been written on H's side of the board	Division of labour and the development of learner roles	Learners checking on what others are doing	X	X		
H decides that he needs to clarify the radius of Mercury	Learners checking on what others are doing		X			
H checks this with A and puts his hand back to the board	Learners checking on what others are doing			X		
H moves around D to put in the radius of Mercury D is writing about atmospheric pressure of team 4 - but it is not clear where he is getting this information from H corrects what D has written about Mercury radius					Conflict and breakdown of collaboration	X X
H continues to improve and write up what is on the board	Division of labour and the development of learner roles		X			
D has walked off There is ongoing argument in the background with B getting more and more frazzled					Conflict and breakdown of collaboration	X X
B again starts to feed information to H - again about orbit periods	Division of labour and the development of learner roles		X	X		
Scene 104						
D and B at the microphone - getting ready to go - ok wait						
Scene 105						
B at the microphone - says that D is doing very well - D stands at the edge	Division of labour and the development of learner roles		X			
Scene 106						
D at the microphone - the first team was R and Z - doing about Neptune - and it is the fourth largest planet - reading this from the whiteboard - but what is everybody else doing - more detail about the planet read out - A was doing about Mars - again more detail about this planet - invites H to the microphone at the last minute	Division of labour and the development of learner roles		X	X		
Scene 109						
D again - repeating what he said above - again where is everybody else and what are they doing - J did about Mercury etc.			X	X		
Scene 110						
H this time - we have now used the virtual world to produce information - Wrapping up	Division of labour and the development of learner roles		X			
U1.1						
3733 L.K.L.4 appears All negotiating the teleporter	Negotiation between learners about what to do and how to do it		X	X	X	X
3758						
3825 L.K.L.3 arrives ... All four avatars in scene						
4110 Enters teleporter						
4151 Drops out and returns to spacecraft						
4447 All avatars at teleporter						
4452 Briefly teleports to Mars and then drops out						
4600 Using map to make sense						
4657 Teleports back to Mars						
4748 Checks notes on Mars						
5607 Finally drops out of Mars following long period of inactivity L.K.L.4 says 'pick up the phone'	Negotiation between learners about what to do and how to do it		X	X		
5628						
5630 L.K.L.1 says hi'						
5642 Thrown out of SL						
6300 Back in spacecraft L.K.L.1 says 'Neptune is the fourth largest planet in the solar system'	Division of labour and the development of learner roles		X			
6503						
6610 Briefly teleports to unknown planet						

7040 Winds up in NASA auditorium
7215 Starts to look up sandbox

LKL2

3542	Tries to teleport manually ... No success in getting into constructed teleporter ... LKL4 appears								
LKL1	returns ... Tries to get teleporter to work by pointing at it - three avatars now in the same place	Division of labour and the development of learner roles	X						
3612									
3640	LKL3 arrives ... Now all of team by teleporter								
	All trying their luck at getting into teleporter ... Quite hesitant about how to proceed	Negotiation between learners about what to do and how to do it	X	X					
3646									
	All stand staring at the teleporter ... Seem to be quite hesitant ... What is happening in the real world at this stage??								
3745	LKL2 is now close to getting it to work ... Right click but still not correct menu	Learners checking on what others are doing	X						
3758									
3814	LKL4 gets into the teleporter - problem solved?		X						
3911	Calling each other names								
3922	LKL1 has successfully entered the teleporter								
3942	LKL1 has gone!								
	LKL4 enters the teleporter and goes - how has this been resolved (and what has LKL3 been typing all this time)	Learners checking on what others are doing						X	
4003									
4022	LKL2 enters teleporter							X	
	LKL2 leaves teleporter - still in world - lots of possible typing with LKL3 - need to know what is going on here	Negotiation between learners about what to do and how to do it		X				X	
4106									
4218	LKL1 returns ... This was not meant to happen! (LKL2 and 3 have never left!)								
4303	Chit chat and introductions between LKL1, 2, 3			X					
4312	LKL1 returns to teleporter and goes off again								
	LKL3 says 'just me and you'	Negotiation between learners about what to do and how to do it				X		X	
4332									
4335	LKL2 says 'I know'					X			
4431	LKL2 finally gets teleporter to work - depart menus displayed					X			
4444	Arrives Mercury								
	LKL2 says 'alone and no one next to you Aman'	Learners checking on what others are doing				X			
4506									
4540	Falls out of solar system and lands in lake								
4611	Checks map to find others							X	
	Attempts teleport to find others	Learners checking on what others are doing	X						
4622								X	
4700	Several attempts at teleporting - similar to before								
4757	Wanders through Auditorium								
4929	Teleports back to planetary teleporter								
4940	Sits in teleporter - wants to go back to Mercury								
	Gets information on Mercury - spends some time checking this	Learners checking on what others are doing	X						
5013									
5106	Checks this information for a second time - again for a while								
5245	Moves to Venus								
5310	Arrives Venus								
5332	Teleports to Earth								
5407	Teleports to Mars ... LKL1 is there ... Nobody talks								
5440	Drops out								
5548	Teleports to more central location in spaceport Alpha								
5605	Returns to planetary teleporter								
5642	Goes to Uranus this time								
5649	Sees LKL3								
5740	Runs off and teleports to Neptune - Spends time getting information								
5807	Seems to be getting information on moons of Neptune		X						
5810	LKL4 is in the background								
5831	LKL4 says ... 'hello' (no response)								
5922	Teleports to Jupiter								
5952	Returns to Uranus								
6026	Returns to Neptune (LKL4 is there)								
6040	Moves to Pluto								
6050	Drops out								
6132	LKL1 says 'hi Azim'								
6210	Returns to teleporter ... Then to asteroid belt								
6352	Goes to Jupiter ... Time lookate at information								
6358	Teleports to Uranus ... LKL3 is there (but away)								
6415	Goes to Neptune again - sits on the moons this time								
6500	Goes to Pluto again								
6557	Goes to Mars (sits on more moons)								
6627	Drops out								
6722	Returns to teleporter ... Then to nowhere ... Decides to walk around rockets instead								

Learners entire list X X X X

LKL4

3926	Discovers how to use the map								
3930	Several attempts to use teleporter - to spell right name correctly								
	Teleports - sees LKL1 and LKL3	Learners checking on what others are doing	X					X	
3936									
4013	Lots of walking around ... Getting closer to teleporter								
	All four avatars are in scene (some modifying appearance)	Negotiation between learners about what to do and how to do it		X				X	
4100									
	Competition between avatars to get teleporter to work	Learners checking on what others are doing	X					X	
4117									
	Gets into teleporter - successful	Division of labour and the development of learner roles	X					X	
4205									
4247	This is Dhanrait and Mohammed (from speech)								
	Following more wandering in circles - Enters teleporter - Goes to Neptune ... Reads notes for a long time								
4400									
4934	Drops out following long period of inactivity								
5055	Back in Spaceport								
5111	Air of competition - Runs back to teleporter!								
5129	Back to Neptune								
5220	Still in Neptune ... Playing with gestures and clothes								
5311	Clothes change in Neptune								
5630	Finishes clothes change								
5710	LKL4 says 'is Renaldo'								
	LKL4 says 'in Neptune, come'	Division of labour and the development of learner roles						X	
5721									
5749	Attempts private call to LKL1 - Not clear what is said though (if anything)								

All working quietly - MAJ ... With B checking what J is doing ... J moves chair to fit in shot ...	Learners checking on what others are doing	Division of labour and the development of learner roles	X	X	X	X			X	X						
B says all are doing well ... A wants to use laptop ... Slowly grabs it from M	Learners checking on what others are doing								X	X	X					
A pairs laptop up with J so as to see what is on his screen (this is good)	Learners checking on what others are doing										X					
Scene 117*																
The laptops of A and J remain paired up	Learners checking on what others are doing								X	X						
Teacher intervenes - who can colour something in - little response Again A is checking what is on J's screen - still non verbal	Learners checking on what others are doing										Interventions to keep the activity	X	X			
B appears at the last second			X		X											
Scene 120																
Still on the paired laptops	Learners checking on what others are doing	Division of labour and the development of learner roles							X	X						
Again with interrupting natural interactions - can you lot stop now											Interventions to avoid breakdown		X			
Scene 121*																
Teacher speaks to camera We need to put the building to some sort of use - so the practice is finished We are going to build a model of the Solar System Lots of general task descriptions about colours and sizes - but so far nothing in the way of assuming roles or saying who does what The usual roles are assigned but it is not made explicit what each of them must do D and B again in charge	Division of labour and the development of learner roles		X	X	X	X	X	X								
M's laptop is put back on by the teacher The pairing of A and J continues	Learners checking on what others are doing															
It is briefly supervised by B and D - but no change	Division of labour and the development of learner roles	Learners checking									X	X				
Z keeps going on all alone B checks what is on J's screen	Learners checking on what others are doing		X		X						X	X				
B clarifies the sandbox spelling to M	Learners checking on what others are doing	Division of labour and the de			X						X	X				
B returns to J ... That looks like a semicircle to me	Learners checking on what others are doing				X		X									
A checks what is on J's screen ... But not so much the other way around	Division of labour and the development of learner roles	Learners checking									X	X				
Why does B keep focusing on J			X		X											
Scene 122*																
A checks very carefully what J is doing	Learners checking on what others are doing															
B keeps watch on what J is doing	Learners checking on what others are doing	Division of labour									X	X				
B announces we got the Sun J adds its not the right colour Teacher - How many planets have we got B - One Note the sleepy kind of collaboration that has taken hold now!	Learners checking on what others are doing	Division of labour	X	X	X	X					X	X				
J - we might be able to make it bigger Teacher - we have 15 minutes (more disjunction of natural interactions) J checks A's screen	Learners checking on what others are doing												Interventions to improve collab	X		
A says - I got Venus M shouts from background - I got Mercury A starts checking with Z where he is - navigating him around the sandbox (by pointing at the screen)	Learners checking on what others are doing	Division of labour			X		X				X	X				
J is checking A's screen quite closely - something of a reversal	Learners checking on what others are doing		X		X						X	X				
J - hey look my sun A keeps checking J's screen whilst changing the cable	Learners checking on what others are doing										X	X				
J to M - do you want to sit on the sun	Division of labour and the development of learner roles		X								X	X				
Teacher intervenes - checks M's screen Teacher asks J to get up and move over to M's screen - location or building?			X										Interventions to im Interventions to recover from breakdown of activity	X	X	X
Scene 123*																
J returns to seat Note how A has been checking his screen in his absence	Learners checking on what others are doing		X		X								X	X		
B is still trying to keep order and makes jokes about green semicircle D crawls back and checks what J is doing	Learners checking on what others are doing															
B announces that D is the 'current' manager	Negotiation between learners about what to do and how to do it				X											
A keeps checking what J is doing	Learners checking on what others are doing				X		X			X						
Teacher briefly intervenes to check what J and A are doing J announces that im trying to name the planet	Division of labour and the development of learner roles												Interventions to keep activity in progress	X		
J moves over to M					X		X									

